AVIATION IN THE XXI-ST CENTURY

INTERNATIONAL CIVIL AVIATION ORGANIZATION
NATIONAL ACADEMY OF SCIENCES OF UKRAINE
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY

PROCEEDINGS

THE SIXTH WORLD CONGRESS "AVIATION IN THE XXI-st CENTURY"

"Safety in Aviation and Space Technologies"

Volume 2

September 23-25, 2014
Kyiv, Ukraine

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UDC 528.7:621.3:629.7

V.P.Kharchenko, Doctor of Science (Engineering), Professor
D.E. Prusov, Cand. of Science (Engineering), Associate Professor
(National Aviation University, Kyiv, Ukraine)

THE REMOTE-PILOTED AIRCRAFT SYSTEM DEVELOPMENT AND ITS EXPERIMENTAL TESTING ACCORDING THE CERTIFICATION BASIS

The integrated approach to the theoretical foundations for development of remote-piloted aircraft system that includes a twin-engine unmanned aircraft, automation system for optimal control of unmanned aircraft system with elements of self-adaptation, automation system for landing unmanned aerial vehicles, the equipment for secure transmission of radiotelemetering data and for video surveillance, integrated navigation complex of unmanned aircraft has been considered.

The integration problems of the civil Remotely Piloted Aircraft Systems (RPAS) into the common aviation system are concerning all the issues to be addressed and establishes a step-by-step approach to address them, aiming at an initial RPAS integration by 2016, in three main areas: a Regulatory Approach, a Strategic Research Plan, and a Study on the Societal Impact. In particular, a Strategic R&D Plan identifying the technology enablers and the research activities necessary to achieve a safe integration of RPAS.

In terms of International Civil Aviation Organization (ICAO) objective consideration of the characteristics in addressing unmanned aviation is to provide the fundamental international regulatory framework through Standards and Recommended Practices (SARPs), with supporting Procedures for Air Navigation Services (PANS) and guidance material, to underpin routine operation of RPAS throughout the world in a safe, harmonized and seamless manner comparable to that of manned operations.

One of the important factors of efficiency of industrial-economic complex of Ukraine is the development of Remotely Piloted Aircraft Systems (RPAS). Such systems can effectively resolve a wide range of problems from agricultural oriented tasks to environmental monitoring, condition of pipelines, protection of state borders etc. Worldwide experience of RPAS using confirms their high efficiency, profitability, and feasibility of increasing their share in the overall structure of both civilian and military aviation.

The theoretical investigation and development the own remotely piloted aircraft systems, necessary equipment, a comprehensive national regulatory for its application, the development of international cooperation and coordination on RPAS regulation is important for Ukraine as a country, which includes the full cycle of development, production, operation of aerial vehicles, training of aviation specialists and has significant potential for development, manufacture and operation of its own remotely piloted aircraft systems, as well as exporting them overseas.

The National Aviation University was one of the first institutions in Ukraine, which drew attention to the problem of development of unmanned aviation complex of civil purposes.

National priorities for own unmanned aircraft systems application is the operation in various sectors of the economy and in military affairs. The use of unmanned aviation complex in the national economic sector, in the interest of environmental authorities, enterprises of fuel and energy complex and other subjects of the national economy, in the problems of emergency situations, as well as for air surveillance and border security, for the monitoring of the situation on the highways, in the interests of regional bodies of economy, the bodies of land utilization, municipal and regional administrations, etc., which will improve the effectiveness of operational control by means of various departments during the performance of assigned missions.

The National Aviation University has a scientific and technical base, and all the necessary resources to create effective Remotely Piloted Aviation Systems (RPAS). More attention both from the International RPAS Community, government and business representatives is paid to the projects of unmanned aircraft complexes creation.

At the National Aviation University is carried out a perennial work concerning the principles of design and creation of experimental remotely piloted aircraft systems.

Unmanned Aircraft System "Ukraine",
which has been developed at the National Aviation University

Remotely piloted aircraft systems (RPAS) "Ukraine"

Function: mission assurance of the twin-engine aircraft M-7B5 "Sky Patrol" in a dedicated airspace to perform aerial work in the interests of the economy and national defense. Served by ALS "Ukraine" outside a crew of at least four persons.

RPAS based on the UAV M-7B5 "Sky Patrol" structurally consists of the one UAV M-7B5 on the trailer-platform in the container; and one land control station (НСК-1-7B5) on the trailer.

The use of remotely piloted aviation system in the national economic sector, in the interest of environmental authorities, enterprises of fuel and energy complex and other subjects of the national economy, in the problems of emergency situations, as well as for air surveillance and border security, for the monitoring of the situation on the

highways, in the interests of regional bodies of economy, the bodies of land utilization, municipal and regional administrations, etc., which will improve the effectiveness of operational control by means of various departments during the performance of assigned missions in money saving with a help of creation of unified remotely piloted aviation system are very important. Ukraine for a short term can receive national advanced unmanned aviation complex of civil purposes with a help of joint efforts of relevant authorities of executive power and their focus on main areas is a topical issue.

According to all listed industry problems Ukraine has a serious technical base, and all the necessary resources to create effective automation unmanned systems. More attention both from the government and business representatives is paid to the projects of remotely piloted aviation systems creation.

The purpose of the complex approach is the construction and design principles establishment for the relevance experimental RPAS creating based on the two-engine unmanned aircraft equipped with modern engineering equipment with automation control based on new information technologies. The purpose implementation is to obtain and implement new knowledge in the field of remotely piloted aviation system, focused on the UAV use in the economy of Ukraine and other countries. The main use of unmanned aircraft can be defined aerial photography, real-time video surveillance and patrolling of linear and planar objects. The obtained results can allow to Ukrainian developers and manufacturers of unmanned aircraft to get the effective tools for the development of remotely piloted aviation system of national production.

An integrated approach to the remotely piloted aircraft system developing with unmanned aerial vehicle involves the following objectives:

— the construction principles determination of remotely piloted aviation system on the methodology "The safety management system" according to the international requirements;

— the hybrid composite materials development and production based on the strength criterion;

— the nano-technical complex development and manufacturing for the RPAS on-board and ground equipment;

— the control complex development and production for the board and ground RPAS systems;

— the scheme-technical solutions development for automation flight trajectory based on new information technologies;

— the methods and algorithms development and implementation for the automation UAV landing on network signals of orbiting satellite systems;

— the information protected data channel "board-to-land, land-to-board" development, the flight control system design, and standardization of protocols recommendations;

— the RPAS standard model design, production, and testing with energy efficient avionics equipment;

— the training programs development for UAV operators and RPAS ground personnel;

— the normative and technical documentation development for RPAS certification.

In the research and production center of unmanned aviation "Virage" of National Aviation University the line of domestic UAVs have been developed: one-engined M-3 "Border", M-6 "Skylark"; two-engined M-7, M-7D, M-7B5 "Sky Patrol" drones (the UAV) and UAV with an electric motor "Eye". Their tactical technical data are as follows. Thus the ways to solve the problem of integration, search, recognition and processing of satellite tracking, navigation and UAV-onboard avionics.

UAV M-7B5 «Sky Patrol»

Purpose: designed for aerial photography, real-time video surveillance, patrolling line objects, and perform other types of aerial work including over populated areas. Launch weight – up to 200 kg.

UAV M-7D «Sky Patrol»

Purpose: mapping and aerial photography, real-time video surveillance, patrolling line objects and areas. Launch weight – up to 150 kg.

UAV M-6 «Skylarc»

Purpose: mapping and aerial photography (M-6K), real-time video surveillance (M-6P), patrolling line objects and areas (M-6CX). Launch weight – up to 12 kg. (Electric version, Petrol version).

UAV M-10 "Eye"

Purpose: real-time video surveillance, patrolling the line objects and areas, the small objects security, the situation in small territories monitoring. Maximum take-off weight – 3 kg.

Purposes and objectives are achieved by performance of works in the following areas:

— development and manufacturing the two-engine unmanned aircraft;

— development the automation system for optimal control of remotely piloted aviation system with elements of self-adaptation;

— investigation the hybrid composite materials on strength criteria for use in the unmanned aircraft;

— establishment the automation landing system of unmanned aircraft;

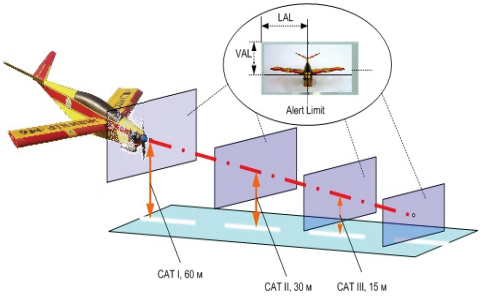
— design and production of the experimental equipment model for secure transmission of radiotelemetering data and video surveillance;

— development and manufacturing the integrated navigating complex for unmanned aircraft;

— development the scientific and methodological support and technical measures for ground personnel training of remotely piloted aviation system;

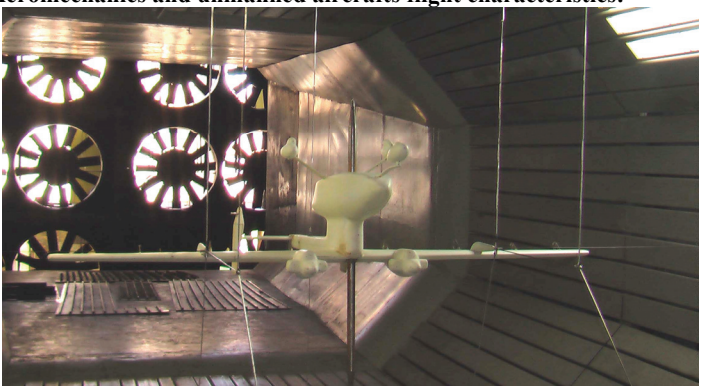
— development the normative and technical documentation for certification manufacturing of the remotely piloted aviation system.

The automated system for unmanned aerial vehicle landing:



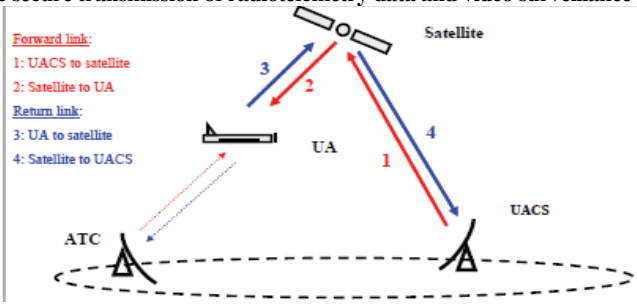
The methods and algorithms development and implementation for the automation UAV landing on network signals of orbiting satellite systems. The functional scheme development, the functional elements modeling, and system prototype design. The experimental researches carrying out and results processing.

Aeromechanics and unmanned aircrafts flight characteristics:



Calculation of longitudinal and lateral stability characteristics and limit parameters of operational flights safe modes. The flight characteristics Determination and recommendations development for improving the stability and controllability of UAVs.

The secure transmission of radiotelemetry data and video surveillance equipment:



The information protected data channel "board-to-land, land-to-board" development, the flight control system design, and standardization of protocols recommendations. Production of experimental prototype equipment and tests performance.

The automated system for the operational purpose data processing from the board

The interpolation methods development based on local polynomial interpolation splines that are close to the average in the task of rotation aerial photographs. Video processing performance advantage with using OpenCV framework in real time critical in time systems based on analysis time and memory consumption operations with high optimized algorithms. Nonuniform objects recognition method is realized for objects of complex shape on aerial photographic data. The method is based on the process of passing on the perimeter of the texture, which contain the object recognition and analysis of the intensity of color components of the raster.

Ukraine's integration into the international aviation community and the development of unmanned aircraft necessitate improved decision-making dispatching personnel in the system of air traffic services (ATS) on the basis of the provisions of the systematic approach and modern information technology.

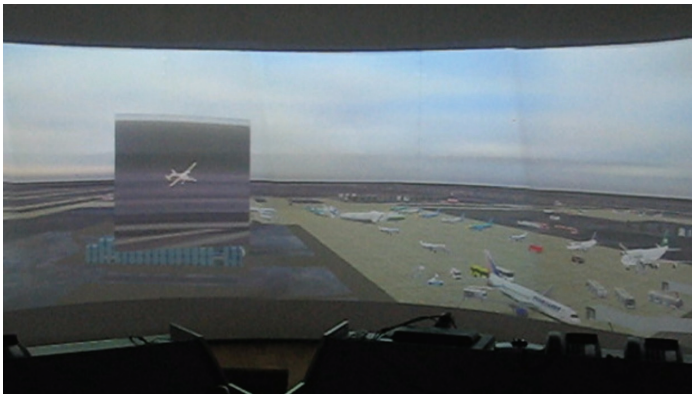
The UAS control center for external pilot and target workload operator.

The software design of processes for flying unmanned aircraft. The system provides a simulated flight UAV among ATS, a the decision making support system to justify the flight plan of RPAS division, the training programs development for uav operators and rpas land personnel, the normative and technical documentation development for RPAS certification.

The Project SMGCS Airport Movement Simulator (SAMS) was initiated by the European Commission (EC) for research path "human operator - air/ground environment".

The project is implemented the model Advanced Surface Movement Guidance and Control System (A SMGCS), which can be explored in a variety of weather conditions.

The simulation model has been first implemented as the UAV integration into the common airports airspace.



Simulation control tower via SAMS

Based on the investigation and research principles of the land and onboard equipment constructing for the remotely piloted aircraft systems (RPAS) and experimental types of unmanned aerial vehicles (UAV), and to determine the structure and form of regulatory documents on certification, the analysis of prospects for the development of research and development directions has been carried out on the design, manufacturing and installation of UAV's onboard equipment and RPAS' land equipment to further testing of its experimental types, connecting all components developed into a number of remotely piloted aircraft systems, holding their flight testing, and the creation of the complex of normative documents on certification.

Conclusion

Given the above, National Aviation University in recent years has refined theoretical principles, concepts, technical and technological solutions for the program implementation of unmanned aircraft systems into the civil aviation practice.

For this purpose, were organized a series of works devoted to optimizing the UAV dimension-type, construction, and structure of its air-navigation, telemetry, radiocommunication, and other vital systems, and also personnel training. At the National Aviation University are developed a number of unmanned aircraft systems types to address a wide range of tasks most civilian and military.

In terms of Ukrainian aviation market development is extremely important to develop its own unmanned aircraft systems and national laws - the legal basis of UAS use, that should be based on the modern international norms and standards. In order to combine different groups efforts and research of the National Aviation University scientists and experts according comprehensive implementation of these strategic objectives for the country the performers team has been formed for the research and development the complex work on a unmanned aircraft system prototype generation. This work is a priority direction in the world market regarding the scientific and technical prospects.

UDC 629.735.7

Krzysztof SZAFRAN PhD eng.
(Institute of Aviation, POLAND, Warsaw)

BALLOON PLATFORM AS A SAFETY SYSTEM FOR TESTING UNMANNED AIRCRAFT EQUIPMENT

The paper presents the concept of building a safety platform for testing equipment, control and communication systems to be used for unmanned aircraft. The idea of balloon platform is based on the structure of aerostat. Two versions are suggested: aerostat tethered and aerostat remote controlled - airship. The author proposed building of the test vehicle for the real testing in the actual/current weather conditions. On the platform valuable and complicated apparatus, intended to equip unmanned aircraft, can be tested. The paper discusses basic elements of the platform, initial calculations and some laboratory tests of drive components.

1. Introduction

Multiple unmanned systems - including the aircraft configurations (the most common), rotorcraft, fan-rotorcraft, flexible wing, gliders, rockets - require building in its interior a variety of systems and components. In current versions of these systems they are expensive and exceed the value of the carrier that is an airframe, a helicopter or a rocket. High speeds and congestion as well as the unpredictability of some disturbances are affecting the experimental flight of an unmanned flying object and often lead to numerous disasters. In many cases it ends up with the damage or destruction of valuable equipment and onboard equipment. Better and more accurate calculation and simulation methods allow to safer plan an experiment, but in all new constructions there is a high probability of failure. The performance of the group drone flights in automatic mode operation is a completely new issue.

Therefore, the idea of creating a secure test platform, on which a variety of new equipment systems of unmanned objects without exposing them to destruction or damage could be tested. Such platform may be particularly useful for testing apparatus used for spatial control of a flying object. Testing of control algorithms, procedures maneuvers require many attempts at critical ranges. In real conditions critical maneuvers are very rare and usually lead to damage or destruction of property. It seems proper to conduct safety tests carried out at least until the performance test. On the basis of the balloon platform tests it will be possible to develop optimal procedures for a variety of unmanned facilities.

2. The concept

A balloon filled with lighter than air gas - helium for example, has a platform in its gondola to which it is possible to attach the test apparatus. Tests are performed for different heights. It's possible due to the attachment of an anchor cable system of an aerostat to the substrate. Another option is a balloon equipped with a fan propeller that allows to move the airship in space. Remote control allows to schedule the trajectory of the flight, complies inertia and aerodynamic resistance, avoiding

obstacles, changes in altitude. A tethered Research platform allows to safely simulate external disturbances such as wind, rain, icing.

The Institute of Aviation designed and built a platform for spatial observation. Platform balloon [6] is shown in photo 1. The technology of coatings is little permeable for helium and that allows an aerostats operation over a long period of time with minimal gas loss from the balloon envelope.

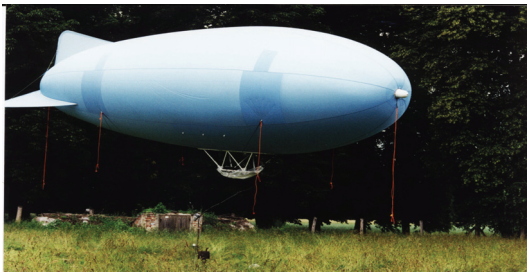


Photo.1 Balloon platform project in Institute of Aviation [6]

3. Mathematical model and draft calculations stability balloon platforms

In calculations it was schematically assume that the system consists of two rigid elements, fixed at the top in the plane of symmetry of the balloon and a lower coupling point connected to the carrier cable. Statics and dynamics calculations were performed for two rope lengths l = 100 m and
l = 300 m. Assumed constant wind profile with height lifting aerostat. For the condition of rope length l = 100 m was assumed as the air density of 0 according to the standard atmosphere (AW), [3], [4], namely ρ_p = 1.2263 kg/m^3, while for l = 300 m as the height of 300 meters by AW, or ρ_p = 1.1909 kg/m^3. For l = 100 m assumed carrier cable system with power cable assuming the thickness d_c = 0.007 m linear density ρ_c = 0.085 kg/m. For l = 300 m, excluding power cable, d_c = 0.005 m and ρ_c = 0.015 kg/m. Aerostat mass values and the displacement are respectively for l = 100 m: m_b = 41.7 kg and W=572 N and for l =300 m : m_b =40.1 kg and W =556 N.

These data entered into the calculations, shown also in the headlines Tables 1 and 2. All calculations were performed for wind speed V_0 =0, 5, 10, 15 i 20 m/s.

Table 1. *Parameters of geometry and load to the rope the platform as a function of wind speed.*

Terms drain		Lina l = 100 m, d_c = .007 m, ρ_c = .085 kg/m (with power cable), ρ_p=1.2263 kg/m^3, W =572 N, m_b=41.7kg					Lina l = 300 m, d_c = .005 m, ρ_c = .015 kg/m (without power cable), ρ_p=1.1909 kg/m^3, W=556 N, m_b=40.1 kg				
l.p	Parametr	1	2	3	4	5	6	7	8	9	10
1.	V_0 [m/s]	0	5	10	15	20	0	5	10	15	20
2.	δ_1 [°]	37.5	42.9	60.9	89.4	117.2	37.5	42.8	60.2	88.1	115.8
3.	δ_2 [°]	49.4	49.5	46.5	37.5	26.7	49.4	49.5	46.7	38.0	27.2
4.	N_1 [N]	106.1	96.0	77.7	72.1	87.7	106.1	96.3	78.1	71.9	86.2
5.	N_2 [N]	129.5	128.3	130.9	149.2	189.2	129.5	128.3	130.7	148.0	186.4
6.	P_x [N]	0	13.1	52.3	117.6	209.1	0	12.7	50.8	114.3	203.2
7.	l_2 [m]	2.74	3.07	4.12	5.62	6.78	2.74	3.06	4.08	5.56	6.73

4. Dynamic stability balloon platform

The system of equations of motion of the balloon platform for so called " small disturbance" was created, based on the method given in [2].

The rigidity of solid aerostat system and its connection with the cable carrier and the inflexibility of the rope was founded. An Anchor - rope, divided into n elements and assumed the beginning of the current coordinate of the "s" at the point of attachment to the land.

Other atmospheric, geometric and mass conditions were adopted, as in the static calculation of the aerostat, and the value of the moment of inertia of the aerostat relative to the body of the transverse axis, and in its center of mass of the system adopted by. position [1] as I_y = 325 kgm^2.The movement of the carrier cable in the plane XOY can be described by the following equation Vector

$$\mathbf{a}\ dm = \mathbf{A}\ ds + \mathbf{G}\ ds + \frac{\partial}{\partial s}(Tt)ds$$

The system of equations describing the motion of small disturbances of aerostat was adopted on the basis of [7], [8], [9]. The general equation is:

$$\dot{\mathbf{x}} = \mathbf{S} \cdot \mathbf{x}$$

Solving the system of equations

$$\dot{\mathbf{x}} - \mathbf{S} \cdot \mathbf{x} = 0$$

and the characteristic equation of the matrix condition **S** :

$$\left|\lambda \cdot \mathbf{I} - \mathbf{S}\right| = 0$$

we obtain the general solution of the form:

$$\mathbf{x} = \mathbf{x}_k\ e^{\lambda \cdot t}$$

Table 2. Characteristics of dynamic stability of an object with cable system as a function of wind speed.

Terms drain		Lina l = 100 m, d_c = .007 m, ρ_c = .085 kg/m (with power cable), ρ_p = 1.2263 kg/m^3, W = 572 N, m_b = 41.7kg					Lina l = 300 m, d_c = .005 m, ρ_c = .015 kg/m (without power cable), ρ_p = 1.1909 kg/m^3, W = 556 N, m_b = 40.1 kg				
	Parametr	1	2	3	4	5	6	7	8	9	10
1.	V_0 [m/s]	0	5	10	15	20	0	5	10	15	20
2.	T_1	5.47	5.43	5.26	4.55	3.77	6.20	5.24	5.32	4.24	2.98
3.	ς_1 [-]	0	.2502	.3830	.3675	.3001	0	.5332	.8280	.7843	.6515
4.	$T_1(1/2)$	∞	2.32	1.40	1.27	1.32	∞	.916	.400	.370	.382
5.	fn_1	.183	.190	.206	.236	.278	.161	.226	.335	.381	.443
6.	T_7	.794	.791	.749	.654	.548	.916	.925	.910	.719	.611
7.	ς_7 [-]	0	.0350	0554	.0523	.0417	0	.1585	.2512	.1916	.1755
8.	$T_7(1/2)$	∞	2.49	1.49	1.38	1.32	∞	.635	.387	.363	.378
9.	fn_7	1.259	1.265	1.338	1.530	1.827	1.092	1.095	1.136	1.584	1.662
10	T_p	$4.41_{(sw)}$	-	-	-	-	$4.52_{(sw)}$	-	-	-	-
11	ς_p ω_{pp}	0	1.382	2.950	4.575	6.159	0	1.337	2.871	4.508	6.075
12	$T_p(1/2)$	∞	.50	.23	.15	.11	∞	.518	.241	.154	.114
13	fn_p	.227	-	-	-	-	.221	-	-	-	-
14	T_w	39.05	43.33	40.56	31.14	27.81	60.53	132.52	48.18	38.50	34.85
15	ς_w [-]	0	.4878	.7575	.7989	.8340	0	.9321	.9072	.8794	.9004
16	$T_w(1/2)$	∞	8.56	3.85	2.59	2.03	∞	5.89	2.46	2.30	1.86
17	fn_w	.026	.026	.038	.053	.065	.017	.201	.055	.066	.066
		instability					instability				
18	Tap(1/2	-	-	-	23.8 h		-	-	-	9.6 h	-
19	Tp	-	-	245.1 s	95.7 s	78.0 s	-	-	-	50.8 s	40.6 s
20	Tp(1/2)	-	-	67.2 s	28.3 s	28.0 s	-	-	-	78.8 s	324.3 s

The calculations and simulations made it possible to estimate the horizontal and vertical deviations of balloon platforms for different wind speeds. These data were verified in traverse conditions. The platform has successfully passed all performance tests.

5. Test fan electric drives

The next stage of research on the balloon platform were research on a model fan electric propulsion propeller. The team had to be designed to drive the airship. With commercially available propellers modeling, several types with different geometrical parameters were selected. A test rig to test drive propeller was designed and built. A model fan tunnel and propeller were made and adjusted on the drive. The test stand shown in photo 2 laboratory of the Institute of Aviation studied various configurations of propellers and fan tunnel.

The main purpose of the studies was to choose the best variant of the propeller which was used to drive the model radio-controlled airship or performing a flight after previously programmatically set trajectory.

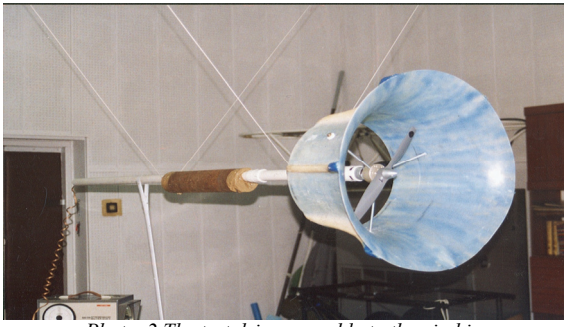


Photo. 2 The test drive assembly to the airship

Measuring stand.

The laboratory room the suspending of the electric drive with the mass of aggravating simulating inertia aerostat was made. The mass was chosen so that there was no impact on the different measurements, with and without fan adjustment. Propeller drive electric motor constituted parameters given below. Read thrust implemented on the scale placed under the power train. The electric motor was powered with a stabilized high current rectifier unit. Increasing of the current allowed to inflict different speeds. Speed measurement was performed using a laboratory strobe.

To drive design initially adopted electric motor company MOTORS MODEL Typ.AXI-2820/12 with the following technical parameters:

Rated voltage	$U = 11V$
Current max	$I_{max} = 26.9$ A
Turnover	$n_o = 7850$ rpm
Ratio of cases	$\eta = 0,78$
Power	$Pe = U \cdot I_{max} \cdot \eta = 223W$

For a preliminary assessment of the value generated within the team during the laboratory measurements as a function of rotation Pc= f (n) to obtain the results. The examples are the following table.

Parametr	***1***	***2***	***3***	***4***	***5***	***6***
Revs *[rpm]*	*2700*	*3100*	*3800*	*4200*	*5400*	
Traction *[N]*	*1,6*	*2,8*	*4,2*	*5,5*	*9*	

Concidering that in the proposed propulsion system, designed for experimental airship, engine power of one drive unit (223 W) is over two times greater than the power in the engine laboratory system (100 W), one can assume interpolation chart for speed n = 8500 with which implies that the thrust reaches a level of ~ 20 N.

Conclusion

Three tunneled engines built on AXI-2820/12 engine with blades 300 - 160 (12x6, 5) Aer, providing total string Pc> 60 N enable the airship to move at a speed of 10 [m / s] in windless weather.

Summation

Air safety of new unmanned aircraft in roughly growing field of technology which are unmanned ((BSP), (BAL), (BSL) - naming is in the process of evolution) is an important issue/the overground problem. There is a growing mass of drones, their speed and maneuverability. On the other hand, we have to deal with the increasing severity of passenger flights.

The proposed concept of the research balloon platforms, especially for new or upgraded systems, circuits and teams drone can reduce the risk of collision, and above all, protect equipment owners against losses.

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E.P. Udarcev, doctor of science (NAU, Ukraine, Kyiv)

CONCEPTUALLY NEW APPROACH TO THE FORMATION OF AERODYNAMIC LAYOUT OF WING. VORTEX ACTIVE UAV WING

The concept is that the flow around the wing is formed as unsteady longitudinal vortex flow. Shape of leading and trailing edges of the wing should be of specific vortex generating shape, which is optimized for each airfoil type. Vortex active wing of UAV was investigated in flight.

The concept is based on the research achievements of unsteady vortex flow around the wing at high and supercritical angles of attack. Unsteady flow over the wing starts when angle of attack is increased more than acceptable. Then a traditional vortex flow pattern is formed on the upper wing surface in the form of separating vortices at the trailing edge (viscous stall) and separation at the leading edge in the form of a powerful vortex (dynamic stall). Attached vortices are located spanwise (transverse vortices). Trailing vortices propagate downstream (longitudinal vortices). Fig. 1 shows a fragment of the unsteady flow around a wing that we obtained in the water tunnel [1].

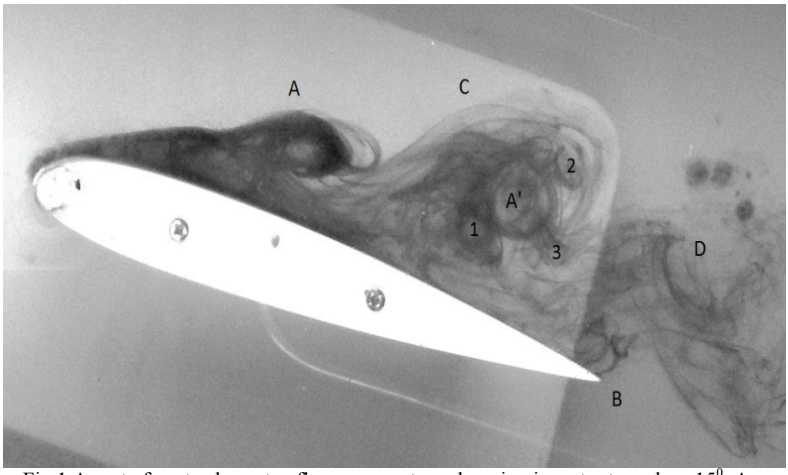

Fig.1 A part of unsteady vortex flow over rectangular wing in water tunnel, $\alpha=15^0$: A – transverse vortex of dynamic stall; B – formation of the vortex at trailing edge; C – interaction between dynamic and viscous vortices; D – vortex burst. Viscous vortices (1, 2, 3) spin around dynamic vortex.

Transverse vortices are unstable to perturbations on wing surface and sensitive to atmospheric turbulence [2].

At present time micro vortex generators and boundary layer turbulators are used in order to prevent vortex separation on the airfoil. Such turbulators and vortex generators create microvortices and turbulence.

In world practice longitudinal vortices, generated by vortex generators, were studied in traditional way, according to reviews and special studies [3, 4, 5]. In 1990-2000-ies researches of boundary layer vortex generators have been applied in aircraft industry practice. They are used to prevent separation of viscous boundary layer, separation of reattached longitudinal vortex at leading edge and reduce acoustic impact of λ changes at transonic speeds [6]. Nowadays turbulators and vortex generators, which are used on aircrafts, have form flat plates, plows, etc., called Vane-Type VGs, Wishbone, Wheel VGs, Low-profile Wheeler's doublet VGs, Forward Wedge, Counter-rotating Vane, Backward Wedge, Single Vane, etc. Turbulators are installed on sport aircrafts Cessna, transport aircrafts Boeing, Embraer, etc. Vortex generators in form of vortilons are used on Embraer aircrafts.

Macrovortex effects on the aerodynamics of supersonic aircraft during takeoff and landing are known. Vortex is created by leading edge extensions. Leading edge extensions are powerful generator of longitudinal vortices.[7]

These vortices have large capacity, reach trailing edge and increase maximum lift from 0.5 to 0.65, aerodynamic quality from 3.75 to 4.5 at angle of attack 12^0. Furthermore, leading edge extensions influence longitudinal moment, which depends on area of leading edge extension. This data presented in researches by "Northrop" and TsAGI [8, 9]. In 1980s a monograph, summarizing researches of management of vortices generated by leading edge extensions, edited by G.S. Byushgens was published [7]. A famous aerodynamic TsAGI scientist Fedyayevskyi K.K. also should be mentioned. In 1971 he published a paper [10] in which indicated that the axial velocity in longitudinal vortex generated by leading edge extension is more than the velocity of flight by 50% on the wing with leading edge of special form.

The analysis of the macrovortex unsteady flow around wing, taking into account vortex generators and turbulators influence on unsteady vortex flow characteristics is carried out. Macrovortex flow around the wing with vortex generators on the leading and trailing edges is experimentally studied in wind tunnels and on flying model [11]. This is the basis for a conceptually new approach to the design of aircraft wings, wind turbines, turbine blades.

Vortex generators on the leading edge of the wing create helical spiral flow over the wing, which is energetically more powerful than microvortices created by turbulators. As a result, on the upper surface of the wing unsteady longitudinal vortex flow is organized, which divides separation vortices of dynamic and viscous origin. This leads to an increase in the critical angle of attack by 30-40% and lift coefficient by 10-15%, stabilization of longitudinal moment by angle of attack, elimination of the hysteresis effect and improves control surfaces operation, preserving their effectiveness at high angles of attack. At the same time the optimum flight angle of attack and aerodynamic quality vary slightly as a result of the suction force and reduction of frictional drag [12].

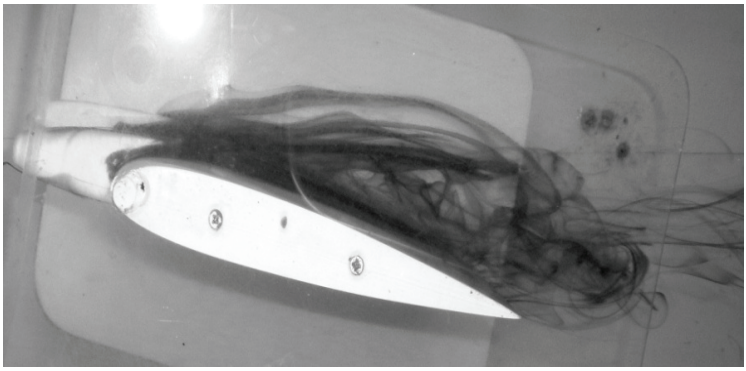

Fig.2 A part of unsteady flow over the wing with vortex generator on the leading edge, $\alpha=15^0$

Vortex active wing allows to reduce negative effects of vertical gusts, retains stability at high angles of attack and protects control surfaces from flutter. At supersonic speeds nose vortex generators will provide subsonic flow around leading edge of the wing. Organization of a fundamentally new type of unsteady flow over the wing can be optimized for each particular profile by computer solution of the Navier-Stokes equations for the flow with a given condition and the apparent viscosity of the helical flow (coincidence of streamlines and vortex lines on the wing). Research results of vortex active flow around the wing are presented in [11, 13] and patented [14, 15, 16, 17].

The future static research with vortex active wing is planned to carry out in subsonic wind tunnel (elliptical working section, 750*402, flow velocity up to 30m/s, turbulence rate ε=2.4%). The purposes are to optimize vortex generators form and their spanwise distribution, obtain momentum characteristics and aerodynamic centre of the wing displacement, and analyze suction force and its influence on total drag.

The dynamic research is planned to carry out on the oscillating wing in big subsonic tunnel (working part 4.0*2.5m, flow velocity up to 40 m/s, turbulence rate ε=0.9%). The purposes are to study unsteady aerodynamic characteristics, dynamic loop size on oscillating wing with different oscillation frequency and amplitude at flight and supercritical angles of attack, to determine suction force value and momentum characteristics.

Conclusion

Conceptually new approach to the aerodynamic design of the wing allows organization of unsteady longitudinal vortex flow over the wing, which has the best aerodynamic characteristics at high angles of attack. It has significant advantages for practical use, as avoids static hysteresis effects as the angle of attack is decreasing in supercritical zone, eliminates the problem of flutter and improves controllability, maintaining the effectiveness of the ailerons. It is supposed that nose vortex generators will prevent nose shock waves appearance at high subsonic speeds.

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S.I. Alekseenko (NAU, Ukraine, Kyiv)
O.O. Zhdanov (NAU, Ukraine, Kyiv)

VORTEX SLAT OF UNMANNED AERIAL VEHICLE

Vortex slat significantly improves aerodynamic characteristics of unmanned aerial vehicle at high angles attack as a result of organized unsteady longitudinal vortex flow.

Vortex slat is a set of vortex generators located on the leading edge of the wing in optimal positions in order to improve wing aerodynamics. Vortex slat organizes unsteady longitudinal vortex flow around the wing that significantly improves unmanned aerial vehicle aerodynamic characteristics (Fig.1).

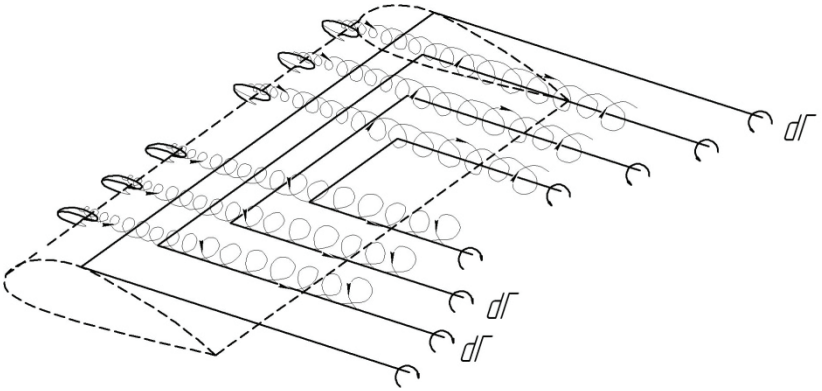

Fig.1. General view of vortex slat and its effect on vortex flow

Vortex generators may have different configuration (symmetrical, asymmetrical). The use of asymmetric vortex generators gives possibility to make influence on flow wash and inductive drag by creating on left and right sides longitudinal vortex flow with different direction of rotation and by decrease of vortex sheet (Fig.1). Effects that arise from vortex generators: increase in critical angle of attack, hysteresis elimination, possibility to influence inductive drag. All these can be seen on comparative polar (Fig. 2), which was constructed on data obtained during weight tests on three components weight AVMK in wind tunnel UTAD-2. The model was rectangular wing (l = 400mm, b = 150mm) with asymmetric profile and relative thickness 16%, flow speed = 20m/s.

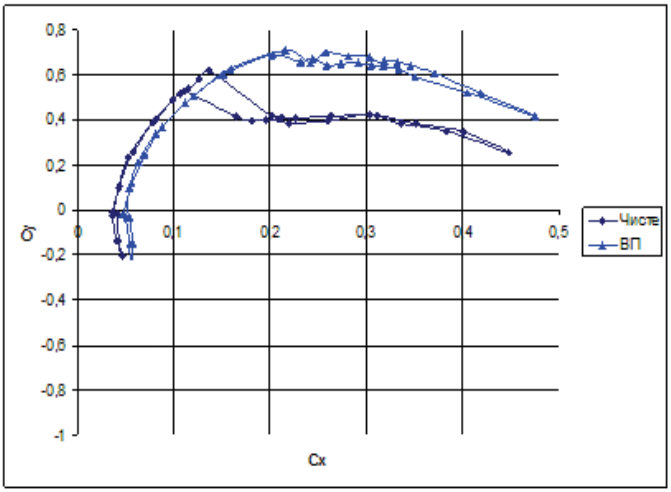

Fig.2 Comparative polar

A series of qualitative tests were made in order to study vortex generators performance. During these tests, which were carried out on wing model (400 * 150mm) with asymmetric profile $\overline{c}$ =0.16, the efficiency of different types of vortex generators was checked. The qualitative influence of different types of longitudinal vortex generators on airfoil aerodynamic characteristics was studied. For comparison purpose the influence of turbulators was studied. As a result of research aerodynamic characteristics were presented in graphs.

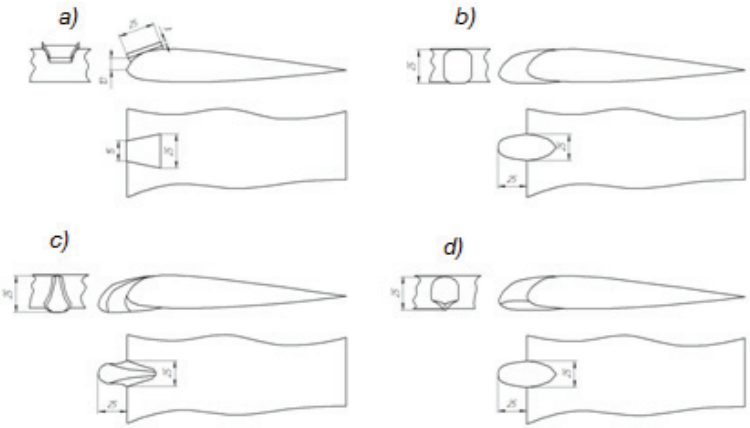

Fig. 3 Types of vortex generators, which were studied:
a) trapezoidal shape, b) variant 1, c) variant 2, d) variant 3

The wing model has distinct hysteresis of aerodynamic characteristics. Seven generators of longitudinal vortices are located on the leading edge of the wing. The distance between vortex generators is 50mm. Shapes of vortex generators, which were tested are presented on fig. 3. Dependence $C_y=f(\alpha)$ is shown on fig. 4.

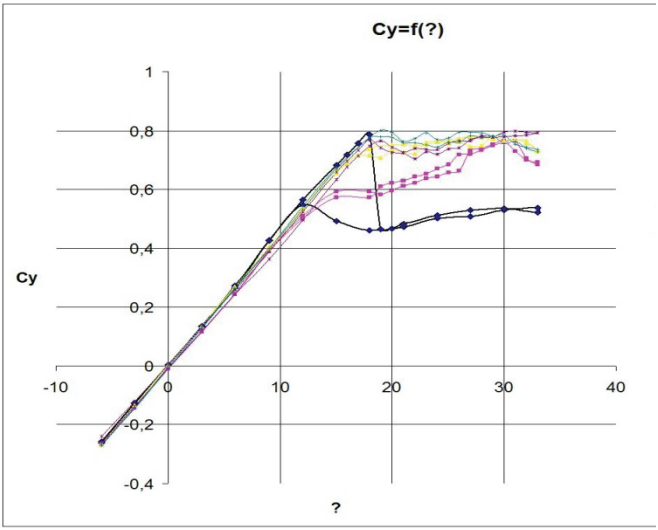

Fig. 4 $C_y=f(\alpha)$

By comparative analysis the plow type vortex generator was determined as the most efficient. The next step was flight tests of remote-controlled model with vortex slat. Determination of vortex generators optimal shape, position, angle between vortex generator's chord and chord of the wing was made directly on the wing of the model. Visualizing tufts were installed on the model to indicate flow separation on the wing. The critical angle of attack for the wing was chosen on the basis of tufts behavior. Then with the help of vortex generators, installed in optimal positions with optimal angle, unseparated flow was restored for the same angle of attack. Tufts behavior on the upper part of the wing was filmed during the flight. Good stability and controllability of the model should be mentioned. By tufts and horizon it is possible to admit a stable flight at high angles of attack.

Conclusion

As a result of studies critical angle of attack during wind tunnel tests was increased by $7\text{-}10^0$, the change in aerodynamic quality was insignificant, hysteresis was eliminated. During flight tests with vortex slat was proved that aircraft remains stable and controllable, and stall is absent during flight with high angles of attack.

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P.O. Prystavka, dr. of technical sciences, prof. (NAU, Ukraine, Kyiv)
E.P. Nichikov, graduate student (NAU, Ukraine, Kyiv)

DIGITAL VIDEO STABILIZATION FOR UNMANNED AERIAL VEHICLE

A video stabilization information technology from unmanned aircraft proposed. It allows compensate the impact of macromotions and micromotions of video camera, ie remove the fluctuations of individual video frames and increase their sharpness. The above methods and means can be used for video processing in real time.

At the beginning of the 21st century more than 60 countries develop and manufacture unmanned aerial vehicles (UAV) of various types. In addition to issues directly related to the design and performance of aircraft, there is a topical question of processing video data from the board of UAV in solving problems of military and civil purposes (including patrolling of long objects, tracking of forest fires, target fixation, and so on). Companies, scientific and production centers and other organizations of different ownership are involved to development of UAV prototypes in Ukraine. They are focusing more on the development and usage of UAV small and medium types. Specific to UAV small and medium types is a speed more than 60 kmph and an insignificant altitude. Through the influence of these factors, to operator rather difficult to analyze video obtained directly from the aircraft. Quickly change of a shooting scene is tiring the operator. The movement of the camera does not allow focus on objects that are of interest to the observer.

The reasons that lead to a reduction in visual quality of the video are macromotions and micromotions of camera. Macromotions may be caused by the movement of an aircraft. Through this type of distortion occurs frame "shake". Micromotions of the camera occur as the result of a work of the engine, and so on. Distortions such as defocus or streaks appear in weakening the top spatial frequencies images.

Outcome following noise can be reduced by mechanical devices (gyrostabilized cameras, etc.). However, apart from high cost of these devices, they can have more weight, consume more energy, which can be critical when limited size and payload volume of an aircraft. Therefore there is a need to use mathematical treatment procedures that allow eliminating the impact of a camera motions.

The need for data in real-time, reliability and versatility are a significant obstacle for constructing high-performance processing systems digital video stream. This is due to the fact that known approaches are typically algorithmically difficult. This leads to extra time and hardware costs. In addition, the algorithms of used methods should allow to perform parallel calculations in the implementation in the software and also video processing system must be integrated into complex ground control station UAV. So actual is the development of information technology (IT), which would allow removing fluctuations of individual video frames and increasing their sharpness in real time and would be part of this complex.

Existing video stabilization tools (for example, Warp Stabilizer [1], VirtualDub Deshaker [2], proDAD Mercalli [3], and so on) allow to process already captured video (only postprocessing). In addition, as already noted, the information

technology should be a part of the UAV ground control station. Usage of third-party software does not allow integrate a video processing procedure to the complex.

The information technology video stabilization from the UAV was developed at the Department of Applied Mathematics of NAU. Informational technology allows respond to changes captured by hardware to operators of decision-making systems in real time. It implements two main stages of video processing. The first stage is the macromotion compensation. The procedure of elimination of the negative impact of macromotions can be used in solving of the following tasks: stabilization in planar aerial filming and fixing the object of observation. Next stage is the micromotions compensation. It can be performed parallel to macromotions compensation.

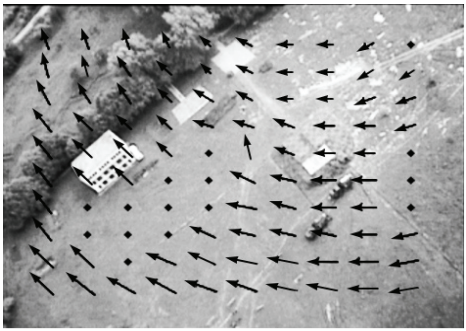

Fig. 1. Determining of offset points relative to the previous frame.

In case of planar filming, the camera is pointed down perpendicular to the earth surface. Shooting scene is constantly changing. To stabilize the video, you must define a regular grid of points that will be detecting. Next to each video frame will be determined offset of these points relative to the previous frame. The figure (Fig. 1) shows an example of the shift points of the frame. Next, calculate homography transform of frame based on landslides series of frames. Shake compensation is through the perspective transformation of the current frame.

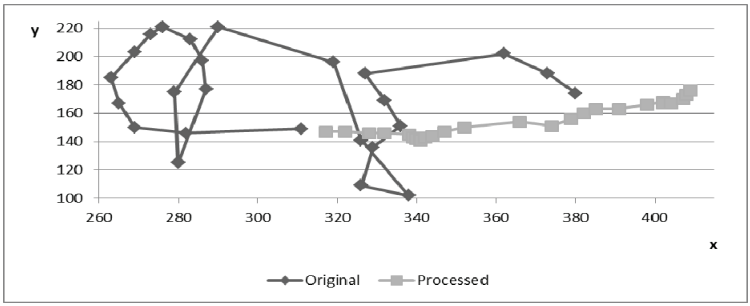

Fig. 2. Coordinates of the position of the control point on the original and processed videos.

In task of fixing object of observation camera pointed in this object. Shooting scene is constant. However, through the movement of an aircraft, objects can

approach and depart, viewed from different angles. It is necessary to define feature points [4] for the initial frame of the video to compensate macromotions in solving the problem of fixing the target. Next calculate the offset of these points for each frame. The next step is calculating the average value of the offset feature points relative to the previous frame. On the processed video motion of the control points appears more smoothly. It can be illustrated on the chart (Fig. 2), which shows the relative coordinates X and Y of the control point at 25 frames of original and processed videos. In this example, the length of a curve which is defined by moving the control points, after processing decreased 5.5 times.

When implementing procedures digital stabilization (sharpening of the digital image), which actually spend processing in real time, preference is given to those that reach the target processing functions with a minimum of computing operations. In fact such linear operators obtained in the form of a discrete convolution non-ferrous components and raster mask filters-stabilizers [5]. In paper [6] analyzed such linear operators and experimentally proved their effectiveness in the tasks of increasing the sharpness of a digital images distorted by camera micromotions in the real-time.

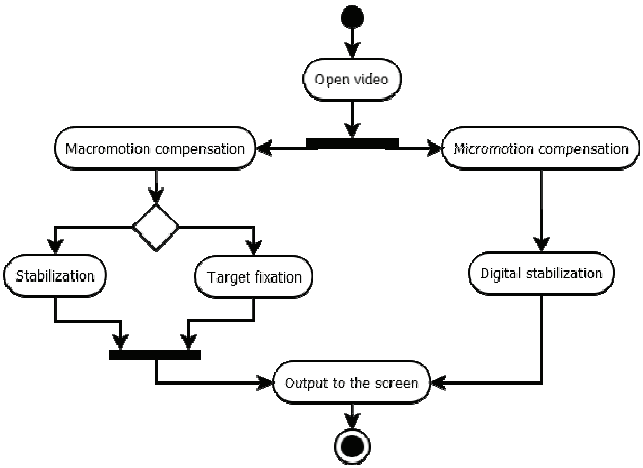

Fig. 3. Activity Diagram

For realization of stated mathematical aspects of information technology that is proposed, developed an automated system intended for stabilization of the video from the UAV. OpenCV computer vision library is used in the implementation of the automated system. Used methods [5, 6, 8, 9] and tools allow you to make calculations in several threads; it allows to carry out processing of video in real time.

In the first step of "Activity Diagram" (Fig. 3), the user can have only one option "Load video" from which we need to start working. This video can be in streaming format, or as a file. After opening the source video, the user can choose one of the parallel actions: compensation of macro- and micromotions. To compensate macromotions select one of two modes: video stabilization or target fixation.

Automated system was tested using data obtained from the board of UAV M-10 "EYE", development of scientific-production center of unmanned aviation "Virage", National Aviation University. Testing conducted on the recorded video with a resolution of 320x240 pixels at 30 fps. Video processing in real time was spent on the Dell Latitude E5530 Intel will be Core i5-3320M CPU @ 2.60 GHz and 8 GB. RAM. Video processing of larger size is possible in not real time or with lesser fps.

Conclusions

The information technology of stabilization of the video from UAV developed. IT allows operators of decision-making systems to respond to changes captured by hardware in real time. Used methods and means allow you to make calculations in several threads, which significantly increases the speed of data processing and allows video processing in real time.

Implementation of information technology can be used to create a workplace of the second external pilot of unmanned aircraft.

Further studies suggest the implementation of a multi-threaded processing by means of the GPU, increase the frame size of the processed video, usage of the additional data transferred from UAV etc.

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A.A. Rohatiuk, graduate student
(National Aviation University, Ukraine, Kyiv)

PROCEDURE OF RECOGNITION TARGET OBJECT ON VIDEO FRAMES IN A VIDEO STREAMING DATA FROM UAV PROCESSING SYSTEM

Developed the procedure of recognizing objects in video frames by using etalon data that is simple in the implementation in a video streaming data processing system, and provides the necessary performance when working in real time. The results of testing of procedure in system graphical data processing obtained from unmanned aircraft vehicle (UAV) was considered.

Over the past decade, with development of computer hardware capabilities, object recognition in video is one of the most rapidly developing areas of research. In particular, justify its use video surveillance system with elements of video analytics: recognition of various objects and classification of the current situation at the facility. These systems find their use when working with the data obtained by the UAV, for example, processing a large number of photos and video.

These tasks, such as moving object detection or identification may be resolved by installing the technical means like day or night sensors vision, and so on. However, a higher quality of image will be obtained by a more expensive, larger and heavier system, possibly requiring greater electrical power for its operation. Thus the heavier, more expensive equipment, whether it be electro-optical, thermal or radar imaging or a combination of these, will require to be carried by a larger, heavier, more expensive UAV which will have to stand off further away from the area of survey for reasons of overtness and survivability than will its smaller UAV cousin. The smaller cousin will have to approach more closely to the target to achieve results with its lighter, less capable equipment [1].

Therefore, the development of new methods of detection, recognition and identification is less expensive area of research, ensuring their relevance. In general, it should be noted that there is a lot of scientific and applied problems related to the problem of automatic image analysis, are not yet fully resolved.

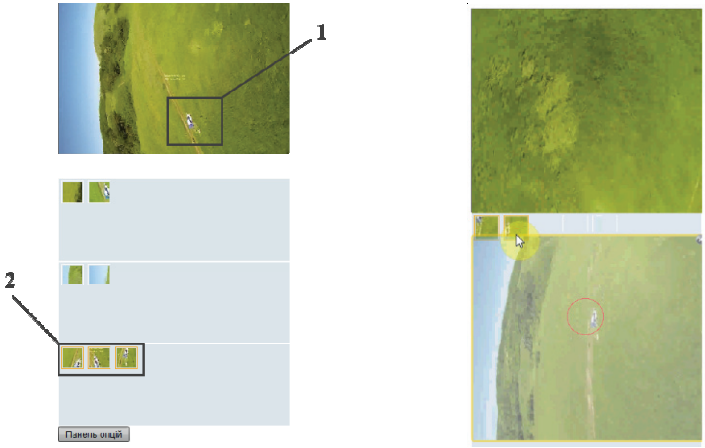
In general, the requirements for such recognition algorithms are as follows.

1. Low computational complexity and work in real time.
2. Stable detection at different times of the day in the presence of artificial lighting.

The National Aviation University, within the UASAnalizer system of data obtained from the UAV has developed the procedure of object recognition on video by an etalon data that is simple in the implementation in a video streaming data processing system, and provides the necessary performance when working in real time.

The procedure of recognition the target object as first stage are included video frame data processing method based on histogram ratings samples that are considered in [2], and processing of the etalon object, which is set at the entrance. The procedure is based on a mixture decomposition method presented in

homogeneous clusters based on estimates of the relative frequency histogram, and which is independent of the apparent number of distributions in the mixture.



a) b)

Figure 1. a) The implementation of procedure of recognition of objects in the video by the etalon image; 1) target object on video frame; 2) the results of recognition. b) reproduced trajectory of targets that has been recognition.

This procedure has been implemented in a video streaming data processing system [3] of cameras assigned for UAV, which receives and processes from UAV following data: current geographic coordinates, flight path, photos and videos.

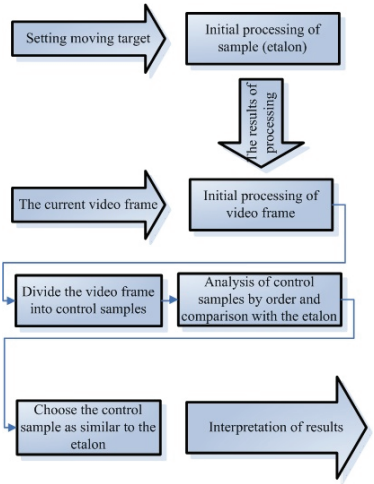


Figure 2. The general scheme of the moving target maintain procedures.

Software implementation of recognition module is designed for multimedia platform Adobe Flash [4]. Adobe Flash is chosen because of the wide range of operating systems on which the application is supported and the possibility of fast video streaming implementation [4]. Launching applications is supported both: through Adobe Flash Player [5] (integrated system), and through the Adobe AIR (autonomous system). This system allows the use of cross-platform data processing and analysis of digital video on most modern operating systems.

Additionally, for each moving object is detected in the process of recognition implemented maintain moving target algorithm that considered in [2]. The steps of the maintain of moving targets are given in the diagram (Fig. 2). Showing results allows to trace the trajectory of the found object in each video frame from the moment of recognition to the disappearance from the visible area.

The procedure was tested using data obtained from the board of UAV M-10 "OKO", which is a research and development center for unmanned aircraft "Virage", National Aviation University. The users were given a etalon image of the object on the input to the procedure of recognition. In Fig. 1.a. shows an example of identification of the target video type "car". At the top of the window displays the video stream; in the center of the screen displays the results of the identification of foreign textures; at the bottom of the window displays the results of identification by the etalon image ("car"). In Fig. 1.b. shows an example mapping the trajectory of the detected object "car". Application interface allows user to view the movement of the object in the video for additional window and perform parallel search procedure.

Conclusions

As part of the program complex UASAnalizer data processing from UAV's cameras developed the procedure of object recognition on video by the etalon image. The calculation is performed in multiple threads, which significantly increases processing speed and allows you to process video in real-time. Implemented algorithm maintain moving targets for the identified objects. Application interface allows to track the trajectory of the found object on video frames. Further research is planned as part of the modernization of methods of recognition by the etalon image for creating multi-threaded processing of video technology.

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V.P. Kharchenko, Doctor of Sciences, Professor, Vice-rector
(National Aviation University, Ukraine).
Professor (Traffic College of Ningbo University of Technology, China),
Wang Bo, PhD in Economics, Associate Professor
(Economics and Management College of Ningbo University of Technology, China),
D.O. Bugayko, PhD in Economics, Associate Professor,
Leading Researcher (National Aviation University, Ukraine)

FUNDAMENTALS OF SAFETY AND EFFICIENCY OF THE NEXT GENERATION UNMANNED AIRCRAFT SYSTEMS

The safety principles of next generation unmanned aircraft systems of FAA, NASA, US Secretary of Defence, NATO, SC203 RTCA, F-38 ASTM International, SAE S-4 Unmanned Systems, AIAA, IEEE, EASA, EUROCONTROL, EUROCAE, CAA of United Kingdom, EDA are considered.

The literary sources analysis shows the XXI century as the unmanned aviation century. According to the predictions almost 90 % of military aircraft will be unmanned and only 10 % – manned. Similar tendency is deduced in civil aviation too. This stipulates the importance of the considered in the program fundamental theoretical problems of unmanned aircraft systems (UAS) application of next generation for civil aviation purposes. However the main point restraining the unmanned aircraft systems application in the world is lack of it's safety investigation, that is the main criterion in the world aviation activity. The unmanned aircraft systems application of next generation for civil aviation purposes is waiting now for the technical and management problems solutions. The main problems are connected with the air area usage, frequency range allocation for the new generation unmanned aircraft systems control and information transmittal from board to earth and conversely, and with the development and generation of the civil aviation service market [1].

As mentioned above, one of the most crucial point of the unmanned aircraft systems application of next generation is it's low price and efficiency. The methods and technologies of unmanned aircraft systems generation are available to many specialists and enterprises which are engaged in aviation equipment development and production. But the lack of the collision prevention system of the unmanned aerial vehicles (UAV) with other airplanes, high probability of uncontrolled ground impact make the UAV flights in the same area with other airplanes and near populated locality regions impossible. Some unmanned civil aviation systems application benefits are lost, and it's usage in the conditions of intensive air traffic and in the populated locality regions is getting fully unreasonable. This stipulates the importance of unmanned aircraft systems safety problem solution.

Nowadays unmanned aircraft systems are forming new component of general aviation system and at the present time International organization of civil aviation

(ICAO), regional and national organizations such as European aviation safety agency (EASA), EUROCONTROL, European Defense Agency (EDA), European Space Agency (ESA), European Organization for Civil Aviation Equipment (EUROCAE), North Atlantic Treaty Organization (NATO), Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), Radio Technical Commission for Aeronautics (RTCA), government and airspace branch are conducting operations connected with their study, determination and finally integration. These systems are based on recent development in the sphere of airspace technology which make possible to realize new types of aviation application in civil/commercial purposes and also to increase flight safety and efficiency of civil aviation application in general [2]. However, the displacement of pilot from the board of the aircraft outlines important technical and operational tasks, the character of which should be carefully studied.

At the present time there is a problem when technical and system decisions in the sphere of unmanned aircraft systems of next generation don't satisfy the requirements.

In the USA such organization as Federal Aviation Administration, National Aeronautics and Space Administration (NASA), Secretary of Defense Radio Technical Commission for Aeronautics (RTCA) etc. deal with the regulation of safe application of unmanned aircraft systems. Federal Aviation Administration (FAA) cooperates with such European organizations as European Aviation Safety Agency (EASA), EUROCONTROL. FAA regulates the flight, using the norms of USA Public Law according to the Code of Federal Regulations Title 14 - Aeronautics and Space. The main document which promulgated FAA policy according the regulation of the safe application of unmanned aviation systems is the Policy and basic principles of unmanned aircraft systems operation05-01(AFS-400 UAS Policy 05-01) [3].

The aim of this document is the elaboration of the policy of unmanned aircraft systems application. This document is presented like temporary guidelines on the basis of which it is permitted to use unmanned aircraft systems and flight operation in the air space of USA. When the Ministry of National Security claimed that the activity of unmanned aircraft systems is a part of "national security", FAA can approve a request for Airworthiness Certificate if they are in agreement with the Standards of this policy. In this case the norms of National Security set the requirements concerning the level of potential risk and in the application request of the Airworthiness Certificate the applicant should inform about all possible risks connected with the activity of unmanned aircraft systems.

FAA confirmed three leveled 15-hour development plan of the safe regulation of unmanned aircraft systems application. Every level of the general plan has a purpose to elaborate Special Federal Aviation Regulation (SFAR). The first was FAA SFAR – 01 Special Federal Aviation Regulation Target – UAV Flight Under Visual Flight Rules. Next step is the elaboration and implementation of Special Federal Aviation Regulation - UAV Flight With DSA Collision Avoidance Technology. Final stage is the elaboration and implementation of FAA SFAR – 03 Special Federal Aviation

Regulation – Overall UAV US NAS Guidance Regulations – Unrestricted File and Fly Use of UAVs. The implementation is planned till 2020.

In the document AFS-400 UAS Policy 05-01 FAA sets a task for Special of Radio Technical Commission for Aeronautics (RTCA) to help in formation of the recommendations for the standards of unmanned aircraft systems application. These recommendations are used by FAA with a purpose to elaborate the policy, programme and regulative decisions. Special Committee203 (SC203 RTCA) develops Minimum Aviation Performance Standards (MASPS).

Committee F-38 ASTM International also conducts a great work concerning the elaboration of standards of UAV application. This Committee presents open forum for the standards elaboration.

Except above-mentioned organizations, Society of Automotive Engineers (SAE) S-4 Unmanned Systems; American Institute of Aeronautics and Astronautics (AIAA), Technical Committee on Aerial Robots (IEEE) also elaborate the standards for unmanned aircraft systems. North Atlantic Treaty Organization (NATO), which deals with the elaboration and operation of military unmanned aircraft systems, proposes the system of standards STANAG.

One of the main directions of the European regulation of unmanned aircraft systems safety is the approach concerning reviewing flights of the UAVs within the existing structure of rules which control the normal flights in the European air space. Thus successful operation of these flights, their essential adjustment is necessary. Presence of many powerful organizations and the qualified experts actually gives leadership potential to the European region in this sphere. However, it is necessary to develop the variety legislative and regulatory tools, mutually coordinate, accept and apply. The purpose is to apply reliable and profitable UAV, which are equipped by the systems of the collisions prevention (Sense and Avoid - S&A).The main problem is the correspondence of UAV to the equivalent security level of aviation in the region and in the world. In a case when UAV should fly in controllable air space, it is necessary to receive specialized permission from the local aviation authority [4].

UAV with the general take-off weight over 330 pounds/150 kg. should receive Airworthiness Certification from EASA (the basic document concerning UAV application with the general take-off weight over 330 pounds/150 kg.: EASA A-NPA [5]). Meanwhile, in Great Britain aviation flight standards and UAV safety are regulated by Civil aviation authority UK – CAA [6]. Thus in the Policy of development of light unmanned aircraft systems (UK - CAA policy for light UAV systems), the requirements concerning light unmanned aircraft systems have been formulated in details. Recently UK - CAA has produced the third update of the document CAP 722 and some European countries have expressed the interest concerning the coordination on its basis.

Despite of explicit achievements of the European institutions, the elaboration of general European agreement has a great perspective because EUROCONTROL – (the organization is responsible for co-ordination of UAV integration) has 38 countries - participants. The European Defense Agency (EDA) has announced that UAV should fly in the European controlled air space till 2015. But the majority of

the European experts named the dates which are closer to the end of decade. European Organization for Civil Aviation Electronics (EUROCAE) coordinates the development of a regulating infrastructure on behalf of EUROCONTROL. Its working group WG-73 develops the cooperation with numerous international participants from manufacture, armed forces, academic and state structures.

Parallel with the activity of legislators which is directed on the introduction of functional standards of the Airworthiness certificates and the rules of flight, industrial engineers conduct the works concerning the development of easy, power-intensive, effective system of collision avoidance Sense and Avoid - S&A. This technology is very important achievement of the flights satisfactory security level. This system will guarantee automatic frictionless flight of the UAV in general air space. It means that the flight service shouldn't conduct constant tracking for the purpose of safe allocation between the UAV and other users of air space. Many components which are necessary for such system are already developed. The program of the elaboration of the collision avoidance system in MIDCAS air space is supported by European Defense Agency (EDA).

An insurance is the important factor of the development of all commercial unmanned aircraft systems. Access to the insurance is one of potential factors of the development of unmanned aircraft systems market. At the moment within the legislation of the EU countries, essential changes in this sphere are happened; however the insurance of the UAV is not mandatory for all Europe.

In Australia the safety of unmanned aircraft systems application is regulated according to the document of Australia Civil Aviation Safety Regulation Part 101.

At the present stage of the aviation operation and in the functioning of many independent operating organizations, the aircraft economic efficiency is individual for each potential problem. It is clear that given a list of tasks requires the UAV presence aboard large complex target load, and the UAV should have fairly high performance characteristics that can make it quite expensive. To reduce the cost requires the use of advanced techniques for developing new techniques with extensive use of features modular construction and design modifications at the level of structural design blocks.

Theoretical number of options UAV can be defined by the following expression:

$$N_B = \prod_{i=1}^{n} m_i \ , \tag{1}$$

where n – number of variables structural design modules of the UAV, m_i – number of the same structural and constructional module.

Thus, during RPAS creation focuses on increasing aircraft utilization while reducing the required UAV series to one type. The group applications of the same UAV types could provide a multitude problems solving that could require the several UAV types using. This significantly reduces operating costs associated with the diverse nature of UAV and land facilities, which are part of complexes with UAV.

Concerning the special unmanned aircraft systems the effectiveness as aircraft as well as an integrated UAV system should be considered, which belongs to a

specific operating organization, and service infrastructure, and sometimes part of that system should include the object in whose favor the applicable UAV. The economic efficiency criteria and calculation methods has been evolved in connection with the of the remotely piloted aircraft systems (RPAS) economic effectiveness analysis that is based on the appropriate models development, such as volume optimization model patrol flight, which is used to assess the costs of air monitoring at the rate of 1 year, and develop appropriate methods to assess the demand for RPAS and efficiency of their application.

The ideology of the aerial means using for reconnaissance and observation is the assessment of unmanned aircraft systems efficiency to solve the above-mentioned problems by determining the cost of removal of information from one area of the earth's surface $\overline{C}_I$ is an important fact that allows to use the ideology of aerial reconnaissance means and surveillance:

$$\overline{C}_I = \frac{\frac{C_{AC}}{n_{AP}} + C_{AED} + C_{FEM}}{P_{PSP} \cdot F_{\Sigma}^1} \tag{2}$$

where C_{AC} – is a cost of a new aircraft; n_{AP} – is an estimated amount of unmanned aircraft application (multiplicity); C_{AED} – is a cost of additional expendable devices for one flight (the cost of powder accelerators, bolts, etc); C_{FEM} – is a fuel cost and expendable materials (fuel lubricating materials, industrial gases, etc); P_{PSP} – is a probability of simultaneous performance of other tasks; F_{Σ}^1 – is a total area of the earth's surface in one radius.

The productivity calculation of aerial survey works performance on linear objects is carried out in accordance to the treated area in one shot. When flying UAV aerial photographs size calculated according to the following formulas:

$$\frac{1}{2}\mathrm{L} = \mathrm{H} \times \mathrm{tg}\frac{1}{2}\lambda(\beta); \tag{3}$$

$$\mathrm{S}_{\text{зн.}} = L_x \times L_y;$$

where H – is high, m; λ, β – are viewing angles without approximation respectively horizontal and vertical, deg; $S_{зн}$ – is size of aerial photographs, m^2; L – is side of aerial photographs:

$$\frac{1}{2}\mathrm{L}_{\mathrm{x1}} = \mathrm{H} \times \mathrm{tg}\frac{1}{2}\lambda \ ; \tag{4}$$

$$\frac{1}{2}\mathrm{L}_{\mathrm{y1}} = \mathrm{H} \times \mathrm{tg}\frac{1}{2}\beta \ \cdot$$

Treated area per hour:

$$\mathrm{S}_{\mathrm{hour}} = \left(\mathrm{S}_{\mathrm{ph.}} - p\right) \times \mathrm{N}_{\mathrm{ph.}}; \tag{5}$$

where p is longitudinal overlapping of aerial photographs, %; N_{ph} is frames per hour; N_{ph}=3600/t;

Calculation of hourly productivity UAV in processing linear objects is performed at a linear photographing areas. The time between each frame is calculated by the formula:

$$t = \frac{L_y - p}{V}; \quad (6)$$

where V – is the speed, m/s; p – is longitudinal overlapping of aerial photographs, % [7].

Markets patrol operations and UAV are relatively new and rapidly developing in recent years. So much for them unsuitable recommendations produced empirically for air markets and traditional products of the aviation industry – such as transport aircraft. On the one hand, it gives rise to new methodological problems in the area of marketing. On the other – to solve these problems may be relevant for the traditional market segments of aviation, which is entering a period of profound structural change. With increasing demand for new types of aircraft, new monitoring tools, information and control systems, organizations interested in applying RPAS, increase economic efficiency and safety of its operation, and contribute, in turn, to a certain extent the development of science intensive industries and diversify Ukrainian economy. Thus, the demand for UAV and executed them for patrol work is determined by economic efficiency patrols. Application of Policy Patrol can bring substantial savings not only through the reduction of patrol flights, but by reducing the expected loss due to early detection of abnormal and emergency situations, which is achieved by increasing the intensity of patrols. Considerable uncertainty output, depending on the specific areas and tasks of RPAS, requires parametric calculations in a wide range of model parameters. The appropriate economic and mathematical models development can be an effective marketing tool that allows developers and potential customers RPAS predict the effectiveness of their use in the civilian sector, evaluate and coordinate the approximate volume of their output, mutually specifications and prices [8].

The analysis of the present stage of unmanned aircraft systems development and the international regulation of the unmanned aircraft systems operations allows to come to a conclusion that at the moment, reliability of unmanned aircraft systems is not so reliable as commercial air service (it is less than 1 incident on one million of flights). The system of regulatory documents which regulates the organization of the unmanned aircraft systems flights in the air space isn't created. Despite the full autonomy of the unmanned aircraft systems, their flights in the controlled air space without communication and the control from the centers of the organization of air traffic aren't permitted. It confirms the necessity of the subsequent integration and harmonization of aviation legislation and the standards in the field of unmanned aircraft systems safety, both in the European region, and in the world. Hence the globalization of the markets, including the market of the unmanned aircraft systems, first of all demands the adherence of appropriate safety level at their application in the different countries of the world. In order to improve the efficiency has been

proposed the advanced methods using for a new unmanned vehicles development with extensive use of features modular construction and design modifications at the level of structural design blocks.

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V.V. Kabanyachyi, Dr. Sci. Tech., D.M. Matijchyk
(National Aviation University, Ukraine)

TRAINING OF PERSONNEL OF UNMANNED AIRCRAFT SYSTEMS

Based on the analysis of unmanned aircraft system operation it is developed requirements for training of personnel.

Formulation of the problem. About 30 operators providing services in the field of aerial works. Due to greater economic efficiency of unmanned aircraft systems (UAS) [1] they have the potential to become operators of UAS. Modern UAS is technically complicated and highly cost, and must meet at least the minimum requirements necessary from the point of view of manned aircraft. Remote pilot with the duties of pilot-in-command is a critical element in the implementation of UAS. Thus the effective and safe operation of UAS for a wide range of aerial works is impossible without availability of qualified remote pilots. The latter, as well as other personnel of UAS should be trained and receive a certificate in accordance with Annex 1 to the Convention on international civil aviation [2]. The main difference of the existing provisions of Annex 1 concerning an aircraft with a pilot on board is in adding of remote pilot station and its connection with unmanned aircraft (UA). Consequently, training of personnel of UAS is very actual.

Analysis of recent researches and publications. Currently, UA can be divided into two groups [8]: one for flights within visual line of sight and second for flights beyond visual line of sight. Such distribution suggests the use of different control systems and different training and licensing of civil of remote pilots. Despite all the dissimilarity of control systems a unity in the methods and techniques of piloting in these cases are kept [3]. This leads to the conclusion about the need to develop a generalized method of both training and licensing of civil remote pilots.

A high and uniform level of both training and licensing should at all times be ensured in civil aviation, by the adoption of common safety rules and by measures ensuring that products, persons and organizations in the Ukraine comply with such rules. This should contribute to facilitating the free movement of goods, persons and organizations in the internal market. The Chicago Convention already provides for minimum standards to ensure the safety of civil aviation. Ukraine essential requirements and rules adopted for their implementation should ensure that Ukraine fulfills [6] the obligations created by the Chicago Convention [4] and Joint Aviation Requirements – FCL 1 – Flight Crew Licensing [9].

Statement of problem. Regarding the UAS, the requirements are determined in accordance with the standards and recommended practices established by Chicago Convention to aeronautical engineering, parts and technology, persons and organizations involved in UAS operation, as well as for persons and products involved in training and medical examination of pilots.

It would not be appropriate to subject all UA to common rules, in particular UA that are of simple design or operate mainly on a local basis, and those that are home-

built or particularly rare or only exist in a small number; such UA should therefore remain under the regulatory control. Consideration should in particular be given to USs with a low maximum take-off mass, which are produced in an industrial manner. UAs involved in commercial air transport, as well as pilots and persons, products and organizations involved in their training and medical examination should be certified or licensed once they have been found to comply with essential requirements to be laid down by the Ukraine in line with standards and recommended practices set by the Chicago Convention.

Presentation of the main material. An UA defines as one that is operated without the possibility of direct human intervention from within or on the aircraft. ICAO have adopted the term UAS to designate them as aircraft and to recognize that a UAS includes not only the airframe, but also the associated elements – the control station and communications links – as shown in figure 1.

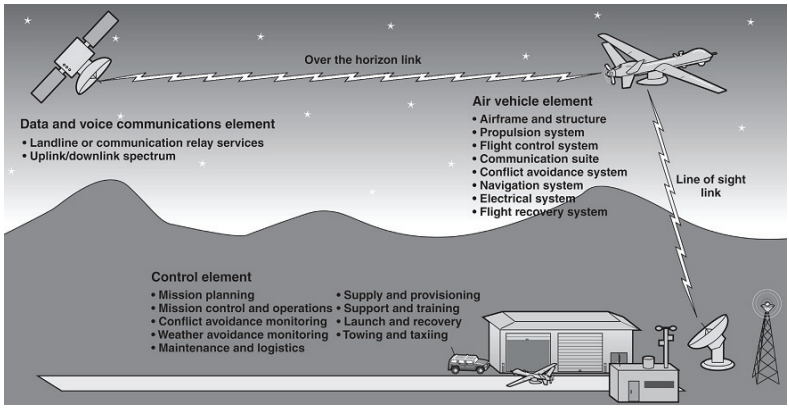

Figure 1. Conceptual Unmanned Aircraft System [5]

Figure 2 shows process structure of UA piloting based on peculiarities of piloting of both manned [7] and unmanned aircrafts. The process is a sequence of remote pilot actions for detection the UA attitude and subsequent correction of this attitude by remote control system. Deviation signal is the discrepancy between the actual and desired UA attitude. Comparison is conducted by means of both visual and partially hearing analyzers that transfer information to the central nervous system of remote pilot.

Actually the remote control system itself is a transmitting-receiving device, transmitting part of which is on ground control station, and receiving one is on UA. Command and control line is used to transfer data between the UA and ground control station for UA control.

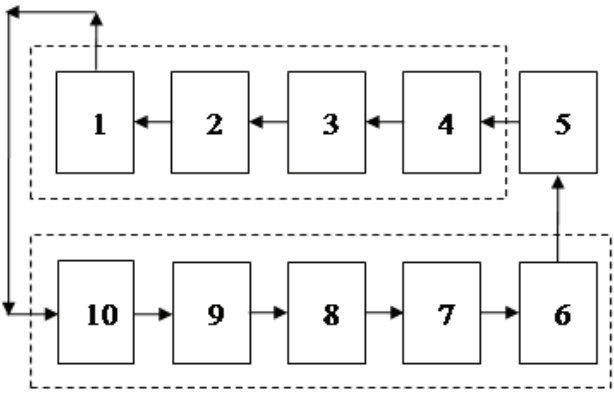

Figure 2. Structure of UA piloting:
1 – UA attitude;
2 – UA control surface deflection;
3 – UA servo mechanism;
4 – UA part of remote control system (receiver);
5 – command and control line;
6 – ground part of remote control system (transmitter);
7 – executive controls (remote pilot hands);
8 – central nervous system of remote pilot;
9 – peripheral nervous system of remote pilot;
10 – analyzers of remote pilot

Mobile ground control station is used for flights within visual line of sight. In this case the transmitter of the remote control system equipped with two controls which are deviated by remote pilot hands from a neutral position in two mutually perpendicular directions. The controls allow using simultaneously all three channels of UA control surfaces and control channel of engine control lever. Besides for rapid turn of support functions, important lever or push-button switches may be installed on the tips of the main controls that allow switching them without removing the hand from the main levers. So actually in the process of UA control a pilot use visual and hearing analyzers, and commands executed by fingers of both hands. In this case, UA is piloting only by one remote pilot. And aircraft maintenance engineer is necessary for UA maintenance.

Stationary ground control station is used for flights beyond visual line of sight. As a rule, control is conducted by two remote pilot: one as pilot-in-command, and second as operator of special equipment installed for aerial work. In this case, assemblage of UA from transport position in flight one, disassembling of UA from flight position in transport one, UA line maintenance and little repair is also required aircraft maintenance engineer. If during UA conveyance he will perform functions of driver, UAS staff should be three members.

Conclusions

UAS personnel staff: flights within visual line of sight - remote pilot and aircraft maintenance engineer; for flights beyond visual line of sight - two remote pilot: one as pilot-in-command, and second as operator of special equipment installed for aerial work, and aircraft maintenance engineer who during UA conveyance performs functions of driver.

Minimum UAS personnel staff is remote pilot with functions of pilot-in-command, operator of special equipment installed for aerial work, aircraft maintenance engineer and driver.

Remote pilot must acquire and maintain following practical skills: pre-flight, in-flight and post-flight activities, including UA performance, mass and balance determination, UA inspection and servicing, fuel planning, weather appreciation, route planning, airspace restrictions and runway availability; aerodrome and traffic-pattern operations; collision avoidance precautions and procedures; UA control by external visual reference; flight manoeuvres; normal and cross-wind take-offs and landings; flight by reference solely to instruments; operational procedures; navigation; abnormal and emergency operations; compliance with air traffic services and communications procedures; UA type or class specific aspects; practical skill and non-technical skills, including the recognition and management of threats and errors.

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V.P.Kharchenko, Doctor of Science (Engineering), Prof.;
T.F. Shmelova, Doctor of Science (Engineering), Prof.;
D.E. Prusov, Cand. of Science (Engineering), Assoc. Prof.
(National Aviation University, Kyiv, Ukraine)

DEVELOP THE CURRICULUM FOR UNMANNED AERIAL VEHICLES OPERATORS

By means of methods of expert estimates determined difficulty of tasks according to simulator practice of Air Traffic Controller. Using expert's opinion and criterion of weight coefficient defined hard zone for operation on initial training. Analyzed calculation from which we can see terminal control area have first position according to complexity of operation and procedure in air traffic control.

Statement of purpose. The aviation industry - one of the leading part of science and technology all over the world. The department is highly skilled aeronautical more responsible for aviation - air navigation service which is performed at all stages of the flight of aircraft (unmanned aircraft too) for the purpose of air traffic, radiotechnical flight support, provision of aeronautical and meteorological information in accordance with the laws of Ukraine, standards and recommended practices of ICAO and EUROCONTROL requirements.

One of the main trends of aviation technology is the active development of unmanned aircraft. ICAO has recently begun to develop international regulatory framework necessary for exploitation unmanned aircraft systems in civil airspace. Training operators control unmanned aerial vehicles (UAV) is an urgent need in the development of unmanned aviation in general. In 2014 the ANS Department started training specialists in projecting, exploitation of unmanned aircraft systems.

The purposes of the publication are:

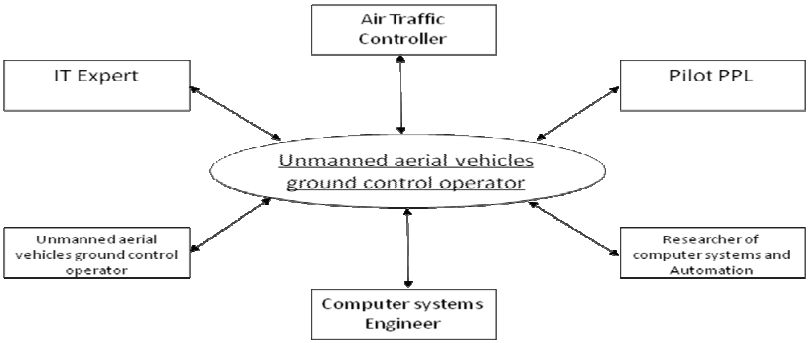
- analysis of documents which regulate training of operators of the UAV;
- to develop the curriculum for UAV operators.

Main part.

In according regulatory framework [1] to training of UAV's operator such operators in projecting, exploitation of unmanned aircraft systems there are next main blocks of training of UAV's operator:

1. *Professional training of Unmanned Aircraft Systems* (classification of unmanned aircraft systems (UAS), design of UAS, UAS purposes, general characteristics and principle of work o UAS, UAV's design, principles of flight UAV and UAV's flight characteristics)
2. *Providing of unmanned aircraft systems* (communications and surveillance unmanned aircraft systems, Satellite navigation system of unmanned aircraft systems, airborne and ground-based equipment unmanned aircraft systems, flight control systems, automated drones)
3. *Providing flights of unmanned aerial vehicles* (flight support drones, human capabilities and limitations (human factor)).

Possibilities of UAV operator (expert) represents on fig.1



Students that choose this qualification, in addition to receiving professional training in technology projecting and exploitation of unmanned aircraft systems get more programming skills and administration of computer systems engineer qualification of computer systems and research engineer computer systems and automation. Basic computer training units: Architecture of computer systems, networks and service platforms; Languages of programming; Operational Systems and System Programming; Information Technology of Mathematical modeling; Programming of microprocessors and microcontrollers; Decision – making Informatics; Information security in aeronavigation systems. In order to free orientation in modern information space all our graduates are fluent in such of software and hardware as: MATHCAD, MATLAB, C ++, MULTISIM, COREL DRAW, PHOTOSHOP, 3DS MAX, MS ACCESS, LINUX/UNIX, NetCracker.

To coordinate the courses were built based schedule of teaching by which developed the curriculum and work plan preparation UAV operators. Quality of training operators control unmanned aerial vehicles is important to decrease the influence of the human factor. Simulator practice of UAV is a necessary part of the professional training. Training including technical subjects and UAV theory and simulator practice.

The curriculum is a mandatory part of the training according to the standards of education of Direction of training 6.070102 «Aeronavigation», such as Humanitarians and Socio-Economic Subjects (History of Ukraine, History of Ukraine Culture, Ukrainian Language (professionally-oriented), Philosophy, , English Language, Physical Training, Political Science), Mathematics and Natural-Sciences Subjects (Higher Mathematics, Physics, Information Technologies, Metrology, Standartization and Sertification, Safety of Human Activities, Fundamentals of Radio-engineering and Electronics, Fundamentals of Ecology, Fundamentals of Labour Precaution) and Professional and Practical Subjects (Introduction in Air Navigation, Aerodromes, Meteorology, Aircrafts (Principles of Flight, Construction and Equipment), Geoinformation Systems, Fundamentals of Air Navigation, Navigation, English Language (Professionally-Oriented), Avionics,

Safety of Flights, Aviation Security). Subjects selected by the University including next professional objects:

- Unmanned Aviation Systems.
- Principles of Flight, Performances and Consrtrucion of Unmanned Aerial Vehicles.
- Satelite Systems for Unmanned Aviation Systems Navigation.
- Systems of Communication and Survailence for Unmanned Aviation Systems.
- Programming Languages.
- Electronics and Automatization Design of Unmanned Aviation Systems.
- Microprocessors and Microcontrollers Programming.
- Airborne and Ground-Based Equipment for Unmanned Aviation Systems.
- Automatic Flight Control Systems of Unmanned Aerial Vehicles.
- Securing of Unmanned Aviation Systems Flights.
- Human Capabilities and Limitations (Human Factors).
- Architecture of Computer Systems, Networks and Service Platforms.
- Operating Systems and Programming Systems.
- Informatics of Decision Making.
- Information Technologies of Mathematical Modeling.
- Information Security in Air Navigation Systems.

To ensure the formation of practical skills of students future UAV's operator at the Department of Aeronavigation exists "Aerospace Centre" and Laboratory unmanned aircraft systems, researchers who are working on developing hardware and software of UAS.

Specialists, graduates of the specialty "Operator of ground control unmanned aerial vehicles" can use and serve unmanned aeronautical systems and their components to be experts in management of unmanned aerial vehicles, equipment and personnel. The education term of qualification "Bachelor" is 4 years, "Magister" – 1,6 years. For a complete list of major disciplines for specialists training more details can be found in the "discipline" of our website [2].

In addition, the new strategy for the training of highly qualified scientific personnel at the National Aviation University has been developed due to the european third-cycle engineering education within the framework the International Tempus-Project implementation "New Model of the Third Cycle in Engineering Education due to Bologna Process" (NETCENG).

National Aviation University became a member of the International Consortium for the International Tempus-Project "New Model of the Third Cycle in Engineering Education due to Bologna Process" (NETCENG), that is accepted for execution during 2014-2016 years. This Project has been funded with support from the European Commission.

The project goals and objectives is to ensure that the targeted Universities introduce pilot Doctoral Programs in Engineering in line with the Bologna Process, according to 10 principles of Salzburg and Bucharest Forum.

The specific project objectives are following:

– to develop, implement and accredit new core and transferable curricula including

ECTS;

– to establish new structured Doctoral Programs in target area according to requirements of Labor Market;

– to develop innovative teaching/learning environment for Doctoral Programs;

– to bring the Higher Education Institutions of PCs closer to the Labor Market.

Target group is post-graduates, graduates, students, teaching, research, administrative staff; management of educational organizations, local community administration staff.

The Project performing includes the following Activities:

– Review current doctoral programmes and develop model for new structured doctoral programmes;

– Develop and accredit new core and transferable curricula;

– Establish innovative teaching/learning environment;

– Set up "Doctor Engineers in Labour Market (DLM) offices" to support Dr. Engineers in Labour Market;

– Sustainability through implementation;

– Quality control.

Principal outcomes and outputs of the Project are following:

– 8 new core and 3 transferable curricula developed, implemented, accredited;

– Innovative teaching and learning environment including Joint Web Platform, Doc Colloquium Rooms, Labs and Doctoral Summer schools established, equipped and open for operation based upon Master Classes and pilot operation conducted;

– DLM Offices to support Researchers in Labor Market based on pilot operation in function;

– Dissemination of project results.

Thus, the objectives of the project are to develop, implement, transfer and accreditation of training programs, including their adaptation system ECTS, installing new structured doctoral programs in the target area in accordance with the requirements of the labor market, the development of the learning environment for doctoral programs according to the Bologna process and bring Doctoral graduates of universities closer to the labor market and the urgent priority directions of science and technology. Therefore, the Project is in line with national priorities of Ukraine in the engineering field, considering the priorities of all partner countries universities, aimed at reforming the curriculum, the development and implementation of a new model of the third cycle in technical sciences.

The project partners have identifed by an analysis inquiring the priority to develop the third cycle programmes in Engineering which is logically related to the fact, that the first cycle BA and the second cyc1e MA in Engineering are already successfully implemented. Ukraine have joint the Bologna process so it have to tune our Doctoral Education System to various aspects of the Doctoral programmes of European Knowledge Society. An overview of the political decisions of the last few years shows that the objectives of the Project are shared in partner coutries.

International Project Consortium consists of 22 institutions from 6 countries, including 14 universities, of which 3 - Ukraine National Aviation University, National Technical University of Ukraine Kyiv Polytechnic Institute and Cherkasy State Technological University. Participating in the consortium partner institutions with

different needs according to the stakeholder groups they represent, with varying experience of European projects, establishment of academic and non-academic consortium members in the project. The project will have an important impact in the process of modernization and reform, meets the academic, professional and social needs of target countries, developing plans targeted universities, institutional and socio-economic support and political priorities of the target countries.

During the project partner countries universities must be accredited new curricula and new teaching materials at the institutional level following close to the subject project courses and disciplines, "System modelling and simulation", "Navigation in Transport Systems", "Sensoric in research" "Power electronics and systems", "Mathematical modelling", "Satellite images processing techniques", "Robotic systems", "Materials Science and Solidification Processing".

The methodology of the project based on the following principles. The project represented all levels of key institutions, including universities, ministries of higher education stakeholders. These horizontal and vertical linkages are to provide high quality and efficiency in the performance of the work plan . Business plan consists of a series of stages, due to the implementation of which should be achieved measurable and tangible results are to be used in subsequent stages of the project. Activity for the duration of the project is to ensure its efficiency and stability. Particular attention is paid to project management and administration of each organization make up the consortium.

Great importance is the presence of perspective development plan of the University of introducing new subjects and research areas, close to the subject matter of the project departments targeted communications with stakeholders (the subject of the project) in the field of industry organizations, institutions of research and development activity, and related universities, given the presence of organizations interested in graduates with the academic title in the subject project [3].

Conclusion

In first time in addition to receiving professional training in technology projection and exploitation of unmanned aircraft systems, students receive additional skills in programming and administration of computer systems.

Further, the new strategy for the training of highly qualified scientific personnel at the National Aviation University has been considered due to the european third-cycle engineering education within the framework the International Tempus-Project implementation "New Model of the Third Cycle in Engineering Education due to Bologna Process" (NETCENG).

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A.Yu. Assaul, post-graduated student (National Aviation University, Ukraine, Kyiv)
Yu.V. Sikirda, Candidate of Engineering, Associated Professor (Kirovohrad Flight Academy of the National Aviation University, Ukraine, Kirovohrad)
O.S. Stasyuk, student (National Aviation University, Ukraine, Kyiv)
T.F. Shmelova, Doctor of Engineering, Prof. (National Aviation University, Ukraine, Kyiv)

DETERMINING THE INFLUENCE OF FACTORS OF INTERNAL AND EXTERNAL ENVIRONMENT OF MANAGEMENT ON THE SAFETY OF AVIATION ENTERPRISE

The structure of environment of aviation enterprise's management was studied. The decomposition of factors of internal and external environment of aviation enterprise's management was conducted and with the help of set-theoretical approach its unhomogeneous factors were generalized. The influence of factors of internal and external environment of management on the level of safety of aviation enterprise was determined.

Problem statement. It is considered that aviation is the most fail-safe type of transfer. In as little as century aviation in the sphere of flight safety rose through the ranks from unstable system to the first "ultra safe" system in the history of transport, it means that system in which the number of catastrophic failures in the sphere of safety make up less than one per one million of production cycles [1].

According to ICAO's data [2], comparing with 2001, in 2012 the number of incidents in the world decreased on 21% and number of fatalities decreased on 10%. Consequently, the least number of deaths was fixed in 2012, starting from 2004. But, nevertheless, the elimination of aviation events and serious incidents continues to be final goal of human activity in the sphere of safety of aviation, but aviation systems cannot be wholly free from dangerous factors and connected with them risks. None of human activity or created by human systems does not guarantee a total absence of exploitation failures and consequences from them [3].

ICAO constantly develops and improves proactive, based on the risks evaluation methods, directed on the farther decrease in number of aviation events in the world and also encourages aviation communities to recognize the importance of adherence of the single global approach for improvement and monitor of safety [2]. A modern approach, founded on the characteristics (performance-based approach – PBA) [4], based on the next three: the main aspect on desired/necessary results, decision making, oriented on desired/necessary results, using facts and data while decision making. Herein the principle "using facts and data while decision making" admits that tasks shall comply with the widely known in west management criteria SMART [4], that correspond to abbreviation of five English words: specific, measurable, achievable, relevant and timebound.

Such level of accuracy of tasks determination may be achieved only using the way of consistent and structural description of unhomogeneous components of aeronavigation system - aviation enterprises, aviation personnel, aviation infrastruc-

ture, techniques, rules and information that is used for provision of safe, regular and efficient air navigation service for users of airspace [5; 6].

The purposes of the publication are:

- to study the structure of environment of aviation enterprise's management;
- to conduct decomposition of internal and external environment of aviation enterprise's management;
- to generalize unhomogeneous factors of internal and external environment of aviation enterprise's management with the help of set-theoretical approach;
- to determine the influence of factors of internal and external environment of management on the level of safety of aviation enterprise.

Main part. Safety management of the aviation enterprise is directed on the fostering and ensuring the achievement of its goals through efficient use of resources (labor, material, financial, information, etc.) [7; 8].

Aviation enterprise is under continuous pressure from separate branches of internal and external environment [8]. The environment of aviation enterprise's management is represented as a complex of defined conditions and factors as in the middle so around of it, which influence on decision making [8] (fig.1).

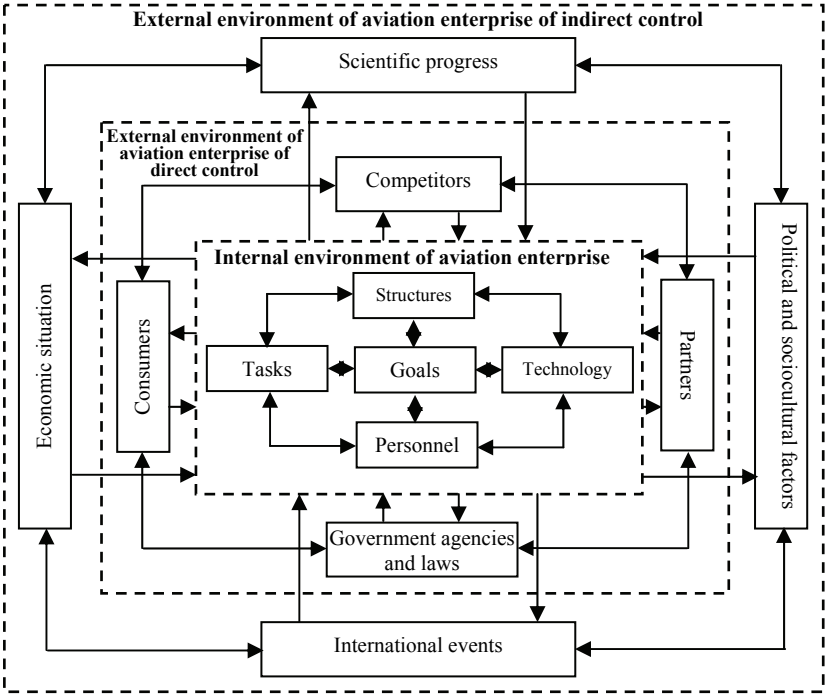

Fig. 1. Environment of the aviation enterprise's management

The internal environment of the aviation enterprise's management is a complex of elements, connected with each other with the help of defined structures within it. External environment of the aviation enterprise's management - a complex of elements which are not part of the enterprise, but make some influence on it.

Decomposition of factors, which influence on safety in aviation, was done in order to provide the structural analysis of environment of the aviation enterprise's management (fig. 2).

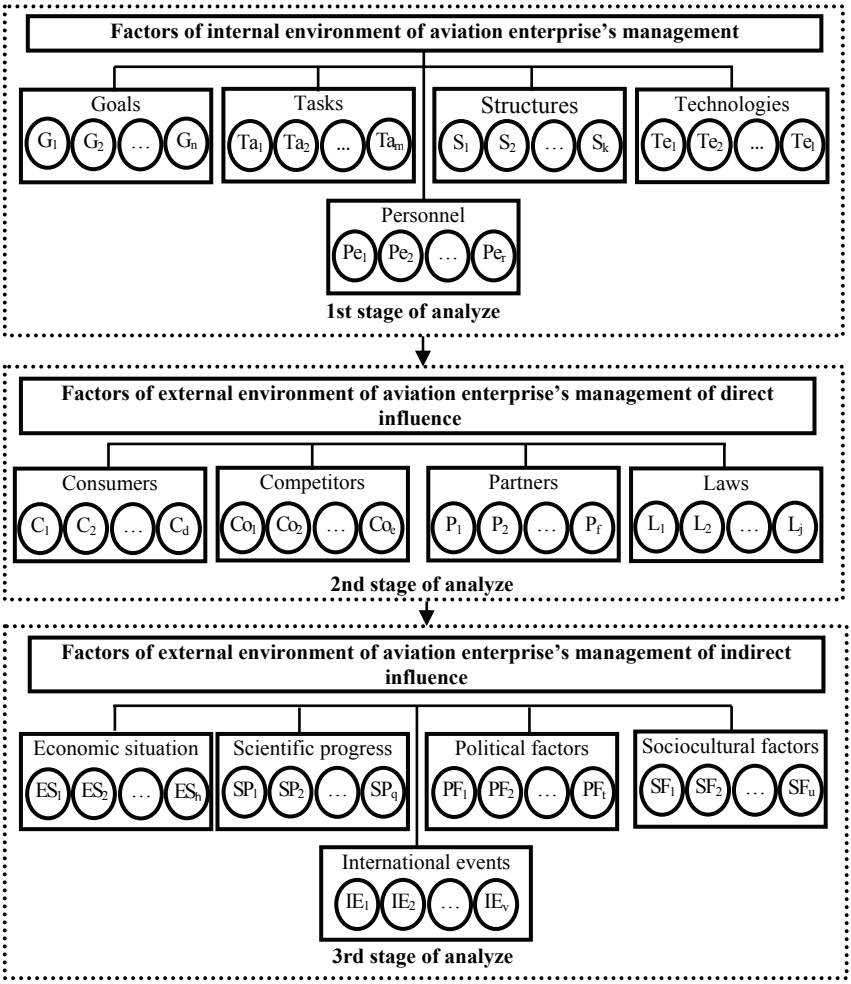

Fig. 2. Decomposition of factors of environment of the aviation enterprise's management

According to the analyze, as an example, concerning the importance of factors the next graphs are suggested: the goals, which belongs to the internal environment of the aviation enterprise's management (fig. 3) and international events, which belongs to the external environment of the aviation enterprise's (fig. 4).

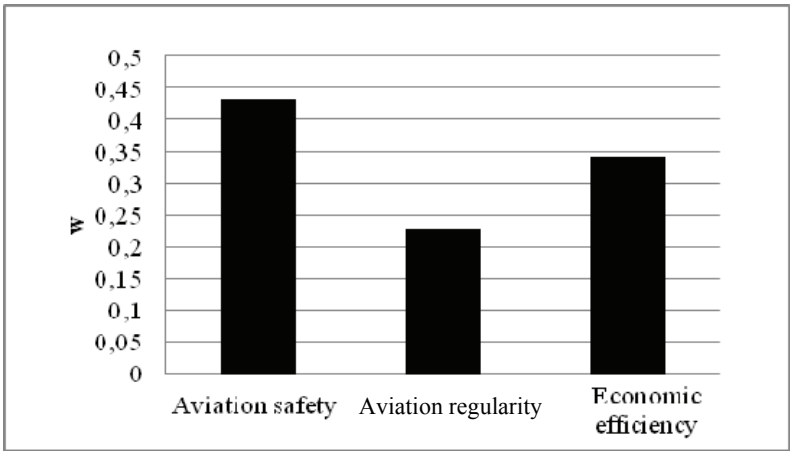

Fig. 3. The factor of internal environment of the aviation enterprise's management

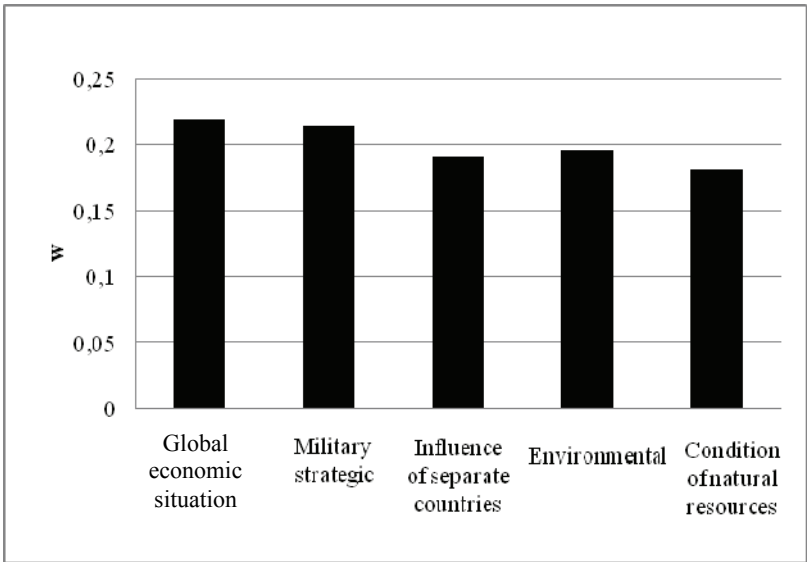

Fig. 4. The factor of external environment of the aviation enterprise's management

Conclusion

Aviation enterprise is an interaction of such basic elements as goals, tasks, structures, technologies, people, and also environment - political, economic, cultural, market, to which aviation enterprise must adapt. The internal environment of the aviation enterprise is the source of its vitality and includes potential that enables aviation enterprise to exist and survive in a certain period of time, but it can be a source of problems. The external environment is the source of resources necessary to support its internal potential at the required level in order to achieve goals.

Decomposition of factors of internal and external environment of the aviation enterprise's management that affect the safety of aviation activity was conducted. Unhomogeneous factors were generalized with the help of set-theoretical approach. This gives possibility to determine that among the goals the biggest influence on safety of aviation enterprise from internal environment has the safety of aviation activity and from external environment among international events – global economic situation.

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A.P.Bilko, V.A. Lazorenko, Senior Lecturer,
O.V. Poluhovich, post-graduated student,
T.F. Shmelova, Doctor of Engineering, Prof.
(National Aviation University, Ukraine, Kyiv)

NEURAL NETWORK FOR AUTOMATED ESTIMATION OF PRE-SIMULATING TRAINING

With the help of methods of expert estimates determined difficulty of tasks according to simulator practice of Air Traffic Controller. Using expert's opinion and criterion of weight coefficient defined hard zone for operation on initial training. Analyzed calculation from which we can see terminal control area have first position according to complexity of operation and procedure in air traffic control.

Statement of purpose. Statistical data show that human errors account for up 80% of all causes of aviation accidents [1]. Safety in aviation will continue to be highly dependent on the reliability of air traffic service (ATS). That reliability will be directly linked to the ability of ATC planners and managers to incorporate the many lessons of history regarding the impact of Human Factors on controller performance. According to list of factors performance include: quality of selection criteria, initial and recurrent training, and retention programs for air traffic controllers [2].

Quality of aviation training is important to decrease the influence of the human factor. Simulator practice of air traffic controllers (ATC) is a necessary part of the professional training. Training including technical subjects and ATC theory and simulator practice. The object of initial training is to prepare an ab initio for training at an ATC unit [3].

The purposes of the publication are:

- estimation of the complexity of procedures performed by ATC, depending from type of airspace zones;
- to develop neural network for automated estimation of tasks in the pre-simulation training system.

Main part. States shall select those airspace classes appropriate to their needs. And also have 3 zones of airspace – important elements of air traffic management, with individual restrictions according to Ukraine normative document [4].There are [5]:

1.Control zone - a controlled airspace extending upwards from the surface of the earth to a specified upper limit.

2.Terminal control area (TMA) –a control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.

3.Control area - a controlled airspace extending upwards from a specified limit above the earth.

Analyze airspace classification in Ukraine. Implementation of airspace classes in Ukrainian airspace in accordance to requirement of normative acts:

- Control zone (CTR) – class D;

- Terminal control area (TMA) - D (except Boryspil TMA, where class C is applied due to high traffic volumes);
- Control area (CTA) - D and C.

Weight coefficients of complexity in zones (CTR, TMA and CTA), procedures of ATC and classes ATM was obtained with a help of method of expert estimates [6]. The experts are Air Traffic Controllers, who operated in training course. Estimation of complexity tasks in the pre-simulator training with the help method of expert estimates represented in Table1.

Table 1. The results of obtaining hard zone according to procedures.

№	Comments	Formula for obtaining	Results
1.	Questionnaires for experts – ATC with working experience.	$r_{ij} = \begin{cases} w_i^* >> w_i, r = 1 \\ w_i^* << w_i, r = 0 \\ w_i^* \approx w_i, r = 0.5 \end{cases}$	$\overline{\underline{r_{ij}}}$, $j = \overline{1, n}$, $i = \overline{1, m}$ m - quality of experts n - quality of estimated parameters (zones)
2.	Matrix of individual preferences of m-experts.	For example, $R_i = R_{iTMA} \succ R_{iCTA}, R_{iCTR}$.	Systems of individual preferences of m – experts.
3.	Matrix of group preferences.	$R_{gr} = \frac{\sum_{i=1}^{m} R_i}{m}$	R_{grCTR}=2,642857; R_{grTMA}=1,14285; R_{grCTA}=2,214286.
Coordination of experts opinion.			
4.	Calculation of dispersion D.	$D = \frac{\sum_{i=1}^{m} \left(R_{gr} - R_i\right)^2}{m - 1}$	D_{CTR}=0,401099288976; D_{TMA}=0,131868480769; D_{CTA}=0.335164576356.
5.	Calculation of square average deviation σ.	$\sigma = \sqrt{D}$	σ_{CTR}= 0,633324; σ_{TMA}=0,363137; σ_{CTA}=0,578934.
6.	Obtained coefficient of the variation ν.	$\nu = \frac{\sigma}{R_{gr}} 100\%$	ν_{CTR}=23,9636; ν_{TMA}=31,77445; ν_{CTA}=26,14542.
If $\nu_{CTR,TMA,CTA} \leq$ 33 %, opinion coordinated, and obtained system of expert group preferences, $R_{gr} = R_{TMA} \succ R_{CTR} \succ R_{CTA}$.			
7.	Weight coefficient w_j of complexity j – zone.	$w_j = \frac{C_j}{\sum_{j=1}^{n} C_j}$; $C_j = 1 - \frac{R-1}{n}$; where *n* – quality of zones	w_{CTR}= 0,322954746; w_{TMA}= 0,348873; w_{CTA}= 0,328172.

Calculations was obtained for using program MSExcel. So, we can see that the most difficult zone of airspace, according to opinion of expert is Terminal control area (w_{TMA}= 0,348873). In future ATC instructor would take into account this experts opinion for formation task according to difficulty.

For automate estimation of pre-simulation training on initial stage built neural networks - multilayer types [6; 7].

Fig.1 represents the neural network admission student to simulator training by the number of hours and level of training. It is neural network with type multilayer perceptron in which one layer is hidden:

– first layer - calculation of hours on theoretical training in accordance with the evaluation of student's knowledge;

– second layer - restrictions on given number hours (hidden layer);

– third layer - restrictions on passing mark hours (hidden layer).

Threshold functions activation building according with requirements of hours and level of marks task (discipline) in compliance with criterion of estimation of task.

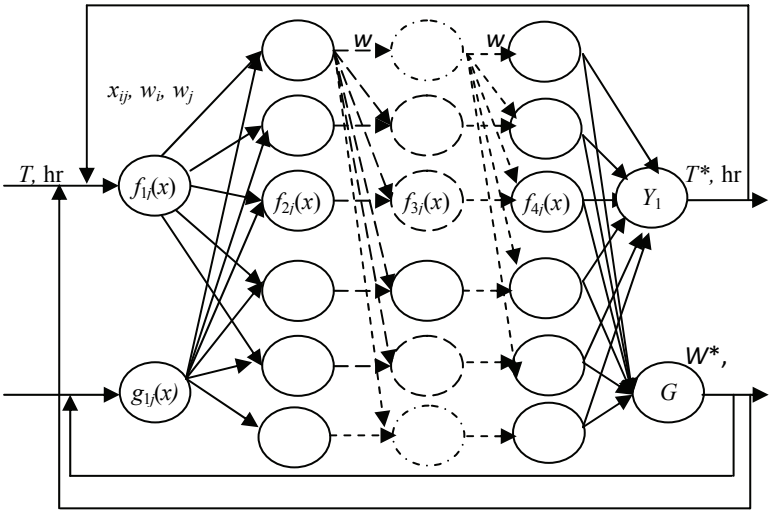

Fig.1 Neural network admission student to simulator training by the number of hours and level of training.

Integrated estimate Q_{jl} of tasks with *j*-th level of complexity in air traffic control for n-zones would be:

$$Q_{jl} = \sum_{j=ll=1}^{n} \sum^{L} w_j p_j z_j q_l,$$

where Q – estimate for task with given complexity and types of airspace zone (CTR, TMA and CTA); Q_{jL} – mark according to task; w_j ,p_j, z_j - weight coefficients (complexity of airspace zone, procedures of ATC and classes ATM, etc), $j = \overline{1,n}$; $L = \overline{1,l}$; l - level of task.

Threshold functions activation building according with requirements of hours and level of marks task (discipline) in compliance with criterion of estimation of task. Tasks' assessment criteria has list of general principles. All positions of assess criteria are prescribed and have to be used in a proper way as given below:

1. To take a duty and work place preparation - a_1.
2. An ability to follow the prescribed standard phraseology (excepting tasks with emergency and urgency situations) – a_2.
3. Coordination with adjacent ATC units and other kinds of aerodrome service provision units – a_3.
4. Handling of procedural control – a_4.
5. Handling of visual control – a_5.
6. Daily flight plan conduction – a_6.
7. Execution of traffic massages timesheets – a_7.
8. Timeliness and accuracy of decision-making in ATC – a_8.
9. Compliance with safety in ATC – a_9.
10. Performing of console operations – a_{10}.

Tasks' assessment criterions chose with the help Hungarian method for solving the transport problem - the method of appointment [8] and depends from type of ATM.

Conclusion

Automation of estimation of pre-simulator training on phase of initial training specialists of Air Traffic Control increases the efficiency of simulator training through interactive evaluation of the performance of student's tasks. Integrated estimate of tasks use in pre-simulating training for evaluation of theoretical training of students.

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D.I. Bondarev, post-graduated student (National Aviation University, Ukraine, Kyiv)
T.R. Jafarzade, Ph.D (Eng), Senior Lecturer (National Aviation Academy, Azerbaijan, Baku)
A.N. Kozub, Candidate of Engineering, Prof. (National Defence Academy of Ukraine)

UNMANNED AERIAL VEHICLE'S GROUP FLIGHTS

This article offers an analysis of options for constructing structures groups of UAVs in the performance of collective tasks. Found that the basis for constructing them in a network structure, which is characteristic for multi-user information systems. A generalized indicator of quality monitoring system whose components are the delay, loss, completeness and accuracy of information, analyzes their impact on the performance of the system depending on the hardware implementation.

Statement of purpose. Development of unmanned aircraft systems (UAS) based on unmanned aerial vehicles (UAV) is performed at this time virtually all industrialized countries. The use of UAS as effective in exploration tasks, and civil aviation, in particular when dealing with the consequences of emergencies and disasters and agriculture, relay communications, and so on. The main focus of the development of the UAS until recently considered multitasking (multiple use) such as driving condition monitoring and protection of forests and breeding grounds, ice reconnaissance, etc. However, due to the volume of planned tasks assigned to individual aircraft, they can not be performed in a limited time and for such purposes as appropriate use group use UAV. A number of issues of collective (group) actions of autonomous aerial objects considered in Reported additional useful properties possessed by a group of UAVs compared using one UAV.

To overcome the difficulties of applying classical control theory applied the idea of applying a control system based on behavioral responses using neural networks, which is owned by Brooks and a group of Montgomery. Layered control system developed by Montgomery, assumes that the Summit resolved long-term task faced by UAV: the movement for a given trajectory, providing the necessary orientation in space when passing through a given trajectory, etc. Intermediate control system provides the necessary "modules" for high-performance teams, providing a number of "elementary" maneuver performed by helicopter: the transition to the new desired height, providing the required spatial orientation of the helicopter, etc. Lower level management is responsible for ensuring the survival of unmanned machine by a very rapid response to external stimuli while retaining the helicopter in hovering mode. The structure of a group of UAVs found the following deficiencies: difficulty distribution of tasks between the operator of the flight, and the elements of the group of UAVs; lack of efficiency in solving the problems of patrolling, hunting and retransmission in the proposed area; the need to describe the protected area reference points (coordinates GPS); limited duration UAV route group; automatic redistribution (overlapping) tasks within a group of UAVs with the advent of an emergency within patrolling area; need to increase the duration of patrol by the action of the UAV.

The aim is to study the structures monitoring system using a group of UAVs, which provides control of the situation in the area of patrol; detection and localization of an emergency, such as, for example, a forest fire; delivery of information to the control point by patrolling areas, performed by a group of UAVs; effectiveness analysis group topology UAV; development of a database for UAV monitoring system.

Main part. Set custom shape area S, removed from the control point at a distance R. The region is characterized by the fact that it is possible emergencies that need to react in order to reduce damage to. These unacceptable situations include, for example, forest fires, floods and other natural disasters. The area controlled by the UAV, the main task is to monitor the state of patrulyuyemoyi zone, early detection unacceptable situation, determine its characteristics, a preliminary assessment of keeping damage. It is believed that each member of a group of UAVs during the execution of a task can change the route, area patrols, share information on the results of observation, react to signals control points. It is clear that the system of control groups for each element solution of the problem should be composed of the subsystem of acceptance and transfer of information, traffic management, monitoring and terrain recognition unacceptable situation. As the performance of the system UAV selected quality indicators of the information received: delay information T, the loss L, completeness V and probability P. When functioning monitoring system should provide the specified performance E_{dop} by meeting criteria:

$$E(T, L, V, P) \le E_{dop}, \qquad (1)$$

where $T \to \min, L \to \min, V \to \max, P \to \max,$ E – a function that describes the ability of an information system.

Thus, the task of developing the structure of the monitoring system that provides control of the situation in the area patrol, detection and localization unacceptable situation, issuing information on the control point by patrolling areas, performed by a group of UAVs and to determine the factors that influence the effectiveness of (1). Patrol area plane S in the interest of solving the problem is divided into n - subzones approximately equal area:

$$S_i = S / n, \qquad (2)$$

where $i = \overline{1, n}$, n – group number of UAVs.

In the event of such an organization, each member of a group performs the same function but in different subzones Si. We believe that consumer information is the point where the start is made UAV. Then the tool point control can be enhanced, and consist of the distribution zones between elements of the group determine the route the individual elements of the group, issuing control commands, communication with external systems. Function group elements are as follows: in flight, orientation in space, fixing unacceptable events, issuing reports on monitoring results. A simplified view of the structure can be represented in Fig. 1. The structure in Figure 1 is a network organization with centralized control. Thus the elements of the group comes from the channels point to control online information i_1, ..., i_n. Item

control has an additional channel of communication with external systems, which gives information to organize actions with additional tools. Given the nature of the network structure may also assume that the group will have UAV more complex - a tree structure in which the elements of the group E_{l1}, E_{l2}, ..., E_{ln} closed on E_{l0} root element. In this case, a significant part of the tasks of operative management team relying on E_{l0} element, that thus can be unloaded center management team that will only solve the problem of flight preparation and broadcast media i0 external system. It should be noted that the structure presented in Figure 1, Figure 2 is almost identical, the feasibility of a particular structure is determined only by the characteristics of distance communication channel, the quantitative composition of the group and the vitality of the group. Obviously, the distance values structure tree structure higher than the structure, which is shown in figure. However, the quantitative composition control better the structure shown in Figure 1, by eliminating the intermediate control

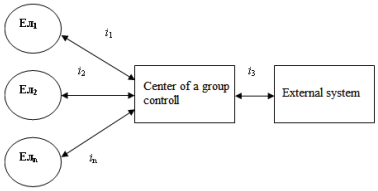

Figure 1. The simplified structure of a group of UAVs

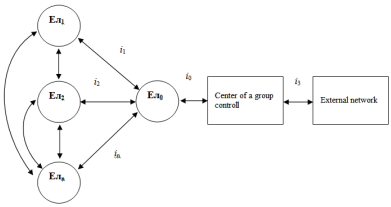

Figure 2.The structure of multi-agent group UAVs

Proximity Fig.1 and Fig.2 structures suggests the applicability of neural networks to the device definition with the signal, Figure 1 (i0, Fig. 2), ie, the output signal of the network can be represented as:

$$i_0 = \begin{cases} 1, & \text{if } I(\text{ел}) > T, \\ 0, & \text{if } I(\text{ел}) \le T, \end{cases} \qquad (3)$$

where $I(ел)$ – so-called activation (crucial) feature syhmovieving types, to classify the unacceptable situation, and T - threshold value for their determination. Mathematically, the activation function can be written as

$$I(ел) = \frac{1}{1 + \exp(-\sum_{i=1}^{n} k_i ел_i)},$$

where k_i – weighting coefficients.

The structure with network architecture and their use is justified by the importance of tasks. The most promising among the considered structure is considered a group of multi UAV. The internal architecture of the control group elements can be constructed as in on the basis of behavioral responses (Behavior-Based Architecture), which has a representation of the structure of the control algorithm for multi-channel control system as a set of relatively simple and possibly minimally coupled to each other computing modules that form the behavioral

responses of control systems using high medium and low. Each behavioral response is responsible for the solution of specific administrative tasks. Architecture of the control system using a three-level control system shown in Fig. 2. Architecture of the control system of this kind is actually a description of the structure of information communication between various control circuits (behavioral responses) is determined at the design stage and is rigidly fixed. Each reaction is responsible for a specific task management. These tasks are performed in parallel and with the aim to ensure the task set before the element group. Subsystem control form behavioral responses that are structured multi-input systems. Levels of classified speed execution of behavioral responses. Under such a construction of different behavioral responses can use the readings from the same sensor and, therefore, deviations, which represent the difference between the intended behavioral response to the real purpose and object state management, working in parallel on each channel. The current state of the object is measured at the control sensor that can be used behavioral reactions of different levels.

At the highest level are resolved long-term objectives faced by UAV: the movement for a given trajectory, providing the necessary orientation in space when passing through a given trajectory, etc. These objectives are formulated based on commands received from a central point of control or operator of the flight, as well as on current indications sensors (of aircraft). Intermediate control system provides the necessary "modules" for high-performance teams that are designed to perform a number of "elementary" maneuver performed by UAVs: the transition to the new desired height, providing the required spatial orientation, etc. Issuing commands actuating mechanisms responsible management of low-level behavioral responses. Low-level behavioral reactions responsible for the contours of control, requiring "fast" reactions and reflexes are called level because this control circuit is responsible for stabilizing the UAV in physical space, and the speed of responses to emerging external perturbation.

Analysis of the functioning of Fig. 1, 2 can identify the main factors that determine (1). Delays Information T_3 (c) defines the time delay due to traffic neohidnist route to patrol the area, due to the nature of communication, because of the need to make decisions. Enter the designation, T_{pr}, T_{dv}, T_{pv}, where expression of a common information delay has the form:

$$T_3 = T_{dv} + T_{pv} + T_{pr} . \qquad (3)$$

The largest contribution to the expression (3) is T_{dv}, with preliminary estimates and Tpv Tpr components can be neglected, so, we assume that $T_3 \approx T_{dv}$. Minimizing delays should be done by optimizing the route. The amount of information I (measured in bits) is determined by a binary logarithmic function

$$I = \log_2 (1/P_k),$$

where P_k – probability of message k, Pk value takes a value between 0 and 1.

The possibility of measuring the amount of information that can be transmitted (in bits/s) through any channel in the presence of a certain level of signal S and noise N is an important aspect of the term "information". To measure its quantity used Shannon-Hartley theorem:

$$\tilde{N} = B \log_2 (1 + S/N),$$

where B – channel bandwidth (Hz).

Information loss L (dB) on the path flow of information will distinguish between hardware L_{ap} incurred in obtaining the information loss associated with the environment L_{cr} distribution losses associated with information processing L_{ob}. Then the general expression of information loss in the system has the form

$$L = L_{ap} + L_{cr} + L_{ob}. \quad (4)$$

Minimizing the components in (4) is provided based on experience applying modern computational tools and appropriate methodological apparatus. Sufficiency of information V shall determine the number of messages transmitted V_i from individual network elements

$$V = \sum_{i=1}^{n} V_i. \quad (5)$$

The value of V_i in (5) is determined by the type of information and the applied techniques. Modern communication systems can provide digital stream 100MB / s and more, allowing you to build a message in the form of a frame with a view to solving the problem of monitoring and acceptance decisions based on it.

Probability of information transmitted P_i is determined by obtaining the information and the probability of correctness of the transmitted messages pi a source

$$P_i = 1 - (1 - p_i)^m, \quad (6)$$

where m – number of confirmation transmitted message.

In addition to the factors affecting the informative work group UAV flight, the main performance topology of multi-UAV groups: control reliability, structural compactness, degree of centralization and the persistence of groups using known methods for the analysis of computer networks in information technology. Some indicators of informativeness of individual and group flying UAV effectiveness of various topologies, the characteristics of modern UAV according to the classification of civil and military UAV as well as the regulatory framework UAV entered the reference database "Informational system of unmanned aerial vehicles."

Conclusions

Thus, the task of creating management systems group behavior UAV advisable to rely on a network basis. Further research should be directed to the solution of practical problems of implementation of group management in controlling the UAV, which leads to more efficient use of UAVs, namely the possibility of adjusting the plan and optimize the route of flight, are based on data obtained from other UAVs; increase the likelihood of success of the task; considerable gain in time; simultaneous examination of area and increase the area of simultaneous monitoring; possibility of setting different tasks for multi-UAV team members based on the efficiency of topology groups.

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V.I. Chepizhenko, professor (National Aviation University, Kyiv, Ukraine)
R.E. Lukiianchuk, post-graduate student (National Aviation University Kyiv, Ukraine)

SYSTEMATIZATION OF AIRCRAFT WAKE VORTICES MODELING TYPES BASED ON THE USE OF VARIOUS MATHEMATICAL METHODS

All pilots need to be aware of wake turbulence. Depending on the type of aircraft, the phase of flight, and the weather conditions, the potential effect of an aircraft's wake turbulence on other aircraft can vary. Encountering wake turbulence can be especially hazardous during the landing and takeoff phases of flight, where the aircraft's close proximity to the ground makes a recovery from the turbulence-induced problems more difficult. This article provides a systematization of aircraft wake vortices modeling types based on the use of various mathematical methods.

Current trends concerning the increasing of aerodrome capacity and air traffic intensification leads to the raised significance of the preliminary mathematical analysis and modeling of aircraft movements including wake vortex. It allows to improve existing procedures along with capacity, safety and efficiency enhancements.

On the 12th ICAO Air Navigation Conference that was held in Montreal (Canada) in November 2012, States have claimed its intentions to change existing separation minimum due to its inveteracy [1]. Last revision of separation minimum with regards to the wake vortex was performed 20 years ago and it has a conservative approach in terms of lack of accuracy for the existing air traffic models as well as accuracy for data concerning the actual pattern of wake vortex.

Changing of the existing separation minimum can be achieved without implementation of any changes in aircraft's equipments and without any changes to aircraft required navigation performance. Modernization consists of three elements:

- Element 1 is a revision of existing ICAO separation minimum including the vortex track in order to increase the aerodrome capacity without any risks for incidents caused by wake vortex.
- Element 2 is an increasing the number of arrivals on the parallel runways, when the distance between runway center line is equal to 760 m (2500 ft), by modification of the separation scheme taking into account wake vortex.
- Element 3 is an increasing the number of departures from the parallel runways by changing the separation scheme taking into account wake vortex.

On the 37th ICAO Assembly Session, that took place in Montreal (Canada) in September 2010, it was noted that the wake vortex problem, among other factors, is very important from economic point of view [2]. After the world's financial crisis the situation with ensuring of sufficient capacity for big aerodromes has gained its relevance. According to the EUROCONTROL data, around 15 major airports in Europe are close to the limitation of its functional capabilities. One of the main factor that causes limitations for the number of take-offs and landings is the requirement to ensure aircraft separation taking into account wake vortex. Therefore

the development of systems for monitoring and predicting of wake vortex at the airports is one of the major tasks for aviation community.

Investigations of different types of wake vortex provided society with a great opportunity to learn the wake vortex structure. It can be schematically divided into the following zones (Figure 1):

- Formation zone;
- Zone of sustainable wake vortex;
- Zone of unsustainable wake vortex;
- Zone of broken track.

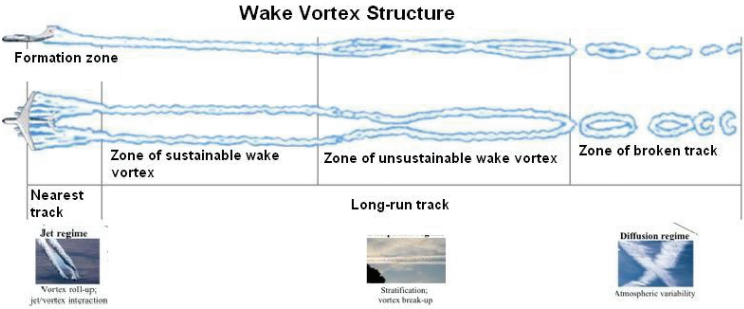


Figure 1. Wake Vortex Structure

Currently there are a lot of different models for the wake vortex calculation and prediction. Those models differ from each other by its complexity and accuracy. Analysis of variety methods for mathematical modeling of wake vortex allowed to identify more useful and reliable types of them.

Those models are presented according to the complexity:

- Reynolds-Averaged Navier-Stokes [13,14].
- Large Eddy Simulation [4,10,11,12];
- Direct Numerical Simulation [4-9].

In addition it is important to consider method of discrete vortexes and different hybrid methods.

Direct Numerical Simulation (DNS) method [5] is based on the numerical solution of Navier-Stokes equations and allows to simulate the movements of viscous compressed gases considering the chemical reactions of laminar and turbulent regimes. Current method does not require additional equations. Unsteady Navier-Stokes equations can be resolved with a little progress in space and time.

The main drawback of DNS method is a requirement to use the superpower computer systems. In addition, this method is not effective for a small Reynolds numbers ($Re = 10^3 - 10^4$), the use of DNS is limited by simple geometry. Due to a big volume of information received from the numerical simulation, it is vital to have the average values of the solutions in order to compare it with other models.

Large Eddy Simulation (LES) method [5] has an immediate position between direct numerical simulation and averaged Navier-Stocks equations. It is based on the following assumptions:

1. The stream field is divided on the motions of the large and small eddies. Large eddies are calculated. Small eddies is considered to be isotropic and has a universal character.
2. It is assumed the hypothesis about the statical independencies of large and small eddies. The non-linear interaction between large and small eddies is defined towards the large vortices using the networked simulations. LES method is used for the resolution of space-filtered Navier-Stocks equations however only motions of large eddy are differed. Influence of eddies that are smaller that estimated environmental grid is replaced by empirical simulations.

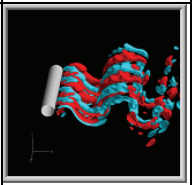
The advantage of LES method is a simplicity comparing to DNS method. LES method is more informative than DNS method.

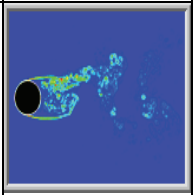
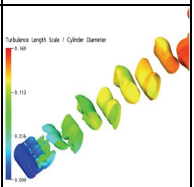
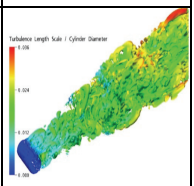
Reynolds-Averaged Navier-Stokes (RANS) method allows to produce only average values of scalar and vector parameters of the stream. RANS application is defined by the closing level of averaged equations. The Navier-Stocks equations averaged by Reynolds number can be resolved taking into account the appropriate tasks, required accuracy, computer resources, time and different limitations.

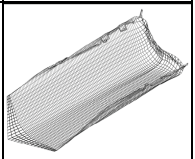
Method of discrete vortex is used for a big Reynolds numbers. Current method is based on the replacement of the streamlined body and its wake vortex by the aggregated and free vortices. Therefore the problem is solved within interim steps till the final estimated step. Using the Cauchy-Lagrange integral the loading is calculated on each estimated step. If necessary its averaging can be done.

All above mentioned modeling have its own advantages and drawbacks as well as appropriate area of application. The main characteristics and properties of those models are provided on the Table 1.

Table 1. Comparison of the main aircraft wake vortex modeling types

Methods of numerical modeling	Description	Reynolds number	Complexity of modeling	Example of model's form
Direct Numerical Simulation	It is based on the numerical solution of the Navier-Stocks equations.	Calculation of vortices for different scales ($Re = 10^3$-10^4).	Calculation for the streams with a simple geometry ($Re=10^4$). There is a need for powerful computers.	

Methods of numerical modeling	Description	Reynolds number	Complexity of modeling	Example of model's form
Large Eddy Simulation	The resolution of space-filtered Navier-Stocks equations; only motions of large eddy are considered.	It is used for simulations of large and medium vortices (Re = 10^5–10^7)	Comparing to DNS, LES requires less computer resources.	
Reynolds-averagedNavier–Stokes (RANS)	It is used for the resolution of averaged Navier–Stokes equations. It allows to modulate only large vortices as medium and small vortices disappear after averaging.	It allows to produce only average values of scalar and vector parameters of the stream (Re = 10^5 – 10^7)	Navier-Stocks equations averaged by Reynolds number can be resolved taking into account the appropriate tasks, required accuracy, computer resources, time and different limitations	
Hybrid methods (Detached Eddy Simulation – DES).	This is a hybrid of Reynolds equations and method of the large eddies.	Re = 10^5 – 10^7	-	

Methods of numerical modeling	Description	Reynolds number	Complexity of modeling	Example of model's form
Method of discrete vortex	It is based on a closed constructive mathematical model as well as on the interpretation of the free vortices theory.	It is used for the calculation of aerodynamic characteristics before vortices formation and its deformation as appropriate Re = 10^5–10^7	Required accuracy, computer resources, time.	

Conclusion

Nowadays aviation community is looking for the right steps in order to increase airspace capacity and airspace flexibility along with enhancement of operator's efficiency; however flight safety remains the first priority. Wake vortex can cause significant incidents and accidents that lead to human deaths. Therefore it is vital to analyze the reason of wake vortex formation, to arrange appropriate measures in order to avoid it.

It is appropriate to conclude that all simulation methods have its own disadvantages however all of them are used in specific conditions and situations. Current analysis shows that LES method and hybrid methods are more adapted for the simulation of wake vortex. It allows to simulate large and medium vortices as well as it is not necessary to have a high accurate and super powerful computer systems for this purpose. Scientific research and digital simulation of aircraft wake vortex using above mentioned modeling types helps to prevent undesirable safety occurrences caused by wake turbulence. Although the selection of appropriate simulation method should be done according to the goal and circumstances and all additional factors have to be taken into consideration.

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Yu.V. Chynchenko, I.M. Kim, O.S. Samartseva, V.O. Vakhrina
(National aviation university, Ukraine, Kyiv)

EXPERIMENTAL RESEARCH OF TERMINAL CONTROL AREA OPERATIONS UNDER UNCERTAINTY CONDITIONS

The experimental research of terminal control area operations under uncertainty conditions is considered. The Identification and assessment of threat factors in air traffic controller operation, identification of the point of controllers' extreme operational conditions appearance and recommendations on associated errors capture and mitigation and improvement of airspace structure on the strategic planning phase are considered.

Introduction

The workload of a controller must be accurately assessed to permit optimum efficiency. If it is too high for too long, they may be overstretched. That is why it is necessary to define, when exactly the extreme conditions for controller operations start to appear and to identify possible consequences of this as well as to provide countermeasures to avoid them with the aim of supporting effective safety provision.

Considering specificity and complexity of process of ATCO activity in terminal control area (TMA), identification and analysis of threat and risk factors are extremely important task of Safety Management System with the purpose to maintain correspondent safety level. In this term EUROCONTROL has developed Air Navigation system Safety Assessment Methodology, ANS SAM) that includes threat and risk assessment. Methodology provides implementation of necessary strategies for maintenance of acceptable safety level, constant monitoring, regular assessment of achieved safety level and making continuous improvement to the overall level of safety [1-4].

Identification (assessment) of threat factors in ATCO operation under uncertainty conditions

On the basis of existing risk assessment principles, specific method of assessment concrete identified threats examples was developed that is applicable for operation of ATCO of TMA. The first step of conducted investigation was identification of main threats during operation of controller in terminal area. The next stage was making of creating questionnaires and making survey among group of air traffic controllers of correspondent workplace. Respondents should arrange the values of probability (from 1 to 100%) and severity (from 1 to 10) that treat will occur (Table 1).

The next step of investigation was creation of matrix of threats and risks that were characterized in term of severity and probability and definition of temporary, acceptable and non-acceptable regions. Assessed threats were put into matrix and it was defined regions what definite threat was belong to. For threats that belong to non-acceptable region the specific strategies of control and mitigation are applied. Application of such a strategies transit threats to the temporary area and then specific methods

are used to transit them to acceptable region. In case if strategies are not applicable then activity that revoke definite threat should be terminated.

Table 1

Results of questionnaire among ATCO of TMA

№	Threat	Probability (0-100%)	Severity (1-10)
1	Variable flight profile	85	3
2	Insufficient horizontal size of TMA for maneuvering (in case of high intensity)	70	4
3	Adverse meteorological conditions	90	8
4	Go-around aircraft	40	4
5	Aircraft that perform flight in holding area	35	2
6	Errors of adjacent ATCO	20	4
7	Errors of ATCO passing of duty	25	4
8	Technical maintenance of ground equipment	80	5
9	Failures of airborne equipment	35	6
10	Psycho physiological state of ATCO	25	5
11	Psycho physiological state of pilot	25	6
12	Professional training of ATCO	23	7
13	Professional training of pilot	23	7
14	ATC in contested airspace (ATC without co-ordination)	65	8
15	Similar callsigns	35	4
16	Excessive (insufficient) workload of ATCO	60	6

Identification of the point of controllers' extreme operational conditions appearance and recommendations on associated errors capture and mitigation

Defining the factors influencing workload increase

During the 1st step of the research there were firstly analysed literature resources and defined the factors that may contribute significantly to the increase of workload under uncertainty conditions. After that the participants were provided with a list of the most widespread factors that can cause extreme operational conditions during the shift. After analysing the results and calculating all necessary statistical characteristics there was obtained the ranking of the factors contributing to workload increase under uncertainty conditions. The first three of them were: high density of flights, bad meteorological conditions, bad cooperation with other controllers in a shift.

High density of flights was considered the most important and highly influencing factor on the air traffic controller workload by almost all the experts. That is why this factor will be further investigated by us in the second step of the research.

Investigation of the point of extreme operational conditions appearance

During the 2nd step of the research the participants were provided with the information regarding the workload categories as well as the map and some data regarding a special sector for which they had to perform the task. The task was to identify the number of ACFT for this exact sector at which the controller experiences each of the workload categories.

The obtained results were represented on the figure 1, which shows how workload increases and how its category changes according to controllers' opinions with increase of ACFT being simultaneously under control (under uncertainty conditions).

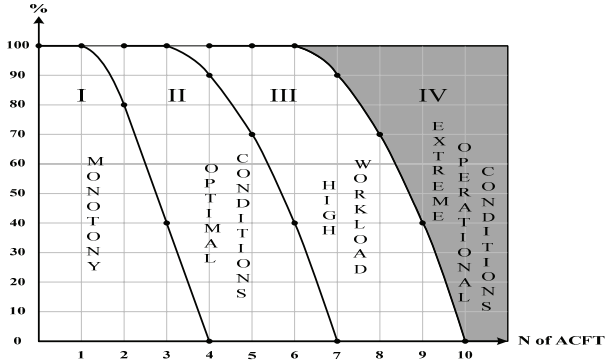

Fig. 1. Experimental correlation of workload from ACFT number under control

Identification of errors that may appear in extreme operational conditions

During this step there were identified errors that are most probable to occur in extreme operational conditions. The participants had to tick off those errors from the list, sorted to the categories, which, on their opinion, could be caused by IV category of workload described in previous step.

There was also found out that the most probable errors to occur in extreme operational conditions are as follows: missed calls, making incorrect inputs to the automated system, rushed handover, wrong clearance, altitude or heading communicated, misinterpretations of requests. These and other errors that have a possibility of occurrence more than 50% were considered in the 4th part of the research and were provided with the countermeasures for their avoidance and mitigating.

Providing recommendations and countermeasures

After providing the investigation there were offer certain countermeasures that can help to avoid and/or neutralize the exact errors that are most probable to occur under extreme operational conditions as this state is the most dangerous and errors mitigating during it has the greatest influence on safety provision. For this purpose there were analyzed known resources and composed a list of countermeasures that can be used to avoid errors mentioned in step 3 of the research. The list included such countermeasures as enhancing the team climate, improving planning and execution procedures, providing necessary reviews and modifications and organizing trainings for the personnel.

Improvement of airspace structure on the strategic planning phase

The newest route structure that is being currently implemented in the major European TMAs is Point Merge System (PMS). To define what advantages PMS brings to the Kyiv TMA the modelling of PMS arrivals was performed with the help of NEST modelling tool provided by EUROCONTROL.

After trajectories simulation was performed it is possible to analyse whether the route structure is efficient using traffic indicators. With the help of functions embedded in NEST the route length, airspace load and workload of current Kyiv TMA route structure and PMS were performed under uncertainty conditions. The results showed the decrease in route length by 3209.6 nm (1.28%). The comparison of workload is shown in Fig. 2. Moreover, capacity evaluation was performed using CAPAN methodology with the help of MatLab.

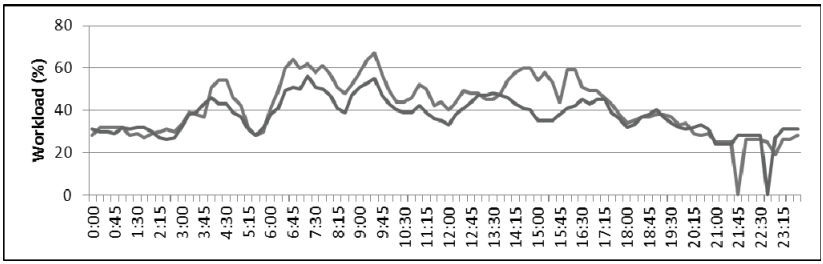

Fig. 2. Comparison of ATCO workload under current arrivals (blue) and PMS (red)

Conclusions

As the conclusion, the results of the experiment can be used in educational purposes and further researches on the topic (TMA operations under uncertainty conditions) as well as to utilize the developed countermeasures on practice for experienced air traffic controllers on the daily bases. This could help to enhance personnel knowledge regarding safety, decrease operational uncertainty and support safety provision by mitigating the errors that may occur, that is to encourage the first and main purpose of the aviation.

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O. Kozhokhina, V. Gribov, PhD of Tech. Sci., S. Rudas
(National Aviation University, Kyiv, Ukraine)

PROFESSIONAL RELIABILITY OF OPERATOR OF AIR NAVIGATION SYSTEM

Analytical model of structural reliability of operator of air navigation system developed. Mathematical dependence to calculate the probability of error-free operation of operator of air navigation system determined. Features of professional reliability of operator of air navigation systems have investigated.

In the normal condition of systems operation operator of air navigation systems perform continuous monitoring of dynamic air situation and perform typical professional tasks according to the working instructions in terms of expected activities.

Active inclusion of the operator occurs when a situation characterized not stereotypical and acute shortage of time in deciding and implementing control actions. Such situations arise during the direct control of air traffic in deviation of actual and desired states of the ATC, with the necessity of choosing control actions aimed at restoring the normal operation of systems and system reliability are connected.

The concept of reliability as a qualitative characteristic of the system (or a unit) to perform the necessary functions in specified time interval B. Lomov were considered [4].

Quantitative evaluation of the operator of air navigation system reliability can be used as a probability of the successful performance of work or task, at a given system operating step, at a given time interval [5].

System of air traffic control is ergatic control system, which includes both an elements: technical equipment and operators that interact with the system.

Therefore, to obtain an objective assessment of reliability of air navigation system we should take into account not only the effect of air navigation systems technical equipment quality, but also results of operator of air navigation systems activity, that depends on many factors.

When we evaluate air navigation systems reliability, we can count only technical equipment failures; failures to the operator activities are not related. That means that the operator reliability defaults to the absolute when operator reliability $R = 1.00$.

Error of operator of air navigation systems is an incorrect performing or failure to perform the prescribed action.

Operator errors are due to the following main reasons:

- unsatisfactory training or poor qualification of the operator;
- unsatisfactory performance of operating procedures by operator;
- bad working conditions;
- lack of incentives for operators;

Four groups error causes can be independent considered and classified by the following types:

1. Functional.
2. Operational.
3. Information.
4. Professional.

In accordance with the classification of the cause's errors of operator of air navigation system was withdrawn similar components of its reliability and their definitions. Let us consider the specific features of professional reliability of operator of air navigation system.

Professional reliability of operator of air navigation system - inerrancy and timeliness of operator of air navigation systems at achieving a specific goal under the given conditions in the interaction with the hardware and other professionals under condition of correct perform regulations. The main reason for the decrease of professional reliability of operator of air navigation system is the ignorance of the basic tasks of instructions or professional activity and unwillingness to perform them (Fig. 1).

In quantitative estimates of reliability should be considered informational, functional, professional and operational reliability components as series of connected parts of the one physical system - operator of air navigation systems. [1] Presentation of a functional diagram of the reliability of system structural model as series of connection elements means that the failure of any parts of the system leads to a failure state. [2]

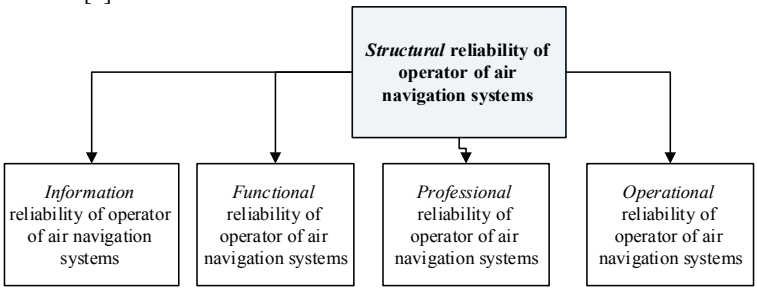

Fig. 1. Structure of operator of air navigation systems reliability

By analogy with the reliability of the technical systems, in which one of the leading indicators of reliability is the probability of reliability function, for estimating the reliability of operator of air navigation system, let us introduce the index of probability of error-free operation. Probability of error-free operation characterizes by the degree of sustainable efficiency of operator of air navigation systems within a given working cycle. [6]

Consequently, if we consider the relationship and influence constituents of error-free operation of operator of air navigation systems, it is necessary to note that the most important task of operator of air navigation system to develop faithful errorless decisions.

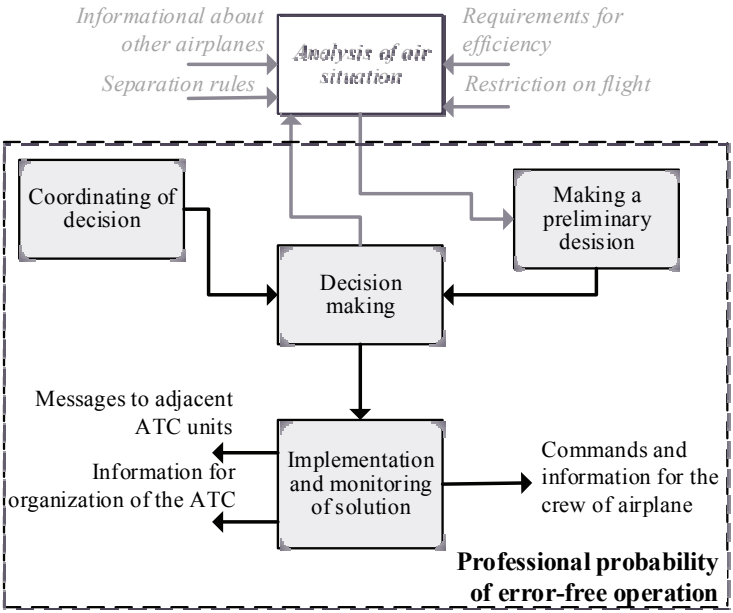

Fig. 2. Structure of professional probability of error-free operation of air traffic controller

Fig. 2 shows the structure of professional probability of error-free operation of air traffic controller.

Let us consider the proposed simple structure depending on the type of connection links, serial and parallel to analyze given scheme using method of decomposition.

In serial systems (Fig. 3) failure of any component of the structure leads to failure of the whole system. [2]

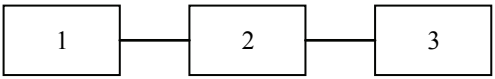

Fig. 3 Serial connected elements

In general, the probability of error-free operation of the system with the serial elements is:

$$R = \prod_{i=1}^{m} R_i$$

where R - error-free operation, m - the number of serial elements in the system [1].

In a system with parallel structure (Fig.4), system failure generally occurs only at failure of all elements.

In general, the probability of error-free operation of the system with the parallel elements is:

$$R = 1 - \prod_{i=1}^{m} (1 - R_i)$$

where R - error-free operation, m - the number of serial elements in the system.

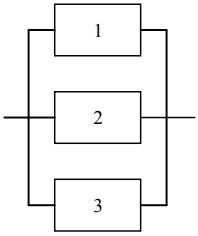

Fig. 4. Parallel connected elements

Based on the proposed structural analytical model of operator of air navigation system and professional probability of error-free operation of air traffic controller (Fig 2) developed formula of professional probability of error-free operation of operator of air navigation systems:

$R_{prof} = \left[\prod_{n=1}^{k} R_p \right] \left[1 - \prod_{i=1}^{m} (1 - R_i) \right]$ - complex professional probability of error-free operation of operator of air navigation systems; R_p - professional probability of error-free operation of operator of air navigation systems; *k* - the number of serial elements in the system, m - the number of serial elements in the system.

Under the professionally prepared operator of air navigation systems to respond to ATS means a one that satisfies simultaneously the following conditions and standards:

- has knowledge skills abilities and professional competence that allowing solving the entire spectrum of professional tasks in compliance with the guaranteed level;
- level of professionally important qualities of operator of air navigation systems can effectively solve the most complex and demanding professional tasks.

According to research focused formation of readiness to stressful situations reduces the number of errors significantly reduces the number of accidents, incidents, equipment failures, his failures (in air navigation systems by 25-30%) [3]. That is why in order to increase the accuracy of calculation of professional probability of error-free operation of operator of air navigation systems and ensure the required level will add an extra factor into the professional probability of error-free operation formula.

Availability factor characterizes the probability of inclusion operator of air navigation systems into the work.

$$A_f = 1 - \frac{t}{T}$$

where t - time during which the operator is not able to take the information coming; T- total work time.

Influence of operator of air navigation systems the availability, and its professional reliability of on flight safety generally is very high. This applies both issues of recovery of ergatic systems and the operators' ability consciously control themselves in a difficult situation.

In this case let's developed formula of professional probability of error-free operation of operator of air navigation systems.

$$R_{prof} = A_f \cdot \left[\prod_{n=1}^{k} R_p \right] \left[1 - \prod_{i=1}^{m} (1 - R_i) \right]$$

Conclusions

1. Influence of operator of air navigation systems the availability, and its professional reliability of on flight safety generally is very high.
2. Failure of any parts of the structural or professional reliability of operator of air navigation systems leads to failure state of all air navigation systems.
3. When we evaluate of air navigation systems reliability counted only technical equipment failures, i.e. failures are not related to the operator activities, this means that the operator reliability defaults to the absolute when operator reliability $R = 1.00$.

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A. Zadorozhnia, post-graduate student,
S. Pavlova, Doctor of Engineering, Professor
(National Aviation University, Kyiv, Ukraine)

ANALYSIS OF EUROPEAN CONCEPTS IMPLEMENTATION IN ATM

Volume of air traffic is growing steadily every year, which implies the need of continuous improvement of European Air Traffic Management (ATM). Therefore it is vital goal to increase capacity and efficiency, with regards to environment and safety.

Nowadays the subject of air traffic control (ATC) is an organization of aircraft movements in airspace, including the methods and practices in managing and securing traffic. It has been developed a lot of concepts and procedures aimed at enhancement of flight operations ensuring a high level of flight safety meanwhile.

Free Route Airspace Concept

The idea of Free Route Airspace was adopted as an Eight-States project in 1998 with the requirement to develop and implement a Free Route Airspace Concept within the airspace of Belgium, Luxembourg, Germany, Denmark, Norway, Sweden, Finland, the Netherlands including Maastricht UAC.

Free Route Airspace is defined as a specified airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) way points, without reference to the Air Traffic Services (ATS) route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.[1] In other words Free Route Airspace allows to organize direct routings, but only between defined points as it shows on Figure 1.

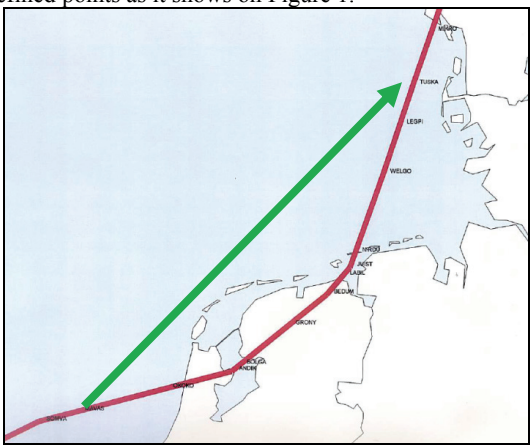

Figure 1. ATS Routes Straightening within Free Route Airspace

Implementation of Free Route Airspace in Europe is not controlled by any mandate. States, air navigation services providers, or functional airspace blocks (FABs) can establish Free Route Airspace according to its needs and demands. Free Route Airspace cannot be implemented immediately however there are initiatives to introduce free route airspace in phased approach, e.g. only during the night. This practice shows no problems at the beginning of implementing free routes infrastructure, because at night there is less traffic, sectors can be unified and the overall air traffic controller workload is lower.

Free Route Airspace implementation brings a lot of benefits, which impacts all performance areas, such as:

– Environment: improvement of flight planning which results a possibility to uplift less fuel. This reduces the weight of the aircraft during flight and hence gives a benefit of reduced fuel burn and CO2 emissions during the whole flight. After the implementation of Free Route Airspace over Europe it is expected to save around 8000 tones of fuel that is equal to 27000 tones of CO_2 emissions.
– Safety enhancements by using new navigation and communication systems and complexes.
– Network Efficiency: reduction of complexity of the route structure and flight planning. There is also opportunity to rationalise some legacy inefficiencies in the network. [4]
– Cost-efficiency: it is expected to save around €6 million.

Analysis of Free Route Airspace implementation within Europe

By 2014, at least 16 ACCs of the 64 European ACCs will implement various steps of Free Route Operations. They represent more than 25% of the NM area. Savings from these projects would account to approximately 25000 NMs per day. As a result of these free route projects, flying distances would be reduced by approximately 7.5 million nautical miles, this representing the equivalent of 45000 tons of fuel saved, or reduced emissions of 150000 tons, or 37 million Euros. [9]

Free Route Airspace implementation can take various operational formats. The states where Free Route Airspace is implemented today are Portugal, Ireland, Denmark and Sweden, as well as the Upper Area Control Centres in Maastricht (MUAC) and Karlsruhe.

Portugal and Ireland implemented Free Route Airspace in 2009. It is applicable above flight level 245, 24 hours a day, and there is no fixed route network above FL245. Direct flying is allowed between entry and exit points, via intermediate waypoints if necessary.

In Sweden, Free Route Airspace has been implemented for all flights with a planned cruising level above FL285. In the Denmark/Sweden Functional Airspace Block Free Route Airspace implementation began in a phased approach in November 2011.

Maastricht and Karlsruhe was combined for geographical and time-based factors, with implementation phased over 2011 and 2012 by publishing allowed direct segments. [7]

Since 2 May 2013, additional Free Route Operations are active at night in Croatia, Serbia, Poland and the Czech Republic**.**

Ukrainian authorities has approved Free Route Airspace in Ukraine (FRAU) Airspace Design Working Plan and adopted the Order of establishment expert working group for FRAU implementation.

Figure 2 shows the detailed analysis of Free Route Airspace implementation within Europe, according to which 12,5 % of EUROCONTROL Member States have fully implemented free routes in upper airspace. Meanwhile 17,5 % of EUROCONTROL Member States (Poland, Croatia, Serbia, Czech Republic, Austria, Germany and Finland) have partially implemented free routes. Those States decided to apply phased approach for this process.

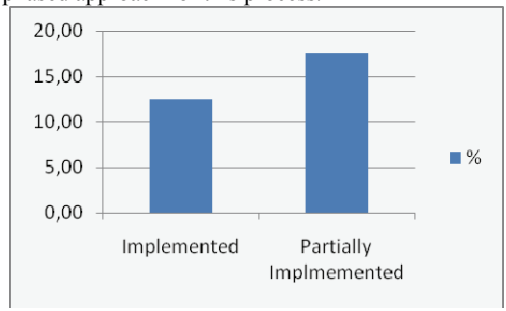

Figure 2. Free Route implementation status within Europe

Preparation and validation for 24-hours Free Route Operations in Hungary and Spain, Night Free Route Operations in Italy**,** Slovenia and Moldova, joint Night Free Route Operations in Bulgaria and Romania as well as further expansion of Free Route Airspace Maastricht and Karlsruhe are ongoing for implementation**.**

Performance Based Navigation

Area navigation (RNAV) is a method of instrument flight rules (IFR) navigation that allows an aircraft to choose any course within a network of navigation beacons, rather than navigating directly to and from the beacons. RNAV facilitated a type of flight operation and navigation in which the flight path no longer had to be tied directly to overflight of ground navigation stations.

The use of Area Navigation systems is a basis for Performance Based Navigation (PBN) Implementation.

ICAO's PBN Concept was introduced through the ICAO publication in 2008.

PBN concept specifies that aircraft RNAV system performance requirements be defined in terms of accuracy, integrity, availability, continuity and functionality required for the proposed operations in the context of a particular airspace concept, when supported by the appropriate navigation infrastructure.[6]

PBN concept identifies three components (Figure 4):

- the NAVAID Infrastructure;

- the Navigation Specification;
- the Navigation Application.

The NAVAID Infrastructure refers to ground- and space-based navigation aids.

The Navigation Specification is a technical and operational specification that identifies the required functionality of the area navigation equipment and associated aircraft avionics. It also identifies the navigation sensors required to operate using the NAVAID Infrastructure to meet the operational needs identified in the Airspace Concept. A navigation specification is either an RNP specification or an RNAV specification. An RNP specification includes a requirement for on-board self-contained performance monitoring and alerting, while an RNAV specification does not. Both RNAV and RNP specifications include requirements for certain navigation functionalities.

Figure 4. Components of PBN Concept

The Navigation Application is the use of the NAVAID Infrastructure and Navigation Specification for the design of ATS Routes as well as Instrument Approach Procedures. [5]

The development and implementation of a PBN-based Airspace Concept makes significant contributions in terms of safety, environment, capacity and flight efficiency, such as:

- safety is enhanced by increased pilot situational awareness and by provision of precise lateral and vertical flight path that causes the reduction of Controlled Flight Into Terrain occurrences;
- PBN routes are more direct that reduces the track miles flown, which means lower fuel use and lower emissions;
- capacity and efficiency is improved by placing ATS routes in the most optimum location in lateral and vertical dimensions;
- enhanced reliability, repeatability, and predictability of operations lead to increased air traffic throughput and smoother traffic flow;
- PBN enables a decommissioning of typical navaids such as NDB and VOR. This causes a cost reduction for the users due to eliminating costs for procurement and maintenance.

Analysis of PBN implementation status within Europe

ICAO specification RNAV 5 became mandatory as the primary mean of navigation in all ECAC en-route airspace from FL95 and above. VOR/DME should remain available for reversionary navigation and for use on domestic ATS routes in the lower airspace, as appropriate.

Analysis of PBN implementation status in Europe is based on the ICAO statistics expressed in percentage of runways where PBN is implemented (Figure 5). Analysis shows that six States (Austria, Finland, Hungary, Lithuania, Germany, and Czech Republic) have implemented PBN for more that 50% of runways however five States (Denmark, Iceland, Norway, France, and Switzerland) have implemented PBN up to 50% of runways.

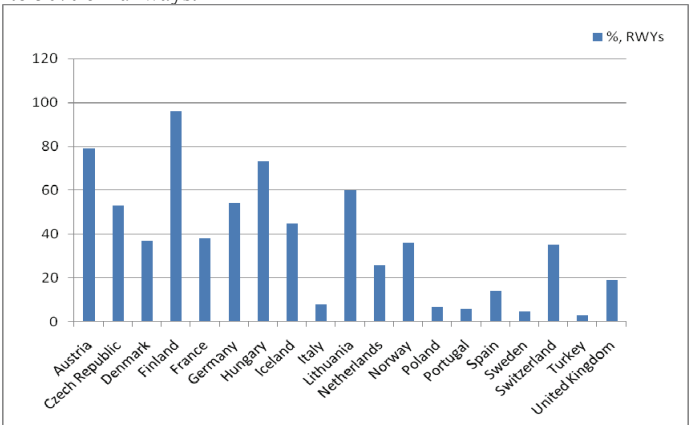

Figure 5. Analysis of PBN implementetion status within Europe

Conclusion

European aviation community is currently looking for the right steps in order to increase airspace capacity and airspace flexibility along with enhancement of operator's efficiency. The environmental impact remains the vital problem for aviation industry. The step ahead concerning all this issues is the development and implementation of Free Route Airspace and PBN in Europe, designed by EUROCONTROL and ICAO as appropriate. Those concepts brings sufficient benefits, such as cost-efficiency, reduction of CO2 emissions in the atmosphere, safety enhancement by establishing additional procedures for the flight operations. European States have supported the implementation of Free Route Airspace and PBN within their national airspace and have already initiated some preliminary actions for this.

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D.I. Tereshchenko (National Aviation University, Ukraine, Kyiv)

INDICATORS OF INTEGRITY SATELLITE CHANNEL DEPENDING ON ANTENNA GAIN

The integrity of communication systems – generic specifications, which determines their property stay means to achieve the goal in the operation of a real electromagnetic environment. On the integrity of communication systems affect the characteristics of antennas. Research integrity parameters depending on the characteristics of the antennas in this work was performed by simulation in Matlab software.

The continuing growth of aviation places increasing demands on airspace capacity and emphasizes the need for the optimum utilization of the available airspace. These factors, allied with the requirement for operational efficiency within acceptable levels of safety have resulted in the need for a performance-based airspace system. The transition to a performance-based airspace system is a critical aspect of evolving to a safe and efficient global ATM (Air Traffic Management) environment. As ATM evolves, it will be necessary to ensure acceptable operational performance, taking into account the changing technologies and a changing environment. ATM is the aggregation of the airborne functions and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations. ATM is achieved through the collaborative integration of humans, information, technology, facilities and services, and supported by communication, navigation, and surveillance capabilities that are dependent on each other. The RCP (Required Communications Performance) concept provides a means to ensure the acceptable performance of communications within a complete ATM system.

In order to simplify RCP type naming convention and to make the required communication transaction time readily apparent to airspace planners, aircraft manufacturers and operators, the RCP type is specified by the value for the communication transaction time associated with the ATM function. An RCP type comprises values assigned to the parameters: communication transaction time, continuity, availability, and integrity.

The integrity of communication systems - generic specifications, which determines their property stay means to achieve the goal in the operation of a real electromagnetic environment. Result of natural influences in the channels is to reduce the ratio of power engineering S/N (signal/noise ratio). Signal-to-noise ratio (often abbreviated SNR or S/N) is a measure used in science and engineering that compares the level of a desired signal to the level of background noise. It is defined as the ratio of signal power to the noise power, often expressed in decibels. This ratio defines the fidelity of information is defined as the probability of error per bit of information – BER (bit error rate).

In power engineering ratio of signal/noise ratio, among other factors, affect the characteristics of antennas. If we assume that the transmitting and receiving antenna for satellite communication directed each other their main lobe patterns and not moving (in fact, this case is close geostationary satellite and directed in his

ground control station), we can say that matched the integrity of without considering the weather conditions, affect only their equivalent isotropically radiated power (EIRP - Equivalent Isotropically Radiated Power).

In radio communication systems, EIRP or, alternatively, effective isotropically radiated power is the amount of power that a theoretical isotropic antenna (which evenly distributes power in all directions) would emit to produce the peak power density observed in the direction of maximum antenna gain. EIRP can take into account the losses in transmission line and connectors and includes the gain of the antenna. The EIRP is often stated in terms of decibels over a reference power emitted by an isotropic radiator with an equivalent signal strength. The EIRP allows comparisons between different emitters regardless of type, size or form. From the EIRP, and with knowledge of a real antenna's gain, it is possible to calculate real power and field strength values. Since the output signal is fed to the antenna does not depend on the antenna itself, but from the transmitter and feeder, it can be argued that, in this case, the integrity of the system, the characteristics of the antennas only affects the gain.

Research integrity parameters depending on the characteristics of the antennas in this work was performed by modeling radio frequency satellite channel in Matlab environment in the block simulation package Simulink (Fig. 1.).

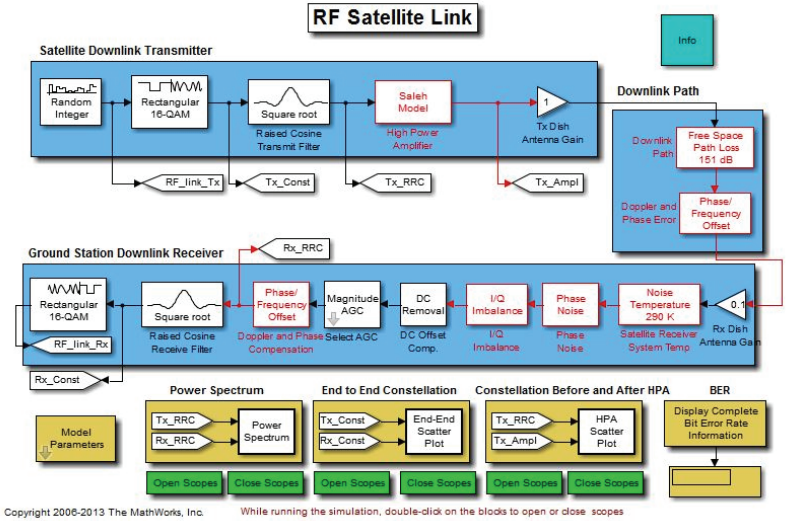

Figure 1. View of the simulation program

Simulations were carried out for low earth orbit (LEO) satellite constellation. Altitude of the orbit 780 km above sea level, carrier frequency - 1090 MHz. All other settings were install to default and changed, in order to research only the gain of the transmitting antenna. Simulated antenna gain following values: 0 dB, 0.1 dB, 0.2 dB, 0.3 dB, 0.4 dB, 0.5 dB, 1 dB, 1.25 dB, 1.5 dB, 1.75 dB, 2 dB, 3 dB, 4

dB, 5 dB, 6 dB, 7 dB, 8 dB, 9 dB, 10 dB, 20 dB, 30 dB, 40 dB, 50 dB, 100 dB. Also was consider two variants of thermal noise: typical level – 290 K (Fig. 2.) and very low level – 20 K (Fig. 3.). Figure 4 shows a compatible graph for both levels of thermal noise.

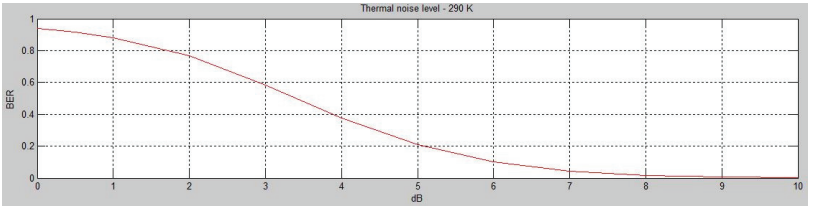

Figure 2. Dependence BER from antenna gain, thermal noise level – 290 K

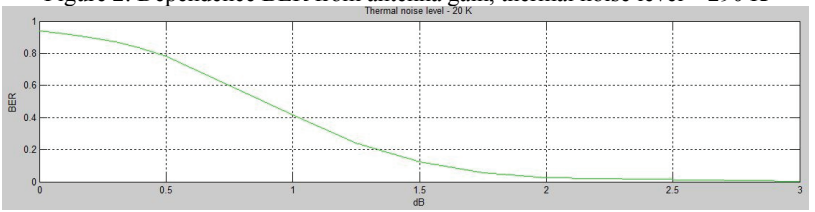

Figure 3. Dependence BER from antenna gain, thermal noise level – 20 K

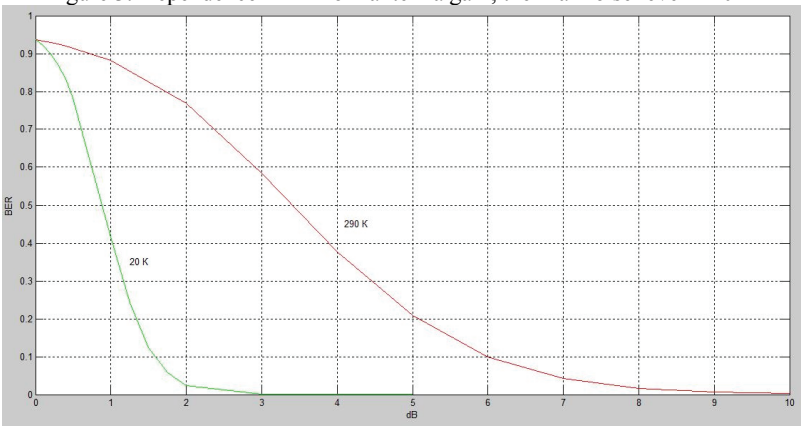

Figure 4. A compatible graph for both levels of thermal noise

Conclusions

As a result of the simulation revealed that the greater the level of thermal noise, the greater the need to have the gain of the antenna to ensure an acceptable level of errors per bit of information. Also, it was found that in the case of a typical level of thermal noise (290 K), the greatest gains in reducing the level of BER obtain the interval from 1 to 7 – 8 dB, further gains are less. It follows that in this case, not worth the antenna design task, in which the level of gain exceed 8 – 9 dB. This means that when you reach in the development of this level of gain, you can focus on other characteristics of the antenna, such as improved radiation pattern.

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I.V. Ostroumov, cand. of science
(National Aviation University, Ukraine, Kyiv)

NAVAIDS FACILITY FOR AIRCRAFT POSITIONING

The key positioning algorithms by data from Distance Measurement Equipment and Very high frequency Omni-range Radio beacons have been discussed. Results of accuracy estimation of different positioning approaches for Ukrainian airspace were represented.

Introduction

Positioning of aircraft location in the airspace is one of the key problems in aviation. Accuracy and availability of coordinate detection are valuable part of flight safety. Many different approaches have been using to improve positioning losses on board of aircraft.

Nowadays Global Navigation Satellite System (GNSS) provides more accurate global position data than other technics. GNSS is represented by GPS, GALILEO and GLONASS satellite systems. In despite of high accuracy of GNSS the special ground base augmentation systems (GBAS) are used in wide areas for GNSS improvements [1].

Each airspace user has to use GNSS equipment for positioning purposes. But some time in some regions accuracy of positioning may be not enough to guarantee the required level of flight safety. It may be result of radio frequency interference, geometry of space satellite location, solar activity and others. Flight management system (FMS) uses other positioning methods to determine the coordinates in case of malfunction airborne equipment of GNSS or inability to determine the coordinates. In this case we can use other positioning technics such as inertial navigation or positioning by signals from radio beacons (NDB, DME, VOR, DVOR). Inertial Navigation System may be used for limited time in consequence of the additive error. Positioning algorithms of FMS are alternative source of position information. It is based on information usage from navigation beacons. According to decreased positioning accuracy the next navigation methods are used: DME/DME, VOR/DME, VOR/VOR, ADF/ADF [2].

DME/DME

The principle of determining the coordinates of an aircraft by DME beacons signal grounds on distance measurement method of positioning. During the flight avionics equipment analyze all of the available DME ground beacons at the point of your location. Available ground beacons are used to determine distance between the aircraft and the beacon with the use of time-based criteria. In cases of two accessible beacons holdings the result of navigation equation solving will be two points of location, one of that will be missed by tracking algorithm as impossible location. In positioning techniques by two radio beacons only pair of beacons with angles from 30° to 150° should be used that depends on RNAV accuracy characteristics[3].

Usually global geocentric coordinate system ECEF is used for aircraft coordinates (x_A, y_A, z_A) detection in case of more than two available ground station [4, 5]. Position of aircraft is found by the solution of navigation equation:

$$D_i^2 = (x_A - x_{\text{DMEi}})^2 + (y_A - y_{\text{DMEi}})^2 + (z_A - z_{\text{DMEi}})^2 ,$$

where x_{DMEi}, y_{DMEi}, z_{DMEi} – coordinates of i^{th} DME ground beacon; Di – real distance between ground station and an aircraft.

Navigation equation may be solved by linearization of equation and then by least square method:

$$\Delta D_i = \hat{D}_i - D_i ,$$

$$\Delta x_i = \hat{x}_i - x_A ,$$

$$\Delta y_i = \hat{y}_i - y_A ,$$

$$\Delta z_i = \hat{z}_i - z_A ,$$

$$\hat{r}_i^2 = (x_A - \hat{x}_i)^2 + (y_A - \hat{y}_i)^2 + (z_A - \hat{z}_i)^2 ,$$

$$a_{xi} = \frac{x_{DME} - \hat{x}_i}{\hat{r}_i^2} ,$$

$$a_{yi} = \frac{y_{DME} - \hat{y}_i}{\hat{r}_i^2} ,$$

$$a_{zi} = \frac{z_{DME} - \hat{z}_i}{\hat{r}_i^2} ,$$

where $\hat{x}_i, \hat{y}_i, \hat{z}_i$ - nominal points coordinates, ΔD – distance between nominal point and aircraft.

According to relation above navigation equation will be represented in the next matrix form:

$$\Delta D = H \Delta X ,$$

where

$$\Delta D = \begin{pmatrix} \Delta D_1 \\ \Delta D_2 \\ \vdots \\ \Delta D_N \end{pmatrix}, \; H = \begin{pmatrix} a_{x1} & a_{y1} & a_{z1} \\ a_{x2} & a_{y2} & a_{z2} \\ \vdots & \vdots & \vdots \\ a_{xN} & a_{yN} & a_{zN} \end{pmatrix}, \; \Delta X = \begin{pmatrix} \Delta x_i \\ \Delta y_i \\ \Delta z_i \end{pmatrix}, \; i = 1 \ldots N .$$

Aircraft location may be calculated by the next relation [3]:

$$\Delta X = \left(H^T H\right)^{-1} H^T \Delta D .$$

Usually for nominal points in represented above approach DME ground station location has been used.

Accuracy of positioning by DME/DME approach depends from geometry location of ground station, ground beacon classes and accuracy of DME. Figure 1 represents accuracy of DME/DME positioning for Ukrainian airspace for altitude of 8000 m.

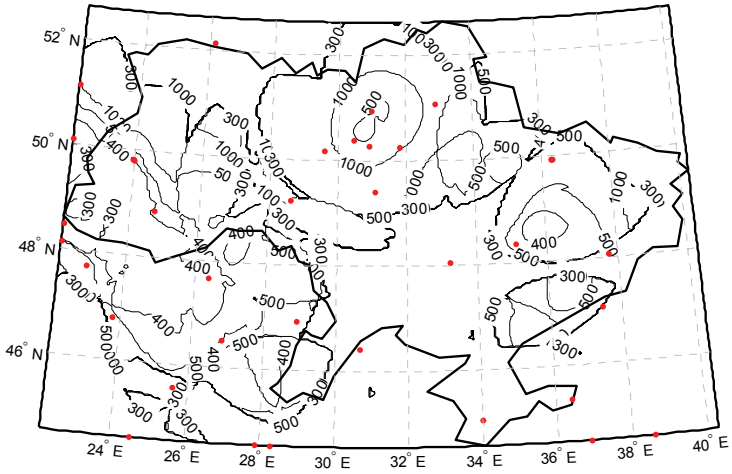

Fig. 1. Accuracy of DME/DME positioning

VOR/DME

Typically ground DME station is grouped with VOR ground radio beacon. They use different frequencies but operate in co-located channels and antennas are located in one place. Co-located group of DME and VOR ground equipment provide aircraft a unique positioning possibility because it is possible to calculate position of aircraft by distance (d) to ground radio beacon from DME and azimuth (α) to VOR equipment. Of course it needs information about ground beacon antennas location (x_{VOR}, y_{VOR}).

Navigation equation contains simple trigonometric functions because it is result of rectangular triangle relations:

$$x_A = \begin{cases} x_{VOR} + d\sin(\alpha), if\ 0 \le \alpha \le \dfrac{3\pi}{2} \\ x_{VOR} - d\sin(\alpha), if\ \dfrac{3\pi}{2} < \alpha \le 2\pi \end{cases},$$

$$y_A = y_{VOR} + d\sin(\alpha).$$

Accuracy of this positioning approach indicates bad characteristics according to DME/DME position approach.

VOR/VOR

Positioning by VOR equipment is grounded on angular positioning approach. VOR equipment provides angles between north and direction to the ground station. Also it needs information about location of ground stations.

Location of aircraft is calculated by rectangular triangles in plane of ground station [6]. Typically North-East-Down (NED) Cartesian coordinate system has

been used for coordinate detection. Location of VOR ground station holds the center of NED coordinate system.

Navigation equation grounds on relations in rectangular triangles [7]. Aircraft position detects by the following simple equation for n^{th} number of ground stations:

$$tg(\alpha_i) = \frac{\Delta x_i}{\Delta y_i} = \frac{x_A - x_i}{y_A - y_i},\ i=1..n,$$

It can be represented in other form:

$$x_A - y_A tg(\alpha_i) = x_i - y_i tg(\alpha_i),\ i=1..n,$$

where x_A, y_A – aircraft position,
x_i, y_i – VOR ground stations location,
α_i – VOR azimuths.

In matrix form:

$$A \cdot X^T = B,$$

where

$$A = \begin{bmatrix} 1 & tg(\alpha_i) \end{bmatrix},\ X = \begin{bmatrix} x_A & y_A \end{bmatrix},\ B = \begin{bmatrix} x_i - y_i tg(\alpha_i) \end{bmatrix},\ i = 1...n\ .$$

Aircraft location by VOR information is calculated by the following formula [8]:

$$X = \left(\left(A^T A \right)^{-1} A^T B \right)^T .$$

But positioning by VOR information has been limited by VOR ground station geometry location and in case of aircraft location at the line which connects two ground stations it is impossible to solve positioning equation.

The geometric dilution of precision (GDOP) coefficient shows geometrical influence of ground station location on position accuracy. GDOP usually is a part of total precision. Result of Analysis of Ukraine national VOR ground beacon system (represented on figure 2) represents availability to receive VOR signals on 1.8% country territory from 6 beacons; 4,6% – 5; 22,2% – 4; 52,4% – 3 and 19% – less than 2.

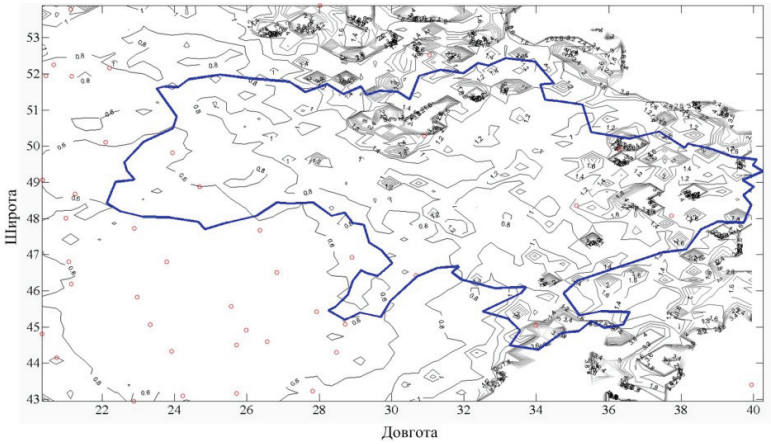

Fig.2. Coefficient of GDOP for VOR/VOR positioning in Ukrainian airspace

Therefore navigation by VOR station signals is available on 81% of Ukraine area. GDOP coefficient for VORs ground station system in Ukraine region has the following view:

- for 3.8% Ukrainian airspace GDOP coefficient will be less than 1,
- for 78.8% – from 1 to 2;
- for 17.4% – more than 2.

Conclusions

All of represented positioning algorithms have been computing inside of FMS. During the whole flight FMS controls positioning information from GNSS sensors and if it recognizes bad accuracy or unavailability it automatically uses inertial principle and then after some time DME/DME, VOR/DME or VOR/VOR positioning algorithm.

Alternative positioning systems are extremely important today. Result of investigation indicates that accuracy of positioning depends on geometry of ground station location. DME/DME approach is the most useful for Ukrainian airspace. To improve safety of flight the best way is to increase a number of ground DME stations.

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N.S. Kuzmenko, post-graduate student
(National Aviation University, Ukraine, Kyiv)

SPLINE AS A UNIVERSAL MEAN FOR CONTINUOUS UAV PARAMETERS PROCESSING

The reasons of UAV information flow fault during the flight are considered. An importance of UAV data flow monitoring for predictive control was proved. Spline as a universal mean for continuous UAV parameters processing and its methods were discussed. The methods were checked by modeling using real data of UAV flight.

Introduction

Nowadays, unmanned aerial vehicles (UAVs) operate in real missions with various levels of autonomy. They are used for search, rescue, monitoring, collaborative indoor and outdoor surveillance and protection. Moreover, UAV applications include firefighting, some level of policing, support in case of natural disasters, remote sensing, scientific research, and geographical surveying. It is commonly acknowledged that the development of UAVs gives the possibility to perform missions that are too dull, dirty or dangerous for humans.

There are several flight-critical components and systems for the UAVs operations such as actuators, control surfaces, engines, sensors, flight computers, and communication devices.

During the flight, a variety of events may affect the operation of UAVs. These include faults, or malfunctions, and failures, or complete breakdowns, in flight-critical components, platform damage, faults and failures in intervehicle information flow, anomalous behaviors or environmental occurrences such as bursts of wind or extreme weather.

Removing the human from some of the flight control tasks and replacing by software systems is a challenge that addresses safety implications. When UAVs are flying, their onboard systems exchange the necessary information via the communication network. Suppose one of the actuators of a UAV develops a fault. If the control system of the faulty UAV is not equipped with some form of robustness to fault, or if the control system is not capable of providing sufficient recovery to the fault, the vehicle may lose stability and exhibit an unpredictable behavior.

Faulty aerial vehicles, become inefficient in terms of energy consumption, fail to fulfill mission objectives, and represent a danger to humans.

UAV information flow fault reasons

Each UAV can be viewed as a node equipped with wireless transmitter and receiver capable of transmitting and receiving data packets to and from its neighbors. Wireless communications are subject to environmental intrusions that interfere with the signals and block their paths, introducing echoes, noise, and jamming. The limited available onboard power, the mobility of the vehicle, and the presence of nearby users also constrain the effectiveness of inter-vehicle communications.

The information flow fault may arise from a communication breakdown due to obstacles, jamming, a node loss, the crash of a UAV, or because of transmitter and receiver or flight computer failures.

Information can be transmitted by means of the wireless communication network, onboard sensors, and subsequent interpretation by onboard processing. Each vehicle transmits the information about itself, such as current position, velocity, health status, target zones visited, assigned targets.

Loss of some or all communication links during flight may occur for various reasons. A fault in the transmitter and receiver devices may result in an information flow fault. Sensors being used as an alternative means of communication to collect information on neighboring vehicles may also be at fault. Regardless of the cause of the information flow fault, elements of information are missing and, unless the health management system enables the UAVs to handle information loss, the integrity of the collaborative mission may be under the risk.

Thus, continuous UAV data flow monitoring has an extreme importance and is a key challenge for predictive control.

Spline approach for data processing

Spline approach is a universal mean of parameters processing and prediction on the computer. Spline is continuous and defined on fragments function S, which consists of fragments that are functions of the same species and docked in a special way. Points of docked fragments are called spline nodes. The basic condition for joining the fragments is continuity of values and derivatives at the docked points.

Spline apparatus has a row of advantages [1]:

First, good differential, approximation and algorithmic properties.

Second, experimental information has a discrete nature (for example, the values of a process at different times) using splines can be converted to a continuous form recorded as a function of approximately reflecting the real process.

Third, the experimental data, no matter how they are obtained, always have some errors. Using such data as input for the various calculations can lead to significant distortion of the result. Smoothing in many cases allows transforming the initial information to a form suitable for the further use.

One of the most suitable spline curves is B-spline. It possesses a good interpolation and approximation properties for real data processing. Also it guides through basic points which provides the possibility of precise fitting. B-spline interpolation is grounded on data separation into several intervals (N) with the corresponding interpolation at each interval. Resultant curve is a sum of splines at each interval. In a common way B-spline curve can be represented by the following formula:

$$S(t) = \sum_{j=1}^{N} B_j(t) x_j \ , \ 0 \le t \le T \ ,$$

where $B_j(t)$ - B-spline for specific time t; x_j – control points coordinates.

B-spline functions can be of different order and can be calculated using the Cox-De Boor relations.

There are a lot of challenges when it is necessary to estimate multi-parametrical data simultaneously. B-spline interpolation in such case can applied in a simple way by adding new control points and inserting B-splines into main formula.
Besides, B-splines were used to be applied for the prediction of dynamic system parameters.

One of the most important problems in spline interpolation is intervals selection. Typically interpolation intervals are uniformly distributed and the task is to estimate the optimal grid step. But for more precise fitting is suitable to use non-uniformly distributed intervals. In that case the most appropriate methods of interval calculation are chord length and centripetal methods [2].

Chord length method provides a large deviation from mean value of the interval but has good flexible characteristics. Uniform method has opposite characteristics to the previous one. Centripetal can be considered as an extension to the chord length method.

These methods were checked by modeling using real data of UAV flight. Data is represented in local NED coordinate system. Coordinates are represented as a distance from the starting point in meters. Z axe has downside direction.

The results of modeling are represented on fig.1-4.

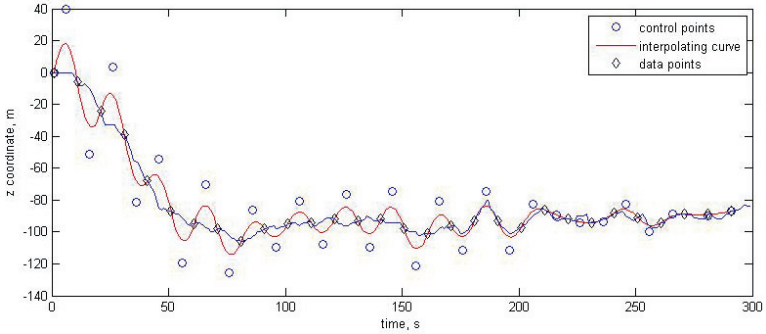

Fig. 1. Z coordinate interpolation by uniform method

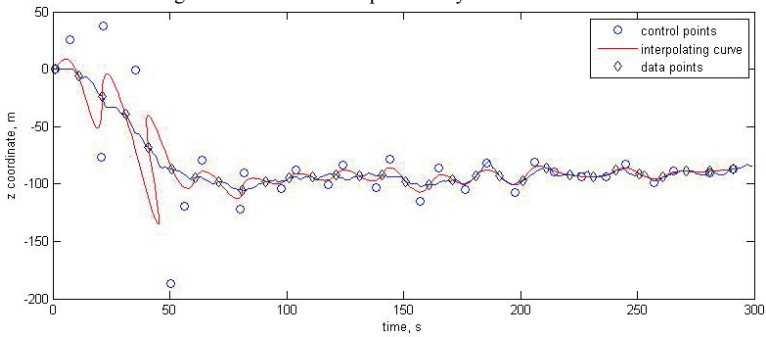

Fig. 2. Z coordinate interpolation by chord length method

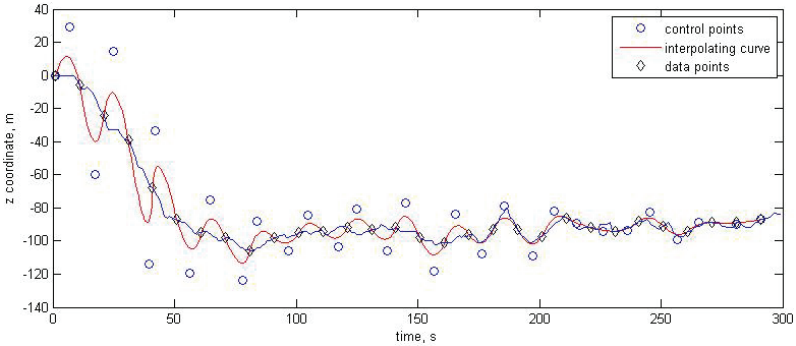

Fig. 3. Z coordinate interpolation by centripetal method

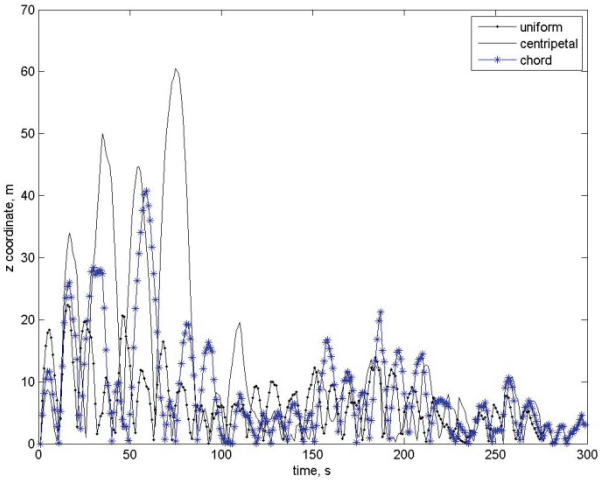

Fig. 4. Z coordinate interpolation error

Conclusion

During the flight UAV is a subject of information flow fault due to a lot reasons. To guarantee flight safety the continuous UAV data flow monitoring has a primary importance for predictive control. Spline approach is a universal mean for continuous UAV parameters processing. Uniform, chord length and centripetal methods can be used. Method selection depends on input data character.

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E.O.Kovalevskiy, candidate of engineering
V.V. Konin, doctor of engineering
T.I. Olevinska, post-graduate student
(National Aviation University, Kyiv, Ukraine)

AIRCRAFT LANDING FLARE

Two methods of aircraft flare are considered. One of them uses fixation of touchdown point and altitude exponential step change, another one uses step change of trajectory slope. In both cases gradual descending of height and vertical speed was achieved. A Math modeling of these methods was performed.

Aircraft landing is one of the most technically complex and potentially dangerous phase of flight. Landing is divided into linear decrease on the glide slope and maneuver of flare, in which aircraft is moving by the exponential trajectory. A pitch during flare is gradually changing from small negative to small positive values. Besides, during flare the vertical speed is strictly decreasing. It provides touchdown with acceptable G-load. Automation of flare maneuver is necessary to provide safe automatic landing by III ICAO category.

A method of flare (fig. 1), which is presented in paper [1], is based on algorithm, which is presented in paper [2]. The bottom line is fixation of flare beginning point coordinates (x_f, h_f) and touchdown point coordinates (x_{td}, h_{td}). Other designations on the fig. 1 are: (x_g, h_g) – glide slope beginning point, (x_{g0}, h_{g0}) – is a fictitious point on the ground on which glide path is projected, (x_∞, h_c) – is a final point of flare which is chosen in such way, that the exponent of flare trajectory intersects the ground at the touchdown point.

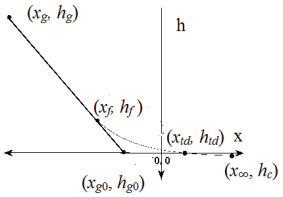

Fig. 1 – Flare trajectory

We consider the situation where the automatic control system has already led the aircraft to initial point of the glide path (x_g, h_g) with horizontal speed W. We suppose that the wind speed is zero, and the automatic control system completely compensates the disturbances. We will solve the task of reaching desired horizontal and vertical speed at touchdown point x_{td} in two stages. On the first stage we decrease horizontal speed W up to desired value W_z from point x_g to point x_f while height is on level $h_f = h_z$. When considered angle of trajectory is small, the

horizontal speed is almost equal to speed on glide path. We can find the exponent index α and the interval of speed change dT from the relation:

$$W_z = We^{-\alpha dT}$$

$$h_z = (D_0 - \int_0^{dT} We^{-\alpha t} dt)\sin\gamma$$

where D_0 is the distance between points (x_g, h_g) and (x_{g0}, h_{g0}), γ – glide slope angle. Solving the last system of equations, we can obtain:

$$\alpha = \frac{W(1 - e^{\ln(\frac{Wz}{W})})}{D_0 - \frac{h_z}{\sin\gamma}}$$

$$dT = \frac{-\ln(\frac{Wz}{W})}{\alpha}$$

On the second stage we can fix the horizontal speed and begin to change the height by the exponential law from the value $h_z - h_c$ to the value h_c in such a way, that the exponent line crosses the point x_{td} with the vertical speed of h_p. The values of exponent k_x and h_c can be found by solving the system of equations:

$$h_c + (h_z - h_c)e^{-kx(xtd - xf)}$$

$$h_p = (h_z - h_c)k_x x_p e^{-kx(xtd - xf)}$$

A Math modeling was performed using an input data: D_0 = 3,008*10^4 m, W = 200 km/h, W_z = 40 m/c, γ = 0,05 rad, h_p = 0,2 m/c, x_{td} = 100 c, and it shown (table1), that this method allows to reach the desired horizontal and vertical speed in touchdown point.

Table 1

t, s	641	650	655	660	665	668	669
h, m	24,56	9,5	5,2	2,48	0,76	0,055	-0,14
h_p, m/s	2	1,08	0,68	0,43	0,27	0,2	0,19
W, m/s	40	40	40	40	40	40	40
x, m	-991	- 631	-431	-231	-31	89	129

This method provides satisfactory accuracy, but when it comes to UAV we often have no need to accomplish a touchdown in a strictly defined point. So the more simple method was developed. It provides touchdown within some area and uses gradual alteration of trajectory slope angle.

The input data for Math modeling is:
Horizontal speed: Wz=40 m/s;
Desired vertical speed in touchdown point (point where h=0): phz=0.5 m/s;
Initial trajectory slope angle in radians: γ_0 =0.097;
Flare beginning height: hz=15м.
Flare begins at the moment: t=655s.
We will change the trajectory slope angle from the flare beginning by the law:

$$\gamma = \gamma_0 \cdot e^{-\mu \cdot t}$$

The height is changing by the law:

$$h = h_z - Wz \cdot \gamma_0 \cdot \int e^{-\mu \cdot t} dt$$

That is:

$$h = h_z - Wz \cdot \gamma_0 \cdot \frac{e^{-\mu \cdot t}}{-\mu}$$

The vertical speed is changing by the law:

$$ph = Wz \cdot \gamma_0 \cdot e^{-\mu \cdot t}$$

A flare period is defined by equation:

$$\Delta T = \frac{-\ln\left(\frac{phz}{Wz \cdot \gamma_0}\right)}{\mu}$$

The parameter μ we can find by equation:

$$\mu = \frac{Wz \cdot \gamma_0 - phz}{h_z}$$

So we can obtain the system of equations:

$$\left(h_z - Wz \cdot \gamma_0 \cdot \int_0^{\Delta T} e^{-\mu \cdot t} dt\right) = 0$$

$$Wz \cdot \gamma_0 \cdot e^{-\mu \cdot \Delta T} = phz$$

Solving this system, we can obtain the values of height and vertical speed for each period of time.

From the above equations and our input data we got the next values: μ=0,23, ΔT=9. Results of height and vertical speed calculation are given in table 2.

Table 2

t	655	656	657	658	659	660	661	662	663	664	665
h	15,3	11,4	8,8	6,6	4,8	3,5	2,4	1,5	0,8	0,26	-0,18
W	40	40	40	40	40	40	40	40	40	40	40
ph	3,9	3,1	2,45	1,95	1,55	1,23	0,98	0,78	0,62	0,49	0,39

Fig. 2 and fig. 3 show the dependence of height of time and vertical speed of time respectively.

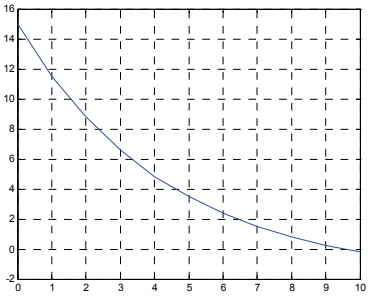

Fig.2 – Height changing during flare

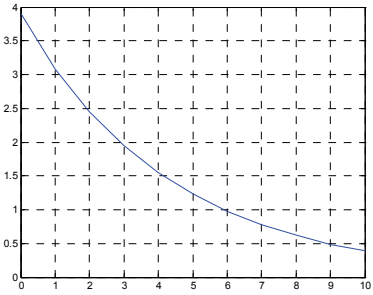

Fig. 3 – Vertical speed changing during flare

The conclusions

A Math modeling shown that both of flare methods provide acceptable and comparable vertical speed changing and trajectory of aircraft moving. At the same time the first methods provides more accurate touchdown, but the second method takes into account the trajectory slope angle changing.

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Valter Melkumyan, professor
Tetiana Maliutenko, assistant
(National Aviation University, Ukraine, Kyiv)

CONTROL OF PROCESS DEGRADATION OF TRANSPORT TECHNOLOGICAL SYSTEM

The model of transport technological system control which includes three main links - an assessment, decision-making and implementations of controlling influences is considered

The transport technological system represents set of the equipment and technological processes, and also correlation in between for provision of transport services. Proceeding, from this transport technological systems get under category of service technological systems, that is provide services of transportation of passengers, baggage, goods, etc[1].

By external destabilizing factors will be read thus as accidental impacts on system which are connected to instability of the market of services, change of customers requirements, toughening of ecological requirements, change of normative and legal basis, climatic conditions of an external environment of functioning of system.

Internal factors of influence on quality of service technological system function will read the factors connected to processes of physical and an obsolescence of elements, by violation of technological, production and performing discipline.

Prior uncertainty of conditions of measurement of characteristics of destabilizing factors doesn't allow to consider fully their influence on processes of degradation of elements in case of service technological system design.

Therefore, the important problem in the design of transport technology system there is a need to consider the effect of destabilizing factors on its functionality.

The task is consolidated to formation of a certain class of processes of regeneration in transport technological system, adequate to a level of degradation of characteristics of its elements for the purpose of elimination of destabilizing factors influence.

A generalized description of the process, taking into account the degradation and regeneration processes can be represented as:

$$\eta(A,B,C,t) = \eta(\eta(A,t),\eta(B,t),\eta(C,t)), Y_P(\eta_Y(A,t),\eta_Y(B,t),\eta_Y(C,t)/\xi(t)) \quad (1)$$

where $\eta(A,t), \eta(B,t), \eta(C,t)$ – the current state of technological processes of transport systems;

$Y_P(*)$ – the vector of controlling influences which creates process of a

regeneration of necessary level of transport technological system function in case of deterioration of its characteristics;

$\xi(*)$ – the functionality of the description of change dynamics of destabilizing factors.

The block diagram of model of technological system interaction with the control object (CO) within transport technological system is shown in fig. 1. As CO set of n-1 of elements of transport technological system thus appears. Three main segments are included in composition of the generalized model of system - an assessment, decision-making and implementations of controlling influences [2].

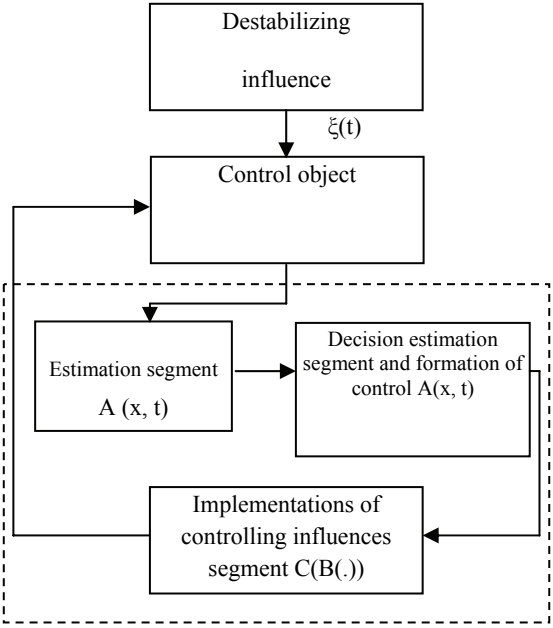

Fig.1 Block diagram of control model

Set of sequences of the connected algorithms of A (y, t) B (A, t) and C (B, t) which is created and implemented in segments of model of system taking into account being destabilized factors can be provided as:

$$P_{\eta}(t) = \prod_{j=1}^{n-2} P(\eta_1(t)/\eta_j(t)), \quad (2)$$

where $P_{\eta}(t)$ – probability of execution of the task (the general factor of quality function of system);

$P(\eta_1(t)/\eta_j(t))$ – the conditional transition probability of transport technological system from j state under the influence of controlling influences in a state with potential possibility of execution of the laid functions.

The conditional transition probability of states of transport technological system it is possible to provide as function of factors which enter structural elements of technological system:

$$P(\eta_1(t) / \eta_j(t)) = \varphi(P_A(t) \cdot P_B(t) \cdot P_C(t)), \quad (3)$$

where $P_A(t)$, $P_B(t)$, $P_C(t)$ – characteristics of functions quality using segment of estimation, formation and implementation of controlling influences.

$P_A(t)$ represents probability of an assessment of unmatched current values of the current parameter values of CO and the set tolerances in phase space:

$$P_A(t) = \sum_{i=1}^{K} \sum_{i=1}^{M} P_{\text{det}}(R_i(\tau + j) \geq V / R_i(t) < V_{ij}), \quad (4)$$

where $P_{\text{det}}(.)$ – the conditional probability of that detection of unmatched values will occur on $\tau+j$ monitoring stage from the moment of its appearance;

$R_i(.)$ - domain of disagreement;

K, M – quantity of the CO elements and their characteristics;

$V_{i,j}$ – admissible area of i values of the j parameter of an element.

For the n-measured frequency curve of probability $P_{\text{det}}(.)$ it is possible to provide as:

$$P_{\text{det}}(.) = \int_{\Omega\tau} \int_{\Omega\tau+1} .. \int_{\Omega_{\tau+j-1}} \omega_n(R_i(\tau)R_i(\tau+1)..R_i(\tau+j))dR_i(\tau)dR_i(\tau+1)..dR_i(\tau+j), \quad (5)$$

where $\omega_n(*)$ – n – the measured frequency curve of probability;

$\Omega_\tau ... \Omega_{\tau+j-1}$ – area of $R_i(.)$ values, considering which decision about a level of compliance of quality of functioning of CO to the set level is made.

The task of a segment of decision-making is search of a rational method of achievement of the objectives that is methods necessary for restoration of high-quality functioning of system.

Conclusions

So, the decision-making process generally can be multiple-choice from the point of view of a choice necessary and a sufficient set of controlling influences. Thus it is necessary to consider a row of restrictions of temporal, economic and technical character which are connected to specifics of decision-making in transport technological systems.

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V.V. Konin, professor
O.S. Pogurelskiy, senior researcher, F.O. Shyshkov,
(National Aviation University, Ukraine, Kyiv)

INITIAL ANALYSIS OF SPACE DEBRIS HAZARD

Space debris is currently an extremely serious problem for any operations in space, including navigation, communications, surveillance and researches. The constantly increasing amount of debris in space near Earth may render it unavailable for generations. The problem of space debris is analyzed.

Introduction

Ever since the launch of Sputnik, mankind has been propelling objects into Earth's orbit and it's starting to add up. We're not only talking about rocket ships, but hundreds - even thousands - of satellites.

The improved tracking abilities allowed us to “see” the debris and gave the idea of its actual number. More than 21,000 orbital debris larger than 10 cm are known to exist. The estimated population of particles between 1 and 10 cm in diameter is approximately 500,000. The number of particles smaller than 1 cm exceeds 100 million.

Space debris as it is

There are a lot of different names to call this notion: space debris, orbital debris, space junk, space waste. But what does it actually mean? Orbital debris are all man-made objects in orbit about the Earth which no longer serve a useful purpose.

Space debris encompasses derelict spacecraft and upper stages of launch vehicles, carriers for multiple payloads, debris intentionally released during spacecraft separation from its launch vehicle or during mission operations, debris created as a result of spacecraft or upper stage explosions or collisions, solid rocket motor effluents, and tiny flecks of paint released by thermal stress or small particle impacts.

The higher the altitude, the longer the orbital debris will typically remain in Earth orbit. Debris left in orbits below 600 km normally fall back to Earth within several years. At altitudes of 800 km, the time for orbital decay is often measured in decades. Above 1,000 km, orbital debris will normally continue circling the Earth for a century or more.

In low Earth orbit (below 2,000 km), orbital debris circle the Earth at speeds of 7 to 8 km/s. However, the average impact speed of orbital debris with another space object will be approximately 10 km/s. Consequently, collisions with even a small piece of debris will involve considerable energy [1].

Most orbital debris reside within 2,000 km of the Earth's surface. Within this volume, the amount of debris varies significantly with altitude. The greatest concentrations of debris are found near 750-800 km. The dispersion of space junk can be seen on fig 1.

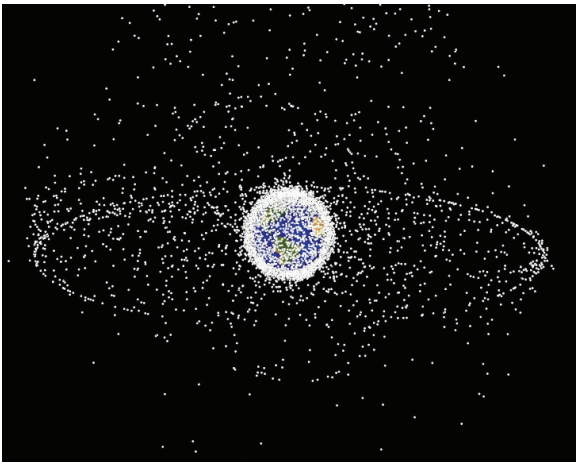

Fig. 1. Space debris populations seen from outside geosynchronous orbit

Why do we fear space debris

The hazard to space operations from debris is a function of the nature of those operations and the orbital region in which they take place. The orbital region is important because the debris flux encountered by a spacecraft varies greatly with orbital altitude and, to a lesser extent, orbital inclination. The nature of the operations is a factor because the same piece of debris that could cause serious damage to one type of spacecraft might do little harm to a spacecraft with a different configuration or orbital attitude.

Operational spacecraft are struck by very small debris (and micrometeoroids) routinely with little or no effect. Debris shields can also protect spacecraft components from particles as large as 1 cm in diameter. The probability of two large objects (> 10 cm in diameter) accidentally colliding is very low. The worst such incident occurred on 10 February 2009 when an operational U.S. Iridium satellite and a derelict Russian Cosmos satellite collided.

Kessler syndrome

The Kessler Syndrome, proposed in 1978 by a former scientist from NASA, Donald J. Kessler, is a scenario in which the density of objects in Low Earth Orbit (LEO) is high enough that a single collision between two objects could cause a cascade – each collision generating space debris which increases the likelihood of further collisions. Which means that there's nowadays so much junk in space that one collision could result in a multitude of others. That in turn could lead to debris being knocked off course and that could be directed to earth.

Every satellite, space probe, and manned mission has the potential to create or become space debris. As the number of satellites in orbit around the earth grows and old satellites become obsolete, the risk of a cascading Kessler syndrome becomes ever greater [3].

Protection against space debris

Orbital debris protection involves conducting hypervelocity impact measurements to assess the risk presented by orbital debris to operating spacecraft and developing new materials and new designs to provide better protection from the environment with less weight penalty. The data from this work provides the link between the environment defined by the models and the risk presented by that environment to operating spacecraft and provides recommendations on design and operations procedures to reduce the risk as required.

Spacecraft shielding is designed to withstand a majority of the micrometeoroid and orbital debris (MMOD) particles that can impact a spacecraft, thus reducing the likelihood of serious damage to the vehicle and/or crew. Shielding is one part of an overall strategy to reduce impact risk that can also include collision warning and avoidance. Although it is not possible to eliminate all impact risk, shields are designed to meet or exceed probability-based protection limits.

Spacecraft shielding for Earth-orbiting satellites must protect against both the natural meteoroid and human made orbital debris which have very different velocity regimes. Orbital debris impact velocities in LEO have an average velocity of about 11 km/sec, concentrating an enormous amount of kinetic energy at the point of impact. Meteoroids have even higher velocities, averaging about 20 km/s and reaching velocities as high as 70 km/s.

One way to shield against MMOD impacts is to increase the thickness of the spacecraft wall so that the wall remains intact after the impact. However, this significantly increases the weight of the spacecraft which must be launched into space. A smarter method is to use the “Whipple Shield” concept.

In the 1940s, Fred Whipple proposed a meteoroid shield for spacecraft, called the Whipple shield in recognition of his contribution. The Whipple shield consists of a thin, aluminum “sacrificial” wall mounted at a distance from a rear wall. The function of the first sheet or “BUMPER” is to break up the projectile into a cloud of material containing both projectile and BUMPER debris. This cloud expands while moving across the standoff, resulting in the impactor momentum being distributed over a wide area of the rear wall. It can be seen on fig 2. The back sheet must be thick enough to withstand the blast loading from the debris cloud and any solid fragments that remain. For most conditions, a Whipple shield results in a significant weight reduction over a single plate, which must be strong enough to receive the projectile kinetic energy in a localized area.

Collision avoidance is an important, but limited, tool for protecting spacecraft in orbit. In 2009, the US Space Surveillance Network was tracking ~19,000 objects larger than 5-10 cm in diameter. Of those objects, less than 5% are operational satellites capable of maneuvering. In addition, maneuverable spacecraft can only avoid the other 19,000 tracked objects, a small fraction of the estimated 500,000 hazardous orbital debris larger than 1 cm.

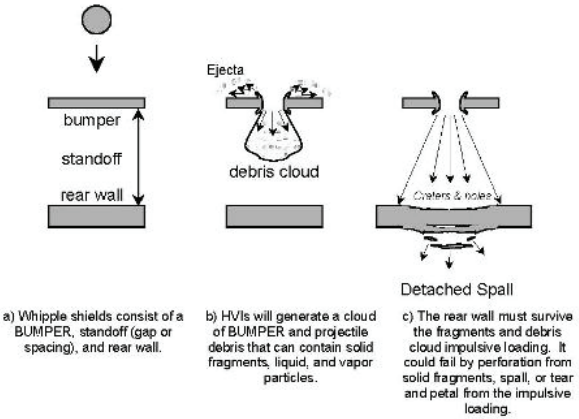

Fig. 2 Whipple shield scheme

Regardless of the limitations, many high value satellites choose to perform conjunction analyses and, if necessary, to execute collision avoidance maneuvers. The NASA Johnson Space Center developed and has been using collision avoidance procedures for many years to support Space Shuttle missions and the International Space Station. Later, the NASA Goddard Space Flight Center developed a conjunction assessment and collision avoidance process for robotic spacecraft, e.g., NASA's Earth Observation System (EOS) in low Earth orbit and the Tracking and Data Relay Satellite System (TDRSS) in geosynchronous orbit.

Conclusion

Space debris has become an essential and serious problem for the development of current space programs and if left as it is will soon make the space inaccessible, destroying a lot of things, which have become common nowadays, including satellite internet, satellite navigation and communication, which are available for civil users.

A way to destroy or recycle this debris is required, but nowadays there are no realistic approaches to it. Therefore it is an actual scientific task to resolve the space debris problem.

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V.V. Konin, professor
O.S. Pogurelskiy, senior researcher, F.O. Shyshkov
(National Aviation University, Ukraine, Kyiv)

MODEL FOR NAVIGATION SATELLITE AVAILABILITY ON VARIOUS ORBITS ANALYSIS

While facing different tasks in space, the necessity to create a reliable way of navigation in space is required. The model is developed to analyze the availability of the navigation satellites in space.

Introduction

Determination of the coordinates of spacecraft in near-Earth space is required when executing a number of tasks that are relevant in the present time (docking, movement to desired orbit), or that would be relevant in the near future (with the removal of large orbit space debris). Satellite navigation systems are most effective on the Earth's surface so far. According to the interface control documents for GPS and GLONASS these navigation systems provide reliable navigation to the heights of 3000 and 2000 km respectively. It is natural to expect that new Galileo and Compass systems when entered in operation would work in the same range.

Availability of navigation satellites is determined using almanac data of GPS, GLONASS, Galileo, Compass, as well as data about the location of the object (latitude, longitude, altitude), and parameters of radiating pattern of antenna satellites.

Model initial data and assumptions

Definition of coordinates, velocity and time of satellite navigation systems in the near-Earth space is performed in the radio navigation field, which is formed by radio signals emitted by satellites. To determine the coordinates in three-dimensional space it is necessary to simultaneously receive signals from at least four satellites.

GPS and GLONASS almanacs were obtained experimentally. Almanacs for Galileo and Compass are formed according to the interface control documents for the systems of orbital constellation of 27 satellites and 30 satellites respectively.

For satellites above the horizon plane beam width is set in the range ± 23°, for satellites below the horizon plane (the back side of the Earth), the radiation pattern in the range of ± 13,8 ° to ± 23 °.

The radiating patterns of satellite antenna systems form radio navigation field in the limits of main lobe. The measured radiation pattern of the GPS satellite is shown on fig. 1.

Model of availability was programmed in MatLab and operates as follows. After loading the almanac satellite navigation object coordinates, date, time interval and observation modes (above the horizon, below or above the horizon and below the horizon) the visible satellites from the object and a time interval during which

there is the necessary number of satellites for navigation are calculated. The simulation results are illustrated by graphs.

Model operates to assess the availability of each satellite navigation system alone or any combination between them.

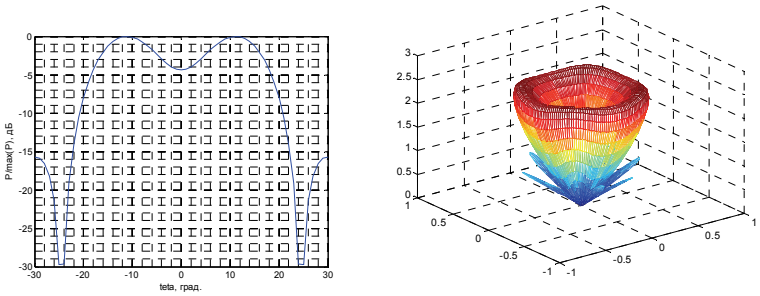

Fig 1. Radiating pattern of GPS satellite

The axis of radiating pattern passes through the phase center of antenna and is directed into the center of mass of Earth. In the center of radiating pattern there exists a specially formed “gap”, which is used to align the field on Earth’s surface.

The radiating patterns of GPS and Galileo satellites can be found on fig. 2 [1].

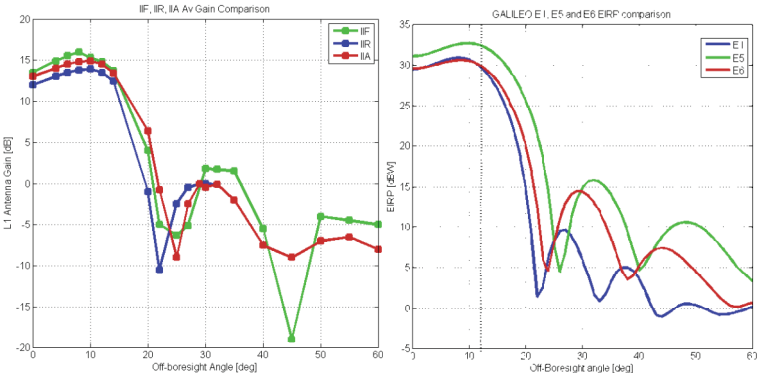

Fig. 2. Radiating pattern of GPS and Galileo

If the distance of the object from the Earth's surface is over 2000 km to GLONASS and 3000 km to GPS, we can talk about unstable radio navigation field, which means that we can not simultaneously receive signals from four satellites of one navigation system.

The radio navigation field is superposition of electromagnetic waves emitted by all navigation satellites within the main lobe of the satellite antenna pattern. The structure of the radio navigation field formation can be seen on fig 3.

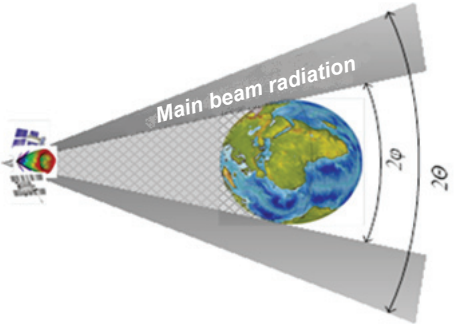

Fig. 3. Radio navigation field formation

Experimental data

The experimental data of the model is illustrated in the graphical form and produces three figures.

The satellites which can be seen above the horizon plane for 3000 km are shown on fig, 4.

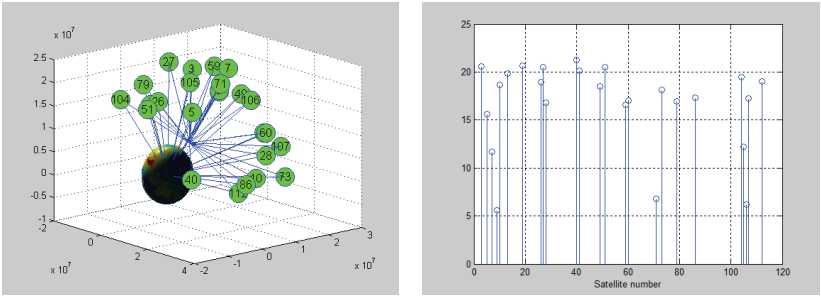

Fig. 4. GNSS satellites geometrically available for an object on altitude 3000 km

The sky plot of the available satellites can be seen on fig. 5.

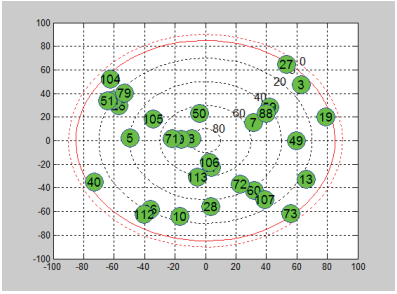

Fig. 5. Sky plot of available GNSS satellites

It is often impossible to use only satellites above the horizon for higher altitudes, therefore satellites below the horizon should be used. The example of available satellites on 20 000 km altitude can be seen on fig. 6.

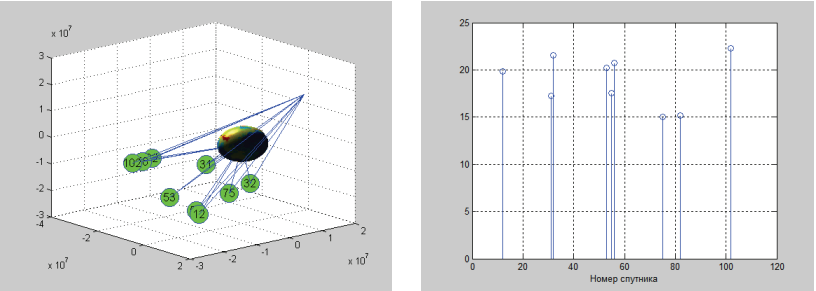

Fig. 6. Satellites geometrically available for an object on altitude 20000 km

Conclusion

The model allows to estimate the navigation field performances on various orbits with heights ranging from 800 km (Low Earth Orbit) to 36 000 km (Geostationary orbit). The model includes satellite constellations of both existing systems (GPS, GLONASS) and systems under development (Galileo, Compass).

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V.V. Konin, professor
O.S. Pogurelskiy, senior researcher
F.O. Shyshkov, postgraduate student
(National Aviation University, Ukraine, Kyiv)

SIMMULATION OF NAVIGATION SATELLITES AVAILABILITY IN THE NEAR-EARTH SPACE

The problem of GNSS performances in the near-Earth space is considered. The main factor that limits GNSS applying in space is district visibility of navigation satellites. The availability of GNSS satellites required number were checked by using model of satellites motion and data about height of user location.

Introduction

The position determination (positioning) of space vehicle in near space is actual task for missions that is going nowadays and will launched in future. The precise positioning in space is important for docking operations and on-orbit activities such as search and utilization most massive and dangerous elements of space debris.

The satellite navigation is effective technology that could be applied for tasks of positioning in near Earth space. According with Interface Control Documents GPS and GLONASS systems provide continuous navigation field up to height 3000 km and 2000 km respectively [1, 2]. Obviously, the new systems Galileo and Compass will have the several performances [3].

Difficulty of receiving satellite navigation signals in the near Earth space is related with district visibility of satellites. It resulted from directivity pattern shape of the transmitting antenna with beam width ±23º [4].

The availability of satellites only GPS, GLONASS, Galileo or Compass system were researched with the help of model developed in MatLab software. It uses almanac of each system for calculation satellite positions and data about user location (latitude, longitude, height).

Satellite navigation on Low Earth Orbits

Low Earth Orbit (LEO) refers to a satellite which orbits the Earth at altitudes between (very roughly) 200 and 2000 kilometers. Low Earth Orbit has been used for both military and aeronautical purposes.

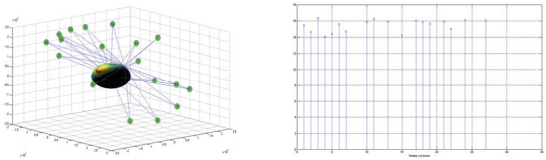

Fig. 1 GPS satellites visibility on height 1000 km

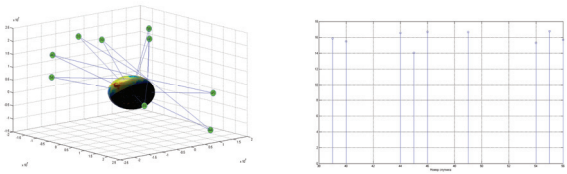

Fig. 2 GLONASS satellites visibility on height 1000 kilometers

The results obtained for height 1000 kilometers confirms that GPS and GLONASS systems could be applied for navigation and number of visible satellites each system varieties between 7 and 16. So, navigation satellites availability on the LEO even better than on the Earth surface. It can be explained by ability to receive signals from satellites located lower plane of horizon and increased beam width compared with the one on the Earth's surface.

Satellite navigation on Medium Earth Orbits

The heights of MEO satellites range from about 2000 to 24000 kilometers. The most common use for satellites in this region is for navigation, such as the GPS, GLONASS and Galileo constellations. Communications satellites that cover the North and South Pole are also put in MEO.

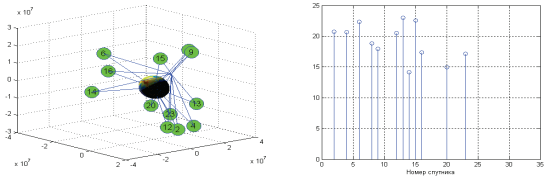

Fig. 3 GPS satellites visibility on height 5000 km

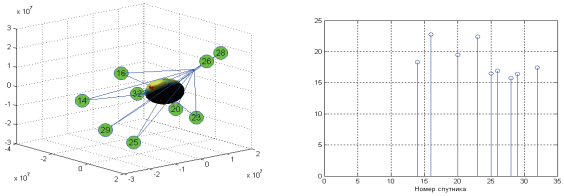

Fig. 4 GPS satellites visibility on height 10000 km

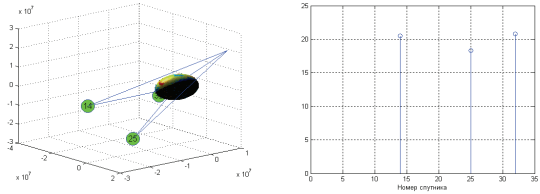

Fig. 5 GPS satellites visibility on height 20000 km

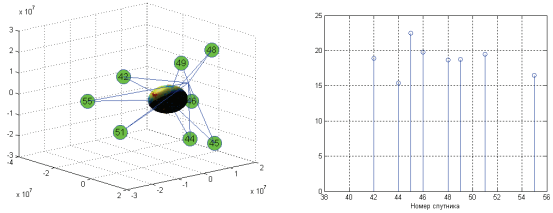

Fig. 6 GLONASS satellites visibility on height 5000 km

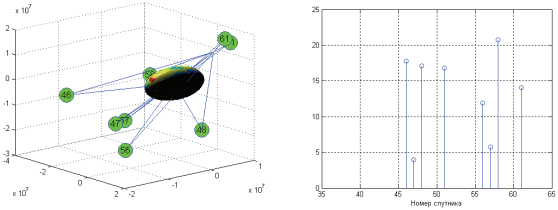

Fig. 7 GLONASS satellites visibility on height 10000 km

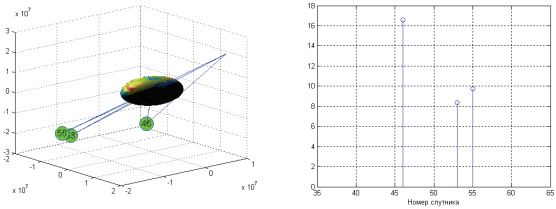

Fig. 8 GLONASS satellites visibility on height 20000 km

The continuity of radio navigation field formed by a single system tends to degrade with increasing height. The significant degradation of GPS is observed from 8000 km, for GLONASS from 6000 km. This problem can be solved by integration of multiple satellite constellations. Currently it is possible only for GPS and GLONASS systems (fig. 9) but in future we expect to add Galileo and Compass (fig. 10).

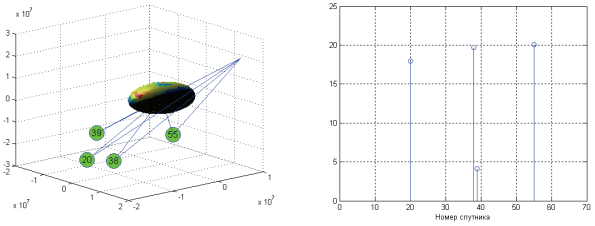

Fig. 9 GPS and GLONASS satellites visibility on height 20000 km

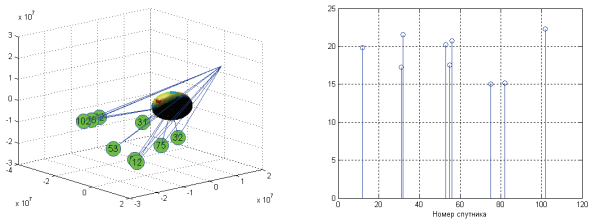

Fig. 10 GPS, GLONASS, Galileo and Compass satellites visibility on height 20000 km

Satellite navigation on Geostationary Orbit

The height of Geostationary orbit is 36 000 km. Navigation with the help of signals of any one system is hard. On average receiver can see 1-2 satellites. The only possible solution is applying data from all available navigation satellite systems (fig. 11).

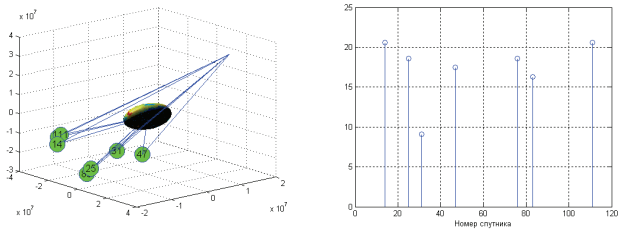

Fig. 11 GPS, GLONASS, Galileo and Compass satellites visibility on height 36000 km

Conclusion

The results of simulation showed theoretical possibility of satellite navigation in near Earth space.

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V. Kharchenko, Doct. of Techn. Sci., V. Kondratyuk, S. Ilnytska, PhD, O. Kutsenko, E. Vyshnyakova, A. Ismael (National Aviation University, Ukraine, Kyiv)

SOME PRACTICAL RESULTS OF INTEGRATED NAVIGATION SYSTEM FLIGHT TESTING

Modern integrated navigation systems are successfully exploited in different applications. At tremendous increase of such market it is very important to develop own reliable and accurate navigation systems. This paper presents some results and analysis of created inertial-satellite integrated navigation system flight testing, approving its efficiency.

Introduction. The last decade has shown an increasing demand for small-sized and low-cost navigation systems for use in many applications such as personal navigation, car-navigation, unmanned aerial vehicles (UAVs), etc [1–2].

To ensure compliance with the requirements for accuracy, availability, reliability and integrity it is necessary to perform data fusion from different systems and integrate them into a single navigation system. Typical candidates for an integrated navigation system are the Global Navigation Satellite System (GNSS) and Inertial Navigation Systems (INS), since such integrated navigation system combines their advantages and eliminates disadvantages [3].

Integrated navigation system development and testing. The prototype of small integrated navigation system (Fig. 1), including 3-axis accelerometers, gyros, magnetometers, barometric altimeter of MEMS type and single frequency GNSS receiver, had been created in Aerospace Center of National Aviation University.

Fig.1. The prototype of integrated navigation system

Fig.2. Photo of small UAV used for experimental testing

At the current version of the integrated navigation system the loosely-coupled approach had been realized, i.e. the procedures of navigation solution calculation could be divided into two main parts: strapdown INS (SINS) functioning and correction by GNSS and other sensors. For an attitude update the quaternion representation is used. To calculate incremental angles, from which the quaternion corresponding to small turn of the rigid body at small time interval is composed, the quadratic spline-approximation is applied as in [4–5]:

$$\nabla\theta_i = \frac{\Delta t}{12}\left[5\omega(t_i) + 8\omega(t_{i-1}) - \omega(t_{i-2})\right],$$

$$\delta q(t_i) = \left[1 - \frac{1}{12}\left\|\nabla\theta_i\right\|^2;\ \ \frac{1}{2}\nabla\theta_i - \frac{1}{24}\left(\nabla\theta_i \times \nabla\theta_{i-1}\right)\right]$$

Attitude update is then performed by multiplication of the elementary quaternions: $q(t_i) = q(t_{i-1})\delta q(t_i)$. Then the specific forces are transformed to navigation coordinate frame using updated quaternion and are corrected to gravitational and centripetal accelerations. The velocity and position are calculated then using approximation similar to the one used for incremental angles calculation.

SINS navigation solution is corrected from GNSS receiver, magnetometer and baro-altimeter using Kalman filtering equations. For increasing the accuracy of calculation procedures the algorithms for computation of Cholesky factors of corresponding covariance matrices had been used. More details about applied computation algorithms are written in [4–5, 8].

A lot of experiments have been conducted to evaluate the performance of the developed navigation system, including laboratory static ones [6], ground testing [7] and flight experiments [8–9]. But all mentioned previous experiments and results present the post-processing mode of data, i.e. raw data from the sensors were recorded at the flash card and the navigation solution were calculated after performing the experiment using Matlab. At the current version all calculations are realized using the Freescale Kinetis K-60 microcontroller [] onboard of the integrated navigation system. The correspondent software modules had been written using Code Warrior Development Studio and embedded C/C++ compiler and debugger.

During the last experiment first few minutes the static data were gathered for initial alignment, and then small UAV (Fig. 2) with the integrated navigation system on board flew in air. Sensors data together with navigation solution (orientation, velocity and coordinates) have been recorded at flash card. The results of experiment are presented at the figures 3–6.

Results. The trajectory of experimental flight is presented at Fig. 3. Time dependences of estimated roll, pitch and yaw angles are represented at Fig. 4.

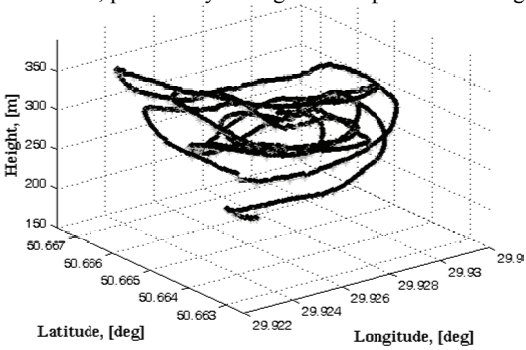

Fig.3. Trajectory of experimental flight

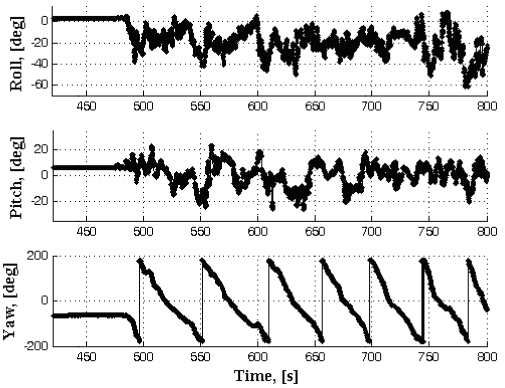

Fig.4. Graphic representation of roll, pitch and yaw angles

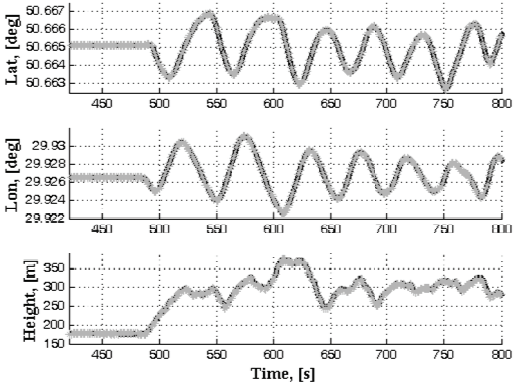

Fig.5. Graphic representation of coordinates in WGS-84

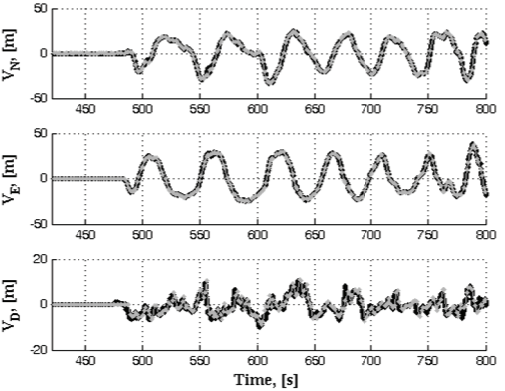

Fig.6. Graphic representation of velocities in NED frame

As it could be seen from the Fig. 3, after take-off and climbing UAV was flying mostly in the counterclockwise direction. Therefore the roll angle most of time had negative sign. The pitch angle was in boundaries ± 30 °, taking negative values during descent and positive – during climbing (Fig. 4). Time dependences of coordinates and velocities are represented at Figs. 5–6 correspondently. Here black solid line depicts the solution of integrated navigation system and grey stars – measurements from GNSS receiver. It can be seen that these values almost coincide.

Conclusions. The prototype of integrated navigation system including MEMS type Inertial Measurement Unit and single-frequency had been created in Aerospace Center of NAU. The results approving its efficiency of functioning from one of the experimental validations have been presented.

Further works of integrated navigation system developers' team will be directed on decrease of its size and weight, implementation of new algorithms, including tight integration scheme and adaptive non-linear filtering algorithms.

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UDC 81`23+378 (043.2)

O.P. Petrashchuk, O.M. Vasiukovych
(National Aviation University, Ukraine)

LINGUISTIC PROFILE OF GROUND-TO-AIR RADIOTELEPHONY COMMUNICATION

Linguistic profile of radiotelephony communication has been studied on the basis of 37 radio telephony exchanges between an air traffic controller and a pilot in non standard situations. Percentage of standard phraseology and plain English used in the exchanges has been calculated.

Introduction. It is well known that a language related human factor is one of those contributing significantly into civil aviation events. It might mean that during all flight stages the quality of verbal communication between an air traffic controller and a flight crew is at high stake. The radiotelephony exchanges serve to provide safe both aircraft operation and traffic control. In order to improve safety the International Civil Aviation Organization (ICAO) has put forward new requirements regarding the level of language proficiency of pilots and air traffic controllers of non-English speaking countries.

The language of radiotelephony is based on standard ICAO phraseology and plain Aviation English. The latter is used when standard phraseology is not sufficient to achieve successful communication between the interactants [1]. It often takes place in non routine situations at any flight phase due to extreme flight conditions and the complexity of the aircraft control under stressful and threatening negative consequences. The literature overview showed that over the passed 15-20 years, 60-65% of aviation events have occurred due to lack of reliability of the aviation personnel knowledge, skills and knowledge of English, which leads to lower levels of professional reliability under extreme conditions and time limits to assess the flight situation for decision-making [2]. So, the question is how much phraseology is substituted by plain Aviation English due to insufficiency of the former.

ICAO Doc 9835 defines the standard phraseology as a linguistic phenomenon which is a set of operating rules. Its main linguistic characteristics are as follows: limited vocabulary (about 400 words) where each word has a precise meaning applied to mainly limited field of aviation and short sentences. Phraseology language is restricted or lack of articles, possessive pronouns, verbs, the personal pronouns and prepositions. [1]

Under the plain language in radio communication one means spontaneous, creative and non-coded to use a specific natural language [4]. In our research we used term of plain English defined by ICAO as the general English in aviation context used by any participant of a radiotelephony exchange (air traffic controllers and crew members) to compensate lack of the standard phraseology [1].

In the course of our study a method of sample survey was used. For the analysis we selected 37 radio telephony authentic episodes of various unusual situations. The episodes have been analyzed according to the criteria of evident quantity of standard phraseology clusters and plain English lexis used simultaneously in the exchanges with a purpose to achieve success in communication.

The analysis of the episodes showed that plain English increases up to nearly 19% of the total number of words used by radiotelephony participants. Therefore phraseology was used in 80% of interaction. The fact proves that the phraseology is substituted in a

proportion of 1 plain English unit to 5 phraseology units. Total 23010 (100%) lexis have been studied where there were 18660 (81.1%) phraseology and 4350 (18.9%) plain English units.

Some examples of the radio telephony episodes analyzed are as follows:

1)C: AB nine four six PAPA, report the reason please
P: We have smoke in cockpit, but we have no fire, light indication now
C: Do you need fire brigade?

2) C: X DELTA X, stand by
C: X DELTA X, do you need position another apron?
P: Yes, sir, so we need GOLF two, MIKE one nine
C: Stand by, please, hold position.

3)C: X Y eight five, zero, what flight level do you wish ?
P: We need flight level one hundred emergency, Mayday, Mayday, Mayday, X Y eight five.

4) C: Speedbird seven four Delta, say again, please.
P: Do we have to fly full departure route or do you give us a heading as usually?
C: Speedbird seven four Delta, say again, please.

5) P : ABC zero two nine four, we would like to come back to the gate, please?
C: ABC zero two nine four,roger and confirm, are you ready to taxi by own?
P: Yes, ready taxi by my own.

Linguistically the radiotelephony communication between a pilot and an air traffic controller lacks of phonetic, grammatical, lexical, syntactic and stylistic features which normally take place in real world conversation.

Phonetic characteristics of broadcasting as a whole are subject to general rules of the English language, and some phonetic pronunciation differences concern numbers (two, four, six) and the presence of special phonetic alphabet which is characterized by specific names of letters of the English alphabet to avoid misunderstanding (e.g., PAPA, MIKE, DELTA) [3].

Syntactically, this type of communication is characterized mainly by incomplete grammatical structure of sentences in which there is no subject, verb bunch to be, as well as other secondary members of the sentence. The radiotelephony interaction is characterized by neutrality, impersonality and lack of emotional expressions utterances [3].

It is important to note that professional communicative competence places a leading role during the radiotelephony exchange on international air routes. Consequently professional (English language related) communicative competence of aviation personnel includes the foreign language knowledge and communicative skills as well as their ability to implement the appropriate use of communication strategies to interact effectively in radiotelephony exchanges on international air routes. Appropriate level of the language communicative competencies using both phraseology and plain English in conditions of professional interaction might be provided by an interaction and interpenetration of linguistic, social, cultural and communicative competencies of a person, which allows the level of development of aviation professionals to effectively implement the English language, and therefore, cross-language, cross-cultural and interpersonal communication [4].

Other research results showed that the main reasons of miscommunication are the following:

a) Improper use of standard phraseology due to underdeveloped foreign language competence.

b) Insufficient spoken language competence development.

c) Use of more than one language in the same airspace (lack of social and strategic competence). [5]

Conclusions. Analysis of 37 episodes of authentic exchanges between air traffic controllers and flight crew clearly showed that the ICAO standardized phraseology is used in all cases where it is required. Only when standardized phraseology can not be used for the purpose of effective communication the plain English language is applied. Therefore two English 'sublanguages' are used in a proportion 5/1 (or 80% - phraseology; 20% plain English). They are usually used together in a single session in non routine situations.

Therefore standard phraseology can not account for all non-standard , abnormal and sometimes emergency situations encountered by aviation personnel; also it is not sufficient to convey additional information about many unforeseen situations at any stage of flight. So, English language training of aviation personnel must be provided by integrative course using aviation simulator to model various unusual situations in the flight.

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Povoroznyk Kathy, senior teacher
(National Aviation University, Ukraine)

TIME PERSPECTIVE AS A PERSONALITY RESOURCE OF AERO NAVIGATION SPECIALISTS

In the paper the focus is made upon the psychological time phenomenon of the personality - time perspective construct; time perspective becomes the resource of a personality development when it becomes balanced.

Introduction

A balanced time perspective (BTP) is announced to be the most salubrious time perspective (TP) (Boniwell & Zimbardo, 2004). According to Boniwell and Zimbardo (2004), a person with a BTP is characterized by being medium present hedonistic, medium future-focused, low present fatalistic, as well as high at the past positive and low at the past negative time frame.

The issue of Balanced Time Perspective is a relevant subject of study in modern psychological researches in the context of personal activity and its efficiency, as its long being proved interconnection of personal activity both physical and mental with its activity through the time of life, on the other hand the quality of this mutual existential activity depends on personal temporal characteristics and their balance.

The professional activity of aviation specialists (pilots and controllers) takes place within strict time limits, the success of it (personal input) is determined by many individual factors, where time factor is not the least. Its vital to notice here that physical peculiarities of chronological time do not overweight psychological time features, which often do not coincide with the latter. According to Jane Collingwood: "We are all time travelers: We draw on past memories, experience the present and look forward to future rewards. But how easily we travel back and forth makes a crucial difference to how well we do in life and how happy we are while we're living it. Our time perspective — whether we tend to get stuck in the past, live only for the moment, or are enslaved by our ambitions for the future — can predict everything from educational and career success to general health and happiness."

Personal experience of Time, the attitude and interaction with it is a fundamental characteristic of human experience, both objective (chronological) and subjective (personal time construct). Temporality being a fundamental characteristic of human existence, saturates human existence with richness and meaningfulness. Modern scientific paradigm tends to view personal activity involving professional one in the context of the personality integrity, where psychological domains are interrelated and make its input into the personality productivity.

Philip Zimbardo & John Boyd state the inevitability of time paradox presence in our lives: "The Time Paradox is not a single paradox but a series of paradoxes that shape our lives and our destinies. For example:

Paradox 1

Time is one of the most powerful influences on our thoughts, feelings, and actions, yet we are usually totally unaware of the effect of time in our lives.

Paradox 2

Each specific attitude toward time—or time perspective—is associated with numerous benefits, yet in excess each is associated with even greater costs.

Paradox 3

Individual attitudes toward time are learned through personal experience, yet collectively attitudes toward time influence national destinies."

The Time Perspective construct has been found to be related to many attitudes, values, and status variables (educational achievement, health, sleep and dreaming patterns). It is also predictive for a wide range of behaviors, involving different risk taking forms, delinquency (Zimbardo, Keough, Boyd, 1997). It appears that scores on the ZTPI factors are indicative of perceived time pressure, that is of great importance for aviation specialists who are operating under time-limited conditions.

The matter is that not every Time Perspective can be productive and resourceful. Here we face the question of Balanced Time Perspective as a development goal to achieve. Zimbardo introduces the concept of a *balanced time perspective* (BTP) and states that 'in anoptimally balanced time perspective, the past, present and future components blend and flexibly engage, depending on a situation's demands and our needs and values' (Zimbardo, 2002: 62). An essential key factor for succeeding in developing a BTP is thus the skill to flexibly switch one's focus from one time perspective to another according to the demands of the moment. It is predicted that mindfulness leads to improvement of sustained attention and switching flexibility of attention (Bishop et al., 2004; De Kleine, Van de Lubbe, Blom, Schreurs, & Bohlmeijer, in prep.).

According to the research of Jonte Vowinckel, Mindfulness plays its role in structurising human relations with time and balancing Time Perspective. The ability to switch mindsets, such as being dominated by a certain timeframe, seems to rely mandatorily on the sub activities, summed up by the five facets of mindfulness: observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience, since these abilities provide the "space' between one's perception and response' (Bishop et al., 2004: 9), and the information about the situation, necessary for the next step, the 'reflectively (as opposed to reflexively)' (Bishop et al., 2004: 9) evaluation of the demands of the moment.

In its turn, Zajenkowski Marcin and Stolarski Maciej (University of Warsaw, Poland) studied intelligence, working memory and time perspective.

Adaptivity of individual Time Perspective dependable on the mentioned above characteristics. According to the authors: "Studies devoted to subjective time shows that Zimbardo's dimensions of time perspective (TP) are associated with various psychological variables. For instance, past positive and future tend to positively correlate with subjective well-being, emotional intelligence, delayed award, while past negative and present fatalism are rather negatively related to these factors. Broadly speaking, one can conclude from these findings that an individual's time perspective may be classified as more or less adaptive. One of the factors determining human adaptive behavior is general intelligence. It was shown that this variable is associated with more adjusted personality profile and many life outcomes, such as earning, educational achievements, even longevity and health. Results indicated that working memory, which is associated with cognitive control, may mediate the correlation between intelligence and future TP."

Time perspective and procrastination in the workplace.

Disbalanced Time Perspective can lead to the phenomenon of procrastination. Ritu Gupta, Douglas A. Hershey, Jighyasu Gaur studied the phenomenon of procrastination in the workplace. According to the authors: "In the workplace, procrastination is typically viewed as a sub-optimal behavior that undermines productivity. As a construct, psychologists typically conceptualize procrastination as a stable and enduring personality trait. It has recently been argued that time perspective is also a personality trait, which has

an important influence on procrastination behavior (Ferrari and Díaz-Morales, 2007 Journal of Research in Personality 41:707–714). Time perspective helps to guide not only employees' judgments and decisions, but also their actions at the individual level." In their study, the scholars examine the extent to which five qualitatively different types of time perspective (defined by Zimbardo and Boyd, 1999 Journal of Personality and Social Psychology 77:1271–1288) predict the tendency to procrastinate in the workplace. Participants were 236 managers and executives sampled from seven major information technology and financial organizations in India. Regression analyses revealed that of the five time dimensions, two were significantly positively related to procrastination, whereas two others showed negative relationships. From a basic science perspective, these findings help to extend our theoretical understanding of both time perspective and procrastination. From an applied standpoint, the results suggest an important individual difference dimension that might be considered during the personnel selection process.

Personality development in terms Time Perspective involves understanding the lifetime as a resource and an active position relative to current policies, planning as well as the ability to see past experience achievements.

Time Perspective as a construct that describes the principle of interconnection and interdependence of past, present and future tense moduses in the mind and human behavior (Frank). As the internal development of the individual, Time Perspective expands and gets complicated with the acquiring of experience uniqueness.

Thus, the study J. Newtten clearly differentiates the structural concept of Time perspective because the term can be attributed to various aspects of psychological time. Therefore, the researcher identifies the following aspects:

1) The first aspect - the actual Time perspective, characterized by :

- length
- depth
- saturation
- the degree of structuring
- level of realism

2) The second aspect - Time setting , more - less positive or negative attitude of a person - with respect to his / her past, present, future;

3) The third aspect - the temporal orientation that characterizes the behavior of the subject determined by the dominant time modus focus in the consciousness [1].

Aero navigation specialists temporal awareness

Personal characteristics influence on the activity in Time can be illustrated by the personal attitude to one's work in time. Timing mode is an inherent part of professional activity of air navigation specialists, including radiotelephony communication. Some of time regimes have a direct impact on quality of professional air-to-ground communication, but this influence is manifested in different ways according to the various personality types.

Individual features in the time perception are displayed as a strong tendency to overestimate or underestimate the time. Thus, the tendency to underestimation of time intervals duration exerts influence upon the speed of practice, which spur acceleration of the latter. As a result of awareness and activity mode performance connection, different personality types have different attitude towards their work.

Thus, " High- speed " type gives priority to " discipline ", " Medium speed " type values rationality as the helpful skill to find the right pace of activity. In this case: highly anxious persons tend to speed the pace of activity, while people with low levels of anxiety - get to a slower pace.

K.A Abulkhanova, T.N Berezina assert that not every expert has an idea about his way of performance through time. Thus, the "optimal" personality type is successfully operating in any of the time mode, while "deficient" is more successful when all other modes are summarized to doing everything at the last minute . " Peaceful " type favors unlimited time mode or excessive one, while " executive " type effectively operates in all modes except mode uncertainty, " anxiety " type in its turn tries to avoid deficiency time mode . Of course, the mentioned above personality type characteristics according to the method of specific time performance affect the professional activity of air navigation specialists.

Thus , five time modes : " deficient ", " limited ", " optimal ", " uncertain " and " excessive " can be correlated with a certain type of personality activity over time. During the analysis of these regimes it should be taken into account the motivation factor that in real activity also gives effect of acceleration or deceleration.

Psychological profile of air navigation specialist and personality Time perspective

It is necessary to mention here, that overall awareness of the life time as well as personal ability to harmoniously interrelate the life time events exert a substantial influence upon psychological profile of air navigation specialist.

It should be noted that the events of the past and the future have an effect on the current behavior of a personality to the extent they are actually given at the cognitive level of one's behavioral functioning. We believe that human assistance in updating the life significant events and forming a balanced picture of them as the time of life is quite relevant in terms of Time perspective.

In studies of P. Zimbardo . , D. Boyd . , L. Bonivilla found a direct effect of Time perspective on the organization of individual psychological time, which building involves cognitive processes that divide human experience into time segments of the past, present and future.

When analyzing the qualitative characteristics of Time perspective, the researchers used the concept of balance: a balanced Time perspective is a psychological construct that is characterized by flexible switching between different time dimensions (the past, present or future) that can be determined both externally and innately. During the empirical research it was found that such Time perspective is the best one in terms of maintaining mental and physical health of the individual, but also in terms of social adaptation and individual functioning in the society [2].

Scientists (K. Lewin , J. Newtten, P. Zimbardo), distinguish in the structure of Time perspective cognitive, emotional and social components; peculiar features of the given construct can make a significant impact on individual behavior and activities.

As far as psychological science today tends to studying personality in the integrity of its structure when an imbalance of one of its levels leads to unbalance of the other, it is important to understand the role of time perspective in real time mental processes, states and personality specifics that has a direct impact on the personality existence.

A series of researches studied time perspective in the light of such important aspects as: age dynamics , the problems of physical and mental health correlation, individual psychological well-being, life experiences . Thus, according to the concept of K.A Abulkhanova, T.N Berezina, the highest level of lifetime organization is the scale of life time. Personal awareness of time should be relevant to the scale of life time, in this case a person goes beyond the limitations of chronological time, creating one's own time space [3].

Thus, each lifetime event has its own scale, which determines its significance in the life of the individual and shows the specific sequence and duration of psychological time. K.

Lewin, in particular, noted the importance of taking into account the different scales of psychological fields to suggestive analysis principle of events simultaneity that make up this field [4].

Personal time organization

According to Y.Y. Holovaha., A.A Kronik, the scale of lifetime event meaning at the level of psychological time is determined by its affect upon the wholy psychology of a personality? taking into consideration its major life spheres. Thus, the surveys found that ups and downs in the graph of key life stages, in the opinion of respondents, coincided exactly with those events that carried significant positive or negative impact on the areas of social , family and professional life . [5]

It is also introduced the concept of personal time organization which plays vital role in understanding time perspective phenomenon. This psychological construct a trinary structure, comprising : a) a component of the realization of a life time , b) components of the experience of a life time, c) activity- component (practical organization of the lifetime). The following functional specific mechanisms help to realize one's life time: memory (primarily long term), anticipation capabilities and the ability to design a holistic vision of time. So, Personality has vitality for acting as a unique complex and dynamic system in time.

It is important to emphasize the existence of two time dimensions: objective and subjective, which are interrelated. The objective time dimension represents a chronological time in itself and determined by psychophysiological factors (can be defined as "determined " time); an objective time dimension is a psychological time, which is undetermined time in its nature, scientists call it epicentric time.

We adhere to the idea of personality resources development through harmonious agreement of chronological and epicentric time (determined / selfdetermined). Such an agreement , on one hand, is impossible without the comprehension of life and its reflection, on the other without individual activity associated with self actualization and self realization, enriching one's life with values, personal and professional self determination. The important thing is that it is on the border of two time dimensions there can arise a conflict between value time perspective and objective time perspectives as a result of inconsistency or imbalance.

Some scientists propose another concept in terms of Time perspective construct research of the individual, namely " psychotemporal personality organization ", or " personality time" which is a dynamic structural entity that has the potential to develop over life -time, and represents an integrated structure of psychotemporal mental formations of consciousness and subconsciousness, behavioral strategies and value ratios (K.A Abulkhanova -Slavskay , V.F Serenkova , V.I Kovalev , L. Kublitskene).

Mentioned above Time perspective psychotemporal specifics is determined by a number of different category factors. Thus, scientists have discovered the existence of individual situational factors that affect the temporal characteristics of ontogenetic development prospects. The social situation of the individual has certain characteristics that make it somehow respond to social challenges . Previous experience failure , superimposed on the structure of prior Time perspective, so that personal characteristics may cause uncertainty in the future perseption and be a factor in the success of a life time .

Types of time regulation

It should be noted that among the principles that structurize Time perspective - the most developed is typological principle. This principle reflects the mechanisms that determine a certain way of personal existence in time. There are several classifications on personality Time perspective organization. Thus, I. Kovalev mentions that the ratio of the

individual to the time of life is not equivalent with respect to the existence of a person and its Self, but rather is a fundamental principle of this attitude that permeates all levels of human existence, that is "the core of all human relationships with the world ." In our opinion, the author's emphasis on the meaning of values that forms " tissue " of human relationships over time is a key idea in understanding man's transition to the level of existential understanding of lifetime [6].

Conclusion

Subjectivity and self determination of one's life can not be fancied without personal attitude of person to Time of his life. The neglect of psychological time aspect (Time perspective) in aero navigation specialists psychological training may lead to mental disorders, thus affecting the overall professional performance, leading to errors and frustration. Time perspective development may exert influence upon methods of performance in time and personal time organization.

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Kharlamova Tatyana, Senior lecturer,
(National Aviation University, Ukraine)

THE AIRCRAFT MAINTENANCE ENGINEER COMPETENCE WITHIN THE CONTEXT OF AVIATION SAFETY REGULATIONS

This thesis is intended to serve as a guide for operation of a flight safety function within international safety organizations. This paper is specifically focused on the impact of European Aviation Safety Agency (EASA) Regulations as they are strongly applied to Aircraft Maintenance. The paper is intended on responsibilities for releasing Aircraft Maintenance Engineer License to sign off aircraft for flight. It also includes guidance to competency requirements of the Aircraft Maintenance Engineer.

The strong safety performance notwithstanding, every accident is one too many. So there is no room for complacency. The industry and its regulators remain focused on safety improvements. Airlines continue to work with the International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), International Air Transport Association (IATA), airports, air navigation service providers (ANSPs), manufacturers, regulators, and multiple international safety organizations on initiatives to raise aviation safety performance worldwide.

IATA released a number of documents in 2011 to assist in safety efforts. These included the second edition of the Runway Excursion Risk Reduction Toolkit, in partnership with ICAO and more than a dozen international safety organizations. Also published were implementation material for competency-based training and qualification schemes for engineering and maintenance and the first joint EUROCONTROL-IATA safety bulletin.

All these programs are aligned in IATA's well-established six-point safety program to systematically tackle the causes of accidents. This focuses on safety data management and analysis, auditing, safety management systems, infra- structure safety, operations and maintenance. The tools and projects developed under the six-point program are in line with ICAO requirements and are being increasingly adopted by governments and regulatory authorities worldwide.

Thus, aviation had its safest year ever in 2012 and the efforts continue for further improvements.

The main tasks of EASA currently include:

•drafting aviation safety legislation and providing technical advice to the European Commission and to the Member States;

•inspections and training to ensure uniform implementation of European aviation safety legislation in all Member States;

•airworthiness and environmental type-certification of aeronautical products, parts and appliances;

•approval of aircraft design organizations world-wide and of production and maintenance organizations outside the EU;

•coordination of the European Community SAFA (Safety Assessment of Foreign Aircraft) program;

•coordination of safety programs, data collection, analysis and research to improve aviation safety.

EASA is responsible for releasing Aircraft Maintenance Engineer License to sign off aircraft for flight. Aircraft anywhere leaves the ground without being checked by a

maintenance engineer. Being an aircraft maintenance engineer means working on the most exciting and advanced technology in the world. Aircraft engineers are always in demand by airlines and aviation companies all over the world. Qualified aircraft maintenance personnel must have a full EASA Part-66 Aircraft Maintenance Engineer. To get this license, the maintenance engineers usually need five years' professional aircraft experience.

Aircraft maintenance engineers need to have an experience in installing, maintaining and repairing aircraft engines; airframes; airframe systems; electrical, instrument and radio systems; and aircraft structures and surface finishes.

Aircraft maintenance engineers may perform the following tasks:

•dismantle, inspect, repair and reassemble aircraft engines, airframe components and systems, electrical components and systems, avionic components and systems, and aircraft structures;

•test aircraft communication equipment, instruments and electronic systems;

•conduct routine pre-flight inspections.

Specializations:

Aircraft Maintenance Engineer (Avionics)

An aircraft maintenance engineer (avionics) maintains, inspects, tests and undertakes fault diagnosis of electrical, electronic, instrument and radio systems, components and accessories on aircraft. These include generator and power distribution systems; navigation, radar and integrated flight systems; indicating and recording systems; lighting systems; aircraft information systems; autopilot systems; fly by wire flight control systems; digital engine control systems; in-flight entertainment and cabin systems; and communication systems.

Aircraft Maintenance Engineer (Mechanical)

An aircraft maintenance engineer (mechanical) maintains, services, inspects, tests and undertakes fault diagnosis of airframe, engine (including propellers and rotors) and electrical systems, components and accessories on aircraft. These include landing gears; wheels and brakes; skids; pneumatic and hydraulic systems; fuel systems; flight control systems; environmental control and pressurization systems; fire detection and prevention systems; oxygen systems; containerized cargo handling systems; doors and windows; lighting systems; and ice and rain protection systems.

Aircraft Maintenance Engineer (Structures)

An aircraft maintenance engineer (structures) fabricates, maintains and repairs sheet metal, bonded and non-metallic composite material, and components on pressurized and non-pressurized aircraft. They must be familiar with airframe, engine and electrical components. They carry out a wide variety of metal forming and joining processes using hand and power tools, and work with various fiber-reinforced plastic materials.

Aircraft Mechanic (Avionics)

An aircraft mechanic (avionics) overhauls, repairs, modifies and tests a range of electrical, electronic, instrument and radio communications and navigation system components in a workshop environment, after they have been removed from the aircraft. These include generator and power distribution systems, protection systems, autopilot and integrated flight systems, environmental control systems, and radar and communication systems. They may also perform flight simulator maintenance.

Aircraft Mechanic (Mechanical)

An aircraft mechanic (mechanical) overhauls, inspects, repairs, modifies and tests airframe and engine components in a workshop environment, after they have been removed from the aircraft. These include landing gears; wheels and brakes; fuel, pressurization, pneumatic and hydraulic devices; flight control surfaces and power control packages;

environmental control components; piston and gas turbine engines; propellers and rotor blades; transmissions; and associated engine components. They may also perform flight simulator maintenance.

Personal Requirements:

•enjoy technical and engineering activities;

•medically fit, with good hearing and vision (colour blindness may make people unsuitable for some aircraft trades);

•good hand-eye coordination;

•able to concentrate for long periods;

•neat and accurate;

•attention to detail;

•able to work in confined spaces and at heights on platforms around aircraft (for some specializations).

Competent engineers are required to take responsibility for engineering projects and programs in the most far-reaching sense. This includes the reliable functioning of all materials, components, sub-systems and technologies used; their integration to form a complete, sustainable and self-consistent system; and all interactions between the technical system and the context within which it functions. The latter includes understanding the requirements of clients, wide ranging stakeholders and of society as a whole; working to optimize social, environmental and economic outcomes over the full lifetime of the engineering product or program; interacting effectively with other disciplines, professions and people; and ensuring that the engineering contribution is properly integrated into the totality of the undertaking. Competent engineers are responsible for interpreting technological possibilities to society, business and government; and for ensuring as far as possible that policy decisions are properly informed by such possibilities and consequences, and that costs, risks and limitations are properly understood as the desirable outcomes.

Competent engineers are responsible for bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues, for ensuring that technical and non-technical considerations are properly integrated, and for managing risk as well as sustainability issues. While the outcomes of engineering have physical forms, the work of professional engineers is predominantly intellectual in nature. In a technical sense, Professional Engineers are primarily concerned with the advancement of technologies and with the development of new technologies and their applications through innovation, creativity and change. Competent engineers may conduct research concerned with advancing the science of engineering and with developing new principles and technologies within a broad engineering discipline. Alternatively, they may contribute to continual improvement in the practice of engineering, and in devising and updating the codes and standards that govern it.

Professional Engineers have a particular responsibility for ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding clearly how new developments relate to established practice and experience and to other disciplines with which they may interact. One hallmark of a professional is the capacity to break new ground in an informed, responsible and sustainable fashion.

The competencies and elements of competency represent the profession's expression of the knowledge and skill base, engineering application abilities, and professional skills, values and attitudes that must be demonstrated at the point of entry to practice.

The maintenance engineers quality of being adequately or well qualified physically and intellectually to accomplish assigned responsibilities. Competency is taken to mean

possession of the required level of knowledge, skills, experience and where required, proficiency in English, to permit the safe and efficient provision of aviation services.

The competence of the personnel for the assigned tasks, and where applicable their satisfaction of medical requirements, are fundamental elements of safety achievement, and therefore of safety management in the provision of aviation services. The high importance and priority of competency in aviation is reflected in harmonized safety regulatory requirements adopted at all levels: global - through the ICAO provisions on personnel licensing; regional - through dedicated acts (e.g. European directives); and national - through the appropriate provisions in the aviation legislation.

Historically, competency requirements have first been established for operational personnel (pilots, aircraft maintenance engineers, air traffic controllers) and then gradually extended to other categories of personnel assigned safety related tasks. In general, staff responsible for safety critical tasks are required to comply with detailed, rather prescriptive, licensing requirements and schemes. Other personnel, involved in less safety critical tasks may be subject to less demanding certification requirements, for example the technical and engineering personnel in air traffic management.

Competencies for a specific job are the cluster of skills set required to perform the JOB effectively according to a given performance criteria. In aircraft maintenance, the performance criteria are set by the authorities and the aircraft manufacturers the like of maintenance manual or *Civil Aircraft Inspection Procedures* (CAIP).

Thus, an aircraft maintenance engineer is responsible for the release (certification) of an aircraft after maintenance, inspection, repair or modification. This is a responsible occupation requiring a high degree of responsibility and skill, which includes:

•certifying airworthiness of airframe, piston and turbine engines, electrical/electronic systems, propellers and rotary systems;

•troubleshooting aircraft structural, mechanical or electrical systems to identify problems;

•adjusting and repairing systems according to specifications, technical drawings, manuals and established procedures;

•repairing and overhauling aircraft structural, mechanical or electrical systems;

•installing or modifying aircraft engines, mechanical, hydraulic, electrical, flight control, fuel and pneumatic systems;

•dismantling airframes, aircraft engines or other aircraft systems for repair, overhaul, inspection and reassembly; and

•supervising, performing and documenting routine maintenance.

Conclusions

EASA Regulations are essentially coordinated set of requirements for effectively managing of the Aircraft Maintenance. There might be flight hazards, both real and potential, associated with the Aircraft Maintenance and human failures. The aim of Flight Safety Regulations is to address and control the flight safety. This is achieved through the EASA Regulations of which ensure the proficient monitoring competences of the Aircraft Maintenance Engineer to prevent the recurrence of similar aircraft incidents which could lead to an aircraft accident.

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L. Nemliy, a teacher
(National Aviation University, Ukraine)

THE EFFECT OF STUDENT-TEACHER RELATIONSHIP ON THE QUALITY OF TRAINING

Many cognitive theorists argue that learning is a social event, and studies have proven that both teachers and students will pay the price if teachers neglect to form emotionally warm, supportive relationships with and among their students. To improve students' chances for academic success, educators must strive to form meaningful personal relationships with students.

Relationships, whether positive or negative in nature, have proven to have profound effects on quality of studying. Students make learning a higher priority and thus work harder for teachers whom they care about and perceive as also valuing their learning[1].

Teachers and students relation is affected by their personality type. Many educational psychologists feel that based on personality type, everyone has an individual style of learning. In this theory, working with that style, rather than against it, benefits both teacher and student. Although controversy often swirls around the educational benefits of teaching students according to personality types, it has gained a large following and been implemented at many levels of education. Today's student can visit any number of websites, take a personality test, and discover what type of student he or she is and how best to study[2].

Not only personality type influences how one learns, it also influences how one teaches. Learning one's personality type helps a teacher recognize how he or she teaches. The match or mismatch between the way a teacher teaches and the way a student learns contributes to student satisfaction or dissatisfaction. Students whose learning styles are compatible with the teaching styles of a teacher tend to retain information longer, apply it more effectively, learn more, and have a more positive attitude toward the course in general. Although a teacher cannot change his or her preferred style of teaching to match a learning style, steps can be taken to actively bridge the differences[2].

The teacher-student relationship is an important element in the mobility training process. The teacher does not teach apart from what he feels toward a particular student. Nor the student learns as though he was receiving his information from a teaching machine. Each has feelings toward the other. If the feelings are positive they will facilitate the learning process. If they are negative they will interfere. The teacher who likes a particular student will be more interested in his progress. On the other hand, the student who likes his instructor will be more eager to please by doing well on his lessons. Conversely, the teacher who dislikes a student may still teach competently, but finds it costs him a greater effort; while the student who has such feelings may resist the efforts of the teacher to help him[2].

The relationship is further complicated by the degree to which either or both are aware of the other's feelings. The teacher may not be experiencing negative feelings toward his student, but if he perceives such feelings in his client, he may find it difficult to maintain any degree of warmth toward him. On the other hand, if the student is aware that his teacher is cool toward him, he may find it difficult to trust the judgment of the teacher. When the teacher perceives positive feelings in his student, he looks forward to these lessons and works harder for the benefit of the student. If the student knows the teacher likes him, he

finds it easier to accept constructive criticism. Both find it easier to communicate their ideas and wishes in such a situation.

Students are more likely to be emotionally and intellectually invested in the classes in which they have positive relationships with their teachers (Phelan). Therefore, teachers who build positive relationships with their students may enjoy the following benefits:

• Increased levels of students' interested in and enjoyment of the class.
• Increased levels of students' academic achievement (Murray).
• A decrease in the occurrence of classroom disruptions (Phelan) [3].

High-achieving students will do what is expected of them, but if a strong student-teacher relationship hasn't been formed, they tend to distance themselves from the teacher and from the coursework (Phelan). Obviously, if teachers form positive relationships with academically successful students, these students are more likely to be engaged in the class and internalize the course materials [3].

Good teaching is charged with positive emotion. It is not just a matter of knowing one's subject, being efficient, having correct competencies, or learning all the right techniques. Good teachers are not just well oiled machines. They are emotional, passionate beings who connect with their students and fill their work and classes with pleasure, creativity, challenge and joy[3].

Teachers can improve their relationship if they do the following:

- Learn as much as possible about students' personal interests and backgrounds.
- Try to connect their personal interests with classroom work, where possible. Also, learning about students' cultures and religious backgrounds may help you relate to them more effectively.
- Include journal-writing activities, weekly student-teacher meetings, and class discussions, which enable students to voice and teachers to address concerns.
- Implement social emotional learning opportunities, which improve students' abilities to understand their own and others' emotions.
- Be aware of classroom dynamics. Try to diffuse tensions that may exist between students.
- Be patient with those students who are disruptive and disrespectful. Bonding with disruptive students may improve their behavior in the classroom.
- Model appropriate behavior. Students are very sensitive to teacher's attitudes towards the class in general; therefore, teachers must be extremely self-reflective, making certain that they are modeling positive behaviors for the class.
- Videotaping several class sessions may make teachers aware of any negative feelings they may be projecting towards their students.

The knowledge, skills and commitment of teachers, as well as the quality of school leadership, are the most important factors in achieving high quality educational outcomes. For this reason, it is essential to ensure that those recruited to teaching and school leadership posts are of the highest caliber and well-suited to the tasks they have to fulfill great care and attention should be devoted to defining the required profile of prospective teachers and school leaders, to selecting them and preparing them to fulfill their tasks[4].

Conclusions

Quality of studying depends on student and teacher relation. Forming strong and supportive relationships with teachers allows students to feel safer and more secure, feel

more competent, make more positive connections with peers, and make greater academic gains.

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Korol Liliya, Lecturer,
(National Aviation University, Ukraine)

DIRECTED ACTIVITIES RELATED TO TEXTS AS MEANS OF TEACHING READING TECHNICAL TEXTS

Directed activities related to texts and their application in teaching reading technical texts for aviation engineers.

Teaching English especially in a country where English is used as foreign language is quite challenging. Teachers have to deal with LEP (Limited English Proficiency) students or students that have limited ability in English. Meanwhile, the students of National Aviation University, Ukraine are required to comprehend science or technical text in English because they are expected to be able to use science and technical literature in English in the process of their studying. This requirement is also obligatory on their future workplaces. They might have good skill in science field but they have limited ability of English because they do not use English regularly for everyday communication. However they should master English language because they are expected to find and comprehend any references of science subject not only from Indonesia but also from another source or country. The literature from other sources is mostly written in English therefore they need to improve their ability to master English language in order they can get a lot of new knowledge from those sources.

To help students mastering science content in English, Directed Activities Related to Texts (DARTs) activity is applied. DARTs are alternative activities that require students to interact with text. The purpose is to improve students' reading comprehension activities in comprehending science in English text. Technique usually used Direct Instruction (DI) to help students learning reading comprehension by giving the worksheet and providing it with questions to find the main idea of the passage. But sometimes the regular worksheets bore them because they get some difficulties to do the worksheet because of their limited ability in English. So the lecturer tries to apply DARTs strategy to motivate students to improve their learning outcomes, because by using DARTs strategy the worksheet can be modified to be more interesting and lower the language barrier.

DARTs is a technique that has evolved to use reading as a way of learning a 'subject'. Its aim is to foster independent reading and actively engage the learner with text. One of its principles is that reading is no longer seen as a solitary activity, but can involve a small group or pair of learners. The technique can be used at any level and with any kind of text, that is why it can be applicable on technical texts for students of different years of studying.

DARTs activities can be divided into two, reconstruction and analysis activities.

Reconstruction activities use modified text. The original text is broken down and given to pupils either in segments or as blocks of text with gaps. Pupils use prediction and then fill in gaps or sequence segments to reconstruct the text. This type of activity can help pupils develop an understanding of the structure of different text types. The following are examples of reconstruction activities:

- Text completion (cloze): These activities require the learner to understand context and vocabulary in order to identify the correct words or type of words that belong

in the deleted parts of a text. Words are deleted from a passage according to a word-count formula or various other criteria, e.g. all adjectives, all words that have a particular letter pattern. The passage is presented to learners, who insert correct words in the gaps as they read, to construct appropriate meaning from the text.

- Diagram completion: Students predict deleted labels on diagrams using text and other diagrams as sources.
- Table completion: Students predict deleted items using table categories and text as sources of reference.
- Completion activities with disordered text: Introducing students to sequencing can help them understand the importance of coherence and cohesion within a piece of text. The process involves the students reorganizing jumbled pieces of text into a logical order but could also be adapted into on-screen 'drag and drop' computer activities.
- Prediction: Using prediction helps students to get an idea of the general organization, major topics and subtopics of a piece of text. It can involve students using the beginning or the appearance (title, headings, illustrations, layout, etc.) of a piece of text to predict what comes next or in creative writing, what happens next. Following prediction, before reading on, students ask themselves questions, e.g. 'What would I need or want to know about this topic?'

Analysis activities use unmodified text. Pupils select specific information from the text and then represent it in a different form. This type of activity helps pupils develop their analytical skills. The following are examples of analysis activities.

- Underlining or highlighting: Students search for target words or phrases that relate to one aspect of content, for example words or phrases that support a particular view.
- Labelling: Students label segments of text, for example they might label a scientific account using a set of labels provided (e.g. prediction, evidence and conclusion).
- Segmenting: Students are given a text that has no paragraphs. They are asked to break the text up into paragraphs using the new paragraph symbol (//) and to write appropriate sub-headings for the text. This tests their understanding of the structure of the text and the subject specific components of the material.
- Diagrammatic representation: Students construct diagrams from text, for example flow diagrams, concept maps or labelled models.
- Tabular representation: Students extract information from a written text, then construct and represent it in tabular form.

Conclusions

All things considered, DARTs has proved to be an efficient way of teaching reading for non-native students of different levels, thus it could be applied on practical lessons in Ukrainian universities, namely in National Aviation University. The activities ensure the learning process to become more effective, entertaining and variable, so that both teachers and students benefit from it considerably.

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Yelena Skipalska (National Aviation University, Ukraine)

WHY USING VIDEO IS CHALLENGING

The importance of using video for adult learners and possible opportunities used to develop language speaking skills.

Video can be used in a variety of instructional settings--in classrooms, in distance-learning sites where information is broadcast from a central point to learners who interact with a facilitator via video or computer, and in self-study situations. It can be used in teachers' professional development or with students as ways of presenting content, starting conversations, and providing illustration for concepts. Teachers or students can create their own videotapes as content for the class or as a means to assess learner performance.

This digest focuses on using video with adults learning English as a second language (ESL). It provides a rationale for using video with these learners, presents guidelines for selecting and using videos in instruction, discusses some commercial videos used in adult ESL programs, and concludes with a discussion of the future of video use in instruction.

There are a number of good reasons to use video in adult classrooms. Video combines visual and audio stimuli, is accessible to those who have not yet learned to read and write well, and provides context for learning. For English language learners, video has the added benefit of providing real language and cultural information. Video can be controlled (stopped, paused, repeated), and it can be presented to a group of students, to individuals, or for self study. It allows learners to see facial expressions and body language at the same time as they hear the language.

Videos can be stimulating to adult learners. Many videos are based on stories, which are enjoyed by almost everyone and particularly favored in some cultures. Videos that use the conventions of entertainment television (plot, character, development, and resolution) may catch the attention of learners who do not yet read.

Using videos in the classroom can provide opportunities for learners to evaluate a medium that they use in their daily life. This is important because, just as learners need to develop critical literacy skills in order to analyze what they read to distinguish fact from fiction or to identify an author's position on a topic and compare it to their own, they also need to be able to do this with what they see and hear, i.e., with films and television programs.

The use of videos is challenging. Often they do not provide the best means of explaining complex concepts or practicing particular grammar or writing skills.

It takes time for the teacher to preview and select videos and then to prepare activities for learners. As the language use and the context of videos are not controlled, teachers will need to take time to explain these.

Videos may contain language, content, or themes that are controversial, or even inappropriate in the adult ESL classroom. It takes time, thought, and careful planning on the part of the teacher to prepare learners to watch and discuss these videos. On the other hand, selecting films may not be advisable, as their content and language may be of little interest and relevance to adult learners. Furthermore, if a video meets instructional objectives and is motivating to the learners, it may serve as a springboard for discussing differing cultural norms as well as the issue of censorship. These discussions can serve to enhance learners'

critical thinking skills while increasing their acquisition of language and cultural information.

It suggests the process of the entire class doing an activity, which could very well be watching a short video, and then discussing and writing about it.

Immediately following the activity, learners are given a short time to write down notes about what they did. Then, the teacher calls on learners to share what the class did -- usually, though not always -- in chronological order. The teacher then writes down what is said on a document camera, overhead projector, or easel paper. It's sometimes debated if the teacher should write down exactly what a learner says if there are grammar or word errors, or if the teacher should say it back to the student and write it correctly -- without saying the learner was wrong. We use the second strategy and feel that as long as students are not being corrected explicitly ("That's not the correct way to say it, Eva, this is"), it's better to model accurate grammar and word usage. Learners can then copy down the class-developed description. Since the text comes out of their own experience, it is much more accessible because they already know its meaning.

The text can subsequently be used for different follow-up activities, including as a cloze (removing certain words and leaving a blank which learners have to complete); a sentence scramble (taking individual sentences and mixing-up the words for learners to sequence correctly); or mixing-up all the sentences in the text and having students put them back in order.

Here is an example how to use video with adult aviation-related learners.

PRE-VIEWING

I. Work in pairs. Discuss what factors below can lead to fuel starvation.

II. Work in groups of 3-5 students. Predict the further development of the events according to the headlines below.

- Declaring fuel emergency
- Engine flameout
- Controllable glider
- Panic on board
- Final approach

III. Put the sentences (1-5) to increase degree of certainty.

1. It must be a computer failure.
2. They must descend quickly.
3. The initial calculations show that that the plane should make it to Lajes.
4. If they miss the runway, the results could be catastrophic.
5. If the pilots make a mistake, they may face a forced landing on the water.

WHILE-VIEWING

IV. Define who says the following phrases from the video clip and restore the situation. Work in groups.

- “Are you declaring emergency?”
- “One of the most sophisticated airliners of the modern era carrying 306 passengers and crew is now nothing more than a giant glider drifting steadily down towards the ocean.”
- “A list of functions we’ve lost: we have no more stabilizer, hydraulic power, no antiskid, rudder trim, radio HF 1 2. We have lost both engines. We have no electrical systems.”
- “We have to ditch on the water.”

- “The loss of engine power means the cabin will soon depressurize.”
- “The chances of surviving when ditching and floating for very long are not very good.”
- “The torture of the whole fact that you gonna die … is worse to me than dying.”
- “Visibility unlimited. You should have the airport in sight.”
- “Let’s open the slats. It will slow us down a bit.”
- “The plane was circling around the island just to slow down, so that we saw land and we saw water and we saw water again. It really strikes me that I can’t survive.”

POST-VIEWING

V. Comment on the situation in mini-groups of three. Student A is an ATCO who tells us about your assistance in this situation; Student B is a passenger telling what he feels; Student C is a pilot analyzing his actions in this situation.

DRAWING A CONCLUSION

VI. Re-write the script of the video clip on one of the following scenario:

- what would happen if a pilot were not so experienced;
- what would be different if the problem was found on short notice.

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O.M. Vasiukovych, Lecturer
(National Aviation University, Ukraine)

AVIATION SAFETY IN THE CONTEXT OF EMERGENCY SITUATIONS

The article deals with the issue of communication between pilots and air traffic controllers as an integral part of aviation safety in emergency situations

Aviation safety is and will remain the central concern of our era, for all people living all over the world. Unpublished and intra-sector data demonstrate that communication problems have indeed cost lives or provoked major incidents. Comprehensive studies of the role of communication in aviation incidents are limited, but they demonstrate how incident data provide insights to accident causes. Incidents are violations of instructions or legal parameters that may or in fact affect the safety of operations. US Federal Aviation Administration (FAA) anonymous Aviation Safety Reporting System (ASRS) reveals over 60% communication problems, in reported cases [1].

Communicating effectively via the radio in General Aviation (GA) is a challenging task for most pilots.

The most important linguistic factor for aviation communication is the choice of lexical items or phrases. This has long been standardised – to a greater or lesser degree in different countries depending on the country (e.g. foreign pilots sometimes complain that US pilots do not use the ICAO standards they are used to) and the type of operations (commercial or GA) – and all pilots are trained in the use of R/T (radio-telephony) procedures, i.e. the correct use of calls and readbacks. Australian pilot training organisations with overseas students have also long been aware of the problems caused not only by accents or dialectal differences, for instance between Australian English and Indian English, but also by the conversational use or interpretation of aviation terminology [2].

Acording to our sample survey thirty seven authentic episodes were chosen for the radio exchange analysis. The authentic episodes dealt with different emergency situations and induced air traffic controllers and flight crew members to use plain English in the aviation context. It is shown that plain English in aviation makes up 19% of the total amount of words. On the basis of analysis, it is shown that the standard phraseology can not completely foresee actions in emergency situations. Knowledge of general English is an integral part of radiotelephony communication.

Plain English examples in the context of emergency situations :

1) P:ABC four five five, we are now radar heading three three zero, we have pressurization problem…pressurization, we starting emergency descent

C: ABC four five five, say again please

P: ABC four five five, X

C: ABC four five five, sir, we are starting emergency descent , due to pressurization problem

This emergency situation is closely connected with the pressurization problem and emergency descent.

2)C: X six nine X X, what kind of problem, report, please

P: OK, no problem for us, we have a only…only information mass on check

C: Information about?

P: And on runway we see bird flocks, on runway was birds

P: Now already, X six nine X X

C: X six nine X X, advise please, did you use extremely breaking?

P: On the right we see on birds, X six nine X X , it was problem for us. Now we

are ready for departure, X six nine X X

In this emergency situation the problem was due to the bird strike on the runway.

3)C: X X three two X X, say again please, your problems

P: We have avionics problems, X X three two X X

C: Roger, X X three two X X

C: X X three two X X, turn right, heading zero one zero, descend altitude six thousand feet, please

P: Right, heading zero one zero, descending altitude six thousand feet, X X three two X X

P: And , this is PAN-PAN X X three two X X. We have a problem with heading indicator on ILS, we can`t to maintain altitude and heading final, just keep, please.

This emergency stuation shows the problem with heading indicator on ILS.

The plain, non-formulaic language used by flight crews and controllers to handle situations andinformation that, while related to flight operations, cannot be completely managed using standardized phraseology [3].

It is well-known that in routine situations, the information can be largely and most properly transmittedusing standard phraseology. However, in non-routine, unusual or abnormal situations mentioned above, there will be a need for plain language to clarify, paraphrase or provide additional information, for example, to describe a system failure, apassenger's state of health or an obstacle on the runway .

"ICAO standardized phraseology shall be used in all situations for which it has been specified. Only when standardized phraseology cannot serve an intended transmission, plain language shall be used " [3].

Both standardized phraseology and plain language are used in radiotelephony communications. Furthermore, they are commonly included in a single transmission.

Standardized phraseology should not be the essential focus of aviation English training in the context of the current ICAO Language Proficiency Requirements. For example [3]:

"Descend to Flight Level 2-8-0" or "Resume own navigation" are examples of standard phraseology.

"Are you going to put me back on course?" or "There is oil on the taxiway" are expressions of plain language.

Conclusion

Communication in aviation safety, particularly between air traffic controllers and pilots plays a significant role.

Standardized phraseology, however, cannot address all of the non-routine, abnormal or, occasionally, emergency situations that occur, nor is it sufficient to convey additional information about any situation such as: reasons for a delay, the state of a sick passenger, the weather situation, the nature of a failure, or an obstacle on a taxiway. These are all circumstances where plain language is frequently required. It is this use of plain language that was the focus of ICAO's Proficiency Requirements in Common English Study Group (PRICESG) [3].

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N.S. Zelinska (National Aviation University, Ukraine)

EDUCATIONAL FUNCTION OF A RESOURCE "CAREER PATH: CIVIL AVIATION" FOR TEACHING AVIATION ENGLISH

The article is considered with the relevance of an educational recourse "Career Path: Civil Aviation" for successful teaching of aviation English. The course is developed for aviation specialists: students and professionals who want to improve their English communication in a work environment.

Nowadays English is considered the language of communication in global aviation community. It is not only used for unambiguous pilot-controller communication but for providing safety for passengers and crew during the flights. Aviation English language contains a very specific list of vocabulary, expressions and functions. The ultimate criterion by which proficiency is assessed is operational efficiency, rather than linguistic correctness.

It is a well-known fact that pilot-controller communication is most often oral and almost always without visual contact. That's why the communicative approach methods in teaching aviation English are of top-priority.

The closer the content matter of a course is to the actual situations, activities, functions and subjects encountered in the students' professional life, the more effective and motivating this courseware will be.

It may be more appropriate for aviation English training designed for pilots to explore a wider range of operational situations, communication registers and interlocutors because pilots are also called upon to interact with other crew members and describe in-flight conditions in greater detail. On the other hand, the language used in airspace management and interaction with emergency services could be more developed when training controllers. (Guidelines for Aviation English Training Programmes (ICAO Circular 323)).

Let us start by considering the facts about an educational recourse "Career Path: Civil Aviation". The first thing that needs to be said that the course is represented as being developed for aviation specialists (both students and professionals who want to improve their English communication in a work environment). The series includes a student's book, a teacher's book and 2 CDs.

The units of a students' book offer trainees the tasks from the four key language components: speaking, reading, listening and writing. The students' attention is called to the key topics such as parts of an aircraft, takeoff and landing procedures, en route events and flight hazards. Suggested information is organized in three levels of difficulty (Books 1-3) and offers vocabulary terms and phrases minimum in number of 400.

Every unit can be used for one lesson in a classroom, as it is a completed presentation of a micro-topic with a test of reading comprehension, vocabulary, listening skills, which help students to make their own written and oral reproduction. Each book ends with glossary that contains topical vocabulary for each unit of the book.

The teacher's book consists of answer keys and audio scripts of every text for reading and career-specific dialogues. The audio SDs contain all recorded materials with the examples of British English and American English. An educational recourse Civil Aviation is rated at A1, A2, B1 respectively to Book 1, Book 2 and Book 3 according to the Common European Framework of Reference for Languages.

One should note here that the use of communicative approach methods to language learning supports the students in reaching and sustaining the required level of communicative proficiency in the most effective way. According to Guidelines for Aviation English Training Programmes (ICAO Circular 323), the examples of a consistently communicative approach to language training can be the following:

interactive listening comprehension exercises which also elicit oral responses from learners;

classroom information exchange and role-play activities in pairs;

practice of vocabulary and grammar through oral use rather than reading and writing exercises;

using graphic (instrument panels and charts) and numerical data (tables and displays) to elicit speech production to mirror pilots' and controllers' working environments and situation management;

group problem resolution activities to develop interactivity and fluency skills.

The education resource "Career Path: Civil Aviation" contains listening comprehension exercises, role-play activities in pairs, questions for classroom information exchange, oral and writing vocabulary practice exercises. It is noticeable that basic information in the course is introduced before more complex one (Books 1 – 3).

The texts include a number of examples of the proper usage of phraseology. Explanation of the aviation terms is given in the glossary at the end of each book. Moreover, the lists of words and word combinations are recorded on CDs, which can undoubtedly be helpful for students' pronunciation skills improvement during self-education at home.

Audio materials provide content and situations applicable to the students' future professional environment. It is so valuable for improving listening comprehension and vocabulary.

Attaining sufficient familiarity with new training materials to be able to deliver them comfortably is a relatively long process for even an experienced teacher. In order to be able to do so, clearly laid-out instructor guidelines or notes are required.

The teacher's book contains answer keys for every exercise. It also gives examples of approximate answers to warming-up exercises aimed for the exchange of information in the classroom. The patterns of professional communications in the form of dialogues are also given to the teachers.

One cannot deny that it saves time when specific aviation information is proposed in the teacher's book if it is not self-evident from the information represented in a student's book. Unfortunately, there are no such helpful guidelines for teachers there.

On one hand, there is no practice of grammar structures in the course. The other side of the coin is, however, that the primary objective of aviation English training is voice-only communication. While memorization of grammar rules may be an initial step in the learning process, there is little need for exercises with grammar practice only because the students have learned general English at the secondary school.

One should, however, not forget that every unit of the student's book is supplemented with the colour pictures, which help to explain the proper aviation terms and processes by depicting the subjects or in diagram form. It is a good example of a visual source of information.

The content of the course is closely connected with the fundamentals of air navigation, meteorology, flight safety and aircraft flight principles, construction and equipment. That's why the resource can be relevant for training English language teachers who have no previous experience of teaching students in the field of aviation.

Conclusion

An educational recourse “Civil Aviation” was successfully used during the practical lessons with the first course students of the area of knowledge 0701 “Transport and Transport Infrastructure”, major 6.070102 “Air Navigation” (Institute of Air Navigation, National Aviation University, Kyiv). We should accept that the education recourse “Career Path: Civil Aviation” can be used for teaching ab initio students-controllers in the course of learning aviation English.

It is recommended to develop a specific placement test and periodic progress and exit tests for the above said educational recourse. It will help to assess students’ progress as objectively as possible.

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A.Chuzha, PhD (NAU, Ukraine, Kyiv)
G. Polozhevets, PhD, (NAU, Ukraine, Kyiv)
I. Donchenko, student, (NAU, Ukraine, Kyiv)

INFORMATIONAL SERVICES FOR CREW ABOUT MINIMAL CRITICAL FLIGHT VELOCITIES

For determining of approaching of critical flight modes, warning systems are installed. However, signalizing about minimal indicated speed is neglected, it is controlled by auto throttle. Therefore, it is necessary to include Informational services for crew about minimal critical flight velocities into warning system.

The analysis of flight accident statistics for the last decade shows, that considerable proportion of it, is faults of flying personnel, especially at critical flight conditions (Fig.1). Therefore, 46 % of accidents is caused by LOC (Loss of control) & CFIT (Controlled flight into terrain)

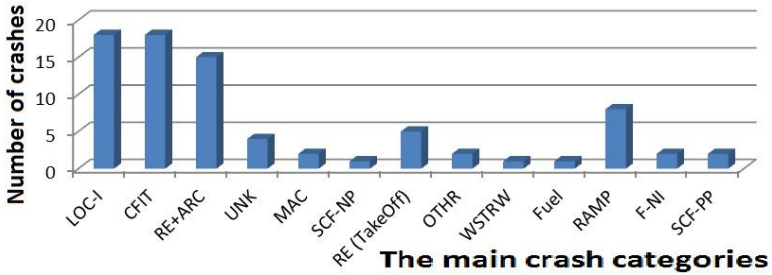

Fig. 1. Analysis of the main crash categories

For the last 35 years, increasing of crashes connected with loss of control. This is because of high automatization level for crew work simplification. Automatization is lead to losing of pilot's skills of flying in extremely conditions, such as fault of automatic control or difficult meteoconditions. Another word, during piloting in manual or direct modes.

The simplification of piloting in manual and direct modes, also prohibition of critical flight modes appearing is demand installation of Flight Warning Systems, which is warn the crew about approaching to the maximum permissible flight parameters and in some cases it corrects controlling of airplane for prohibition of critical flight modes appearing.

Appearing of maximum permissible flight parameters is leads to critical flight modes, i.e. on modes, under which occurs rather dangerous aerodynamic phenomena, such as spin stall.

It's evident, that airplane flies because of lift force (Y), whgich is appears on wing and fuselage:

$$Y = C_y \frac{\rho V^2}{2} S$$

Analysis of the Lift force expression shows, that airflow density (ρ) changes a little during flight, as well as constant aerodynamic airplane areas (wing &fuselage). However, lift force is quickly changes by parameters such as: airplane velocity relatively to airflow (V) (or instrument speed V_{instr}) and lift force coefficient (C_y), which is, basically, the function of the wing angle of attack.

Moreover, overloading parameter (n) includes the set of all forces, which is acts on airplane and determines airplane controllability (fig. 2).

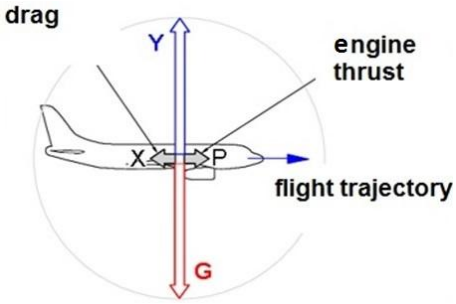

Fig. 2. Forces that act on airplane

Reducing of lift force to the level, that is lowest than gravity force is leads to loss of altitude and to stall. Therefore, one of the main danger for airplane is reducing of instrument speed (V_{instr}) accordingly reducing of lift force and its stall because of loss of speed, or increasing of the angle of attack upper than its critical value.

In modern aircrafts installed warning systems, (fig.3), for ex., on IL-76 for alerting that the level of the angle of attack more than permissible installed.

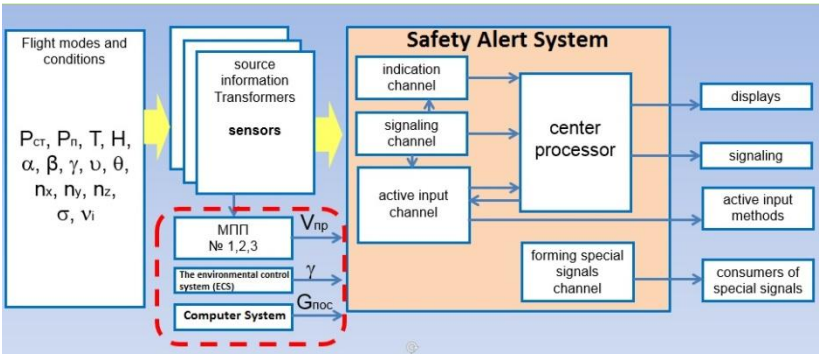

Fig. 3. The structural scheme of critical flight modes warning system

And on airplane An-148 the complex of altitude-velocity parameters is include the signal unit, which is receive information from linear accelerometer unit - about overloading and from flow angle sensor – about angle of attack.

On the base of data about speed and altitude, safety alert system forms signal of maximum permissible angles of attack and overloading and displays information in the form of red bounding sectors on the pointer of angle of attack and overloading on the command-pilot indicator.

On modern aircrafts make notice on critic angle of attack, maximum values of overloading and maximum permissible vertical and horizontal velocities, but signalizing about minimal indicated speed is neglected - it is controlled by auto throttle. Such neglecting can leads to loss of control, as well as during landing and difficult meteoconditions.

During landing pilots tries to touchdown with minimal landing speed, which is must be not lower than minimal controllable airspeed. Therefore on the phase of flareout it is possible increasing of angle of attack for reducing of vertical and longitudinal velocities.

With rising of angle of attack on low speeds – drag is rise; it leads to loss of velocity and altitude. Pilot, who is not have experience in difficult conditions, begins pull control wheel for climbs. Also increasing of angle of attack up to critical at low velocities leads to flow separation on top of wing, that rise decrease lift force coefficient. Significant influence on conditions of stall has roll angle at low velocities and exceeding of airplane weight during landing. Some types of airplanes have fuel availability nearly to weight airplane itself. In such cases weight pf airplane decreases about in two times and such airplanes have strict restrictions over landing weight, which influences on changing of minimum landing speed and critical angle of attack.

All defined parameters must be taken into account when calculating signalization of critical angle of attack and minimum landing speed.

Therefore, proposed to introduce for analysis of determination of critical flight parameters such as the critical angle of attack and maximum permissible overload, information about actual weight of the aircraft, which characterizes the gravity of the aircraft and aircraft roll angle to calculate its influence on reducing the vertical component of lift. In addition, for control of the minimum instrument speed proposed to introduce preventive visual, audio and tactile indication. Indeed, there are situations of loss of lift and stall in straight horizontal flight.

Thus, including of the signalizer about approaching to the minimal controllable airspeed, as a function of the angle of attack, roll angle, plane weight and flight altitude to the warning system about critical flight modes leads to increasing of pilot’s concentration to aerodynamical characteristics on low speeds and high angle of attack contribute to flying safety improving.

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Skrypets A PhD of Tech. Sci. (NAU, Ukraine, Kyiv)
Tronko V. Dr of Phys. and Math. Sci. (NAU, Ukraine, Kyiv)
Hryshchenko Y. PhD of Tech. Sci. (NAU, Ukraine, Kyiv)
Kozhokhina O. (NAU, Ukraine, Kyiv)

RELIABILITY ASSESSMENT OF AIRCRAFT WITH REGARD OF INFORMATION FACTORS AND FEEDBACK LOOPS

Considered calculation of the probability of failure-free operation ergatic the aircraft and the pilot on the example of flight control channel rating the probability of failure-free operation is given based on the information and errors feedback.

Usually functional diagram channel of flight control represents using the circuit, which is on Fig.1.

Fig.1. Functional diagram of the flight control channel: MTP - a measure of the trajectory parameters; CU - the communication unit; O - operator respectively, AP autopilot; BSC – block of the servo control; ConU - control unit; δ - signals of the control parameters of the motion path

In this scheme, there is no comparison unit and specify a communication channel between flight mode and the real mode, which should be linked using the feedback system communication [1-6].

When moving the aircraft operator is the link between given and real flight paths. When moving a real object relationship between the given and real motion path always exists.

The weakening of the feedback associated with increased dynamic stereotype in occurrence factor linings.

Operator functions are reduced to compare of the flight data from an external source of information (e.g. maps, information received from the operator ATC, visual information) with the real rate of motion parameters, and then correcting and managing the flight path.

Emphasize that the functional diagram of the motion of the real object, moving in space independently, does not differ from, shown in Figure 1. Be sure there is a feedback.

In memory incorporated information about the route of object. This information is compared with the real movement of the object (Fig. 2).

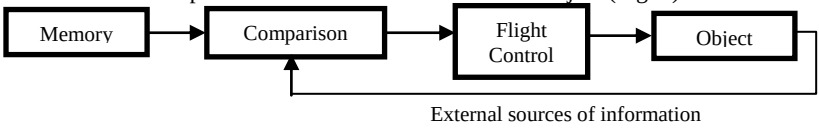

Fig.2. Functional diagram of the external manifestations of the operator when an object moves

Detail the block diagram shown in Figure 1, the three parameters that determine the course of the aircraft and its position in space: azimuth, elevation and velocity. In fact, these parameters is much more roll, pitch, etc.

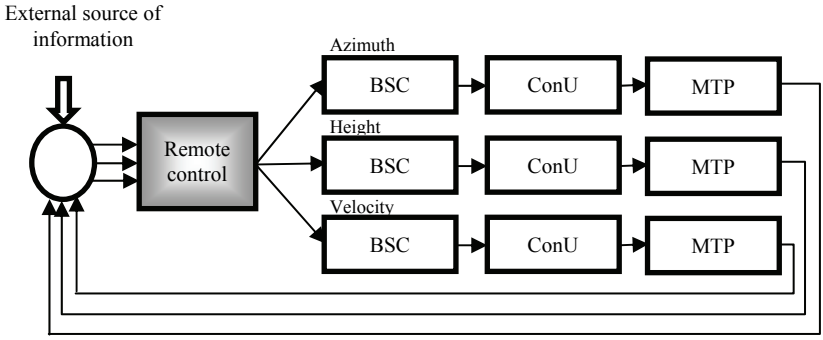

Fig. 3. Structurally logic channel of air traffic control:
BSC – block of the servo control respectively in azimuth, altitude and velocity;
ConU - control units (azimuth, altitude, speed); MTP -
MTP - a measure of the trajectory parameters (specific parameters)

Structurally logic scheme presented in Fig. 3, is not accurate, as meters flight parameters perform their functions by interacting with airframe: azimuth (compass, gyroscope), height (optical locator, barometric altimeter, altimeter), speed (SHS, vario). Based on this, must create a refined structural and logical scheme of air flight control channel (Fig. 1).

In structural logic scheme airframe should be submitted for two reasons: the air vibration; the deformation of the airframe and the displacement of the sensors. These phenomena lead to errors, that is, to reduce transmission probability of useful information, a reduced reliability of the system and the probability of non-failure operation.

Find a mathematical expression for the function of communication system and reliability of its constituent elements.

Function of communication structural logic scheme flight control by one parameter. R denote the probability of failure of any block system on any parameter that determines the movement of the letter i ($1,2,3, \ldots n$), where n-number of measured values (number of channels).

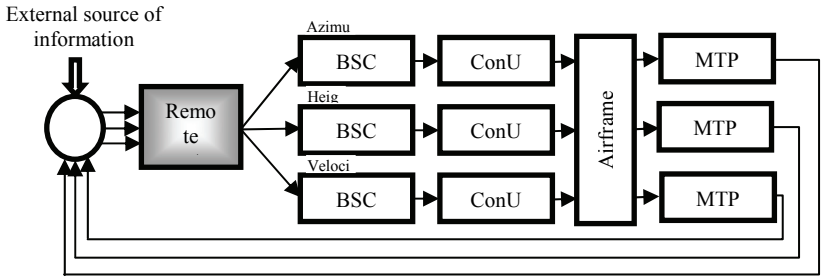

Fig. 4. Detailed structural logic scheme of channel flight control

Reliability function R - its probability of that within given operating time or a predetermined time interval object failure does not occur [7].

Then, based on structural and logical channel scheme of control circuit flight shown in Fig. 4, can designate the reliability function on any channel, measuring a various parameters.

I_0 – full quantity of useful information

$R_i^{external}$ - reliability function of measurement, amount of useful external information

R_i^{oper} - reliability function of external information transmission from operator to aircraft

R_i^{BSC} reliability function of the block gain servo

R_i^{CU} - reliability function of the control unit

$R_i^{airframe}$ - reliability function of the airframe (for measuring)

R_i^{MU} - reliability function of measurement units

R_{si} - reliability function of i-system

Then the significative of non-failure work (for *i* - parameter) of communication link is:

$$R_{si} = R_i^{MU} \cdot R_i^{airframe} \cdot R_i^{CU} \cdot R_i^{BSC} \cdot R_i^{oper} \quad (1)$$

The information received by the operator from the system:

$$R_{si} \cdot I_0 \quad (2)$$

Information, which the operator receives from an external source, is equal to I_0.

It is necessary that the information, which the operator receives from the system, be arbitrarily close to the information received from an external source.

Consequently, the control signal is equal to δ:

$$R_i^{external} \cdot I_0 - R_i^{MU} \cdot R_i^{airframe} \cdot R_i^{CU} \cdot R_i^{BSC} \cdot R_i^{oper}(R_i^{external} \cdot I_0) = S_i \quad (3)$$

where: δ - the value of lost information, it is always positive largest and used to control the *i*-th aircraft parameter ($\delta = \Delta I_0 = I_0 - R_{si} \cdot I_0$ at $R^{external} = 1$).

Ideally $\delta_i = 0$ or close to zero, δ - used as a signal of control for compensating the lost information in the feedback system, both living organisms and the different technical systems.

Let us analyze the expression (3) in the mode of stable flight. Assume that of reliability information retrieval and transfer of external information aircraft operator are equal to unity in this case, the expression (3) simplified

$$1 - R_i^{MU} \cdot R_i^{airframe} \cdot R_i^{CU} \cdot R_i^{BSC} = S_i / I_0 \quad (4)$$

In this case, i.e. in a stable flight mode reliability of the *i*-th system is determined only by the technical parameters of air vessel. We assume that the probability of a wrong decision is the operator zero, as in a tranquil setting enough time to evaluate situation.

$$R'_{si} = R_i^{MU} \cdot R_i^{airframe} \cdot R_i^{CU} \cdot R_i^{BSC} \quad (5)$$

From (4) and (5) determine the relationship between the accuracy (or error) flight *i* - parameter defines the course of the aircraft and of the significative of non-failure work of system

$$R'_{si} = 1 - S_i / I_0 \quad (6)$$

When the operator is not careful, then $R_i^{oper} < 1$; $R_i^{external} < 1$. Therefore, when calculations must take into account the human factor

$$R'_{si} = (1 - S_i / I_0 \cdot R_i^{external}) \cdot 1 / R_i^{oper} \quad (7)$$

Using equation (7), and knowing the level of preparedness of the operator can determine what is the minimum state probability to be in technical system *i* - parameter. Equation (7) shows that decrease R_i^{oper} function to improve the quality of work should be increased. However, with decreasing $R_i^{external}$ function may decrease. This is due, in first glance, the fact that the probability of failure of the technical system of the aircraft may not be sufficiently high if the increased uncertainty in the flight path, the aircraft course. However, it unreal situation, because usually the operator is in a quiet environment, time of searching solutions *i*-parameter is large, $R_i^{external}$ is large and, consequently, R'_{si} tends to unity.

Ratio $(I_0 - \Delta I_{i0}) / I_0$ is the probability of a precise definition of the amount of information that is reliability function.

Conclusion

When calculating the reliability function of operation of the ergatic system airplane and pilot must take into account the impact of information and external

factors effects, and the effects of pilot as the system operator. The impact of these components in emergency modes are most pronounced.

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V. Chepizhenko, DSc (engineering), (NAU, Ukraine, Kyiv)
O. Orlov, PhD (engineering), (NAU, Ukraine, Kyiv)
O. Tryzna, (NAU, Ukraine, Kyiv)

PROBLEMS OF TECHNICAL CONDITION ESTIMATION OF COMPLEX AVIATION SYSTEMS COMPONENTS

There is a problem of aircraft components condition change forecasting, which is the lack of admissible approaches and methods. The solution of the problem - the development of models that allow: to take account of unit condition change, caused by either operating time, or service period, to determine requirements to aircraft maintenance work volume and content, and also.

Aircraft construction should make impossible failures to appear or provide conditions for failure consequences not to have influences on safety (failures possible to foresee are meant).

Failure consequences are considered as basic factor either for maintenance program creation or for pilot reaction speed to failure information. Aircraft operators are responsible for construction safety preservation and dangerous failures prevention. It should be achieved by maintenance program.

Modern maintenance program formation principals provide four basic maintenance types in order to keep reliability and safety.

- units condition control through fixed intervals in order to find and remove potential failures for functional failures frequency preservation and reduction;
- article standard indexes resumption through the fixed service terms in order to reduce functional failures frequency;
- removal of an article or one or more elements in fixed service terms in order to reduce functional failures numbers and frequencies;
- periodical checks in order to find and remove hidden functional failures, which have already appeared.

First three work types are directed on failure prevention, and the fourth one on hidden functional failures consequences, which may take place on the basis of other failures.

During maintenance program development the following conditions should be kept:

- analysis should be realized only for articles important in frames of failure consequences or economic loss, and for “hidden functions” articles;
- failure consequences exact evaluation should be realized for every important article including probable secondary damage consequences;
- following criteria works effectiveness evaluation should be realized by following criteria: failure probability shortening up to allowably small value, in case of probable serious failure consequences in a safety frames; economic effectiveness of works, non-connected with “hidden functions” and safety influences;

- work applicability evaluation, based on failure characteristics, should be realized. Work intervals should be established.

If the failures have any impact on safety, failures intensity reduction works are recommended only in case of economically effective works. If these works are economically ineffective, they should not be performed, and the residual failure intensity should be considered as an intrinsic article reliability characteristic.

Decision-making process of works insertion into the maintenance program lies in answering the line of questions. Maintenance works, selected in such way, flow out of article reliability characteristics. Maintenance program, created under those principals, is adaptable and figured on correction taking into account article exploitation work information receipt.

Western airlines program work experience allowed making a number of consequences.

Technique reconstruction planning works are inoperative for complicated systems, if there is no dominant failure type. They are also ineffective in case of failure influences on safety.

Any way failure data necessary for such works applicability evaluation may be received after temporary aircraft exploitation.

The similar is the situation with rejection works. They cannot be kept until safe works intervals by testing materials at reduction or working out point, which is modeling exploitation conditions, are determined.

Sometimes failure meant to be evident turns out the hidden one. Information collection process is the service period influence investigation, since the available information volume is the direct function of component servicing term, and a part of this information concerns servicing terms of the article. Information search and storage system should be established. In order to avoid useless maintenance expenses and to increase the work volume if necessary, opportune maintenance information use is very important.

Aircraft units' failure information is extremely important for effective maintenance works planning. But in real airline activity conditions there are some problems with current aircraft units condition evaluation, namely: limited failure diagnosis time, lack of equipment necessary for effective separate unit condition evaluation [1], human factor influence on failure detection work results [2].

That is why there is a necessity to know units technical condition peculiarities beforehand in order to make corresponding equalizing measures to detect failures and resumption of their work state or deduction.

Available sources analysis shows that nowadays applying to aircraft units and other complex systems, following items are absent:

- common universal condition evaluation methodology during normal and extreme exploitation for the whole life-cycle interval;
- specific units real technical condition prognosis model during maximal time interval and to maximal exploitation conditions range, corresponding to real life-cycle interval;
- separate articles degradation processes model in general and in parts;
- general methodologies of aircraft unit current wear degree evaluation in real or close to real time;

Modern scientific approaches of wear and aging evolution processes description, taking place in complex technical systems, are based on observations and experiments results generalization, empirical and semi-empirical models construction, formalized in accordance to experimental investigation results, and on the analysis of these models with the aim of internal and external factors influence detection on complex technical systems technical condition parameters.

The totality of those models may be divided on:

- semi-empirical wear and aging models [3-6],
- empirical models of mechanic wear [3],
- structural models of damage accumulation [3],
- stochastic wear and failure models [7],
- economic loss and expenditure models during complex technical systems exploitation [3].

These models are sufficiently common and are the result of experimental data generalization and are more adapted for experimental data processing and analytical results presentation. Their passive and fragmental character, inability to show the most general, fundamental technical system condition condition change pattern in general, in connections with storage, exploitation and functional article application modes are the disadvantages of these models [7].

That is why for in order to solve the evaluation and forecasting task of aircraft units technical condition change it is necessary to use models, based on other approaches.

Any complicated technical system with energy (power) flow during long-term exploitation “during its free movement tends either to balance, or to conservative system movement with the lesser number of degrees of freedom” [8]. The loss of the degrees of freedom characterizes the change of constructive system degradation to its functional degradation. Consequently the amount of energy, passing through the system, determines its technical condition.

It is well known that any physical system properties may be introduced with the help of equation system, establishing correlation between energy and power flows, taking place between system and environment. The best way to describe such dependencies is to use Hamilton differential equation system, which may be easily reduced to canonical Cauchies form. That is the common second order differential system. In general case the input coefficients are the dependences of kinetic, dissipative and potential energy correspondently. At the same time these coefficients are the functions of complicated technical system components parameters, i.e. Hamilton equations allow connecting energetic and parametric (informational) evolution processes characteristics, taking place in complex technical systems [9].

So, integrated dynamic model of complex technical systems may be subdivided in two parts – energetic and informational. Such integrated model should include:

- submodels of complex technical systems component, which are in general an ordered hierarchical structure;
- submodel of energy flow through complex technical systems components;

- submodels of virtual parameters removal of complex technical systems component, provided by flowing through it energy flows.

Conclusions

Nowadays in aviation with the aim of maintenance effective planning, there is a problem of aircraft components condition change forecasting, which is the lack of admissible approaches and methods.

The legacy models are applicable only for common systems, they are mostly directed on experimental data processing and do not consider separate article exploitation conditions peculiarities.

The solution of the problem - the development of models that allow:

- to take account of unit condition change, caused by either operating time, or service period (operation and storage peculiarities);

- to determine requirements to aircraft maintenance work volume and content, and also.

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S.G., Egorov (NAU, Ukraine, Kyiv)
T. M. Kravsova (NAU, Ukraine, Kyiv)

PREVENTION OF CREW AND PERSONNEL ERRORS RELATED WITH THE FAILURE OBLIGATORY ACTIONS CAUSED BY INAPPROPRIATE PSYCHOLOGICAL STATE

There are the accident investigation results caused by the failure obligatory actions of the crew members, aircraft maintenance staff, air traffic controllers at the airport. The nature of the errors of the human- operator in terms of simultaneous problems solutions with flight control psychological state counts. It is provided the recommendations for the errors prevention related with the failure obligatory action in terms of providing the flight safe completion.

Introduction. The problem of wrong actions of an experienced crew, or highly skilled maintenance staff of the aircraft in the airlines or the airport controller in the system (SHME) " System - Human - machine - environment ", after a world's series latest accidents, is not a new problem.

The recent research analysis . Especially serious consequences entail human operator wrong actions or wrong omissions, which for a defined time **went unnoticed** by the operator (or group of operators working together), whereby the opportunity to correct the error is excluded immediately during the person managed process course. In civil aviation the considered problem is directly related to aviation safety or to the aircraft operation. In the last decade continue to occur which are associated with crew members wrong action, objectively necessary for the flight safety or aircraft operation, brought us to assume the influence on the psychological state of a person, so it is proposed to investigate more closely the phenomenon of human operator skipping actions in different areas in civil aviation flight control [1].

Background. It is known [2] that a person's ***aptitude*** to errors in the management of complex technical systems, including modern avionics equipment, automated systems of civil aircraft, is one of the negative elements of human factor, which underlines the ***necessity*** to multiply the efforts in solving [3] this problem. Other words the common opinion that nature created so limited human possibilities that during the flight control process, crew approached to the the edge of their possibilities, which do not correspond to the results of research.

Analysis of recent research. It is known [4] that the current system allows the training of crew allows to distinguish several relatively independent approaches to the assessment and management of the process of formation of professional skills. For example, the characteristics of keeping accuracy of the flight parameters are the most informative indicators of formation within the skill reflex conceptual scheme. Allocation of the crew physiological parameters training level associated with the development of the functional system concept. In its turn, proponents of the physiologic activity concept consider the formation of the flying skills as the action transition regulation leading to the background level of skill and evaluate maturity of high-amplitude ratio skills (working) and low-amplitude (background) movements. Finally, based on the concept of psycho-physiological thresholds crew

training is regarded as a process of increasing the sensitivity of the person to perceive and discern meaningful signals and level of mastering is assessed by the degree of development of differentiation stimuli mechanisms.

Formulation of the problem. Each of these concepts [5] were a definite step in the development of methodological approaches to the evaluation of flying formation skills and had a positive impact on improving the methods of flight training and development of its principles: visibility, consistency and systematic character, individual approach for taking account of the functional and psychological state of the person . In addition, they allowed to substantiate such requirements for training facilities as the necessity for training as close as possible to the simulated conditions of real activity and simulation of individual signals in accordance with the differential and absolute threshold of human perception. Common for the considered conceptual schemes is the assessment of the acquiring skills process on externally observable characteristics (quality of activity, vegetative reactions, the characteristics of sensitivity thresholds, etc.).

The new approach. To solve the problems presented in the hypothesis [3] is as follows. The learning process contains not only in the externally observable forms, but also the change of its internal content, which is due to the mastered activity representation of the subject. Reliance on external indicators - is, figuratively speaking, view on the education "by the teacher's side." To estimate the same essence education it is necessary to look at it " by the disciple's point of view," his internal mental processes that ensure the assimilation of new material and determine the mechanisms of regulation of mastered actions.

A scientific result. Methodological approaches for the training quality assessing with reliance on external performance led to the fact that until nowadays the principles of flight training methods did not exclude "coaching" and "training" as a student in flight, and in simulated conditions and based on the copying of disciple's actions. The dominance of this approach in the development of technical training led to the creation of expensive complex flight simulators, which the application of a technique based on the exercises which are look like a real flight without regard due to the specific activity in simulated conditions.

The research basic material statement. The inspection of the crew errors and omissions causes allows to conclude that the reference to " ***nonchalance*** " of crew members cannot be accepted as a sufficient explanation for the omissions and errors in flight. Crew members are prone to errors and omissions, when they were forced to stop or too loaded by any of several problems which must be solved simultaneously, and delayed at a later time to perform tasks that must be carried out at this time. Professional experience of crew members does not compensate their tendency to errors given category.

The operation aviation technology control process under the current conditions becoming increasingly complex and laborious. On the one hand, the increasing complexity of the operation of new aviation technique and, consequently, the complexity and the labor intensity of this technique preparedness for the other purposes application.. However, chronic underfunding does not allow to perform the required measures comprehensively, which often caused the malfunctions and failures of the aircraft. In solving this problem, it seems necessary to estimate the

number and content of the tasks of technical operation management systems and the required size of the database at each management level.

Problem solving hypothesis. Put in [4]. Denoted in the experiment that for solving problems at the same time it is necessary:

- determine the necessity for solving the problem of aircraft control, operation, aviation safety;
- to construct a matrix "problem-time," which shows the entire set N of tasks and their approximate solving duration τ_{ij}, where i - the number aircraft control, and - j the number of exploitation control problem;
- to determine the solving of control problems in consideration with the frequency λ_{ij} of the aircraft loading operation in the given process

$$\delta_i = \sum_{j=1}^{N_i} \lambda_{ij} \tau_{ij}, \quad (1)$$

where N_i - number of exploitation control problems, solved by i - nd control lever;

- determine the size of the database required for the solution N_i tasks of each i - nd control in the overall process of flight safety;
- рассмотреть варианты состава технических средств авионики и для каждого to consider the options of avionics technical means hardware for each ℓ - nd variant to determine fulfillment of the conditions

$$\delta_i \le \overline{\delta}_\ell, \quad (2)$$

where δ_ℓ - maximum permissible loading of ℓ - nd variant;

$$k_i \le \overline{k}_\ell, \quad (3)$$

where k_ℓ - maximum allowable for ℓ - nd database volume variant.

Proposed to consider a variety of tasks of avionics technical complexes and operational management of safety processes, including the task of maintenance processes. Many tasks avionics technical operational processes have the form

$$N_{зэп} = F_1 N_{цэ}, \quad (4)$$

where F_1 - operator of point on the set projection;

$N_{цэ}$ - a multiplicity of avionics technical complexes exploitation goals.

A multiplicity of the technological processes maintenance tasks has the form:

$$N_{зтп} = F_2 N_{зэп}, \quad (5)$$

where F_2 - operator of point on the set projection;

Then the set of control avionics technical complexes operation problems is given by

$$N_{зуэ} = F_3 (N_{зтп} \times M_{фу}), \quad (6)$$

where $M_{фу}$ - many control functions in the technical complexes operation;

F_3 - operator which is carried out the tasks mapping process on a set of control functions.

Many avionics operation management tasks includes a subset of situational tasks, distribution operations management and technical complexes task between the links of a hierarchical network of aeronautical engineering

$$N_{ЗСР} \subseteq N_{ЗУЭ}, \quad (7)$$

where $N_{ЗСР}$ - tasks situational distribution subset.

Then the set of the aircraft automated flight control and operation problems can be represented as:

$$N_{ЗАУЭ} = F_4 N_{ЗУЭ}, \quad (8)$$

where F_4 - conversion operator control of the operation tasks variety and operation of a multiple tasks in the of aircraft automated control;

$N_{ЗАУЭ}$ - variety of the tasks of the aircraft automated flight control and operation.

Ooperators F_1, F_2, F_3, F_4 - linear operators of matrix type, size and content of which is determined by experts. Using the expression (1-8) it is possible to determine a set of computer-aided control of the aircraft and operation of avionics technical systems developed on the basis of methodology and software for solving these problems in civil aviation.

The major part. It is known [4] that the brain of the human operator in control of the aircraft, or flight, or maintenance of avionics has two ways of processing information related to the task:

1) "Controlled" control, which requires the constant presence of conscious attention of the human operator. Such control - slow, multiple effortless and has low productivity and required in problems with novel features, such as manual flight control;

2) "Automatic" control (control of the aircraft using the autopilot) - fast, with minimal effort, has a great performance; develops in the human operator through a long practice in the performance of the usual procedures; requires minimal control of the mind and are less prone to psychological influence.

Conclusions. Crew members also have the potential to create conditions that allow them to reduce the number of allowable errors action skipping through psychological overstrain. Primarily, the realization of the pilot's own ability to commit an error decreases its probability. Crew, maintenance staff and managers are particularly susceptible to errors when they work with avionics in the cockpit, or computers, or conduct radio communication or other activities, trying to detect other aircraft in the airspace surrounding the airport, perform aircraft failures procedures in flight.

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Sytnyk O.G., (NAU, Ukraine, Kyiv)
Sytnyanskyh L.M., (NAU, Ukraine, Kyiv)
Onyshchuk M.O. (NAU, Ukraine, Kyiv)

RESULTS OF INVESTIGATION THE INFORMATION CRITERIAS TO EMPOWER CREW ENVIRONMENT PERCEPTION POSSIBILTIES BY PSYCHOLOGIC INFLUENCE

Theoretical aspects of optimization and calculation main informational criterions to empower the environment picture perception from cabin are an actual problem. Solving problems of mental state influence on crew and establishing of main informational criterions which have to been calculate to empower possibilities of environment visual perception. It demands explaining many theoretical aspects.

Introduction. In order to empower the visual perception of the external information environment of the cockpit crew was developed the modern theory of imaging [1], and monitoring.

The purpose of the research. Construction of image of the environment subject on the operator's retina according to rules of geometrical optics: light beam from point B, directed through the front nodal point *B* of eye N, passes through the second nodal point N' parallel to the initial direction. Let the object which height y, is at a distance l from the eye. We assume that the absolute value of $l \geq$ f. β_v linear increase, equal to the ratio y' to y takes the

$$\beta_y = \frac{y'}{y} = \frac{\alpha l'}{\alpha l} = \frac{l'}{l} \qquad (1)$$

As l — negative value, increase of β_v — negative. So, image, occurred on the retina, is reverse and reduced.

Analysis of recent researches. Visualizing systems in aerospace industry are subdivided onto two groups [2], which are be applied when angular size γ of observing details of image is too small — lesser than limiting resolution angle. Linear detail's size h is very small too. When accommodation value is 4 diopter, pilot can see subject on the image from distance l_0 =250 mm. Let limiting angle is δ =1', or $2{,}9\cdot10^{-4}$ radians. So $h = \delta\ l_0 = 2{,}9\cdot10^{-4}\cdot250 \approx 0{,}07$ mm. If $h \leq 0{,}07$ mm, linear size h may be great, but distance to image's object and it's details l is very big. But there is no sense to approximate it to distance, less than l_0 (distance of best vision), because further approximation will lead to defocusing the image on retina. If detail's size is so small, that $\alpha = h/l_0 < 3\cdot10^{-4}$, we are unable to see it distinctly. $3\cdot10^{-4}$ – limiting resolution angle (approximately 1'), l_0 usually equal 250 mm with focus distance f, we will see detail not at the angle α , but at bigger angle α : $\alpha' = h/f$ with increasing to formula

$$\Gamma = \alpha'/\alpha = l_0/f \qquad (2)$$

But there is no sense to improve the increase above a certain value Γ_p . Light diffraction limiting the minimal detail's size h on the image, which still may be seen at larger increasing.

$$h = \lambda / (2 n \sin u) \tag{3}$$

where : λ , n — wavelength and medium refractive index;

u — angle between optical axis and last beam emanating from the object;

It's known [1], that multiplication of $n \sin u$ called numerical aperture and is denoted by A

$$A = n \sin u \tag{4}$$

If value u is tends to 90°, so $\sin u \approx 1$. At $n \approx 1.5$ $A \approx 1.5$, and $2 n \sin u \approx 3$. So, in the best case it's possible to see the detail on the image, which size is $h = \lambda / 3$. By naked eye pilot can see part of visual information size h_0 . Considering limiting resolution angle is $\delta = 1' = 3 \cdot 10^{-4}$, we get

$$h_0 = l_0 \cdot 3 \cdot 10^{-4} = 250 \cdot 3 \cdot 10^{-4} = 7.5 \cdot 10^{-2} = 0.075 mm \tag{5}$$

Consider that main characteristics of "eye — visual information" system are: visible magnification Γ_T , angular field 2β and matrix diameter D' which realize definite symbol during image transmission. Visible magnification Γ_T of system is equal to it angular magnification γ_T

$$\Gamma_T = tg \beta' / tg \beta \; D / D' = - f_1' / f_2' \tag{6}$$

where : 2β and $2\beta'$ — angular field of optical system in space of objects on image;

D and D' — diameters of input and output values of system "eye — visual information";

f_1', f_2' — focus distances of system "eye — visual information";

Linear $\beta_л$ and longitudinal α increasing of system are calculated by the formula:

$$\beta л = 1 / \Gamma_T \;, \qquad \alpha = 1 / \Gamma_T \tag{7}$$

Angular field 2β of system "eye — visual information" is interconnected with angular field $2\beta'$ and visible by pilot on the control panel

$$tg \beta = tg \beta' / \Gamma \tag{8}$$

Formulation of the problem. Result of integration the function *f(x, y)*, which is denoted by *R*, depends on the which straight line is used for integration and may be shown in equation

$$\chi \cos \varphi + y \sin \varphi - s = 0 \tag{9}$$

Assume that the function f (x, y) is integrated over all straight lines. Then various values of R are obtained, which in this case act as a function of two variables R (s, φ). Such integration can also be seen as a transformation [3] of the function f (

x, y) in the plane { x, y }, which is to the function R (s, φ) on the set of lines defined by integrals of f (x, y) along the lines. Function R (s, φ) is often called the transformed function f (x, y). In addition, a function R (s, φ) is considered as f (x, y) or as a function which describes the projection data. Last name try to reflect the geometric meaning, namely that in this transformation all values of the function f (x, y) lying on the line, as it were integrally projected to the corresponding point {s, φ}

A new approach to solve problems outlined in the hypothesis [4] is the following. In the mathematical model solution of the problem is reduced to finding obvious inversion formula that allows for the function R (s, φ) to find f (x, y), or otherwise - to search the inverse transformation.

$$R(s,\varphi) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)\,\delta(x\cos\varphi + y\sin\varphi - s)\,dxdy \quad (10)$$

where : s — distance from origin to this line;

φ — angle, between axis x and perpendicular from origin to this line.

Scientific result. We add one more rectangular coordinate *{x', y'},* turned on the angle φ orelatively to *{x, y}*. During transition from one coordinate system to another, coordinates are changing $x = x'\cos\varphi - y'\sin\varphi$, $y = x'\sin\varphi - y'\cos\varphi$, $x' = x\cos\varphi - y\sin\varphi$, $y' = -x\sin\varphi - y\cos\varphi$ (11)

Making values substitution in (11). Than

$$R(s,\varphi) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x'\cos\varphi - y'\sin\varphi, x'\sin\varphi + y'\cos\varphi) *$$

$$* \delta(x'-s)dx'dy' = \int_{-\infty}^{\infty} f(s\cos\varphi - y'\sin\varphi, s\sin\varphi + y'\cos\varphi)dy'. \quad (12)$$

To do so, switch to a coordinate *{x, y},* wherein the line (9) is given by the equation $x' = s$ and is parallel to axis y'. Therefore, integration by this direct function in the coordinates x', y', it is equivalent to the integration over $x'=s$. It is reflected in last equation (12). For function *f(x, y),* which is no equal to zero in limits within a limited area, it also converted value is determined by expression (11) So, if *f(x,y)* is different from zero inside the circle of radius a, then instead of one (12) we have

$$R(s,\varphi) = \int_{-\sqrt{a^2-s^2}}^{\sqrt{a^2-s^2}} f(s\cos\varphi - y'\sin\varphi, \quad s\sin\varphi = y'\cos\varphi)dy'. \quad (13)$$

$$R(-s, \varphi + \pi) = R(s, \varphi). \quad (14)$$

The main material of the study. We believe that the beneficial effect of M perception is greater than less parts that can be considered, i.e., a beneficial effect as it increases visual acuity of pilot's vision

$$M = V'/V \quad (15)$$

where : V и V'— acuity naked and armed eyes correspondingly, during visualizating of environment.

Established[4], that benefical effect of *M* depend on such characteristics of "eye — visual information" system: increasing of perception Γ_T и diameter of the entrance pupil of the eye *D*. The character of this dependence is not the same in different conditions of cockpit lighting.

$$M = c\Gamma_T^X D^Y \quad (16)$$

where : *c, x, y* – numbers dependent adaptive brightness.

At changing brightness from $3 \cdot 10^{-3}$ to $3 \cdot 10^{-2}$ *кд/м*^{2} beneficial obeys the laws of certain experimentally $M = c\sqrt{\Gamma_T D}$, where $c \approx 0{,}3$. For comparative assessment of the characteristics and twilight efficiency often used numerical value $\sqrt{\Gamma_T D}$, which is called "twilight number". Beneficial effect in daytime lighting conditions in the perception of the conditions for $2 \le D' \le 7.5$ suggested to calculate using a formula

$$M_{on} = 1.06\,\Gamma_T \sqrt{1 - 1.65 / D'}\,. \quad (17)$$

Formulas (16) and (17) include parameter *D'*. In daylight perception visual acuity determined by the quality of the image, formed on the retina, which in this case is characterized by indirect parameter values *D'*. Problem solving hypothesis. Denote in the experiment, that m^n – determines as selection the one of equiprobable variants of image perception by "eye — visual information" system and information volume *H*transmitting to eye during visualization is

$$H = n \log_2 m\,, \quad (18)$$

where: *n* — number of independently resolvable elements in eye sight, is inversely proportional to the square resolved element, i.e. $n \approx 1/\psi$.

m — the number of gradation of brightness, which can distinguish eye depends on resolvable element size and contrast threshold.

Decreasing of ψ tends to increasing of contrast threshold and, corresponding decreasing of brightness gradation number. Theoretical research of function *H(K)* showed, that it get maximum at contrast *K*= 1.

Therefore confine ourselves the evaluation of a of H - information capacity, i.e. the maximum amount of information that can get in the perception of environment by the crew eye

$$H = 2\pi \int_0^{\beta} \frac{\sin \sigma \, d\sigma}{(\psi'(\sigma))^2} \quad (19)$$

where : σ — angle between direction to this point of the field of view and the optical axis of the object visualization, *(rad)*;

2β — angular field of visualized object which pilot percepts, *(rad)*;

$\psi'(\sigma)$ — angular limit of eye resolution of image's objects details during perception at give point of field;

$\psi'(\sigma)$ characterizes resolution possibility of "eye — visual information" system.

Information visualization capacity is denoted as H_0. Every real visualized information is denoted K_H value — quality information criterion [2]

$$K_H = H / H_0 \tag{20}$$

where: H — information capacity of visualization when viewed from the cockpit.

Personal contribution of the authors is as follows. For qualitative visualization recommended value set between 0.04 to 0.12, and this criterion depends on the characteristics of pilot's vision age changes for optimal information perception

$$P' = P_1 \times P_2 \tag{22}$$

CONCLUSIONS. Field of view of objects from the cockpit is less than the angular field of visualization environment, i.e., $2\Omega_Г < 2\beta$ и $2\Omega_B < 2\beta$, P_2 =1. However, the probability of detecting an object in the image is determined by monitoring the entire probability P_1. The experiments revealed that the average search time corresponding to the probability of detection of 0.63, will be determined for the images by the configuration of an extended single object and a single point object from the formula

$$\overline{t'} = (2\beta')^2 / \left[c (K')^2 (\gamma')^3 (L')^{0.3}\right],$$
$$\overline{t'} = (2\beta')2 (L')^{2n} / \left(a (E')^2\right) \tag{23}$$

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V.M.Zemljanskij, Dr.Phys.-Math. Sc. (NAU, Ukraine, Kyiv)
M.O. Gusiev (NAU, Ukraine, Kyiv)

INDEPENDENCE OF DOPPLER EFFECT FROM WAVE-LENGTH AT THE MULTIWAVE CONCERTED SOUNDING AND RECEPTION

Our researches allowed to set new patterns of display of transversal of Doppler effect in nonrelativistic case at the multiwave concerted sounding and reception of EM emission, sent to the quadratic detector (QD). On this basis we are develop the methods of multiwave doppler laser locator (MDLL). The distinctive feature of the offered methods of MDLL is independence of frequency of doppler signal on the output of QD from a wave-length the emission accepted EM.

Let a moving object (for example, microparticles) the size of which compare with a wave-length EM emissions move at a speed of $\overline{V}$ through the sounding area (SA).

In a differential method MDLL (fig. 1) a sounding area is formed with a help of
«n»-numbers of pair of coherent beams on lengths of waves $\lambda_1, \lambda_2, \dots \lambda_n$ with the change of frequency of one of beams of pair on a wave-length λ_i on the fixed size $\Omega_м$ which intersect in SA under the concerted angles $\gamma_1, \gamma_2, \dots \gamma_n$. Thus n-numbers lie in one plane (for example, in horizontal plane — OXZ) and bisectrices of angles γ_i (i=1,2,3,…n) all pair of beams coincide in space. The emission dissipated on the moving particle of EM going in a large angular aperture and heads for a quadratic detector.

Expressions, allowing to expect the parameters of differential method of MDLL at which frequency of doppler signal on the output of QD does not depend on a wave-length EM emissions and receive-directions (1)

$$\gamma_i = 2 \cdot \arcsin\left(\frac{\lambda_i}{\lambda_1} \cdot \sin\frac{\gamma_1}{2}\right) \qquad (1)$$

where i = 2,3,…n.

This frequency is determined only the projection of vector of speed on the difference wave vector of soundings pair of beams (for example, ichnography V_x if bisectrices of angles of all γ_i coincide with the axis of OZ) The doppler signal on the output of QD is superposition of n–number signals of one frequency, each of which is formed at a reception EM emission on length of wave λ_i (2)

$$U_g = \sum_{i=1}^{n} U_{mgi} \cdot \cos\left(\left(\Omega_м + \omega_{gi}t\right) - \Phi\lambda_i - \Phi_{si}; \qquad (2)$$

$$\omega_{g1} = \omega_{g2} = \dots = \frac{4\pi}{\lambda_1} \cdot \sin\frac{\gamma_1}{2} \cdot V_x;$$

$$\Phi_{\lambda_1} = \Phi_{\lambda_2} = \dots = \Phi_{\lambda_n}$$

where Φ_{λ_1} - component of phase of doppler signal, determined arrival of particle time in the area of measuring, formed crossing of beams on a wave-length λ_i;

Φ_{g_i} - component of phase of signal, determined the effects of dispersion ($\Phi_{s_i} = 0$, or $\Phi_{s_i} = 180°$ at the use of forming technologies phase the attended doppler signals [5]).

In an inversion-differential method MDLL a sounding area is formed one narrowly directed sounding bunch (axis OZ) which consist of superposition of n - number of beams on lengths of waves λ_i which have flat wave fronts of EM emissions. Emission dissipated on a moving particle for every wave-length λ_i going in two receive-directions from angles between them equal β_i (for example, in OXZ) and after spatial overlay of their wave vectors in an interferometer (IF) further goes on QD (Fig. 2).

Bisectors of the angles β_i lie in the plane OXZ and coincide with each other (for example, axis OZ). Expressions allow calculation of parameters inversely differential method MDLL, in which the frequency of the doppler signal at the output of the QD does not depend on the wavelength and direction sounding, as determined solely by the projection of the velocity vector on the wave vector difference of the two scattered beams at the appropriate wavelength λ_i (3)

$$\beta_i = 2\arcsin\left(\frac{\lambda_i}{\lambda_1}\sin\frac{\beta_i}{2}\right); \qquad (3)$$

$$\omega_{g1} = \omega_{g2} = \cdots \omega_{gn} == \frac{4\pi}{\lambda_1} \cdot \sin\frac{\beta_i}{2} \cdot V_x$$

In MDLL method that implements four-wave mixing mode overlapping electromagnetic EM emission sensitive layer on the surface of the QD, sounding area is formed by two intersecting beams under angle γ, each of which is a superposition of n-number of beams of EM emission at wavelengths $\lambda_i = (i = 1, 2, \ldots, n)$. Moreover, one of these beams passed a delay line therefore SA crosses pair of beams at a wavelength of mutually noncoherent. Overlayed pairs of beams at each wavelength λ_i collected in two symmetrical directions angled β_i (for example, in the plane OXZ). Bisectrices of these angles β_i each pair of beams at wavelengths $\lambda_1, \lambda_2, \ldots, \lambda_n$ coincide (for example with the axis OZ). Further, all the pairs of beams for each wavelength λ_i spatially combined in interferometer and sent to the surface of the QD. Thus one of each pair of beams at a wavelength for QD before mixing takes place also delay line. The delay time is selected from the conditions for ensuring the coherent overlay mode. As a result, the QD is formed at the output the useful Doppler signal, while the HF crosstalk is suppressed. Expressions allow calculation of geometry parameters agreed MDLL sounding and reception at which the doppler signal has a frequency independent of the wavelength of EM emission.

$$\beta_i = 2\arcsin\left[\frac{\lambda_i}{\lambda_1}\sin\frac{\beta_1}{2} + \left(\frac{\lambda_1-\lambda_i}{\lambda_1}\right)\sin\frac{\gamma}{2}\right] \qquad (4)$$

$$\omega_{g1} = \omega_{g2} = \cdots \omega_{gn} = \frac{8\pi}{\lambda_1}\left[\cos\left(\frac{\gamma+\beta_i}{4}\right)\sin\left(\frac{\gamma+\beta_i}{4}\right)\right]V_x.$$

For example, consider this method for optical range EM emission wavelengths using an argon laser which emit at three different wavelengths.

Multiwavelength laser doppler anemometer (MLDA) includes (Fig. 3): multiwave laser 1, which emits a beam 2 at three wavelengths λ_1, λ_2 и λ_3 (for example, argon laser), multiwave beam splitter 3 which divides the beam 2 into two beams 4 and 5 of equal intensity at each of wavelengths of emission λ_1, λ_2 and λ_3,

frequency shifter 6 a high-frequency generator 7, mirror 8, a delay line 9, aperture diaphragm 10 with eight circular holes, focusing lens 11, measurement area 12, where two beams 4 and 5 intersect at the focus of the lens 11 under the angle γ, scattered beams 13, 14,15,16,17 and 18, selective mirror 19 for the wavelength λ_3, selective mirror 20 for the wavelength λ_2, selective mirror 21 for the wavelength λ_1, delay lines 22, 23 and 24, multiwave composite mixer 25 for the wavelengths $\lambda_1, \lambda_2, \lambda_3$, diaphragm 26 with six holes line of six interference filters 27 for the wavelengths λ_1, λ_2 and λ_3 , photodetector 28, meter of doppler frequency 29, block of the formation of two parallel beams 34, which comprises optical elements and devices 3,6 and 8; an optical time delay device 35 which comprises: 9, 19, 20, 21, 22, 23, 24, 30 and 31; sensor 36 which comprises: 10 and 11; receiving block 37 which comprises: 25, 26, 27 and 28.

MLDA works as follows. Laser 1 emit a beam 2 on three powerful lengths of waves λ_1, λ_2 и λ_3 which divided a beam splitter 3 on two beams of equal intensity 4 and 5. That is why power of beam 4: $P_4 = P_{\lambda_1} + P_{\lambda_2} + P_{\lambda_3}$ equals power of beam 5: $P_5 = P_{\lambda_1} + P_{\lambda_2} + P_{\lambda_3}$, where P_{λ_i} - power of emission on wavelength (i=1,2,3). After passing of frequency moving device beam 6 displaced on fixed size frequency $\Omega_м$ and then reflected from a mirror 8 and spreads like beam 4 parallel and symmetric in relation to the optical axis of chart of OZ. Beams 4 and 5 have the consistent states of polarization. For example these beams are apeak polarized. Beams 4 and 5 after passing through two openings of diaphragm 10 focus an object 11 in the area of measuring 12 in which they intersect under an angle γ (fig.3). However, as beam 5 after passing through the delay line 9 delayed time relative to the beam 4 on a value $\tau_3 > \tau_{ki}$ (τ_{ki} - the maximum time coherence of the emission corresponding to the wavelength of λ_i), an interference picture is not formed in the area of measuring. At passing through the area of measuring 12 (for example, current of air) the emission dissipated on microparticless is in directions 13 and 14, 15 and 16, 17 and 18 which are symmetrical about the axis OZ, going a lens 11 within the limits of the small round openings of aperture diaphragm 10 which is located in the focal plane of the lens 11.

Scattered beams 13 and 15 after passing the relevant photoregulation 30 and 31 and reflections from selective mirrors 19 and 20 on the wavelengths λ_1 and λ_2, passing delay lines 22 and 23 and sent to the first output of compound mixer 25. On the same input of the mixer is directed beam 17 after reflection from selective mirrors 21 at the wavelength of λ_3 and going through the delay line 24. Scattered beams 14, 16 and 18, after passing the relevant lines delays 22, 23 and 25, are going for the second entrance of mixer 25 (on fig. 1 on the way beams 14, 16 and 18 shows mirrors 19, 20 and 21 setting of which in the chart of MLDA does not have an of principle value).

Time delay beams 13 - τ_{λ_1}; 15 - τ_{λ_2} и 17 - τ_{λ_3}, created with the help delay lines 22, 23 and 24, choose that at the optical mixing of pair of beams : 13-14; 15-16; 17-18, for these pair there is the module of degree of temporal coherent $\left|\gamma_{\lambda_1}(\tau_3)\right| = 1$. On the output of mixer 25 six beams are formed and proper wavelengths: $\lambda_1, \lambda_2, \lambda_3, \lambda_1, \lambda_2$ and λ_3 which pass through six openings of diaphragm 26 and line from six interference colour filters accordingly on wavelengths

$\lambda_1, \lambda_2, \lambda_3, \lambda_1, \lambda_2$ and λ_3 and further sent on a photocathode of photodetector 28. On the output of photodetector 28 three useful high-quality signals are formed and correspond the optical mixing of the dissipated beams on wavelengths. λ_1, λ_2 and λ_3, on doppler frequency

$$\omega_{g_i} = \Omega_M + \frac{8\pi}{\lambda_1}(\cos(\frac{\gamma + \alpha_i}{4})\sin(\frac{\gamma + \alpha_i}{4}))V_x$$

where α_i - the angle between the scattered beams (i=1,2,3) on wavelength λ_1,

V_x - the horizontal projection of the velocity vector $\overline{V}$.

These three signals coincide on frequency $\omega_{g1} = \omega_{g2} = \cdots = \omega_{gn}$ and added. If the geometry of the probing and scattered beams is the following relation

$$\alpha_i = 2\arcsin\left[\frac{\lambda_i}{\lambda_1}\sin\frac{\alpha_1}{2} + \left(\frac{\lambda_1 - \lambda_i}{\lambda_1}\right)\sin\frac{\gamma}{2}\right]$$

where: $\lambda_1 > \lambda_2 > \lambda_3$

and i=2,3

Three useful signal on one frequency ω_g, specific parameters of the optical scheme of MLDA may have different phase. Therefore for increasing power total useful signal on frequency ω_g, it is necessary to provide the phase concordance of these three signals also [4].

Equiphase condition of these three signals is ensured with the photoregulator 30 and 31. On the output of photodetector 2 also can be formed high-frequency signals-interference, accordingly 5 signals-interference for each of wavelengths λ_1, λ_2 and λ_3.

However, for a scheme of MLDA (fig. 3) these 15 signal-interference automatically suppressed because of these signals module complete the degree of temporal coherence equal zero.

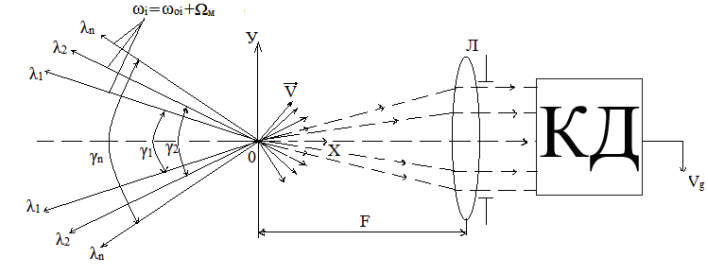

Fig. 1

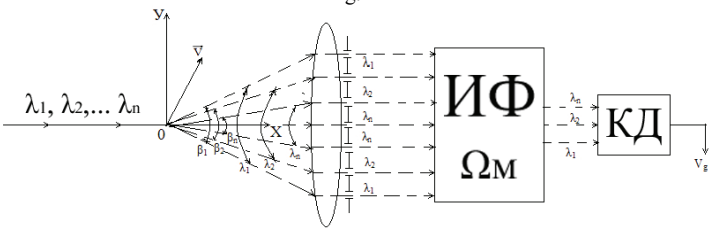

Fig. 2

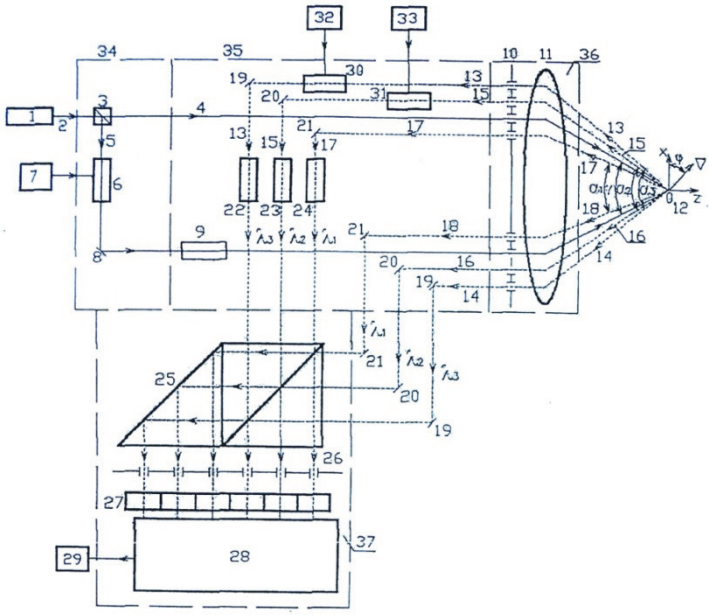

Fig. 3

Conclusion

For the first time established patterns manifestations of doppler effect and proposed methods MDLL which were realized in the developed practical schemes. Based on the first method MDLL in development [1]; the second method MDLL in [2]; and on the third method MDLL in [3] (fig.3); (and in other devices, protected by patents) experimentally confirmed for the optical wavelength range. In this area of spectrum of EM the emissions of MLDL are widely used for the aerodynamic tests of aerospace technique [4,5].

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D.A. Prosvirin, postgraduate student (NAU, Ukraine, Kyiv)

ENCHANTMENT OF AUTOMATIC FLIGHT CONTROL SYSTEM QUALITY AT APPROACH PHASE

Analysis of emergency situations depend on phases of flight is done. Application of modern model based technologies for automatic flight control systems development is considered. The program for aircraft-automatic flight control system control loop simulation and visualisation is developed. Improvement of the automatic flight control system characteristics

Introduction

Analysis of emergency situations abroad shows that, more than 50 % of general accidents happen at take-off and landing phases of flight. And duration of these phases is only 2% from the average flight duration. Specified data were taken from general report of Boeing Company (see Figure 1 below).

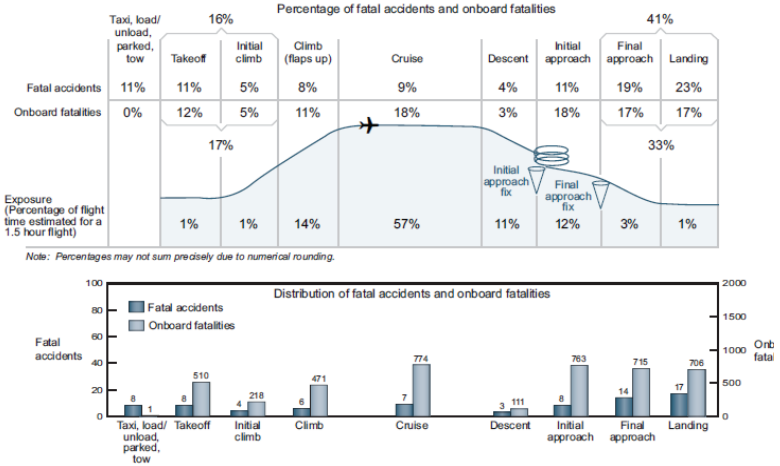

Figure1. Fatal accidents and onboard fatalities by phase of flight (Worldwide commercial jet fleet – 2003 through 2012)

Many academic papers and researches are dedicated to aircraft control quality improvement at the critical flight phases [3-7]. All they are based on knowledge of the nominal aerodynamic characteristics or using normalized diagrams for the correction of the main maneuvers on the take-off and landing according to the a priori known factors: temperature, airport height, runway slope, wind velocity vector, etc. As noted in several studies [3, 4, 8], the existing technique of decision at the take-off and landing based only on the time of reaching the aircraft so-called the decision speed V1, can not prevent accidents are caused by too low acceleration characteristics of the aircraft, the loss of traction, the excess of the permissible mass,

brakes failure or deviation of weather conditions from the expected. So, search for new solutions and methods of improvement automatic flight control characteristics is relevant task and thereby increasing of aircraft flight. In some cases it is not possible to assess the performance of the aircraft flight control systems quality by the direct method - flight tests - because of the limitations of the existing objective conditions for its implementation. This, and the relative duration, spending resource of real assets and substantial economic costs of flight tests enforce to search for a more rational methods of work organization that to assess flight control systems performance [1]. In addition, the U.S. Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA) and other international authorities of aviation security insist on the use of functional safety standards, that to ensure the proper functioning of a complicated electronic equipment of aviation systems in any foreseeable conditions, to exclude defects and the possibility of the aircraft crashes.

Development of automatic control lows

Automatic control of the lateral movement is implementing through the channel of the rudder and ailerons. Rudder channel provides damping of oscillations around the normal axis, and the eliminating of slip angle. Roll and heading purposive control is provided by ailerons in coordinated turn mode. Testing of the specified roll angle and heading is provided by the simultaneous operation of the rudder and ailerons [4]. Research of the automatic control laws of lateral movement is based on a decomposition principle (division) of rudder and ailerons channels. For this purpose, the original object of the control lateral movement is divides into two sub-objects which are implementing flat turn and coordinated turn modes. Approbation of flight parameters prediction method at the landing phase was implemented on computer bench. Operator's panel allows to set the inertial-mass, geometric characteristics of aircraft and creates landing scenarios in accordance with Flight manual (see Figure 1 below).

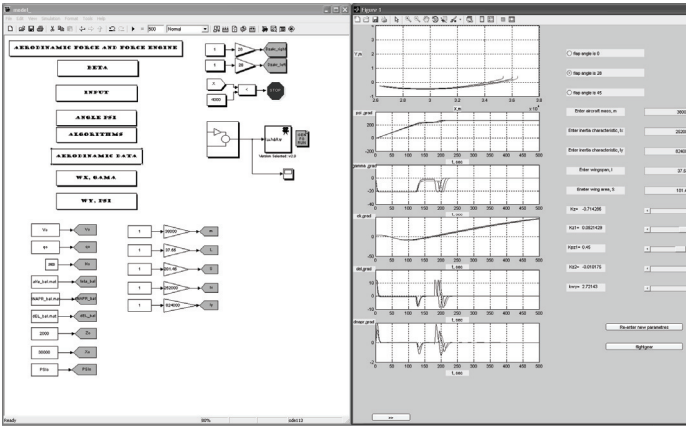

Figure 2. The main operator's panel setting window

Analysis of the control law in the «Approach» mode

In the issue of analysis below, is recommended to reduce the gear ratio for the lateral coordinate to value $K_z = 0.06$ ($K_{z\ calc} = 0.1$). Inclusion to the control law of the mentioned correction improves the control quality in the wind disturbance, i.e, the presence of this correction is required. Analysis of the $K_{\tilde{\Gamma}}$ impact on the control quality at the worst set of disturbances indicates expediency to increase the value $K_{\tilde{\Gamma}}$ to 0.2 (previous value was 0,043). In addition, limitation function is added to the integral component of the control law. The results of the of the control law in the «Approach» mode research (Figure. 3) are the new (improved) control laws in the rudder and aileron channels. The above approach will: carry out the synthesis of automatic control law in the rudder channel; execute the development of aircraft autopilot lateral movement control schemes, implement the following modes of AFCS: roll stabilization mode, heading stabilization mode and to develop the functional circuits that implement automatic control of the heading and roll angles.

Fragment of developed control lows analysis at "Approach mode" with specified conditions showed below.

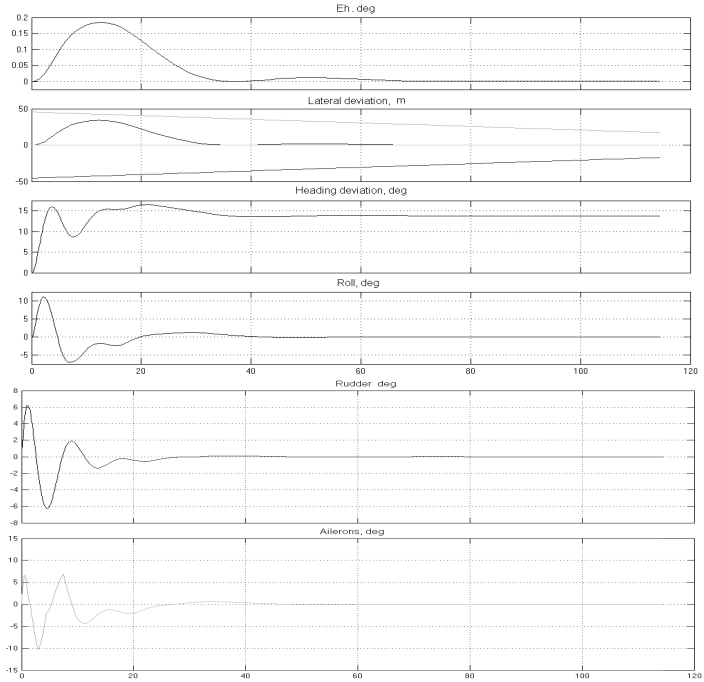

Figure. 3. Wz=-15m/s, Fmx=-1,5(=3 deg), Fmy=1 (=-3 deg), Z=-20m.

Conclusion

This article addresses approach of automatic flight control system quality enchantment that allows engineers to facilitate development and maintenance process. Determination of the automatic flight control system architecture and verification are passing at the level of model. It saves the time, which usually takes to significant verification efforts (models can be verified as soon as they are available even in parts). As it can be seen from above results the mathematical modeling was conducted within the permissible range and did not exceed the requirements of the specified type aircraft. Therefore, the use of the above algorithm is reasonable. In conclusion, we note that the presented approach to the enchantment of automatic flight control system quality allows to perform a preliminary analysis of the different modes of automatic flight control system at the stage of co-design the aircraft and automatic flight control system; to carry out maintenance of automatic flight control system semi-natural test; to perform statistical analysis of approach mode with significant savings in material costs during the flight test ; make recommendations of automatic control loops setting at the flight test of automatic flight control system, which will reduce the time and cost of field research and certification of automatic flight control system; meet the requirements of safety functional standards, simplify the development process and reduces costs.

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V.M.Zemljanskij, (NAU, Kiev,Ukraine)
A.P.Chudecov, (NAU, Kiev,Ukraine)
M.A.Gusiev (NAU, Kiev,Ukraine)

THE TWO-WAVE LDV WITH COPHASED RECEPTION OF THE DOPPLER SIGNALS

Established common development property phase and polarization scattering effects, as well as the conditions of coherent two-beam moving particles sensing, in which the formation of the observed phase conjugate, opposite-and quadrature signals [1,2] allow ODR to develop schemes with optimal reception of the scattered radiation.

Researches of the differential scheme of sensing of optical Doppler radar (ODR) with the reception of backscattered light that shows [1] that the signal / noise ratio at the output of photodetectors essentially depends on the degree of polarization-phase-matching mixed on a photodetector wave.

Established common development property phase and polarization scattering effects, as well as the conditions of coherent two-beam moving particles sensing, in which the formation of the observed phase conjugate, opposite-and quadrature signals [1,2] allow ODR to develop schemes with optimal reception of the scattered radiation.

In the widely used classical scheme of ODL [1] with two coherent beams sensing at the same wavelength [1] and reception of the scattered radiation in a relatively large aperture angle formed by optical mixing a useful signal at the Doppler frequency (determined by the projection of the velocity vector to the difference wave vector two probing beams) depends strongly on the phase matching of elementary Doppler signals for each direction of the reception of the scattered radiation, leading to a sharp decrease of the signal / noise ratio and thus the accuracy of the measurement. By reducing the angular aperture of the receiving power drop occurs as useful Doppler signal which can be compensated by increasing the power to the single-wave laser, which leads to undesirable and thus non-linear increase of weights and dimensions LDV.

An alternative solution to this problem for the ODR can be the use of two or more (in the limiting case of a matrix of n-lasers), semiconductor, compact lasers that emit at different wavelengths of single-mode radiation from a plane wavefront, or dual-wavelength or multi-wavelength mode of the laser.

The physical foundations of constructing multi-wavelength ODR [3] using the two-wave LDV.

The ODR of a new generation is designed on the basis of author's technology of the formation of a phase-conjugate signals [1,2] providing common-mode reception elementary Doppler signals, which in contrast to the classical scheme of the ODR, the frequency of the Doppler signal is independent to the wavelength of the received in different directions of the scattered radiation.

Analyzed the way of developing of the two-wave ODR (TWODR) with the reception of the forward-scattered light, which uses a double-wavelength laser

emitting at two wavelengths λ1 and λ2. This TWODR formed one pair of parallel beams at a wavelength λ1, for example, horizontal polarization, and a second pair of axially symmetric beam at another wavelength λ2, with vertical polarization (polarization azimuths are respectively αλ2 = 90 °; αλ2 = 0 °) - Furthermore, in the TWODR when receiving scattered radiation used polarization filtering of optical signals in conjunction with spatial filtering of the phase signal, as carried out at the wavelength λ1 and the - λ2. Synthesis of phase of spatial filters (PSF) on the computer for two-wave mixing prism with phase matched filtering (set in the receiving channel with the acquisition of forward-scattered radiation), manufactured on the basis of nanotechnology, considered by the authors [4] and is based on developed by us theory and created application of the synthesis of PSFon computers.

We also consider the option of constructing of two-wave TWODR with the reception of the backscattered radiation, which in contrast to the TWODR scheme used sensing beams at wavelengths λ1 and λ2, matched polarization, and a polarization which provides a form of phase-conjugate symmetric signals at the reception as the wavelength of the radiation λ1 and λ2 [1,2].

Use of phase coherent spatial filtering of signals simultaneously at different wavelengths and the conditions achieves optimum reception of the signal / noise ratio at the output of the ODR times and more compared to the known schemes of LDVs. This can significantly improve the accuracy of measuring the speed by using new generation of TWODR [6,7].

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Maksym Romaniuk, Postgraduate student
(National Aviation University, Kyiv,Ukraine)

ORGANIZATION OF INTEGRATED LOGISTICS SUPPORT OF MAINTENANCE AND REPAIR OF AIRCRAFT

Every year the organization of maintenance and repair of aircraft becoming more voluminous. Due to the demand for air travel rostuschim exploiting airlines have large fleet, which in turn differ in types and by producers. To optimize the preparation and planning then injects new system. This work was considering a system of integrated logistics support operation and maintenance of aircraft.

Operating organizations and centers need regular maintenance and repair supplies and maintaining inventory of replacement parts engines (APP) - parts, assemblies, modules.

MTO system, developed in the USSR, needs a thorough reorganization to comply with modern requirements. First of all, instead of a single, very large operating organization, a lot of small and medium-sized carriers, which can not affect the organization of logistics. Effective organization of aftermarket aircraft involves the creation of a global network of regional centers for maintenance and repair, close to home parks places of aircraft and engines, which automatically entails the establishment of a global system of logistic support. In modern conditions sharply tightened requirements for flexibility, efficiency and reliability of logistics support operation and maintenance and repair of aircraft.

Along with the problems, now there are also new possibilities for organizing logistics. First of all, they are associated with the introduction of CALS-technologies. They allow you to implement integrated logistics support products (the ILP; foreign literature-ILS,

Integrated Logistics Support), in the modern sense, LAI operation and maintenance of aircraft should include integrated management processes such as:

- Monitoring (control) the status of each product in the park;
- Planning of maintenance and repair;
- Supply of spare parts, accessories for MRO;
- Training of operators and maintenance personnel, etc.

Technological basis for ILP are:

- Computer-aided inventory control of spare parts (using a standardized electronic parts marking);
- Computer-aided design of orders for delivery of spare parts (the function is implemented in the framework of systems SCM, Supply Chain Management - Supply Chain Management);
- Information system operational support aircraft.

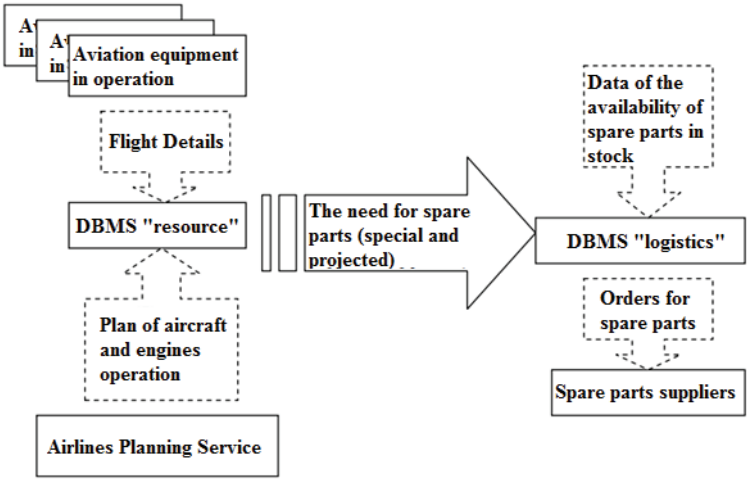
Information support aircraft operation involves providing automated accounting resource generation and control technical conditions of products and their components in real time. The highest requirements for these functions are presented in support of operation of aircraft engines. Developing information support systems operating in the interests of aviation engine (as applied to aircraft

engines, these systems abbreviated ECM, Engine Condition Monitoring and ENM, Engine Health Monitoring,)

Effectiveness of the implementation of information systems is largely determined by the fullness of the services they use new features. In many works devoted to the ILP, the main determinants of its cost-effectiveness, are:

- Automation of inventory control and ordering spare parts for the supply of spare parts at a certain threshold level of reserves, called the reorder point;
- As a consequence, the possibility of optimizing the inventory of spare parts and repair facilities.

That is, essentially, the ILP system is understood as a system of supply chain management (SCM, Supply Chain Management). However, new information technologies and provide other opportunities. First, the information system of aircraft maintenance manual enable realtime automatically control the current technical condition and remaining service life of the elements of each aircraft or aircraft engine. Forecasting is proposed to organize the park needs for spare parts for replacement elements overage. This will allow more reasonable to plan their production and delivery. Informational basis for this prediction can serve schedule. At the same time, forecasts for removal and replacement of elements of aircraft and engines, target volumes and modes of operation of aircraft must be treated the same software and hardware resource balance calculation parts and assemblies, and that the real flight information. Figure 1 depicts the recommended scheme of information flow system integrated logistics support (ILS) operation and maintenance of aircraft.



Recommended diagram of information flow in the system IPL maintenance and repair of aircraft

As a result, the organization of the system LSI, functioning on the proposed scheme, there are the following opportunities:

- Possible reduction of costs associated with the completion and maintenance of required inventory of replacement engines and spare parts, spare capacity and personnel in the field of maintenance and repair, and the like;

- May reduce downtime of aircraft and losses associated with a deficit of replacement aircraft engines and spare parts, as well as the lack of capacity performers MRO.

It should be noted that the system LSI, functioning according to the proposed scheme would be workable only if the unhindered exchange of information operating organizations and suppliers of spare parts in real time. In fact, sometimes the manufacturer must take to fulfill orders for the manufacture and supply of spare parts, when the aircraft is in need of replacement parts and components is still in the air.

In general, the implementation of CALS involves formation of a single information space, and therefore requires facilitate the exchange of data between participants product life cycle in real time. Acceleration and automation of information exchange required to minimize the participation of responsible persons. Naturally, this will solve the complex (technical, legal, etc.), information security, the protection of commercial secrets. However, the presence of these issues in any case should not block the introduction of advanced information technology and business strategies, including, LAI. As a positive example of another industry can lead the global banking information
and control systems, the creation of which have been successfully solved similar problems of information protection (not less important and confidential!) From unauthorized access and modification. Solution to this problem is a prerequisite for the successful implementation of CALS-technologies.

Conclusion:

In this paper we consider the system of integrated logistics support operation and maintenance of aircraft. Shows its advantages in relation to other, older systems organization of maintenance and repair of aircraft. Presented its main provisions. Delivered the main tasks and shows the recommended diagram of information flow in the system.

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V. N. Azarskov. Doctor of Engineering. Professor.
(National Aviation University, Kyiv, Ukraine)
L. S. Zhiteckii. Candidate of Engineering. Professor.
(National Aviation University, Kyiv, Ukraine)
K. Yu. Solovchuk. Postgraduate student.
(National Aviation University, Kyiv, Ukraine)

ROBUST ADAPTIVE AUTOMATIC MIMO PROCESS CONTROL IN THE PRESENCE OF GREAT PARAMETRIC UNCERTAINTY

A new problem of designing the robust adaptive control system applied to linear discrete-time multivariable static plants whose transfer matrices may be, in principle, ill-conditioned or singular subject to bounded disturbances is considered.

The perfect output control performance is an important multivariable control problem closely related to inverse systems. In due time, the discrete-time MIMO (multi-input multi-output) process control systems containing the inverse model was proposed by the authors; see [1] and references therein. Unfortunately, the inverse model approach is quite unacceptable if MIMO systems to be controlled are square but singular because they become noninvertible.

It turned out that the so-called generalized inverse (pseudoinverse) model approach can be exploited to cope with the noninvertibility of singular system [1]. This work dealt with the control of multivariable plants whose parameters are assumed to be known.

Usually, the adaptive approach is utilized to cope with the parametric uncertainty [2–4]. Namely, this approach was before exploited in the work [4, chapt. 7] to controlling a linear MIMO static plant having an unknown but nonsingular transfer matrix. Recently, a new adaptive method has been advanced in [5] to deal with possibly singular MIMO systems. This paper follows the lines of [5].

Let a linear MIMO static plant be described by

$$y_n = Bu_{n-1} + v_n, \tag{1}$$

where $y_n = [y_n^{(1)}, \ldots, y_n^{(N)}]^{\mathrm{T}}$ is the N-dimensional output vector to be measured at nth time instant, $u_n = [u_n^{(1)}, \ldots, u_n^{(N)}]^{\mathrm{T}}$ is the N-dimensional vector of unmeasurable disturbances and

$$B = \begin{pmatrix} b_{11} & \ldots & b_{1N} \\ \ldots & \ldots & \ldots \\ b_{N1} & \ldots & b_{NN} \end{pmatrix} \tag{2}$$

is an arbitrary transfer $N \times N$ matrix.

It is assumed that the elements of the matrix B in (2) are all unknown. However, there are some interval estimates

$$\underline{b}_{ij} \le b_{ij} \le \overline{b}_{ij}, \quad i, j = 1, \ldots, N \tag{3}$$

with the known upper and lower bounds. This implies that B in (1) may be ill-conditioned or even singular, in general. Hence, its rank satisfies $\text{rank}\, B \le N$.

Suppose $\{v_n^{(i)}\}$ are the bounded sequences, i.e.,

$$|v_n^{(i)}| \le \varepsilon_i < \infty \quad \forall\, i = 1, \ldots, N, \tag{4}$$

where ε_i s are constant. For simplicity of exposition, we assume that they are known.

Let $y^0 = [y^{0(1)}, \ldots, y^{0(N)}]^{\mathrm{T}}$ denote the desired output vector whose components satisfy $|y^{0(1)}| + \ldots + |y^{0(N)}| \neq 0$.

The problem is to design an adaptive controller to be able to guarantee the boundedness of all signals in a closed-loop system implying

$$\overline{\lim_{n\to\infty}} (\| u_n \| + \| y_n \|) < \infty \tag{5}$$

provided that the assumptions (3) and (4) hold. In other words, we need to guarantee the requirement (5) for all possible Bs with any elements given by (3).

It follows from the fundamental Hadamard's theorem, which can be found in matrix literature, that if

$$\min\{|\underline{b}_{ii}|, |\bar{b}_{ii}|\} > \sum_{\substack{j=1 \\ i\neq j}}^{N} \max\{|\underline{b}_{ij}|, |\bar{b}_{ij}|\} \quad \text{for all} \quad i = 1, \ldots, N,$$

then the nonsingularity of any $B' = (b'_{ij})$ satisfying

$$\underline{b}_{ij} \le b'_{ij} \le \bar{b}_{ij}, \quad i, j = 1, \ldots, N$$

will be guaranteed. In this "good" case, the adaptive control technique proposed in [4] can be used.

Define a nominal matrix $B_0 = (b_{ij}^0)$ with the elements given by

$$b_{ij}^0 = \frac{1}{2}(\underline{b}_{ij} + \bar{b}_{ij}).$$

Without loss of generality, suppose B_0 is nonsingular: $\det B_0 \neq 0$. Then, it can be established that the set $\{B\}$ of all the matrices $B = (b_{ij})$ whose elements belong to $[\underline{b}_{ij}, \bar{b}_{ij}]$, contains always some singular Bs if

$$1/\| B_0^{-1} \| \le \min_{i,j=1,\ldots,N} \frac{1}{2}(\bar{b}_{ij} - \underline{b}_{ij}).$$

In this case, the method above mentioned does not become admissible.

To overcome a difficulty caused by the possible noninvertibility of B, the following key idea advanced in [5] is proposed. This idea reduces to the transaction from the adaptive identification of the true plant having the singular transfer matrix $\tilde{B}$ to the adaptive identification of a fictitious plant with the nonsingular transfer matrix given by

$$\widetilde{B} = B + \delta_0 I, \tag{6}$$

in which I denotes the identity matrix and δ_0 is a fixed quantity determined later. Note that although $\widetilde{B}$ as well as B remain unknown, the requirement

$$\det \widetilde{B} \neq 0 \tag{7}$$

can always be satisfied by the suitable choice of δ_0 in expression (7).

Further, the equation of the fictitious plant is derived by adding the quantity $\delta_0 u_{n-1}$ to the both sides of (1). Then, due to (6) we obtain the equation

$$\widetilde{y}_n = \widetilde{B} u_{n-1} + v_n, \tag{8}$$

equivalent to the true plant equation for

$$\widetilde{y}_n = y_n + \delta_0 u_{n-1}. \tag{9}$$

We observe from (8) that the true and fictitious plants have the same inputs u_n and are subjected to the same unmeasurable disturbance v_n. It is essential that output $\widetilde{y}_n$ of the fictitious plant, by virtue of (9), can always be measured.

Next, following to [5], define

$$\begin{aligned} \beta_{\min}^{(i)} &:= \underline{b}_{ii} - \sum_{\substack{j=1 \\ j\neq i}}^{N} \max\{|\underline{b}_{ij}|, |\overline{b}_{ij}|\}, \ i = 1, \dots N, \\ \beta_{\max}^{(i)} &:= \overline{b}_{ii} + \sum_{\substack{j=1 \\ j\neq i}}^{N} \max\{|\underline{b}_{ij}|, |\overline{b}_{ij}|\}, \ i = 1, \dots N. \end{aligned} \tag{10}$$

Then, δ_0 required to ensure $\det \widetilde{B} \neq 0$ is chosen to satisfy the conditions

$$\delta_0 > -\beta_{\min} \quad \text{for} \quad |\beta_{\min}| < |\beta_{\max}|, \qquad \delta_0 < -\beta_{\max} \quad \text{for} \quad |\beta_{\min}| > |\beta_{\max}|, \tag{11}$$

where

$$\beta_{\min} := \min\{\beta_{\min}^{(1)}, \dots, \beta_{\min}^{(m)}\}, \quad \beta_{\max} := \max\{\beta_{\max}^{(1)}, \dots, \beta_{\max}^{(m)}\}. \tag{12}$$

Similar to [5, chapt. 7], the adaptive control law is designed in the form

$$u_{n+1} = u_n + \widetilde{B}_n^{-1} \widetilde{e}_n, \tag{13}$$

in which, instead of the current estimate B_n of B, the estimate $\widetilde{B}_n$ of $\widetilde{B}$ is exploited, where the error vector $e_n = y^0 - y_n$ is replaced by

$$\widetilde{e}_n = y^0 - \widetilde{y}_n. \tag{14}$$

with $\widetilde{y}_n$ given in the expression (9).

The adaptive identification algorithm used to determine the estimates $\widetilde{B}_n$ may be taken as

$$\widetilde{b}_n^{(i)} = \widetilde{b}_{n-1}^{(i)} + \gamma_n f(\widetilde{e}_n^{*(i)}, \varepsilon_i, \varepsilon_i^0) \nabla u_n \left\| \nabla u_n \right\|^{-2}, \quad i = 1, \dots, N, \tag{15}$$

which is similar to that in [5, chapt. 7]. In this algorithm,

$$f(\tilde{e}_n^{*(i)}, \varepsilon_i, \varepsilon_i^0) = \begin{cases} 0, & \text{if } |\tilde{e}_n^{*(i)}| \le \varepsilon_i^0 \\ \tilde{e}_n^{*(i)} - 2\varepsilon_i \operatorname{sign} \tilde{e}_n^{*(i)} & \text{otherwise} \end{cases} \tag{16}$$

represents the dead-zone function depending on ε_i and on an

$$\varepsilon_i^0 > \varepsilon_i, \tag{17}$$

and on the identification error

$$\tilde{e}_n^{*(i)} = \nabla \tilde{y}_n^{(i)} - \tilde{b}_{n-1}^{(i)\mathrm{T}} \nabla u_n, \tag{18}$$

where

$$\nabla u_n := u_n - u_{n-1}, \tag{19}$$

$$\nabla \tilde{y}_n^{(i)} := \tilde{y}_n^{(i)} - \tilde{y}_{n-1}^{(i)}, \tag{20}$$

and the notation $\tilde{b}_n^{(i)} := [\tilde{b}_{i1}(n), \ldots, \tilde{b}_{iN}(n)]^{\mathrm{T}}$ is introduced. The coefficient γ_n is chosen at each *n* as

$$0 < \gamma' \le \gamma_n \le \gamma'' < 2 \tag{21}$$

to ensure $\det \tilde{B}_n \neq 0$. The numbers $\varepsilon_i^0 (i = 1, \ldots, N)$ in (25) are chosen by the designer to be as close to ε_is as possible.

The feedback adaptive robust control system described in the equations (1), (3)–(21) together with (10)–(12) is designed as depicted in Fig. 1. In this figure, the symbol ∇ denotes the operation $\nabla x_n := x_n - x_{n-1}$ over any x_n.

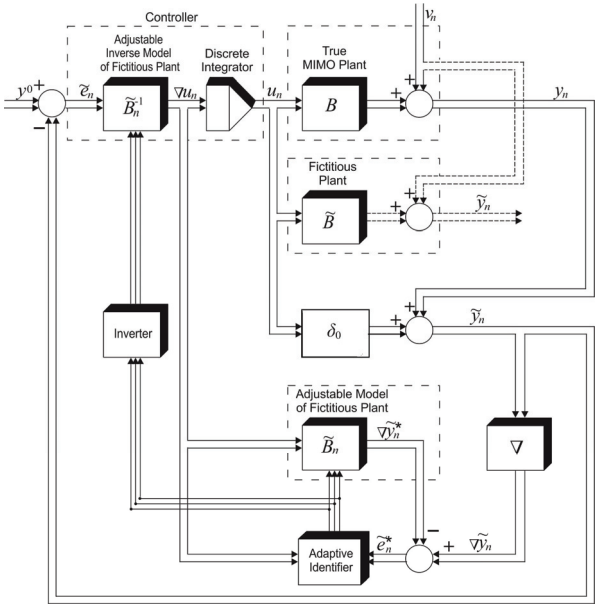

Fig. 1. Block diagram of adaptive control system

Conclusion

We have established that it is possible to design the adaptive robust controller which is capable to controlling the linear MIMO plant with unknown parameters whose transfer matrix may be singular.

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V. N. Azarskov. Doctor of Engineering. Professor.
(National Aviation University, Kyiv, Ukraine)
L. S. Zhiteckii. Candidate of Engineering. Professor.
(National Aviation University, Kyiv, Ukraine)
S. A. Nikolaienko. Postgraduate student.
(National Aviation University, Kyiv, Ukraine)

NUMERICAL ANALYSIS OF STOCHASTIC GRADIENT ALGORITHMS FOR ON-LINE LEARNING IN NEURAL NETWORK MODELS: A NEW SIMULATION RESULT

Some convergence property of the in-line learning processes in a neural network working in the stochastic environment derived via the simulation and numerical data processing is established. This property can also be shown to be valid from the theoretical point of view by exploiting standard tools given in the probabilistic asymptotic analysis.

Neural networks containing at least one hidden layer play a role of universal models for any reasonable complex nonlinear systems [1], in particular, flight control systems. This fact motivates the theoretical studies of learning algorithms for the neural network models. Significant breakthrough in the research area above mentioned has been achieved in recent works [2, 4].

This paper continues the investigation of [3, 4].

Let

$$y = F(x) \tag{1}$$

describe nonlinear unknown function describing a complex system. In this equation, $y \in \mathrm{IR}$ and $x \in \mathrm{IR}^N$ are the output scalar and input vector variables, respectively, available for the measurement at each nth time instant $(n = 1, 2, \ldots)$. This implies that

$$y(n) = F(x(n-1)) \tag{2}$$

with an unknown mapping $F: \mathrm{IR}^N \to \mathrm{IR}$.

To approximate (1), the two-layer neural network model containing M $(M \geq 1)$ neurons in its hidden layer is employed. The inputs to the each jth neuron of this layer at the time instant n are the components of $x(n-1)$. Its output signal at the nth time instant is given by

$$y_j^{(1)}(n) = \sigma\left(b_j^{(1)} + \sum_{i=1}^{N} w_{ij}^{(1)} x_i(n-1) \right), \quad j = 1, \ldots, M, \tag{3}$$

where $x_i(n-1)$ denotes the ith component of $x(n-1)$, and $w_{ij}^{(1)}$ and $b_j^{(1)}$ are the weight coefficients and the bias of this jth neuron, respectively. $\sigma(\cdot)$ represents the so-called activation function given by

$$\sigma(s) = [1 + \exp(-s)]^{-1}. \tag{4}$$

There is only one neuron in the output (second) layer, whose inputs are the outputs of the hidden layer's neurons. The output signal of second layer, $y^{(2)}(n)$, at the time instant n is determined as

$$y^{(2)}(n) = \sum_{j=1}^{M} w_j^{(2)} y_j^{(1)}(n) + b^{(2)}, \tag{5}$$

where $w_1^{(2)}, \ldots, w_M^{(2)}$ are the weights of this neuron and $b^{(2)}$ is its bias.

It follows from (3) – (4) together with (2) that $y^{(2)}(n)$ is a nonlinear function depending on $x(n-1)$ and also on the $(M(N+2)+1)$-dimensional parameter vector

$$w = [w_{11}^{(1)}, \ldots, w_{N1}^{(1)}, b_1^{(1)}, \ldots, w_{1M}^{(1)}, \ldots, w_{NM}^{(1)}, b_M^{(1)}:$$
$$w_1^{(2)}, \ldots, w_M^{(2)}, b^{(2)}]^T.$$

To emphasize this fact, define the output signal of the neural network in the form

$$y^{(2)}(n) = y_{\mathrm{NN}}(x(n-1), w) \tag{6}$$

with $y_{\mathrm{NN}}: \mathrm{IR}^N \times \mathrm{IR}^{M(N+2)+1} \to \mathrm{IR}$.

We assume that there exists at least an unique $w = w^* \in \mathrm{IR}^{M(N+2)+1}$ such that $F(x)$ can explicitly be approximated by $y_{\mathrm{NN}}(x, w^*)$ in the sense of

$$F(x) \equiv y_{\mathrm{NN}}(x, w^*) \tag{7}$$

for all x from a given compact set $X \subset \mathrm{IR}^N$. This assumption mentioned in [1, p. 304] as the ideal case.

Define the infinite sequence $\{(x(n-1), y(n))\}_{n=1}^{\infty}$ of the measurable pairs in which $x(n-1)$s are taken from X. Then, the online learning algorithm for updating the parameter estimate $w(n)$ is formulated as the following standard recursive gradient procedure:

$$\begin{aligned} w(n) &= w(n-1) \\ &+ \eta\, e(n, w(n-1))\, \mathrm{grad}_w y_{\mathrm{NN}}(x(n-1), w(n-1)). \end{aligned} \tag{8}$$

In this algorithm,

$$e(n, w(n-1)) = y(n) - y_{\mathrm{NN}}(x(n-1), w(n-1)) \tag{9}$$

is the current estimation error and the variable $\mathrm{grad}_w y_{\mathrm{NN}}(x(n-1), w(n-1))$ denotes the gradient of $y_{\mathrm{NN}}(x, w)$ at the point $w = w(n-1)$, and $\eta \equiv \mathrm{const} > 0$ is its step size (the learning rate).

To analyze the asymptotic behavior of (8), (9), the scalar non-negative function $V(w)$ given by

$$V(w) = 0 \text{ for } w = w^*, \quad V(w) > 0 \text{ for } w \neq w^* \tag{10}$$

is exploited.

In the presence of the one-point set $W^* = \{w^*\}$, the function $V(w)$ satisfying (10) is usually chosen as

$$V(w) = \| w^* - w \|^2, \tag{11}$$

where $\| \cdot \|$ denotes the usual Euclidean vector norm. It turned out that if the neural network contains the hidden layer, then W^* consists of several isolated w^*s. In particular, in the simplest case, when there is one neuron in the hidden layer ($N = 1$, $M = 1$) and the activation function, $\sigma(\cdot)$ is described by (4) W^* contains two points: $w^{*(1)} = [w_1^*, w_2^*, w_3^*, w_4^*]^T$ and $w^{*(2)} = [-w_1^*, -w_2^*, -w_3^*, w_3^* + w_4^*]^T$.

In the case when W^* is not one-point, instead of (11), $V(w)$ may be chosen as follows:

$$V(w) = \inf_{\mathbf{w}^* \in W^*} \| w^* - w \|^2 . \tag{12}$$

It can be observed that $V(w)$ specified by (12) is not continuous (in contrast to (11)).

The variable $V_n := V(w(n))$ becomes immediately the Lyapunov function of the algorithm (8), (9) if only

$$V_n \le V_{n-1} \qquad \forall n. \tag{13}$$

Since $V_n \ge 0$, the condition (13) under which V_n does not increase is sufficient for existing a limit

$$\lim_{n \to \infty} V_n = V_\infty, \tag{14}$$

where $V_\infty = V_\infty(\omega)$ is a random value (in general) depending on $w(0)$ and $\{x(n)\}$. Nevertheless, the property (13) is not necessary for existing its limit.

To study the asymptotic properties of (8), (9) in the presence of stochastic $\{x(n)\}$, one simulation experiment with the scalar nonlinear system

$$y = \frac{3.75 + 0.05 \exp(-7.15x)}{1 + 0.19 \exp(-7.15x)}$$

were conducted. This nonlinearity can explicitly be approximated by the two-layer neural network described by (3) – (5) with the components of two $w = w^{*(1)}$, $w = w^{*(2)}$ given by $w_{11}^{*(1)} = 7.15$, $b_1^{*(1)} = 1.65$, $w_1^{*(2)} = 3.45$, $b^{*(2)} = 0.3$ and $w_{11}^{*(1)} = -7.15$, $b_1^{*(1)} = -1.65$, $w_1^{*(2)} = -3.45$, $b^{*(2)} = 3.75$, respectively. In this experiment, $\{x(n)\}$ was generated as the sequence of pseudorandom variables from [-1, 1] and η was taken as $\eta = 0.01$. The duration of the learning processes was always equal to 40 000 steps.

The experimental and data proceeding results with initial $w_{11}^{(1)}(0)$ =-0.53, $b_1^{(1)}(0)$ =-0.5, $w_1^{(2)}(0)$ =-0.92, $b^{(2)}(0)$ =1.4 are presented in Fig. 1.

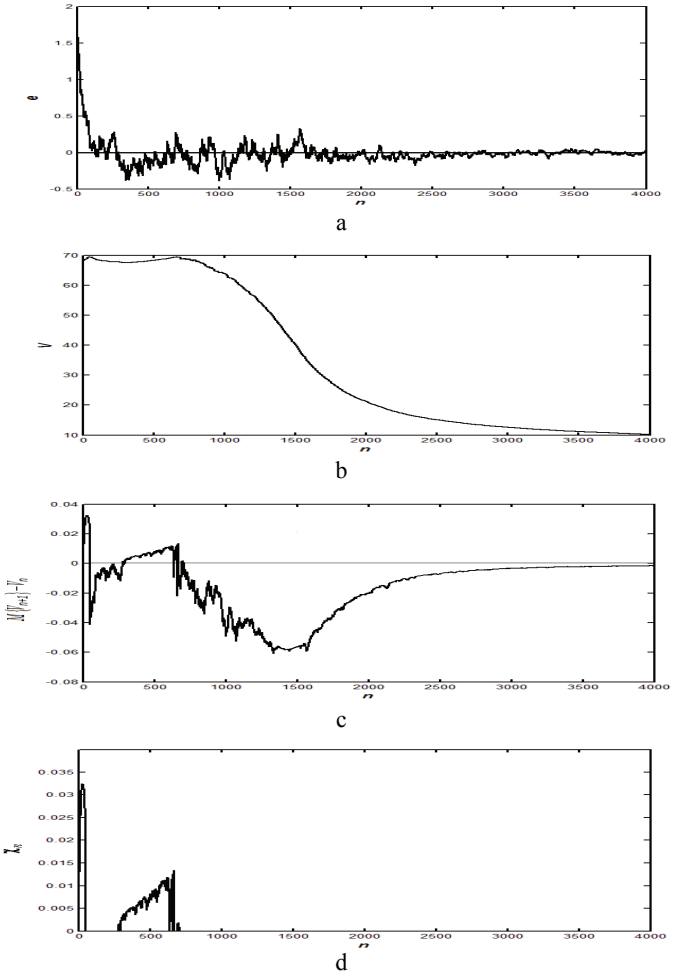

Fig. 1. The learning processes in a simulation experiment:
a= the estimation error $e(n)$; b= the function V_n;
c= the difference between the conditional expectation of V_n and its past value;
d= the variable χ_n

We observed that $\{V_n\}$ is non-monotonic. Moreover, its condition expectation $\mathsf{M}\{V_n \mid V_{n-1}, \ldots, V_0\}$ calculated numerically does not satisfy the sufficient convergence condition

$$\mathsf{M}\{V_n \mid V_{n-1}, \ldots, V_0\} \le V_{n-1} \tag{15}$$

established in [3, Theorem 3]; see Fig. 1, b. This means that if initial estimates $w(0)$ are not close to a neighborhood of $w^{*(1)}$ or of $w^{*(2)}$ then $\{V_n\}$ given by (15) does not become the supermartingale. Nevertheless, we observed that another convergence conditions defined in the expressions

$$\mathsf{M}\{V_n \mid V_{n-1}, \ldots, V_0\} \le V_{n-1} + \chi_n, \tag{16}$$

$$\chi_n \ge 0, \qquad \sum_{i=0}^{\infty} \chi_i < \infty \tag{17}$$

which can be found in [5, chapt. IV] has been satisfied. Namely, Fig. 1, c and d demonstrate the properties (16), (17) of the sequence $\{V_n\}$. Further more, it can be observed that there is a finite n^* that such $\chi_n \equiv 0$ for all $n \ge n^*$; see Fig. 1, d. These properties give that the error $e(n)$ tends to 0 as n goes to infinity (this remarkable convergence result is illustrated in Fig. 1, a).

Conclusion. Simulation examples show the successful ultimate performance of the gradient learning algorithm used for identifying of nonlinear systems in the stochastic environment by means of the two-layer neural network.

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O.A. Sushchenko, Cand. of Sc. (Eng.)
(National Aviation University, Ukraine, Kiyv)

APPROACH TO DESIGN of ROBUST SYSTEMS for STABILIZATION of UNMANNED AERIAL VEHICLES EQUIPMENT

Principles of creation of the mathematical description of triaxial system for stabilization and control by orientation of lines of sight of observation devices operated at unmanned aerial vehicles are suggested. Features of a procedure of the robust structural synthesis in respect to studied systems are considered. The results of synthesized system simulation are represented.

One of actual problems of unmanned aerial vehicle (UAV) equipment design is the necessity to ensure stabilization of observation equipment mounted on it. The observation apparatus operated at modern vehicles may include TV camera, digital camera, laser scanner and so on. Apparatus of the above listed types allows to solve the cartography and aerophotography by means of the digital photogrammetry and TV camera of the high resolution. For the cartographic survey the laser scanner may be used. Usage of this device allows to create the relief model by means of laser impulses forming and reflected signals analysis [1]. The high quality of image may be achieved by means of the system of stabilization and control by the lines of sight of devices mounted at UAV and ensuring the survey [2].

Operation of the observation equipment at UAV is carried out in conditions of external (coordinate) disturbances caused, first of all, by the wind action. Furthermore, internal (parametric) disturbances take place. These disturbances are caused by inaccuracies of the mathematical descriptions and methods used for design of observation devices. Usage of robust control provides stabilization of the useful load in conditions of UAV angular motion caused by disturbances of different kinds.

To provide the high accuracy of observation processes the stabilization of the appropriate apparatus must implemented by three axes connected with UAV. For this the stabilized platform with useful load and measuring instruments is mounted in triaxial gimbals. As measuring instruments pendulous accelerometers and fiber-optic gyros may be used.

Dynamics and kinematics of the platform with mounted on it useful loading and measuring instruments may be described by the Euler equations [3].

Moments acting on the platform include the following components such as moments of dry friction at the gimbals bearings, moments created by stabilization engines and disturbance moments.

These moments may be defined in the following way [4]

$$M_{1i} = M_{fr}\,\mathrm{sign}\omega_i\,;\; M_{2i} = c_m U_{ai} / R_a\,;\; M_{3i} = M_{dist\,i}\,;\; i = x, y, z\,, \qquad (1)$$

where M_{fr} is the nominal moment of friction in bearing mounted in the gimbals axes; c_m is the coefficient of loading at the engine shaft; U_{ai} are voltages of con-

trol windings of engine armatures; R_a is the resistance of circuit of the engine armature, $M_{dist\,i}$ are the disturbance moments.

Forming of voltages in the control winding of the engine armature may be described by the expression [4, 5]

$$T_a\dot{U}_{ai} + U_{ai} = k_{PWD}U_{PWDi} - n_r c_e \omega_i \,, i = x, y, z \,, \tag{2}$$

where T_a is the time constant of the armature circuit; c_e is the coefficient of proportionality between the angular rate of the stabilization engine and the electromotive force; k_{PWD} is the transfer coefficient of the linearized pulse-width-modulator; U_{PWDi} are voltages at the input of the pulse-width-modulator.

Voltages at the output of the angular rate sensor $U_{\omega i}$ [6] look like

$$T_g^2\ddot{U}_{\omega i} + 2\xi T_g\dot{U}_{\omega i} + U_{\omega i} = k_g\omega_i \,, \quad i = x, y, z \,, \tag{3}$$

where T_g is the time constant of the gyro sensor of the angular rate; ξ is the damping coefficient; k_g is the transfer coefficient of the gyro sensor of the angular rate.

Condition of the precision stabilization in projections of the platform axes becomes [7]

$$\Omega_X + \omega_X = 0 \,; \quad \Omega_Y + \omega_Y = 0 \,; \quad \Omega_Z + \omega_Z = 0 \,, \tag{4}$$

where $\Omega_x, \Omega_y, \Omega_z$ are the stabilization angular rates created by the engines; $\omega_x, \omega_y, \omega_z$ are the platform angular rates.

Projections of the stabilization angular rates at the platform proper axes may be described by the following relationships [6]

$$\Omega_X = \dot{\beta}\cos\varphi + \dot{\alpha}\cos\beta\sin\varphi \,; \; \Omega_Y = -\dot{\beta}\sin\varphi + \dot{\alpha}\cos\beta\cos\varphi \,; \tag{5}$$
$$\Omega_Z = \dot{\varphi} - \dot{\alpha}\sin\beta \,.$$

Using the expressions (5) and taking into consideration the relationships (4) the expressions of the platform angular rates during stabilization may be obtained in the following form

$$-\omega_X = \dot{\beta}\cos\varphi + \dot{\alpha}\cos\beta\sin\varphi \,; \; -\omega_Y = -\dot{\beta}\sin\varphi + \dot{\alpha}\cos\beta\cos\varphi \,; \tag{6}$$
$$-\omega_Z = \dot{\varphi} - \dot{\alpha}\sin\beta \,.$$

Using the expressions (6) after some transformations it is possible to obtain the differential equations of the gimbals angular rates

$$\dot{\alpha} = -\frac{1}{\cos\beta}(\omega_X\sin\varphi + \omega_Y\cos\varphi) \,; \; \dot{\beta} = -\omega_X\cos\varphi + \omega_Y\sin\varphi \,; \tag{7}$$
$$\dot{\varphi} = \sin\beta[(\omega_X\sin\varphi + \omega_Y\cos\varphi) - \omega_Z]/\cos\beta \,.$$

Expressions for control moments taking into consideration kinematics of the system may be written in the following form

$$\begin{bmatrix} M_{X(1)} \\ M_{X(1)} \\ M_{Z(1)} \end{bmatrix} = A_3^{\mathrm{T}} \begin{bmatrix} 0 \\ 0 \\ M_{Z_2} \end{bmatrix}; \begin{bmatrix} M_{X(2)} \\ M_{Y(2)} \\ M_{Z(2)} \end{bmatrix} = A_3^{\mathrm{T}} A_2^{\mathrm{T}} \begin{bmatrix} M_{X_1} \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} \cos\varphi M_{X_1} \\ -\sin\varphi M_{X_1} \\ 0 \end{bmatrix};$$

$$\begin{bmatrix} M_{X(3)} \\ M_{Y(3)} \\ M_{Z(3)} \end{bmatrix} = A_3^{\mathrm{T}} A_2^{\mathrm{T}} A_1^{\mathrm{T}} \begin{bmatrix} 0 \\ M_{Y_{ЛА}} \\ 0 \end{bmatrix} = \begin{bmatrix} \cos\beta \sin\varphi M_{Y_{ЛА}} \\ \cos\beta \cos\varphi M_{Y_{ЛА}} \\ -\sin\beta M_{Y_{ЛА}} \end{bmatrix}. \quad (8)$$

The robust structural synthesis of the stabilization system requires usage of the linearized model in the state space. Such model may be created based on the following suppositions such as neglecting by centrifugal platform moments and difference of the axial platform moments; smallness of angles of the platform turns; change of the nonlinear friction moments by the linearized ones; linearization of the pulse-width-modulator model; neglecting by the disturbances moments acting on the platform.

One of modern approaches to the structural synthesis of robust stabilization systems is H_∞-synthesis. Its basic principles are represented in many textbooks, for example, [4], [5]. For design of any control system by means of H_∞-synthesis it is necessary to use the standard configuration, which includes the plant G and the controller K. Such configuration may be characterized by the optimized output vector z, vector of the output input signals w, vector of controls u and the vector of measured signals y entering to the controller input. The statement of H_∞-synthesis problem uses a concept of the so-called interconnected system [5].

The optimization problem of the robust structural synthesis may be represented in the following form [4, 5]

$$K_{\mathrm{opt}} = \arg \inf_{K_{\mathrm{opt}} \in K_{\mathrm{per}}} J(G,K), \quad (9)$$

The optimization problem (9) may be solved by the method of the mixed sensitivity [4, 5]. The modern approach to solving the robust structural optimization problem is based on forming desired frequency characteristics of the synthesized system (loop shaping) by means of the plant augmentation using the weighting transfer functions [5].

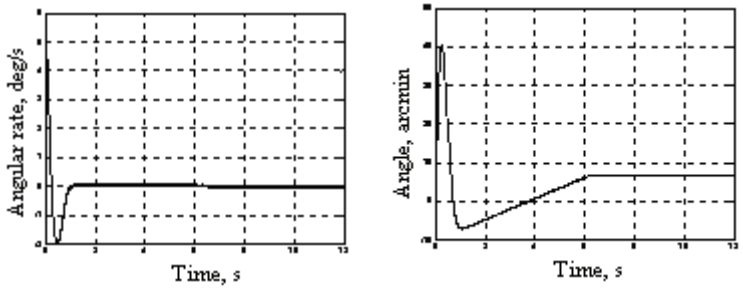
Implementation of a computational procedure based on H_∞-synthesis by the method of the mixed sensitivity includes solution of two Riccati equations, check of some conditions and minimization H_∞-norm of the function of the mixed sensitivity [4, 5]. Notice, that there are automated means of this problem solving, which are based on usage of MatLab.

Method of the mixed sensitivity foresees usage of the optimization criterion based on H_∞-norms of the sensitivities functions of the augmented system [4, 5].

$$J(G,K)=\left\|\begin{bmatrix} W_1(I+GK)^{-1} \\ W_2K(I+GK)^{-1} \\ W_3GK(I+GK)^{-1} \end{bmatrix}\right\|_\infty = \left\|\begin{bmatrix} W_1S \\ W_2R \\ W_3T \end{bmatrix}\right\|_\infty , \quad (10)$$

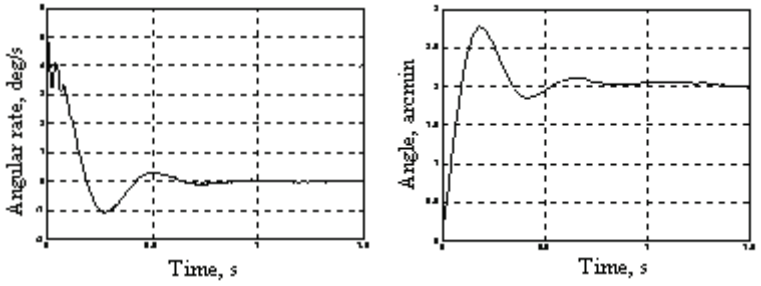
where W_1, W_2, W_3 are the weighting transfer functions; S, R, T are the sensitivity function by the command signal and control and the complementary sensitivity function.

Results of simulation of the synthesized system are represented in Figs 1, 2.



a *б*

Fig. 1. Results of simulation of the platform motion in the mode of the previous stabilization: *a* is transient by the angular rate; *b* is transient by the attitude error



a *b*

Fig. 2. Results of simulation of the platform motion in the mode of the precise stabilization: *a* is transient by the angular rate; *b* is transient by the attitude error

At the represented graphs as disturbance UAV angular rate was considered. Represented results prove the possibility to achieve the acceptable quality indices by stabilization accuracy and speed of operation in complex conditions of external disturbances action.

The procedure of the robust structural optimization based on H_∞ -synthesis includes such phases as creation of the mathematical description both linearized and taking into consideration non-linearities inherent to real systems, choice of

weighting transfer functions, augmentation of the plant and namely the structural synthesis. These phases may be implemented by means of Robust Control Toolbox representing MatLab component.

One of the most responsible phases of the robust structural synthesis procedure is choice of weighting transfer functions based on heuristic approaches.

Conclusions

The basic approaches to the robust structural synthesis of the system for stabilization of observation equipment operated at UAV are represented. The basic principles of mathematical description creation of the system ensuring stabilization and control by orientation of lines of sight of observation devices are represented. Efficiency of suggested approaches is proved by results of synthesized system simulation.

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V.M. Azarskov, doctor of technical sciences
(National aviation university, Ukraine, Kyiv))
S.S. Devyatkina, candidate of technical sciences
(National aviation university, Ukraine, Kyiv)

PROBLEMS OF IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEM ON CIVIL AVIATION AERODROMES

Development and implementation of safety management systems on civil aviation aerodromes is required by modern ICAO standards and regulations. This problem is very important and has some peculiarities concerning Ukrainian civil aviation aerodromes; that is why special approach must be designed. The practical implementation of this approach gives the possibility to create step-by-step effectively operating safety management system.

Main task of aviation-transport system is to make aviation transportations profitable and safety. The conception of flight safety has changed during last five years. According to modern requirements of International civil aviation organization (ICAO) – Standards and Recommended Practice (SARPs) – "safety" means minimum acceptable risk level but not zero risk level (as it was considered earlier). The ICAO SARPs [1] gives the following definition of safety – the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.

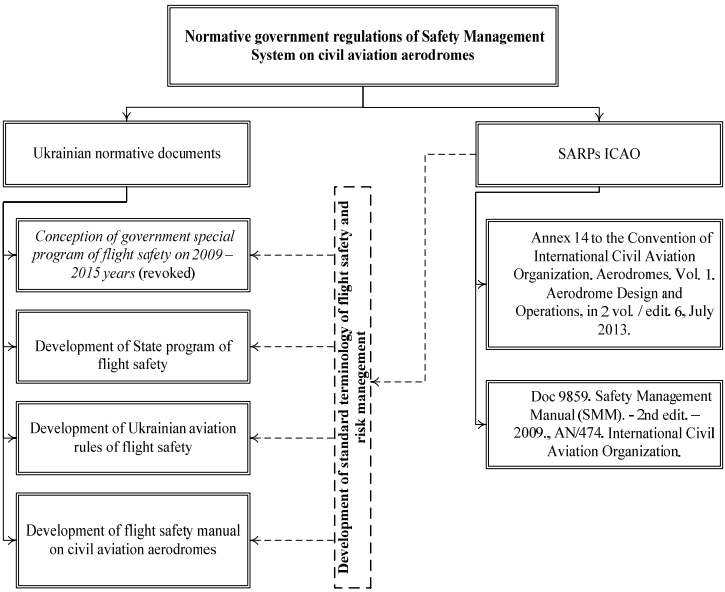
This new concept of safety requires an application of new approaches to flight safety definition, evaluating, monitoring, guarantying and prognostication. For this purpose ICAO recommends to create Safety Management System (SMS) for everyone, to whom it may concern, including civil aviation aerodromes. The SMS represents a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures. In the basis of SMS there is a risk control concept.

As far as civil aviation aerodrome is complex, interlinked, multifunctional and multilevel organization with a lot of employees with their responsibilities – the implementation of effective SMS requires special scientific approach and must be realized in different consecutive stages. Moreover there are some special Ukrainian peculiarities such as absence of national normative documents, difficulties with ICAO SARPs legalizations, pure financing of scientific researches and aerodromes' modernization, expired aerodromes' equipment etc.

The main idea of this report is to present the way of SMS implementation on Ukrainian civil aviation aerodromes, divided by several consecutive stages. Each stage requires solving number of problems – both scientific and organizational kinds.

The development of effective SMS for civil aviation aerodromes is impossible without solving some problems on State authority level. These problems are mainly concerned the development of modern normative documents which must be

in conform to ICAO and European regulations. Solving these problems is the zero stage of SMS implementation on civil aviation aerodrome (Pict.1).



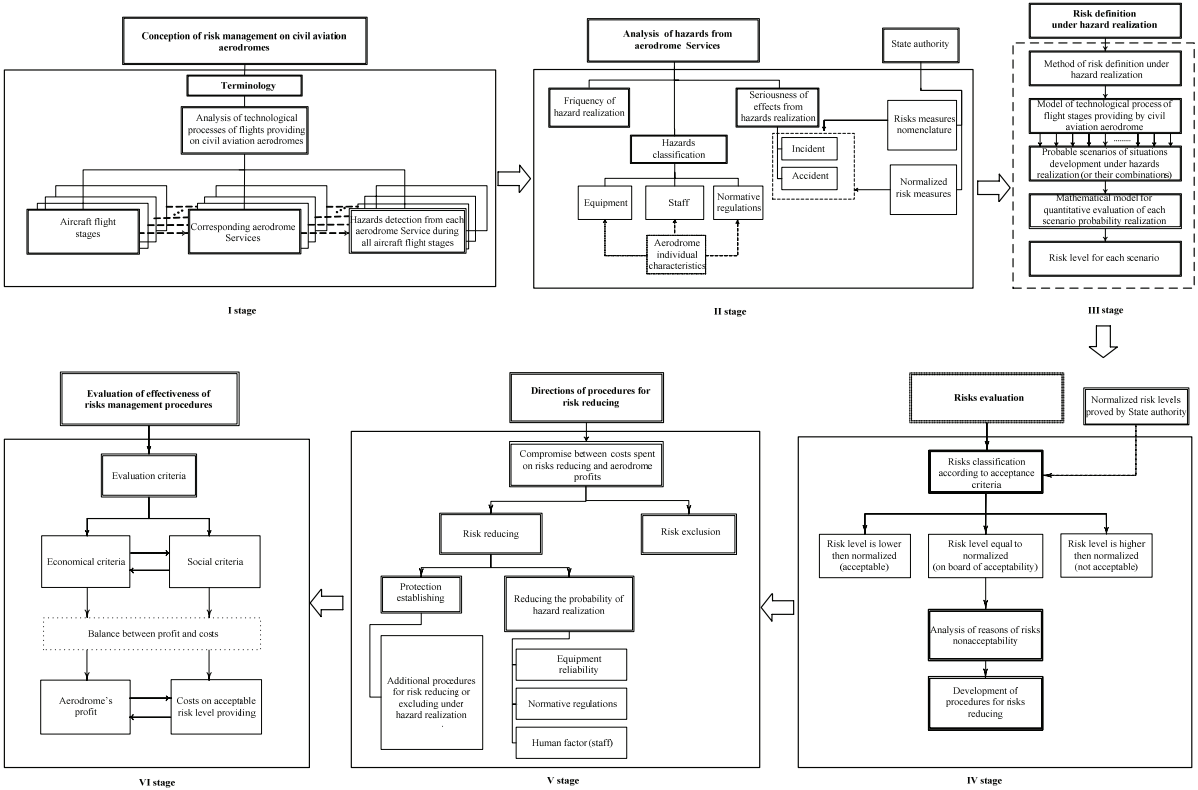
Pict. 1. Zero stage of development and implementation of SMS on civil aviation aerodrome

There are six stages of SMS implementation described in details on the Pict. 2.

The fist stage represents the transfer from old conception of flight safety providing to new conception of flight safety managing, based on risk concept. The main problem here is to create standard terminology in the area of flight safety. United standard terminology for State authority, aerodromes, airlines, air traffic control service and educational organizations is a key factor to having a single meaning in the area of flight safety managing on all levels.

On this stage it is necessary to define the phases of flight which provide maximum risks – for aerodromes it is a visual piloting phase – final approach, landing, take-off (especially during low visibility procedures) and taxing. After that, it is necessary to analyze activities of each aerodrome Services with the aim to identify hazards which may occur because of these activities.

During the next stage it is necessary to make detailed analysis of hazards connecting with aviation staff activities, content of State and aerodrome internal standards and regulations, reliability of aerodrome flight providing equipment. Aerodrome individual characteristics, for example, displaced threshold, high obstacles on aerodrome area, short or curved runway, lateral wind, aerodrome location in the center of the city etc.



Pict. 2. Stages of SMS implementation on civil aviation aerodromes

The aim of analysis is to identify maximum possible number of hazards; this analysis must be continuously repeated as an essential part of aerodrome SMS operation. For quantitative analysis of risks produced by hazard realization, State authority must develop nomenclature and normalized levels of risks measures for aerodrome.

On the third stage Method of risk measures definition must be established by authorized scientific research organization. In the basis of this Method the Model of technological process of flight phases providing by civil aviation aerodrome is placed. This general model is divided by local scenarios which cover all probable hazards and their probable influences on flight result. To get the probable risk value of accident or incident on the outcome, each scenario is described by corresponding mathematical model.

After definition of risk level on the next (fourth) stage it must be evaluated in accordance with normalized levels, proved by State authority. If the risk level is in not more then normalized value then after fourth stage proceed to the sixth stage (avoid fifth one). If risk level is more then normalized (or on the board of normalized level) then proceed to the stage of risk reducing.

On the fifth stage probable ways of risk reducing are considered. They are directed into two ways – the fist way – is to reduce the probability of hazard realization, the second one – is to establish proper protection which will work if the hazard occurs. If it is not possible to reduce a risk down to normalize level its necessary to exclude it. It will probably have negative influence on aerodromes profits that is why, they are extreme measures.

The last stage of SMS implementation is to evaluate its effectiveness by using of two criteria – economical and social one. The dilemma of profits and costs spend on flight safety – is the most important dilemma for aviation organizations. From the one hand earning maximum profit is the most important task of any commercial company (aerodrome as well), from the other hand, providing maximum safety is the most important social task of aviation company. Moreover, the only accident, happened with aircraft causes so huge material losses that may lead to bankruptcy of airline and big loss for aerodrome, including a negative resonance in the society because of human lives loss.

Implementation of SMS on the civil aviation aerodromes made step-by-step with using grounded scientific approach will lead finally to creation effective, permanently developable and improvable system which consolidate experts on proper places equipped with common idea, knowledge, terminology, standards and regulations with the aim to get maximum possible flight safety level.

The way to creation such ”ideal” SMS is not easy, it requires of solving number important problems in many areas.

At fist, as it was mentioned previously, it is the problem connected with creation of Ukrainian normative documents and regulations which must be in compliance with SARPs ICAO and Europe Joined Aviation Requirements, as well as development of common standard aviation terminology. The creation of normalized acceptable flight safety level which is close (or ideally equal) to world-wide level is the key factor for operating SMS in all aviation organizations.

Secondly, there are number of problems connected with making scientific researches for SMS implementation and operation in civil aviation aerodromes:

- developing internal standards and regulations in flight safety managing area (for example, Manual of flight safety (risks) managing for civil aviation aerodrome;
- establishing acceptable and target flight safety levels and corresponding values for flight safety (risks) measures nomenclature;
- probable hazards identification and their seriousness of effects evaluating for all aerodrome activities provided by corresponding Services;
- development of Method of risks definition, evaluating and normalizing for aerodromes activities for aircrafts flight providing;
- development of measures directed to risks reducing or exclusion for all types of aerodromes activities for aircrafts flight providing.

Thirdly, there are number of organizational problems connected with creation of SMS on the aerodrome or modernization of existing structure for flight safety providing. This problem is connected with human factor – corporative culture and human mentality.

Finally, this problem is the most important, because even "ideal" managing system with all necessary structure, documentation support, regulations and reliabilities will not operate effectively without motivated, highly educated team with high level of corporative culture. That is why, many efforts must be directed also to increasing aviation stuff knowledge in flight safety managing area – everyone must be involved in managing process on corresponding level. Only under this condition SMS will operate effectively.

Conclusions

New risk conception, recommended by SARPs ICAO, is the modern approach to flight safety managing instead of flight safety providing. According to ICAO requirements, Safety management systems, based on this conception, must be created and implemented for all basic aviation organizations [2].

Complex scientific approach to step-by-step implementation of SMS on civil aviation aerodromes will guarantee the creation of effective SMS. In parallel with solving the organizational problems, connected with SMS creation, the number of scientific problems must be nesesserely solved.

The implementation of effective SMS on civil aviation aerodromes will give the possibility to manage risks level on all phases of aircrafts' flight providing.

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A.V. Vishnevsky, Ph.D. (National Aviation University, Ukraine, Kiev)

2D FRACTAL MODEL OF AN AIRPLANE WITH 2 SET RADIATIVE ANTENNAS

Abstract. Frequency-spatial division of regular antennas of air-flying vehicle must lean on previous calculations, which it is expedient to conduct yet on the stage of planning of airplane which will allow to get a corresponding economic effect because of costliness and great labour amount of model tests method.

Solution of 3D electromagnetic problems is hard even today. It is very often still impossible to build a good 3D finite elements model (FEM), that can be treated with appropriate engineering software, like programs dealing with electromagnetic compatibility research.

So, how to get rid of this "modeling jam", keeping the object's 3D geometry for FEM processing and at the same time being able to overcome those huge (sometimes hundred thousands or even millions elements sized) matrices factorization crashes, when inverting them in order to find out a desired solution?

Related Works. We want to propose an approach based on well known phenomenon of nature having fractal inner structure [1]. So, if to change in a moment - this harsh for computing 3D electromagnetic model into easy operated 2D clone without losing credibility and satisfactory (at least) verification of the solution got for the task dealt with, all it will give a great push for FEM research science, especially for PC simulation research, compared to experimental investigation algorythms. How to do this?

Well, the answer looks to be obvious: of course by slicing initial 3D EMM to a number of 2D "images" [2] that could be understood as some "fractals" [1] of initial more complex topology.

Electrodynamics. We've taken Comsol® modeling environment for evaluation of EMC of 2 antennas set on a fuselage of an aircarft. The differential equation in partial derivatives for description the physical processes for this model is [3]:

$$\nabla \times (\mu_r^{-1} \nabla \times E) - (\varepsilon_r - j\sigma / \omega\varepsilon_0) k_0^2 E = 0 ,$$

where μ_r - relative magnetic permeability;

E - intensity of electric field at the monitoring point, (*V/m*);

ε_r - relative dielectric permittivity;

σ - conductivity of a proxy element, (*Sm/m*);

ω - circular frequency of oscillations, (Rad/s);

$\varepsilon_0 = 10^{-9} / 36\pi$ - electric constant, (*F/m*);

$k_0 = \frac{2\pi}{\lambda}$ - wave number;

λ - wavelength of oscillations, (*m*).

This ordinary differential equation in partial derivatives is derived from Maxwell's equations. It is solved by Comsol® software with help of numerical methods.

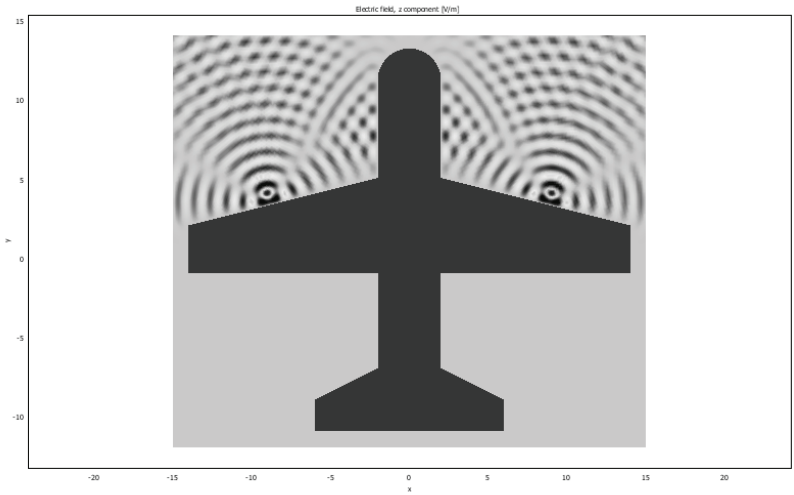

Fig. 1 Radiation pattern of 2 point antennas installed in the middle of the wings of the 2D plane fractal

It was taken as many as 62208 triangilar elements to build an appropriate FEM. Calculations were done in 82,656 sec. using a modest laptop.

Research at 300 MHz. We place 2 point antennas with current I=1A on the wings of an *yz*-fractal slice of a hypothetic aircraft (we are not binding ourselves yet to some more practical model, which can be done comparatively easy later on).

It's nothing more than just a 2D fractal of initial 3D aircraft's FEM model (not shown in the paper for no need).

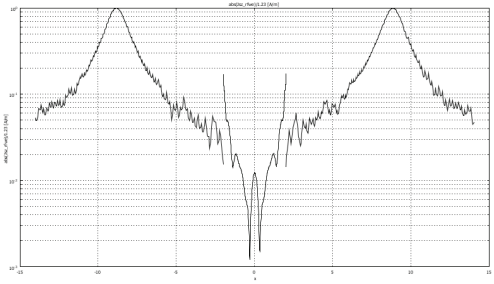

Fig.2 Point antenna on the middle of the wings, 300 MHz, currents distribution along x-axis

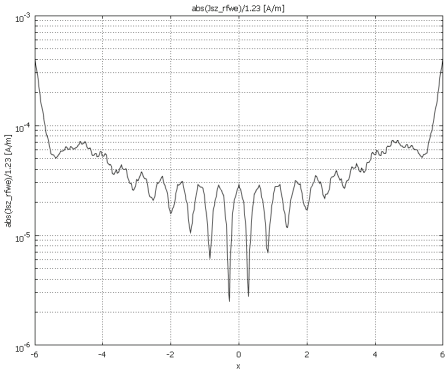

Fig.3 Point antenna on the keel, 300 MHz, currents distribution along x-axis

Conclusions

From fig.2 it can be easily seen, that due to this method realization implemented in the paper, for 300 MHz it's *undesirabe* to put a third antenna in any places near the middle of the wings; This is so because the fuselage currents induced from antenna radiation are *the highest* in these regions. So, they will produce the highest electromagnetic fields around the fuselage and this will result in worsening of EMC situation in the Fresnel zone (close to the airplane's fuselage), if any allocation of a third antenna takes place. It is advisable to put a third antenna on the keel, because fig.3 shows very low currents on it. This method helps to overcome difficulties met when trying to deal with realistic-like 3D FEM models of aircrafts (possible number of FEM elements for such models can exceed hundreds of thousands and even millions, which means huge matrices and their very complex, PC-resource-consuming factorization needed for numerical methods application),

helicopters, other multiple-antenna carrying vehicles. It establishes the rules of constructing equivalent 2D models of such systems, and, after doing so, gives the algoriths of making the final verdict about the antennas installations spots on the airplane's fuselage. This routine can save a lot of money on the stage of aircraft's construction.

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UDC 534.1

V.N. Azarskov, Prof., D.V. Gristchak, Dr. Sci., D.D. Gristchak
(National Aviation University, Kiev, Ukraine)

OSCILLATION DAMPING OF AIR-SPACE STRUCTURES WITH JOINT-UP DYNAMIC ABSORBER

Two-step hybrid asymptotic method on the basis of perturbation and phase-integral or WKB methods are used for approximate analytic solution of nonlinear vibration problem of air-space structure with joined dynamic absorber near disturbed surface to be found. An approximate analytic solution is unbounded with the dimensionless value of disturbance range and degree of nonlinearity of restoring forces is proposed.

During the active control of the aircraft with a load, which influences it, the object of the control is united by the feedbacks with the automatic control system, including measuring, calculating, amplifying, correcting and actuation devices. As a result governing impact on the aircraft as an object of the control depends on the motion variables. Variable parameters of the stabilization controller (attached mass parameters) are added to the number of the joint coordinates, which describe the object motion. And it leads to the significant elevation of the dimensions of the resolving equations system. Due to the influence of the regularly-disturbed (particularly water) surface the aircraft, under specific motion modes, executes forced vibrations in the pitching plane as well as in the area of the careen [1]. Of specific interest, from the point of view of the dynamic effects appearance is a case of the coupled vibrations during the fly at the optional angle φ to the wave. Mechanical analog of this dynamic process may be a vibrations model of the mathematical pendulum with a suspension center waggling according to the desired law, and with a length, which is the temporal function. It should be mentioned, that existing solutions, as a rule, are reduced to the solution of Mathieu-Hill equation on the conditions that the recuperate moment has non-linear (particularly cube) character [3], and dimensionless amplitude of the parametric excitation is a small quantity.

In this paper based on the hybrid asymptotic approach [2-4] we suggest an approximate analytical solution of the problem of the damping vibrations of the aircraft with joined dynamic absorber near the disturbed surface in the cases, when the recuperate moment has nonlinear character of the range m, and dimensionless amplitude of the disturbance μ may not to be the small quantity as in this case the degradation of the dynamic behavior of the aircrafts is possible.

Differential equation system, describing of oscillation process «Aircraft – dynamic absorber» is as follows [1]:

$$\begin{aligned} I_x\ddot{\gamma}(t)+n\dot{\gamma}(t)+C_{11}\gamma(t)+C_{22}\gamma^m(t)+I_{x0}\left(\ddot{\gamma}+\ddot{y}^0\right)=0,\\ I_{x0}\left(\ddot{\gamma}+\ddot{y}^0\right)+n_0\dot{\gamma}^0(t)+C_1\gamma^0(t)=0. \end{aligned} \quad (1)$$

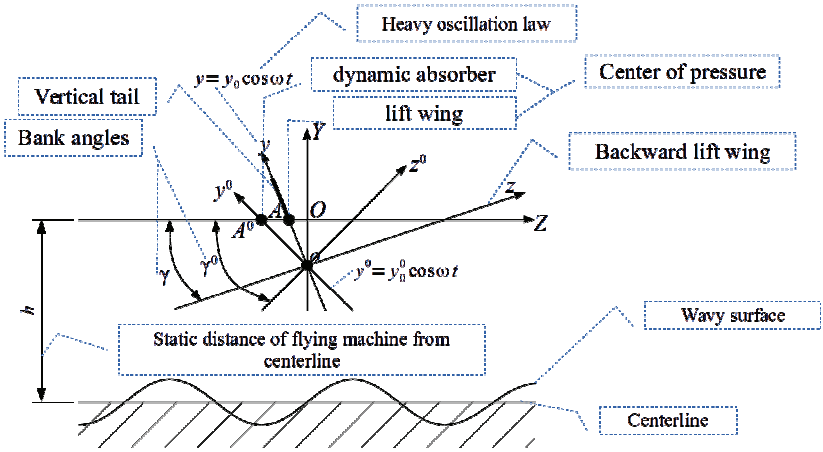

Fig. 1 – Computational scheme

In given computational scheme the frame of axis y^0oz^0 is related to the dynamic absorber.

With due regard to the second equation of the system (1) the main differential tangage motion equation acquires the form

$$I_x\ddot{\gamma}(t)+n\dot{\gamma}(t)+C_{11}\gamma(t)+C_{22}\gamma^m(t)=F\left(\gamma^0,t\right), \tag{2}$$

where

$$\begin{gathered} F\left(\gamma^0,t\right)=n_0\gamma^0(t)+C^0\gamma^0(t), \\ n=n_0+n_1+n_2+n_3; \end{gathered} \tag{3}$$

n_0 refers to the dynamic absorber; n_1 – to lift wing; n_2 – to stabilizer; n_3 – to vertical fin.

Therefore, the problem with attached dynamic absorber reduces itself to previous one with due regard to the right part $F\left(\gamma^0,t\right)$ in initial equation. Coefficients c_{11}, c_{22} are defined by the formulas from [1]:

$$\begin{gathered} c_{11}=c_1+c_2\,;\quad c_{22}=c_1\,3l_1^2/\left(7h_1^2\right)+c_2\,3l_2^2/\left(7h_2^2\right); \\ c_1=2\alpha_1 q l_1^3/\left[5\bar{h}_1^2\left(1+6/\lambda_1^2\right)\right]; \\ c_2=2\alpha_2 q l_2^2/\left[5\bar{h}_2^2\left(1+6/\lambda_2^2\right)\right]; \end{gathered} \tag{4}$$

q – air pressure; l_1, l_2 – wing semi span $\bar{h}_1$, $\bar{h}_2$ – relative wings to screen distance; λ_1, λ_2 – unit elongation; α_1, α_2 – numerical factors, n – total damping factors.

Assuming

$$h_1=h_2=h^*=h+I_0\cos\omega t \tag{5}$$

and taking into consideration repetitive addition of vertical oscillations (aircraft) in pitch plane, and introducing non dimensional time

$$2\tau = \omega t\,, \tag{6}$$

we will get the basic problem of nonlinear homogeneous equation in a following form:

$$\frac{d^2\gamma}{d\tau^2} + \nu\frac{d\gamma}{d\tau} + (a - 2\mu\cos 2\tau)\gamma + \eta\gamma^m = 0\,, \tag{7}$$

where

$$\nu = 2n/(I_x\omega);\quad a = 4c_{11}/(I_x\omega^2);\quad \eta = 4c_{22}/(I_x\omega^2);\quad \mu = aI_0/h = ka\,. \tag{8}$$

In general equation (7) can take the form:

$$\varepsilon^2\ddot{\gamma}(\tau) + \overline{\nu}\dot{\gamma}(\tau) + b(\tau)\gamma(t) + \overline{\eta}\gamma^m(\tau) = 0\,, \tag{9}$$

where

$$(\,)' = \frac{d(\,)}{d\tau};\quad b(\tau) = \frac{a}{\mu} - 2\cos 2\tau;\quad \varepsilon^2 = \frac{1}{\mu};\quad \overline{\nu} = \frac{\nu}{\mu};\quad \overline{\eta} = \frac{\eta}{\mu};\tag{10}$$

ε и $\overline{\eta}$ – scalar characteristics.

General solution of linear problem with due regard to introduced definition (5)-(7) based on the equation

$$\varepsilon^2\ddot{\gamma} + \overline{\nu}\dot{\gamma} + (1 - 2\overline{\mu}\cos^2 2\tau)\gamma = \overline{F}(\gamma, t) \tag{11}$$

where

$$\varepsilon^2 = \frac{1}{a},\quad \overline{\nu} = \frac{\nu}{a},\quad \overline{\mu} = \frac{\mu}{a},\quad \overline{F} = \frac{F}{a},\quad \nu = \frac{2n}{I_x\omega} \tag{12}$$

takes the form

$$\gamma(\tau) = \gamma_{\text{o}}(\tau) + \gamma_{\text{н}}(\tau)\,, \tag{13}$$

where $\gamma_{\text{o}}(\tau)$ – WKB solution of homogeneous equation; $\gamma_{\text{н}}(\tau)$ – particular solution of inhomogeneous solution of linear equation (11) is as follows:

$$\gamma_0(\tau) = \exp\int -\frac{\nu}{2}d\tau\cdot[C_1\,\mathrm{sh}I(\tau) + C_2\,\mathrm{ch}I(\tau)], \tag{14}$$

where

$$I(\tau) = \int \varepsilon^2\left(\frac{\nu^2}{4} - 1 + 2\overline{\mu}\cos^2 2\tau\right)^{1/2} d\tau \tag{15}$$

under condition $\nu = \text{const}$.

Integral (15) appears from transformation, related to elimination of the first derivative of the equation (7) by:

$$\gamma_0(\tau) = U_0(\tau)\exp\int -\frac{\nu}{2}d\tau\,. \tag{16}$$

By way of example system with the following parameters is studied:

$$a = 100\,,\quad \nu = 20\,,\quad \mu = 50\,,\quad \varepsilon^2 = \frac{1}{a} = 0{,}01\,. \tag{17}$$

General solution of nonhomogeneous linear problem takes the form:

$$\gamma_{\text{н}}(\tau) = \exp(-10\tau)\left\{\left[1 + \widetilde{C}_1(\tau)\right]\sin a + \left[0{,}9 + \widetilde{C}_2(\tau)\right]\cos a\right\}. \qquad (18)$$

Comparison of numerical and analytical solutions of homogeneous linear equation of problem is given below on Fig. 2.

Influence of dynamic absorber at solution of nonlinear inhomogeneous problem is presented on Fig. 3.

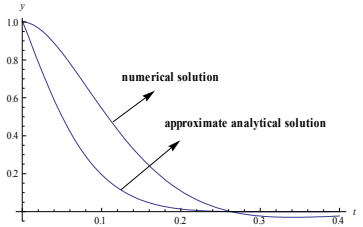

Fig. 2 – Comparison of numerical and analytical solutions of inhomogeneous linear equation of problem

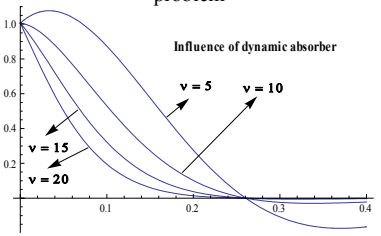

Fig. 3 – Influence of damping coefficient with due regard for dynamic absorber

Solution of nonlinear nonhomogeneous equation (2) with account of (14) and (18) is presented in the form:

$$\gamma^{\text{н}}(\tau) = \gamma_{\text{н}}(\tau) + \eta\gamma_0(\tau)^m\,, \qquad (19)$$

where η is the parameter of perturbation.

Results of numerical analysis of obtained an approximate solution are given below on Fig. 4-5.

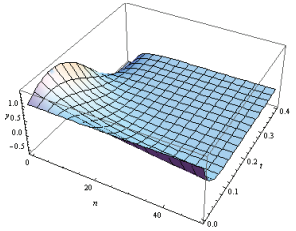

Fig. 4 – Influence of damping coefficient with regard for dynamic absorber

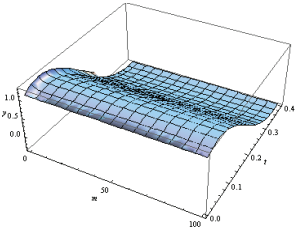

Fig. 5 – Influence of nonlinearity degree of problem

Conclusions

On the basis of hybrid asymptotic approach analytical solution of nonlinear problem of dynamics of flying machine near wavy surface is suggested. As comparison of results on the basis of suggested analytical solution and direct numerical integration of initial equation has illustrated, solution of the problem significantly depends on degree m of its nonlinearity and value of dimensionless disturbance range μ. On the certain time variation range behavior of studied system is not sensitive towards indicator of nonlinearity m. Influence of parameter value of nonlinear η the character of dynamic process of studied system was investigated. For widening the range of oscillation of scalar parameters of asymptotic decomposition the usage of hybrid WKB-Galerkin method (interior asymptotics) on the basis of perturbation method (exterior asymptotics) is considered prospective.

Suggested in the article hybrid asymptotic approach can be efficient in the cases when distance h of flying machine from midline of wave is the function of time (presence of variable coefficient at nonlinear component) and portability of damping coefficient n, that is prospective for further investigations of dynamic stability of flying machine near wavy surface.

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UDC 681.5.013 (045)

A.V. Vishnevsky, Ph.D. (National Aviation University, Ukraine, Kiev)

THE NEURAL REALIZATION OF AN ELECTRONIC COMPOSER

Abstract.The neural scheme of structure, capable for creating voice series for influences on the object of control – human brain – has been offered

Introduction. It Has Been Studied, Tried, Tested, and a Proven Fact that music.... lowers blood pressure, boosts immunity, eases muscle tension, reduces stress, increases/decreases energy, influences emotion, produces changes in brain wave activity, lowers the breathing /heart rate, relieves depression /anxiety.

Academician V.M. Glushkov more than forty years ago commenced the new ways to improving systems' characteristics based on AI programs [1]. But a lack of true followers shelfed the great possibilities opened to late-bloomers. They [2-3] try to establish the fresh connections between the era of AI-beginners and modern fusion-styled scientific cooking of object-oriented programming www-blessed followers. Building a powerful shrewd conforming routine (based in our case on [4]) able for clever classical music composing should be a rich grant for any open-minded wisher in this area.

The neural scheme. Here we shall offer an AI-supported programming classical music writing robot routine.

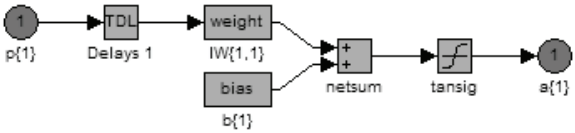

Fig. 1 The neural scheme

Fig. 1 shows a generalized view of the neural scheme. In this scheme the weight coefficients circuit hasn't been depicted yet. It's been opened up in fig.2.

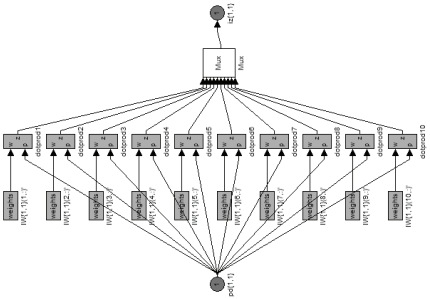

Fig. 2 The weight coefficients circuit

Here it has been revealed the inner philosophy of two random processes routing, of which the first being vector $p[i]$ (our initial signal, coming from the output of GCS - generator of control signals), when the second being $w[i]$ (vector of the weight coefficients.)

Fig. 3 gives the practical realization algorithm for 7-notes-chord parallel processing. Here "x" stands for multiplier, "$\sum$" for adder and "►" arrow sign for a transfer function.

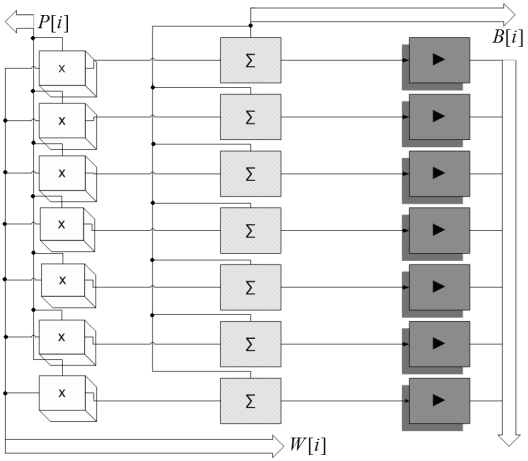

Fig. 3 NN architecture for 7 notes parallel processing (7-notes chord)

$P[i]$ stands for input vector, $W[i]$ - for weight coefficients vector and $B[i]$ for bias vector if used any.

On the other hand, it is possibe of use the 7-neuron NN as one complex 7-input neuron in a matrix scheme, combined of such neurons. The number of neurons Ni, j in it should be defined from practical needs for musical information being processed.

The music composed can be correlated to a number of initial musical sources, giving, for example a fusion of Bach, Mozart and Lesia Dychko or autocorrelated resulting in "shifted" melodies, tempos, harmonies.

Or, the process of music composing can be seen from the point of independent N algorithms realizations leading to "mixing up" their musical text under a certain governing routine applying specific weights and biases and in such a way organizing "collective work" of virtual composers 1,2,…N.

Of course, it all can be deemed as a complex neuron, too. One can then use a NN combined form those neurons, and so on.

Usually the notes are being generated with uniform distribution of random process realization, but having used Newran02 library for C++ we now can generate them with normal distribution. It makes the music more "natural" for ear.

```
// TestNewranNormal5.cpp : Defines the entry point for the console application.
//
#include "stdafx.h"
#include <iostream>
#include <C:\Users\lyo.KYIV\Documents\Visual Studio
2013\Projects\TestNewranNormal5\newran02\newran.h>
int _tmain(int argc, _TCHAR* argv[])
{
Normal Z;
int a;
for (int i = 0; i < 100; i++){
cout << Z.next<<"\n";
}
cin >> a;
return 0;
}
```

Fig.4 Normal distribution random numbers gereration with help of Newran02 library.

Choice of transfer functions, used in NN, can significantly impact the quality of musical text being produced by the virtual composer. Besides, transfer functions can "breathe" under a control of special routine, molding their response. Interesting results gives using a transfer function based on fractional derivatives equation solution [5].

A general matrix equation connecting input (P), weights (W) and output (A) is showed below. It works for any NN-structure possible (it's given without taking into account biases vector B).

$$\begin{vmatrix} w_{1,1} & w_{1,\dots} & w_{1,i} \\ w\dots & w\dots & w\dots \\ w_{1,j} & w_{\dots,j} & w_{i,j} \end{vmatrix} \begin{vmatrix} P_1 \\ P\dots \\ P_j \end{vmatrix} = \begin{vmatrix} A_1 \\ A\dots \\ A_{i,j} \end{vmatrix}$$

Conclusion

The neural scheme of an electronic composer has been given in this paper. This neural scheme should be translated into a PC program or subroutine, that will help to develop virtual music creating software [6-7]. It is a feedforward NN that can be realized both in one- or multilayered versions. The number of hidden layers depends on a musical task given. A lack of feedbacks and target vectors leads to a very quick "on-line" processing mode, that allows to compose large musical texts in the twinkling of an eye. This helpful instrument can significantly reduce monotonous, routine, drudgery work when creating musical texts of a steady emotive temper.

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UDC:621.375.826

V.V. Chikovani D.Sc (National Aviation University, Ukraine, Kyiv)
O.V. Petrenko (Kyiv plant Automatics)
H.V. Tsiruk (National Aviation University, Ukraine, Kyiv)

PRECISE VIBRATORY GYROSCOPE BASED ON RESONATOR MADE OF ELINVAR ALLOY

Abstract. Coriolis vibratory gyro developed by Ukrainian specialists is shortly discussed in this work. Elastic wave digital control system block diagram is presented. Bias stability characteristics is presented. Results of mean time between failure estimation for different environmental conditions are also presented in this work.

Introduction. Coriolis vibratory gyro (CVG) is one of the chronologically last gyroscopic technology appeared in the market in 90-th years of the last century. This technology for sufficiently short time has spread over the world not only because it showed qualities which have not another, competitive, mainly optical technologies (fiber-optic (FOG) and ring laser gyro (RLG) technologies), but because CVG technology lends itself to microminiaturization and has resulted in creation of micro gyro based on microelectromechanical system (MEMS gyro). At present time MEMS gyros are widely used in real practice and are the subject of intensive investigation in all high technology countries of the world.

CVG can operate in two modes: force-rebalance or rate mode and whole angle or rate integrated mode [1]. Comparatively recent investigations, first of all in Ukraine [2, 3], have resulted in creation of third, differential mode of CVG operation for ring-like resonators. Third mode of operation has complemented two other CVG modes having additional capabilities to compensate for the external mechanical disturbances like shock and vibration. At present time investigations are going on to reveal differential CVG capability to compensate internal errors like bias, bias drift etc. [4].

The main achievement of CVG based on resonator made of elinvar alloy is that it can be precise and low cost because resonator made of nickel alloy is simple, manufacturable, and inexpensive with temperature frequency coefficient 5-10 time less than that of fused quarts. CVG based on elinvar alloy resonator can successfully compete with FOG and RLG in price and accuracy exceeding them in reliability parameters almost an order of magnitude. [5].

Rate CVG principal of operation is shortly described in this work. Elastic wave control system block diagram is presented and discussed. Real CVG components photos are shown and bias stability characteristics by calculation of Allan variance graph is presented for each of two gyros with different resonator diameters. Results of mean time between failure estimation for different environmental conditions are also presented in this work.

Principle of operation. CVG principle of operation is based on inertial properties of elastic waves generated in resonators at sound frequencies. Standing

wave generated in, for the considered example, cylindrical resonator (so called drive mode) on the second oscillation mode is characterized by four nodes and four antinodes located along circumferential coordinate of the rim through the equal angle of 45 deg. When resonator is rotated with angle rate Ω there arise Coriolis forces F_1, F_2, F_3, F_4, which generate Coriolis mode (or sense mode) of oscillation in the direction of resultant force F_c as depicted in fig.1, [6].

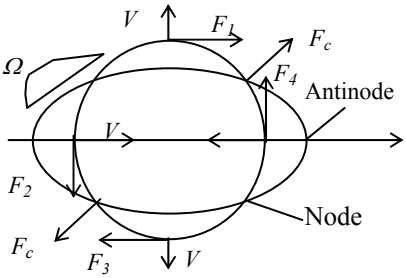


Fig.1. To CVG operation principle

Resultant Coriolis force is equal to $F_c = 2m\,[V \times \Omega] = A\Omega\omega_r \cos(\omega_r t)$. Its amplitude is proportional to angle rate Ω, A is resonator vibration amplitude at resonant frequency ω_r, $V = A\omega_r \cos(\omega_r t)$ is a linear velocity of radial motion in the process of vibration, m is effective vibrating mass.

Coriolis mode amplitude is measured by electrodes located on or near oscillation nodes and with the aid of feedback control circuitry is damped by supplying compensation signal on the other of four nodes. Doing this compensation signal amplitude is proportional to angle rate Ω measured.

CVG design. Fig.2 shows CVG sensor components. Sensor consists of only three components: base, resonator, and cover. Resonator is fixed on the base by standard screw. Because of sensor design simplicity its junction assembling is carried out very fast. The only high technology element is resonator, which should be manufactured precise on rim roundness and minimum wall thickness difference.

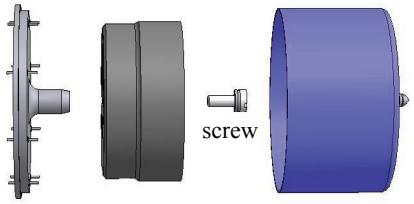


Fig. 2. Sensor components

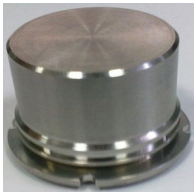


Fig. 3. CVG sensor

Eight piezo electrodes are glued through the angle 45 deg. to the lower thinner part of the cylinder. Such design allows shifting precision manufacturing requirements to cylinder rim only. Pressure of about 10^{-4} atm. is created under the cover. CVG25 gyro sensor with resonator diameter 25 mm, having sizes ∅40×h27 mm and weight 80 gr. is presented in fig. 3.

More accurate CVG43 variant has resonator diameter 43 mm, sizes ∅58×h33 mm and weight 160 gr.

Standing wave control system. Fig. 4 shows CVG standing wave control system block diagram. Diametrically opposite piezo electrodes are connected between each other (1-5; 2-6; 3-7; 4-8). As a result sensor has two input signals (X_{in}, Y_{in}) and two output signals (X_{out}, Y_{out}) (see fig.4). It means that sensor can be considered as two-input-two-output plant. Vibration excitation is provided by supplying periodical signal on the (1-5) electrodes at the resonant frequency. Excitation response is picked off from the (2-6) electrodes and it is used to sustain vibration and tracking for changing resonant frequency. Sense mode amplitude is picked off from the (3-7) electrodes glued on the nodal points of the drive wave and with the help of feedback circuitry signal is suppressed by supplying opposite phase signal on the other two (4-8) nodes. Thus, feedback signal amplitude that compensate nodes vibration is proportional to angle rate Ω.

Control and information processing algorithm are digitally realized in Sharc processor of Analog Devices company (USA). Fig. 5 shows three 45×45 mm CVG circuit boards with total weight 30 gr.

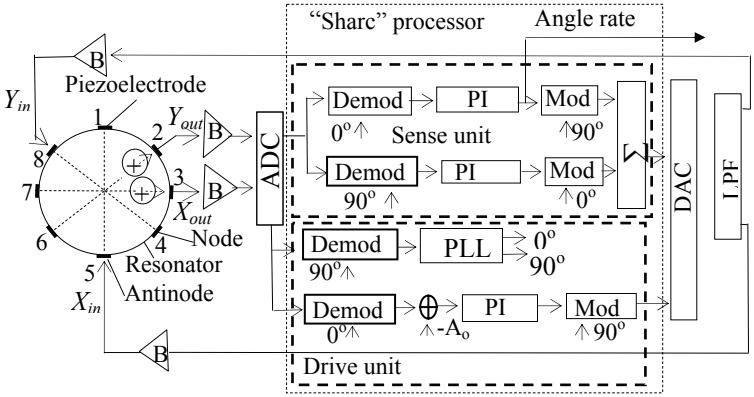
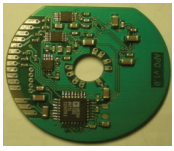
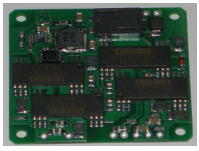


Fig.4. CVG control system block


Proximity board


Power supply board

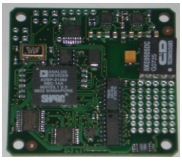

Digital control board

Fig. 5. CVG circuit boards

CVG bias stability. Fig.6 shows CVG25 output signal and bias stability (drift) calculation at temperature +50°C using Allan variance method. As can be seen from the presented data CVG25 bias stability is 0.014 deg/h when averaging time is 100 s, random walk is 0.0025 deg/√h. Allan variance minimum is 0.01 deg/h.

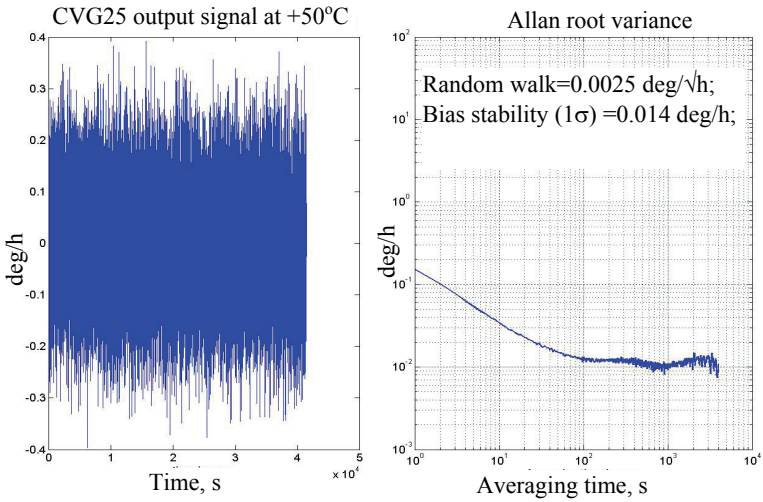


Fig.6. CVG25 bias stability at +50°C

Fig.7 shows CVG43 output signal. It has bias stability 0.0077 deg/h, and random walk 0.00075 deg/√h.

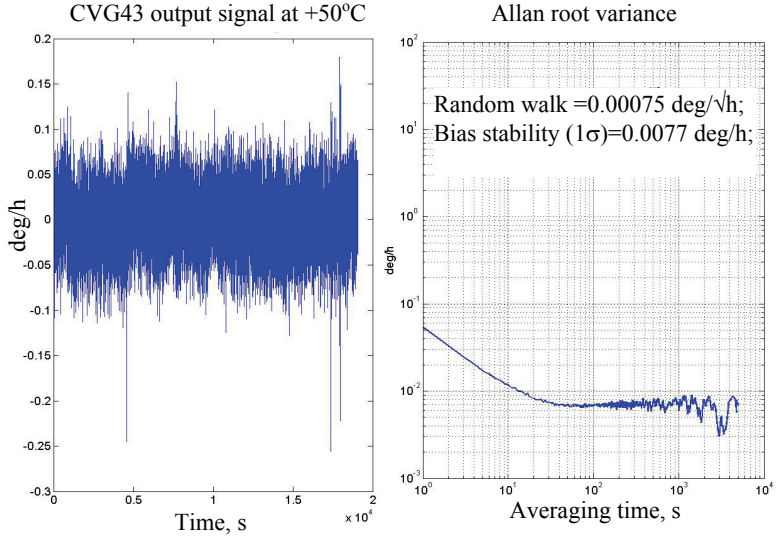


Fig.7. CVG43 bias stability at +50°C

CVG reliability. To estimate reliability stress factor method is used. Reliability estimation have been made by tests data of sufficiently large (40 pieces) of CVG25 gyro. CVG43 differs from CVG25 by only sizes (material used, manufac-

tured technology, circuit boards are the same), the obtained results can be spread out to CVG43 as well. Failure intensity calculation methodic is based on calculation of degradation acceleration coefficients with use of Arrhenius, Coffine-Manson and Hallberg-Peck models. Mean time between failure (MTBF) reliability parameters calculation results are presented in table 1 [5].

Table 1. MTBF calculated using test results

Environmental condition on applications	MTBF Conf.probab.95% hours (years)	MTBF Conf. probab.99% hours (years)	MTBF Conf. prob.99.9% hours (years)
Ground, fixed, $\pi_E = 1$	2 509 145 (286)	1 632 170 (186)	1 087 719 (124)
Ground, mobile, $\pi_E = 4$	627 286 (71)	408 042 (46)	271 929 (31)
Naval, sheltered, $\pi_E = 4$	627 286 (71)	408 042 (46)	271 929 (31)
Fighters, $\pi_E = 5$	501 829 (57)	326 434 (37)	217 543 (24)
Rotary Winged, $\pi_E = 8$	313 643 (36)	204 021 (23)	135 964 (15)
Space, Flight, $\pi_E = 0.5$	5 018 290 (572)	3 264 340 (372)	2 175 438 (248)

Conclusion. Digital Coriolis vibratory gyro with metallic alloy resonator is low-cost, precise and reliable device developed by Ukrainian specialists which can successfully compete with FOG and RLG in cost and accuracy at the time it significantly exceeds them in reliability.

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UDC 503.36+665.662.2

S.A. Chripko,
E.F. Novoselov, associate professor
(National Aviation University, Ukraine, Kyiv)

URBAN TREE BIOMASS AS A SORBENT FOR SPILLED PETROLEUM PRODUCTS

The properties of sorbents obtained on the basis of hydrophobized autumn fallen leaves, conditions for its hydrofobization, allows to obtaining sorbents with maximum petroleum products sorption capacity have been studied. It was found that the investigated sorbents have sorption capacity comparable with those for industrial oil spillage collecting materials.

INTRODUCTION

Every fall in public parks and gardens are accumulated tonnage of autumn fallen leaves. Within the framework of modern environmental management, such material is considered as a valuable resource and should be processed as fully as possible. Typically, the use of urban autumn fallen leaves (AFL) is limited to production of biohumus. The other part of these"waste" is incinerated or exported in the dumps, polluting the air, soil, surface water, while products of incomplete combustion create serious environmental poisons.

In recent years grows interest to produce oil spillage sorbents from various "waste". Owing to its layered structure and high buoyancy, autumn fallen leaves (AFL) may become a promising material for the preparation of such materials. The aim of this work - the study of the properties of sorbents derived from autumn fallen leaves treated by hydrofobization.

MAJOR PART

Existing sorbents comprise a wide range of organic, inorganic and synthetic products designed to recover petroleum products in preference to water.

Sorbent, should attract petroleum products preferentially to water, i.e. being both oleophilic and hydrophobic. These materials can act either by adsorption by absorption while at adsorption, the petroleum products is preferentially attracted to the surface of the material whereas absorbents incorporate the petroleum products, or other liquid to be recovered, into the liquid part of sorbent.

Adsorbents vs. absorbents. Liquids diffuse into the matrix of an adsorbent material by a process similar to capillary, causing it to combine with the material so that it will not leak out, or cannot be squeezed out under pressure. Market available a**d**sorbents are made from polymers with a high surface area to promote efficient adsorption. As they may reduce the surface area of the liquid, adsorbents can be used with volatile petroleum products. A**b**sorbent materials are, in theory, capable of recovering light fuel petroleum products, but the time required for absorption may be longer and, as a consequence, they are suited more to the recovery of low viscosity liquids and also of spilt hazardous and noxious substances chemicals.

Wetting properties. For successful adsorption, petroleum products should

wet the material and therefore spread over its surface in preference to water. A liquid will wet a solid if its surface tension is less than the critical surface tension (J/m) of the solid. For an oil spillage sorbent, it should have J/m value below that of water and above that of petroleum products. The surface tension of water is approximately 60-65 mN/m; for petroleum products it is around 20 mN/m. So PTFE with a J/m value of 18 mN/m will not adsorb petroleum products or water while polypropylene with J/m value of 29 mN/m is good petroleum sorbent. Important inorganic solid vermiculite to possess the required value can be modified by heating. Oleophilic properties of many materials can be enhanced at priming with petroleum products.

Capillary action. With some materials, adsorption occurs via capillary action. The viscosity of the petroleum products has an important effect on the rate of penetration into the structure of the sorbent. Capillary action is particularly important with foam-based sorbents, foams with a coarse cells are effective with viscous petroleum products, on contrary they are not able to retain low viscosity petroleum products.

Cohesion / adhesion/. Cohesion refers to the attraction of a material to itself thereby opposing spreading on a solid surface, while adhesion refers to the attraction of one material to another. Sorbents rely on both adhesion of the petroleum products to the sorbent surface and the cohesive properties of petroleum products. Cohesion is greater for more viscous petroleum products.

Surface area. Sorption rate of a particular sorbent material is directly related to the exposed surface area. In contrast to absorbents, adsorbent materials should be used on volatile liquids with caution. Spreading of the liquid over the internal and external surface area of an adsorbent material can increase the rate of vapor release, with attendant consequences for ignition and/or human health.

Sorbent materials and forms. A wide variety of materials can be used as sorbents. The examples are given in the table below.

Synthetic sorbents are considered generally as most effective in recovering petroleum products. In some cases can be achieved a ratio by weight of petroleum products to sorbent of 40:1, compared to 10:1 for organic products and 2:1 for inorganic materials. Despite the limited adsorptive capability, organic and inorganic materials may be attractive as they are often either abundant in nature or are the waste by-product of an industrial process, and can be purchased readily at low cost or are freely available.

Sorbent in bulk. Most of the materials listed in the table are marketed as loose sorbent and serve a useful purpose to recover small spills of petroleum products on land. Primarily due to the difficulties of controlling their application and retrieval, their use in the real environment should be limited to specific conditions.

Enclosed sorbent. Bulk loose sorbent materials are often enclosed in an outer fabric, mesh or netting to form a boom, pillow or sock that is more straightforward to deploy, control and subsequently easier to retrieve than the loose material itself.

Appli-cation	Material	Benefits	Disadvantages
Bulk	Organic - including bark, peat, sawdust, paper-pulp, cork, chicken feathers, straw, wool and human hair. Inorganic - vermiculite and pumice Synthetic - primarily polypropylene	Naturally abundant or widely available as waste by-product of industrial processes Can be low cost Can serve to protect wildlife at haul-out sites	Can be spread by the wind -difficult to retrieve. Oil products and sorbent mixture difficult to pump - disposal of such mixture limited
En-closed	All of the above bulk materials can be enclosed in mesh or nets	Straightforward to deploy and retrieve than loose sorbent Enclosed boom has a greater surface area than continuous	Strength is limited by the mesh. Organic booms can be saturated and sink. Oil retention is limited
Con-tinuo us	Synthetic - primarily polypropylene	Long-term storage, easy to deploy and retrieve. High oil recovery ratio if used to full capacity	Limited efficiency for viscous oils. Does not readily decompose - limiting disposal
Fibre	Synthetic - mostly polypropylene	Effective on weathered and more viscous petroleum products	Less effective on fresh light and medium petroleum products

Continuous sorbent. Continuous flat sorbents such as sheets, rolls, mats, pads and webs are characterized by their high surface area to volume ratio. Continuous sorbents are primarily manufactured from synthetic materials with woven or melt-blown polypropylene.

Criteria for selecting sorbents

Buoyancy. For sorbents to be used effectively on floating petroleum products they must have and retain high buoyancy, remaining afloat even when saturated with petroleum products and water. A number of natural organic materials such as straw and sawdust have good initial buoyancy but eventually become waterlogged and sink. However, buoyancy can in some cases be crucial to the effectiveness of a sorbent. For example, some light, less dense materials may remain on top of heavy, viscous petroleum products.

Saturation. Sorbents can quickly become saturated by petroleum products. Once saturated, sorbents cannot recover further petroleum products and should be removed as quickly as possible to avoid any subsequent leaching.

Petroleum products retention. Some materials rapidly adsorb petroleum products, but, unless retrieved in good time, the sorbent may subsequently release

much of it as a result of the effects of wind, waves and currents. Sorbent materials with fine pores, such as vermiculite, generally exhibit good petroleum products retention characteristics. The shortcoming with these materials is their poor performance in the recovery of viscous petroleum products.

Strength and durability. The durability of a sorbent is important in those situations where it may be left in-situ for an extended period of time before recovery. Sorbent booms may start to degrade within a matter of hours as a result of objective environmental effects.

Fermentation. Some organic sorbents can ferment when left in contact with water for an extended period of time. In addition to altering their composition and efficiency in selectively recovering petroleum products, this can give rise to problems with recovery, storage and disposal of the resultant sorbent/liquid mixture.

Cost. The cost of sorbent products varies greatly and is primarily dependent upon the material used. Organic and inorganic materials are comparatively less expensive than synthetic products.

Availability, storage and transportation. The performance of synthetic sorbents makes their use attractive but they may not always be immediately available at the site of the spill. While organic and inorganic sorbents may be less efficient, they may offer a practical alternative as they are often more widely available.

Application. The use of bulk sorbents raises a number of efficiency and safety issues, as loose powder or particulate sorbents over open water has several inherent disadvantages. Wind can carry product away from the superficial layers, causing additional pollution. Without suitable mixing of the sorbent material with the petroleum products the sorbent may remain afloat on the top of the petroleum products resulting in poor efficiency. In order to overcome these obstacles, many special devices have been designed to discharge powder and particulate sorbents over the side of a ship in a controlled way. Sorbent boom is far easier to deploy than bulk sorbent.

Use with other clean-up techniques. Careful management of a response and of response personnel is required to ensure that the clean-up techniques employed do not counteract each other. It is important to remember when using sorbents that the surface tension of both petroleum products and water can be significantly altered by the surface active agents present in dispersants. As a result, the use of dispersants or other spill response chemicals can interfere with the ability of sorbents to function as designed, as they can decrease both the oleophilic and hydrophobic properties, significantly increasing the amount of water and decreasing the amount of petroleum products recovered.

Recovery. Unless sorbent is recovered from the water surface, it becomes as much a pollutant as the petroleum products itself.

Incineration. Burning contaminated sorbent may be a practicable option if the sorbent material is combustible and does not contain excessive quantities of water. Incineration is normally strictly controlled and high temperature combustion, together with close monitoring of exhaust gases, will be required to ensure that toxic dioxins, PAHs and HCI are not discharged into the atmosphere. The cost of incineration is often considerably higher than other disposal techniques and this

should be taken into account if this method is selected.

Landfill. Disposal of sorbent material as landfill is also usually strictly controlled by local or national regulations is treated as a hazardous waste and the use of designated hazardous material landfill sites may be required, with consequent increases in the cost of transport and disposal.

Biodégradation. Organic sorbent materials can be biodegradable. Depending on local waste disposal regulations and, disposal of organic sorbents by land farming may be permitted. Degradation may take a number of years, although faster degradation can often be achieved by aeration using cultivation equipment and the application of fertilizers. Composting of certain organic sorbents may also be a viable disposal route.

EXPERIMENTAL PART

As a raw material for sorbents we have used autumn fallen leaves in air-dry state with residual humidity of 10 ± 2%. Dry AFL were easily ground in a disintegrator, type «8255 Nossen» (Germany). For hydrofobized sorbents was used material with particle size: 1-2 mm - 2.3%; 2.3 mm - 5.7%; 5.3 mm - 43.8% 5.10 mm - 48.2%. AFL hydrophobization was carried by the mixture of kerosene T2 and toluene in ratio 7:3 (vol). Weighed sample of AFL were incubated in this mixture for 2 hours and separated by vacuum filtration to achieve the bulk state. Hydrofobized samples allowed to be dried in the air.

Determination of sorbents oil capacity, water absorption and buoyancy was carried out at (20 ± 2) °C according to the procedures set in TU 214 - 10942238 - 03 - 95. Oil capacity was determined also for crude oil (p 0.85 g/cm $^{3)}$. Amount of oil and water absorbed at the same time from the oil films for sorbents was made for AFL and oil layers of different thicknesses. In all experiments to study the properties of sorbents was used AFL fraction size 0.5 - 3 mm.

CONCLUSION

Hydrophobized autumn fallen leaves can be used for production of sorbents for spilt oil products removal. In terms of oil intensity and extent of oil retrieval the obtained sorbents are able to compete with industrial oil sorbents on the basis of peat.

Due to the high buoyancy after collecting oil and a minor degree of oil loosing they can be effectively used to eliminate oil impurities from the water surface. Such sorbent have good oil capacity and is comparable to industry brands.

Obtaining sorption materials is an additional means in possible novel complex autumn fallen leaves processing scheme. It should be noted that the production of new materials made of AFL with practically useful properties allow, if necessary, to adapt such materials to market needs.

Low-cost, locally available organic or inorganic materials may provide a more cost-effective option than stockpiled synthetic sorbents, despite a lower recovery efficiency for the same weight of sorbent material.

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O. Davydenko, graduate student, V. Ledovskykh, Doctor of Chemical Sciences, Professor (National Aviation University, Kyiv, Ukraine)

ELECTROREDUCTION OF ALIPHATIC CARBONYL COMPOUNDS AT THE ALUMINUM CATHODE

The results of research is shown that a relatively high hydrogen overvoltage aluminum cathode course promotes effective processes of conversion of carbonyl compounds into the corresponding saturated and unsaturated hydrocarbons,. According to the data electrolysis processes occur fast in high yield products, which makes them perspective for the regeneration of oxidized engine petroleum used oil.

The using of petroleum products, that includes in oils has become very prominent. During the application of petroleum oils, especially motor, are exposed to physical and chemical transformations caused by the oxidation of hydrocarbons, resulting in the loss of their operating characteristics and needs for replacement [1]. As result formation of large amounts of used oils that create hazardous waste. At the same time it act as an important source of production by regeneration the oil and add the required additive package. Therefore, the development, improvement and cheapening processes of regeneration are relevant and important task [2].

Increased temperature and air oxygen, which come into contact with the oil, causing their oxidation and oxidative polymerization. The oxidation products (resins, aldehydes, ketones, acids, hydroxy acids) are found dissolved state in the oil, it promotes an increase in viscosity and acid number, but asphaltene compounds carbenes and karboidy form varnishes, which leads to sintering and scorching piston ring [3].

In previous research was shown that carbonyl compounds could reduction electrochemically mainly in corresponding hydrocarbons at electrolysis processes when used as an cathode materials of metal that characterized by high hydrogen overpotential: Pb, Cd, Hg, Zn and some others [4-8]. This possible when include the electrochemical processes to prospective methods of regeneration used oils [5]. At the same time as directed cathode metals belonging to the toxic substances that are able to act potential polluters of the environment. and major products cathode electroreduction reactions of carbonyl compounds are alcohols. This caused the need search for and research of new electrode metals that would not belong toxic and also contributed to a high yield of hydrocarbons is important in the regeneration used motor oils.

Purpose - research the reduction of carbonyl compounds (ketones and aldehydes) on aluminum cathode, the analysis of substances formed by and determination of the possibility of applying electrochemical method for the cathodic reduction such as carbonyl oxidation products of petroleum engine oils back into the hydrocarbons at the regeneration process.

Electroreduction of carbonyl compounds

Electroreduction processes carbonyl compounds occur primarily on d-metals with high hydrogen overvoltage. They belong to the II electrochemical group, which

is characterized by relatively low heat of adsorption of atomic hydrogen. When cathode polarization retarded stage here discharge of hydrogen ions:

$H^+ + e^- = H_{ads}$

This stage is much slower than the desorption of H_{ads}, which can flow through the electrochemical mechanism:

$H_{ads} + H^+ + e^- = H_2$,

or chemical mechanism:

$H_{ads} + H_{ads} = H_2$

As a consequence of metal's surface filling adsorbed hydrogen is close to zero, as is observed in the case of Fe, Ni, Cd, Hg, Co at their cathode polarization in acidic solutions. This creates conditions for the adsorption followed by reduction of carbonyl compounds.

In this case, the differential capacitance is close in magnitude to the capacitance of the electric double layer and the capacitance value is almost independent of potential [9].

We hypothesized that as a cathode metal for electroreduction of carbonyl compounds in petroleum used oil of their regeneration can serve as environmentally safe aluminum, which in aqueous solutions of acids is characterized by a relatively high hydrogen overpotential though inferior on these indicators typical metals II electrochemical group. In previous research it was shown that reduction of acetone to isopropyl alcohol and propane at this cathode metal [5].

In order to decision on a matter the regeneration of used petroleum oils in this paper focuses on the research of the general regularities course of cathode processes and search conditions of their performance in the direction of the transformation of carbonyl compounds back into saturated hydrocarbons, ie in the direction reverse to oxidation of oils in their application. The primary focus in this paper is devote to the search conditions for carrying of reduction processes towards conversion of carbonyl compounds primarily back into saturated hydrocarbons, scilicet in the direction the inverse oxidation of petroleum oils during their operation.

As compounds containing a carbonyl group for experimental research were used isovaleric aldehyde ($CH_3CH(CH_3)CH_2CHO$, M = 86,13 g/mol, m.p. = -51˚C, b.p. = 92,5˚C) and 2-pentanone ($M(CH_3(CO)CH_2CH_2CHO$) M = 86,13 g/mol, m.p. = -86˚C, b.p. = 102˚C).

Polarization measurement was performed on the P-5827M potentiostat, used three electrode thermostated electrode (25 °C) cell with operating aluminum electrode mark UpA99 purity 99,99% Al, as an auxiliary served electrode a platinum wire separated from the working electrode porous glass partition potentials was measured against chlorine silver electrode and counted to the normal hydrogen scale. Background in sulfuric acid-aqueous-alcohol (isopropanol) solution composition was: 920 ml of isopropyl alcohol, 56 ml of distilled deionised aqua, 24 ml of concentrated (98%) sulfuric acid (pH = 2.98).

Preparative electrolysis of solutions of isovaleric aldehyde concentration of 0.5 mol/l was performed at a controlled potential (potentiostat) on aluminum electrode (E_{work} = - 0.75 V), current electrochemical process measured by milliammeter M2020 with a scale division of 1 μA.

To analyze the products of electroreduction aldehyde cationit was neutralized with alkali and dried repeatedly roasted absorb aqua reagent $CaCl_2$. After filtration, the solution electrolysis products in isopropyl alcohol was subjected to analysis by component composition for chromatography mark LHM-8MD using nitrogen as bearer gas of high purity (gas feed rate was 30 mL / min at the input of the device) as adsorbent used Inerton Super which applied liquid fixed phase 5% Apiezon L.

Fig. 1 shows a potentiostatic polarization curve aluminum background sulfuric acid aqueous-alcoholic solution. Curve 1 has a limiting diffusion current wave electroreduction of oxygen in acidic solutions, that corresponds to the equation: $O_2 + 4H^+ + 4e^- = 2H_2O$

Limiting diffusion current density of oxygen in the tranquil aqueous-alcohol solution amounted ${}_{O_2} i_d = 3{,}6 \cdot 10^{-4}$ A/cm^2, which is much exceeds its value for aqueous solutions where ${}_{O_2} i_d \approx 5 \cdot 10^{-5}$ A/cm^2. This is explained by the strong growth solubility of molecular oxygen in the aqueous-alcohol solutions.

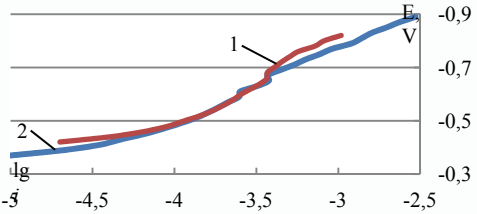

Fig.1. Potentiostatic polarization curves of aluminum (25 °C): 1 - background sulfuric acid aqueous-alcoholic solution; 2 - and in the presence of 0.5 mol/l 2-pentanone.

Curve 2 (Fig. 1) has been two waves of limiting diffusion current, one of them is the reduction of oxygen, and the previous wave corresponds to the limiting diffusion current reduction pentanone-2. From this depending it can be seen on the maximum reduction rate observed upon reaching potential at -0.6 V.

Similar character has a reduction curve isovaler aldehyde on aluminum cathode in sulfuric acid aqueous alcohol solution is shown in Fig. 2.

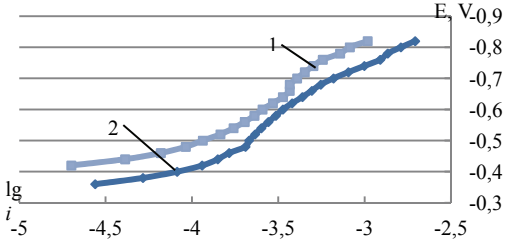

Fig. 2. Potentiostatic polarization curves of aluminum (25 °C): 1 - background sulfuric acid aqueous-alcoholic solution; 2 - in the presence of 0.5 mol/l of isovaler aldehyde.

On the curve 2 there are two waves of the limiting diffusion current, the first of which belongs to the reduction wave of oxygen, and the second reduction wave isovaler aldehyde for potential -0.75 V.

Chromatographic analysis of the reaction mass after the electrolysis of a solution of carbonyl compounds showed that the main product reduction as aldehyde and ketone at aluminum cathode in an acidic medium is a corresponding saturated hydrocarbon, and only in reducing the negative cathodic potentials, the formation of some amount of unsaturated hydrocarbon.

Conclusions

This work demonstrates the possibility of using aluminum as innoxious from an ecological standpoint of the electrode material for the process of cathodic reduction of carbonyl compounds to the corresponding hydrocarbons in process of waste petroleum oils regeneration.

It is shown that in contrast to typical metals with a high hydrogen overpotential (Hg, Cd, Pb, Zn), what are formed in the reduction of the corresponding mixture of hydrocarbons, alcohols and hydrodimers pinacol type compounds. The reduction on aluminum is heaped with formation of saturated hydrocarbons videlicet the complete regeneration of oxidation products back into the hydrocarbons take please at this stage, from which of petroleum oil is consist.

Only at lower negative potential of the cathode, formed a small amount of unsaturated hydrocarbons. In this electrocatalytic effect and manifests at application of different cathode metals.

Determine working parameters perform electroreduction carbonyl compounds.

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A.Kustovska, associate professor, O.Kosenko associate professor
(National Aviation University, Kyiv, Ukraine)

EFFICIENCY OF MODYFIED FORMS OF NATURAL ZEOLITES IN THE PROCESSES OF METHANOL TRANSFORMATION INTO COMPONENTS OF MOTOR FUEL

Usage of modified forms of rocks that contain the mixture of zeolites as catalyst of the process of methanol transformation into dimethyl ether and hydrocarbons was considered. Possibility in principal of usage of modified rocks containing mordenite and clinoptilolite as the catalyst of the process of methanol transformation was demonstrated.

The problem of replacement of traditional motor fuels with the alternative ones is more and more essential. That is why the attention of researchers is attracted to the transformation of methanol into the components of motor fuel, like dimethyl ether and liquid hydrocarbons. These kinds of energy resources have some advantages comparing to traditional fuel. The main advantage is the improvement of ecological properties of exhaust gases emission.

Methanol can be made from natural gas or coal via synthesis gas. The development of processes for conversion of coal, methane and biomass to higher valued products that can be easily transported is one of the key challenges for the use of these natural resources.

The reaction of methanol transformation is usually carried out in the conditions of heterogeneous catalysis using synthetic zeolitic catalyst. The most efficient ones are high-silica zeolites ZSM [1-4]. Generally, three reaction steps are distinguished: (i) the dehydration of methanol to dimethyl ether, (ii) the conversion of a mixture of methanol and dimethyl ether to olefins and (iii) a bond chain polymerization and isomerization of olefins. Therefore, the conversion of methanol-to-hydrocarbons (MTH) over an acidic zeolite catalyst represents the final step in upgrading any gasifiable carbon-based feedstock to gasoline-range hydrocarbons (methanol-to-gasoline, MTG) and light olefins (methanol-to-olefins, MTO). Output of reaction products depends on the proportion of Si/Al in the zeolite and the temperature of process [5].

Comparative study of zeolite ZSM-5 and mordenite, including its modified natural forms, has shown the significant similarity of their acidity spectrum [6-8]. This similarity shows the possibility of the receiving of efficient catalyst for the reaction of methanol dehydration on the basis of natural mordenite.

Dimethyl ether and liquid hydrocarbons using as the alternative fuel foresees their extensive production. Therefore, the development of catalysts for these processes on the basis of cheap raw materials, such as zeolite-containing rocks, seems to be profitable.

In most cases, the technological properties of natural zeolites are as good as the same properties of synthetic analogues, while the cost of preparation is significantly below the cost of production of the latter. Large deposits of natural

zeolites are situated in Europe, Russia, Japan and the USA. Amount of discovered reserves of natural zeolites in countries of the former USSR is about 1,6 bln t. Transcarpathian mordenite, mordenite-clinoptilolite and clinoptilolite deposits that have unique scale and quality of resources, can be considered as one of the largest and most potentially productive in the context of their development [9].

In spite of wide spread occurrence of zeolite deposits and their large amount, today they are mostly used only in agriculture and construction. It is caused by the wide variety of degree of zeolitization and discontinuous phase composition of natural materials that preclude their usage in the complex technological processes. Mordenite rocks are more valuable due to their high chemical and thermal resistance, but their reserves are finite. Therefore, the study of conditions of rocks containing the mixture of zeolites, particularly mordenite-clinoptilolite rocks, is of the special interest. At the same time, works [10,11] show that clinoptilolite has high catalytic activity in the process of dimethyl ether receiving through methanol dehydration. Authors of work [10] have concluded that modified clinoptilolite can be the subject of significant industrial interest due to its relatively low activation energy comparing to other zeolitic and non-zeolitic catalysts for the concerned process.

Sample of rock from Transcarpathian deposit (Lypcha village, Ukraine) containing mordenite and clinoptilolite was taken as the object of the research. The rock has the following chemical content (%, wt): SiO_2 – 64,95; TiO_2 – 0,20; $A1_2O_3$ – 12,23; Fe_2O_3 – 1,06; FeO – 0,22; MgO – 1,21; CaO – 3,22; Na_2O – 0,70; K_2O – 2,35; S – 0,03; P_2O_5 – 0,11; CO_2 – 1,03; H_2O – 12,33. Total content of zeolites in the rock is more than 90% wt, proportion of mordenite and clinoptilolite is 1:1.

Chemical modification of samples was conducted in water solutions of NH_4Cl and HCl p.a. in proportion of solid and liquid phases 1:10 at 96^0C. Decationated forms were received through the processing of sample with solution of NH_4Cl and the following thermal desorption of ammonia. Dealumination was carried out using the solution of HCl. The depth of decationation and dealumination was regulated by concentration of solutions and duration of modification.

The influence of the depth of decationation and dealumination on the catalytic activity of modified forms of zeolite-containing rock was tested at the temperature interval from 160°C to 400°C and atmosphere pressure in flow-type reactor with the stationary bed of catalyst. As a result of the research it was identified that at the temperature less than 200°C, when there are no other products of the reaction except dimethyl ether and water, decationation leads to the increasing of activity and reduction of time of stable catalyst operation, while dealumination reduces activity and increases stability. That is why the using of partially decationated (~ 40 %) and partially dealuminated (~ 25 %) samples of zeolite-containing rock seems to be potentially productive.

Transformation degree of methanol and the content of products of its conversion on original and dealuminated forms of sample significantly differ in the temperature interval from 200 to 400^oC. On the original sample methanol is transformed to dimethyl ether with high conversion degree in the whole researched temperature interval. Hydrocarbons appear only at high temperature. However, their output is low. Transformation degree of methanol increases with the increasing of

dealumination and decationation degree, while in conversion products the content of dimethyl ether decreases and the quantity of hydrocarbons increases. If the dealumination degree is in interval of 47-52%, then hydrocarbons selectivity of catalyst is 99-100%. Further increasing of dealumination degree leads to decreasing of methanol conversion and reduction of hydrocarbons selectivity of catalyst.

Possibility in principal of using rocks containing mordenite and clinoptilolite as catalyst of process of methanol transformation into dimethyl ether and hydrocarbons was demonstrated. The using of partially decationated (~ 40 %) and partially dealuminated (~ 25 %) samples of zeolite-containing rock is potentially productive for dimethyl ether receiving. Deep dealumination of natural samples leads to significant increasing of hydrocarbons selectivity of catalysts, received on the basis of these samples, in the process of methanol conversion. Such samples can be received through acid modification, which results in both dealumination and partial replacement of exchangeable cations with protons. Thus, the energy demanding stage of preparatory decationation of rock through ion exchange of cations of zeolites and cations of ammonia and further thermal decomposition can be excluded.

Obtained results demonstrate the possibility of cheap zeolitic raw materials using for preparation of efficient catalyst. It can be especially important in case of large scale processes of the receiving of ecologically harmless alternative fuel.

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S. Levchenko, assistant, V. Ledovskykh, Doctor of Chemistry, professor
(National Aviation University, Ukraine, Kyiv)

ELECTRO-SPARK TREATMENT OF STEEL SURFACE FOR VARNISH-PAINTWORK QUALITY IMPROVING

Described the study of influence of electric-sparkling steel tube surface treatment method on the painted coatings adhesion to the metal surface and on the rate of its corrosive destruction in the chamber of saline mist.

For preparing steel surfaces are used different methods, which include laser, plasma, impulsive, electric erosive, etc. [1] They have some disadvantages, which are connected with the high costs of the equipment, significant power consumption, ability to apply only to the tubes of a big diameter.[2]

We have suggested the electric-sparkling method of preparing steel surfaces with the help of electric grinding machines, using specially formulated technological liquids and simultaneous applying a protector on the surface of metal.

The aim of the following work is to define the influence of the electric-sparkling treatment on the protective characteristics of varnish-painted coatings, also defining the efficiency of combining of protective and varnish-painting method for metal protection against corrosion.

The preparing of steel coatings by the electric-sparkling method was carried out with the help of electric grinding machine TCM 1-150 with the disc rotating brush. Simultaneously a technological liquid, which contains a combined inhibitory additive of synergetic action, was applied in the treatment area. Between the processed sample and the instrument a difference of potentials was applied - the sample was a cathode and the polishing tool was an anode. The investigations have shown that such manner of using enabled to reduce the power consumption of the process up to 30-35% and to increase the grade of purity by 3 units.

This can be explained as a result that the adsorption of combined additive of synergetic action, containing the cationic and anionic PAR, reduces the surface energy, making easy the displacement of the surface layers of metal, removing microcracks and leads to the increasing grade of purity (Rebinder effect).

Simultaneously applied technological liquids contain mixtures of inhibitors, which effectively protect the steel surface from corrosion during electric-sparkling treatment. [3, 4] Speeded up researches in the chamber of saline mist KST-1 have shown moderate anticorrosion efficiency of electric-sparkling treatment within postoperational period. For increasing the postoperational conservation period was carried out an electric-sparkling treatment of steel surfaces with the help of the zinc-coated brush, during which the layers of zinc coating transfer on the steel treated surface. This was proved by carrying out lye leachimg the steel surface and determining zinc in the solution with the help of atomic adsorptive analysis.

Thin zinc coating create on the steel an effective surface protectors for the electric chemical corrosion. [5, 6] A comparative researches were carried out for comparing the influence of different methods for preparing of the steel surface on

the quality of the following varnish-painted coatings. A varnish-painted coating [7, 8, 9, 10] Ticcurila Termacout TM-40 was applied in a few layers with the general medium thickness of the layer 200 μm(microns) (according to the State Standards 9.032-74)[11] on the steel samples, treated by the sandblast method, by the electric-sparkling method with the ordinary brush and by the electric-sparkling method with the zinc-coated brush. Their adhesion to the surface of metal was measured by the adhesimeter model Constanta K 5. The essence of the method lies in the determining of the strength, needed for the separation of the coating layer from the protected by its surface, in the direction, perpendicular to the plane of the coating layer with the help of the glued metal disc and dynamometer (according to the State Standards of Ukraine 4219-2003).

For the samples, treated by the sandblast method the value of the adhesion was 9, 7 mPa, for the samples treated by the electric-sparkling method with the ordinary and zinc-coated brush- 11,25mPa and 11,23mPa accordingly. That is, the adhesion of the varnish-painted coatings onto the surface of the samples, treated by the electric-sparkling method is better.

On some samples was made artificial mechanical damages of a diameter 5 mm., and they were placed in KST-1 for 168 hours. The other not damaged samples were placed in KST-1 for 720 hours.

For the proving of the efficiency of the electric-sparkling method we have carried out the measurement of the adhesion of the varnish-painted coating onto the surface of the samples treated by the different methods, before and after speeded up research in the chamber of saline mist KST-1.

The average results of the adhesion measuring are given in the picture 1.

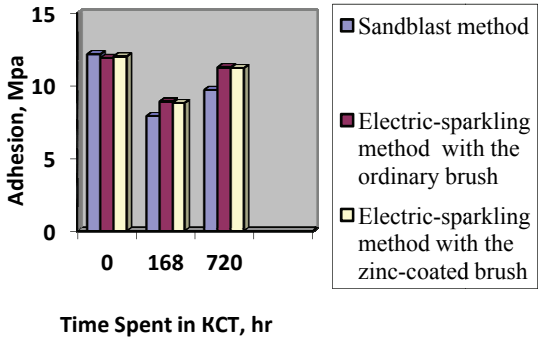

Fig. 1. The dependence of the adhesion of the varnish-painted coating onto the steel surface according to the method of the surface preparing and the time spent in KST-1.

For the samples treated by the sandblast method the value of the adhesion is 7,9 mPa, for the samples, treated by the method using ordinary and zinc-coated brush- 8,9 mPa and 8,8 mPa accordingly. That proves considerable higher adhesion in case of using the electric-sparkling method.

For proving the efficiency of zinc-coated brush use on the samples of artificial mechanical damages were carried out the measurements of the corrosion depth penetration after 168 hours in KST-1. The average values of the corrosion depth penetration are given in the picture 2.

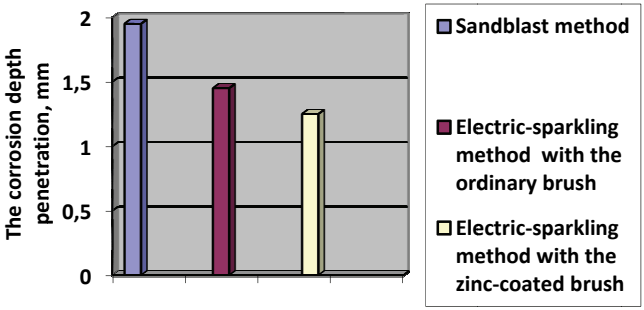

Fig. 2. The corrosion depth penetration depending on the method of preparing the surface before applying varnish-painted coating.

According to the State Standards, the samples in which the corrosion depth penetration damages are less than 2 mm, are supposed to pass successfully testing on corrosion resistance. For the samples treated by the sandblast method, the corrosion depth penetration was 1,95 mm, for the samples, treated by the electric-sparkling method using zinc-coated brush – 1,45 mm, for the samples using zinc-coated brush it was 1,25 mm. The obtained results testify the efficiency of the anticorrosion protection using the zinc applied protector.

Conclusions

- one of the most efficient methods of steel surface treatment is electric-sparkling method, due to the using of special technological liquids it allows to reduce power consumption of the process and to increase the class of the surface's purity;
- electric-sparkling method of preparing the metal's surface allows to improve the protective characteristics of varnish-painted coatings, that was proved by the research of the protective characteristics of the coatings of epoxide type in the chamber of saline mist, by measuring the adhesion and corrosion depth penetration;
- extremely high were the positive values attained at using zinc-coated brush with the further applying of varnish-painted coating, where are implemented the effects of mutual intensification (synergism) between the electric-chemical protection and the varnish-painted coating.

the results of the research are recommended to use as the preparing metal's surface before applying the varnish-painted coatings in order to increase the efficiency of metal protection from corrosion.

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M.R. Maksymiuk, candidate of chemical sciences
V.L. Chumak, doctor of chemical sciences, professor
T.V. Neshta, assistant, U.S. Bosak, assistant, V.V. Didenko
(National Aviation University, Kyiv, Ukraine)

THE INFLUENCE OF LIGHT OIL PRODUCTS ON THE SURFACE ACTIVITY OF LOWMOLECULAR ALCOHOLS

The article presents the results of a study of the process of adsorption on the border of phases: the solution of low molecular weight alcohol (with or without the addition of benzine A-92) - air. The influence of benzine A-92 on the surface activity of low molecular weight alcohols was assessed on the basis of these results.

Introduction. Light oil products are a staple consumption for modern industrial or agricultural enterprises. Benzine (automobile and aviational), the solvent in paint and varnish production, replacing turpentine ("white spirit"), the solvent for the rubber industry, extractional, petroleum ether, naphtha (instrumental), kerosene (lighting, for technical purposes) belong to light oil products [1]. Such widespread usage of light oil products leads to the appearance of these products in waste water in the form of fuel drops, films that create dispersed pollutions.

A lot of water-soluble organic substances of different nature and high dispersed solid contaminants, mainly clayey nature contain in wastewater in addition to oil and fuel contaminants. Surface active agents (surfactants) are a special type of harmful contaminants. Surfactants often fall into the wastewater as a result of cleaning of tanks, decks, platforms, where oil products are stored or during transportation of them. Even small concentrations of surfactants are able to enhance the effect of certain toxic substances. Excessive concentration of surfactants in wastewater are not only a direct threat to the ecological balance of the aquatic biological community, but often the reason of the violation of normal operation mode of treatment facilities.

Flotation is often used for the treatment of waste water polluted by oil products. That is why surfactants, diluted in this water, are automatically used as flotation reagents due to diphilic molecular structure and ability to focus on the interphase surface [2]. The surface activity on the interphase boundary is one of the main properties of surfactants. The surface activity is manifested through the values of surface tension and adsorption. The composition of waste water, in particular the nature of contaminants that reinforce or weaken the properties of one second, affects on the efficiency of the flotation process.

The aim of this work was to study the influence of automobile benzine A-92 on the surface activity of low molecular weight alcohols.

Experimental technique. The research was conducted in aqueous solutions of low molecular weight alcohols of homologous series: isopropanol, isobutanol, izopentanol with and without the addition automobile benzine A-92. Automobile benzine A-92 was added in an amount to obtain a homogeneous system. So the effect of diluted benzine on the surface activity of low molecular weight alcohols

was researched, suggesting that such alcohols also exhibit the properties of surfactants because of their structure.

The adsorption on the boundary of phase separation of alcohol solution with and without the addition automobile benzine - air was researched on the basis of experimentally derived concentration isotherms of surface tension. Calculations were carried out by the Gibbs equation [3].

$$\Gamma = -\frac{C \cdot d\sigma}{RT \cdot dC},$$

where Γ - specific adsorption of solute in kmol/m^2, i.e. excess concentration of solute in the surface layer of the solution compared to its volume concentration C; σ - surface tension of the solution, J/m^2; R - universal gas constant; T - temperature, K.

The derivative dσ / dc (a change of surface tension with concentration) is the surface activity of the solute. If the increase of the concentration of the solute surface leads to the decrease of surface tension, ie dσ / dc < 0, then the adsorption is positive (Γ > 0) and surfactant accumulates in the surface layer. If the solute increases the surface tension (dσ / dc> 0), then the adsorption is negative (Γ < 0), and the concentration of the substance in the surface layer is less than in the bulk solution, and these substances are surface inactive.

Also in this paper, parameters of adsorption process were calculated, including limiting adsorption (Γ_∞) - adsorption in the moment of 100% occupancy of the monolayer, and constants in Shyshkovsky equation [3, 4]:

$$\sigma_0 - \sigma = \Delta\sigma = B\ ln(1 + AC),$$

where A and B - empirical constants; C - concentration of surfactant. A - constant of adsorption equilibrium, B a constant of interaction between the molecules of saturated monolayer.

Surface tension of aqueous solutions of low molecular weight alcohols with and without the addition of gasoline was determined by stalahmometric method [5,6].

Results of the research. Calculations of adsorption and parameters of adsorption process were conducted by two methods on the basis of obtained concentration isotherms with and without addition of benzine. These methods are: graphycall (directly using Gibbs equation) and analytical, using a program called "ZOLOTO", which is based on finding the extremum of function and belong to optimization tasks [7].

Table 1 shows the results of calculations of parameters of adsorption process of low molecular weight alcohols on the boundary of phase separation the aqueous solution of low molecular weight alcohol with and without addition of fuel by two methods.

Table 1

The values of the characteristics of the process of adsorption of low molecular weight alcohols on the boundary of phase separation the aqueous solution of low molecular weight alcohol with and without addition of fuel - air by two methods

Characteristics of adsorption process	Method of calculation	Alcohols					
		Isopropanol		Isobutanol		Isopentanol	
		Aqueous solution	With addition of A-92	Aqueous solution	With addition of A-92	Aqueous solution	With addition of A-92
$\Gamma_\infty \cdot 10^{-9}$, kmole/m^2	Graphical	7,25	8,33	6,33	6,66	5,00	5,88
	Analytical	6,27	8,11	6,47	6,51	5,64	5,77
A, m^2/kmole	Graphical	6,67	8,00	26,67	27,27	69,41	30,91
	Analytical	7,23	7,87	26,65	27,67	47,52	30,54
B, J/m^2	Graphical	0,012	0,020	0,015	0,016	0,017	0,014
	Analytical	0,015	0,020	0,016	0,016	0,016	0,014

On the basis of calculated values (Table 1) we can see, that fuel diluted in water contributes to adsorption on the boundary of phase separation of low molecular weight alcohol solution - air. In particular analyzing values of the limiting adsorption, it should be mensioned that in solutions of low molecular weight alcohols, which automobile fuel A-92 was present, the limiting adsorption was changed by 5-15% (depending on the alcohol) upwards. This means that if diluted fuel and surfactants are present in the waste water the purification of this water will be more effective than in the result of the presence of each pollutant separately.

Regarding the values of adsorption equilibrium (A), then this value increases with increasing the length of the hydrocarbon radical of the low molecular weight alcohol. Such growth is particularly obvious within the limits isopropanol-isobutanol (about 3-3,5 times) and much weaker - for alcohols: isobutanol-isopentanol (in 1,2-2,6 times). The values of the constant interaction between the molecules in a saturated monolayer (B) does not differ substantially and are well correlated with the values of the limited adsorption.

The data of the calculations by two methods are sufficiently similar, and in some cases the same. This permits to say, that experiments and calculations were performed with minimal error.

Conclusions

As a result of studies of the effect of diluted light oil products on the surface activity of low molecular weight alcohols it can be established that:

1. Physical and chemical properties selected in the work give a possibility to analyze the effect of benzine on the surface activity of low molecular weight alcohols, including their adsorption on the interphase surface for the purpose of solving practical problems such as removal of diluted oil products from wastewater.

2. Automobile benzine A-92 diluted in water makes an influence on the surface activity of aqueous solutions of homologous series of alcohols isopropanol - isobutanol - isopentanol. The presence of fuel increases the surface activity of alcohols on the boundary of phase separation according to the increasing of length of the hydrocarbon radical of alcohols.

3. It is reasonable to recommend the refineries, which produce wastewater contaminated with oil products and surfactants the usage of flotation methods for their treatment. Surfactants should be used as flotation reagents, and the diluted fuel will enhance the effectiveness of such treatment.

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E.F. Novoselov, associate professor,
O.I. Tkachenko, assistant, V.A, Kachur
(National Aviation University, Ukraine, Kyiv)

BETULINIC ACID DERIVATIVES SYNTHESIS

Pharmacological properties of triterpenoids betulinic acid and related compounds reviewed, research results on the extraction from natural bioresources and chemical transformation of this class of compounds are presened

INTRODUCTION

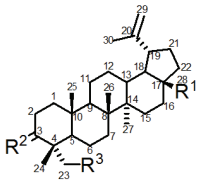
Triterpenoids as a large class of pharmacophoric compounds

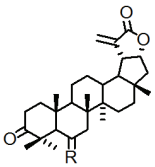
Triterpenoids are substances which are abundant in natural green plants sources, such as in extract of bark of birch *Betula pendula.* They are a group of isoprenoid compounds constructed from 6 isoprene units. In terms of the classification of organic compounds they relate to the series of lupane.

Triterpenoids have a wide range of pharmacological activities, of which the most noteworthy are: antiviral, anti-inflammatory, antiulcer, antimicrobial, anticariogenc and most importantly, anticancer activity.

Betulinic acid **(1)** and many triterpenoids of lupane series is known for more than a century, but until recently their cytotoxic activity, specifically on human melanoma cells was unknown.

Thus a number of triterpenoids derivatives of lupane with cytotoxic activity against melanoma cells have been actually developed over the past fifteen years. Betulinic acid has been given most attention, because it was historically the first known triterpenoid active against melanoma. Betulinic acid is currently in the second phase of clinical trials for the treatment of *dysplastic nevus*, and consequently has a high potential for use in future clinical practice.





1: $R^1 = CO_2H$, R^2 = β-OH, α-H, R^3 = H
2: $R^1 = CO_2H$, R^2 = β-OH, α-H, R^3 = OH
3: $R^1 = CH_2OH$, R^2 = β-OH, α-H, R^3 = H
4: R^1 = COH, R^2 = β-OH, α-H, R^3 = H
5: $R^1 = CO_2H$, R^2 = O, R^3 = H

6: R = H, H
7: R = O

Fig. 1 Betulinic acid **(1),** its derivatives and the compounds atoms numbering

Triterpenoids which are used to treat various diseases.

Betulinic acid has also other interesting biological activities, including anti-HIV, anti-inflammatory, etc. Distinctive anti-HIV activity of betulinic acid **(1)** and its derivatives was first described by two independent research groups. Since then where synthesized, published and patented a large number of new derivatives with significant activity against HIV.

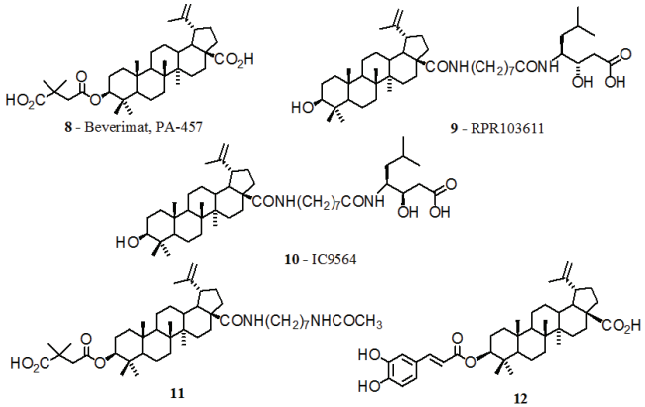


Fig. 2. Patented triterpene derivatives with significant activity against HIV

Among these derivatives **(8-12)** it is worth mentioning 3β-O-acyl-derivatives of betulinic acid suppressing maturation of virus HIV and especially 3β -O-3',- 3'-dymethylsuccinylbetulinic acid **(8),** also known as PA-457, or Beverimat, which is the most developed representative of this group.

EXPERIMENTAL PART

1. Extraction of initial compounds of triterpenoids lupane series

To the triterpenoids of lupane series belongs betulin **(3).** Betulin is widespread and easily obtained in almost any quantity from birch bark, where it can present up to 35% by weight. For the extraction of betulin are used hydrophilic solvents, hydrophobic solvents and solvent extraction in the supercritical state. The analysis has shown that none of them can be applied to obtain pure betulin for use in the industry for the manufacture of pharmaceutical and food, since these processes use toxic solvents.

We have offered and developed method involving a preliminary extraction of betulin with 94% ethanol directly from the birch bark, the following auxiliary recrystallization from the same solvent; it can help organize the production of this drug from the bark of birch at the national equipment in compliance with high health and environmental standards.

Scheme of betulin extraction with bioethanol

Preparation of raw material

Birch bark is harvested at the stage of stripping the birch tree trunk. Raw material then is dried at 20 - 35 ^{0} C for 72 hours and crushed to an average article size 1 cm.

Extraction and crystallization of the primary product betulin

Raw material is placed in a vessel equipped with a stirrer, heating jacket, and reflux cooler. Pour into the reactor 94% ethanol. The suspension was heated at reflux with stirring for 2 hours and stirring stopped. The hot mixture is sent immediately through a hot filter into the crystallization vessel, bark chips separated. In the crystallization vessel equipped with stirring and cooling jacket providing temperature near ^{0} 0 C, crystallization is carried out for 2 hours.

The suspension of crystals obtained is released from the mother liquor at a vacuum filter and collected.

Recrystallization of the primary product and obtaining pure betulin substance

The crystalline mass is loaded into a reactor equipped with a stirrer, heating jacket, and reflux, 94% ethanol is poured into the reactor and heated at reflux at stirring for 0.5 hours. Stirring stopped, the solution is sent through a filter into the crystallization vessel equipped with stirrer and cooling jacket to 0 ^{0} C. Crystallization is carried out for 2 hours at stirring. The suspension of crystals is separated from the mother liquor at a vacuum filter.

Drying and packaging of betulin substance

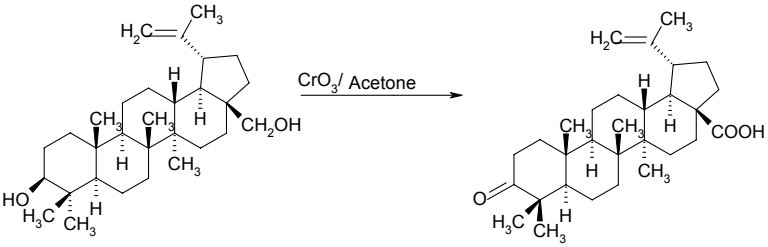
The wet product is dried on filter air at drying cabinets on pallets at 50 ^{0} C for 10 hours at air circulation and mandatory compliance with fire safety regulations. The product is cooled in air to ambient temperature and packed in sealed metal or plastic containers.

2. Synthesis of betulonic acid

The last two decades have given serious hopes of beginning treatment of diseases, drugs based on a series triterpenoids of lupane series. These hopes, of course are related to betulin - (3β, 28-dihydroxy-20(29)-lupen).

Triterpenoids are surprisingly widespread in nature and are readily available in almost any quantity mainly as betulin. Several studies had compared the cytotoxicity of methyl, pivaloyloxymethyl of acetoxymethyl esters of betulinic and betulonic acid on various cancer cell lines, in contrast to the 3β-amino analogs the obtained by reductive amination betulonic acid compounds have shown *anti-MEL-2* activity comparable with betulinic acid.

We have explored methods of synthesis of perspective derivative of series lupane - betulonic acid (5) from betulin (3) and developed a new synthetic route to obtain it according to the following scheme of reactions.



Betulonic acid synthesis was performed as follows: into three necked 50 ml flask equipped with a stirrer, a solution of 0.5 g load betulin in 20 ml of fractionated

acetone was loaded. The reaction mixture was cooled with a mixture of ice and water and at stirring was added drop wise the calculated quantity of chromium (VI) oxide in acetone. At the end in the reaction flask was added 6 ml of methanol and stirring was continued for another 5 minutes. The reaction mixture was poured into 40 ml of ice water and added drop wise dilute hydrochloric acid to precipitate formation ending. The obtained precipitate of crude acid was filtered off, washed on the filter with water to neutral reaction and dried in air.

The precipitate of crude acid was dissolved in 25 ml diethyl ether, the organic layer was washed twice with dilute hydrochloric acid, then with water and separated. The obtained organic solution was shaken up with 7 ml of 2N sodium hydroxide solution. The ether layer was separated, the aqueous layer was treated with dilute hydrochloric acid until precipitate formation. Precipitate was filtered off and collected.

The precipitate of betulonic acid was dissolved in diethyl ether, washed with water, the organic layer was separated and the solvent distilled off, the resulting residue was dried at 60 $^{\circ}$ C for one hour. Thus were obtained analytically pure betulonic acid with the melting point of 252 - 253 ° C.

Therefore it is shown that for the oxidation time of 0.5 h at a molar ratio betulin: CrO_3 - 1: 0.7 and a temperature around 0 º C can be obtained analytically pure betulonic acid with a yield of 60%.

Conclusions

1). A survey of the pharmacological properties of betulinic and betulonic acids related compounds was performed.
2). Found optimal conditions for lupane series compounds extraction from birch *Betula Penula* and its chemical transformations to yield pharmacologically valuable betulonic acid.

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I.V. Olshevsky, post graduate,
T.A. Haievska, assistant,
Yu.V. Bilokopytov, Dr.Sci.
(National Aviation University, Ukraine, Kyiv)

CATALYST SURFACE ACIDIC PROPERTIES AT RAPESEED OIL HETEROGENEOUS CATALYTIC TRANSESTERIFICATION WITH ETHYL ALCOHOL

The acidic surface properties of synthesized solid catalysts WO_3/TS (TS – titanium-aerosil support), Cr_2O_3/TS, ZrO_2/TS for the process of rapeseed oil heterogeneous catalytic transesterification with ethyl alcohol were studied, compared the results of oil conversion degree.

Biodiesel is gaining more importance as an attractive fuel due to the depleting fossil fuel resources [1]. It is a promising alternative for conventional diesel fuel as it can be used in a normal diesel engine without its modification while produces much lower levels of pollutant gases upon combustion and increases engine lifecycle. Nowadays this renewable transport fuel composed of fatty acid methyl esters is produced in an inefficient and expensive batch process in which are used homogeneous acids and bases as the catalysts in esterification and transesterification [2] processes, respectively. Introduction of heterogeneous catalysis to produce biodiesel will give significant advantages over homogeneous catalysis because it will reduce the costs of the catalyst used and also costs on the stages of separation. Solid acid catalysts can speed up reactions transesterification and esterification simultaneously. Although active solid acidic catalysts possess active centers similar to the concentrated sulfuric acid, due to a lower concentration of acid sites per unit mass of catalyst, they are not as active in comparison per unit mass of the liquid acid. However, such catalyst can be used at higher temperatures (> 60 ° C), when the alcohol will be in the gas phase. Liquid acid is difficult to operate in the presence of multi-phase, but solid catalysts can be effective even at such conditions. Thus, the lower activity of solid acidic catalysts for the model reaction temperature in the liquid phase can be compensated using higher temperatures.

Therefore, we investigated the acidic surface properties of solid catalysts WO_3/TS (TS – titanium-aerosil support), Cr_2O_3/ TS, ZrO_2/ TS which we used in the process of rapeseed oil heterogeneous catalytic transesterification with ethyl alcohol. Research was carried out my means of adsorption and programmable thermal desorption of ammonia at the installation shown in Figure 1.

Catalysts were prepared by impregnation of titanium-aerosil support with the solutions of chromium, tungsten and zirconium salts ($(NH_4)_2Cr_2O_7 \cdot H_2O$, $(NH_4)_2W_4O_{13} \cdot 6H_2O$, Zr $(NO_3)_4 \cdot 5H_2O$), followed by drying at 120 º C and calcination at 500 º C for 4 hours. Salts amount was such that on the support surface (120 m^2/g) was deposited 5 wt. % metal oxides.

The catalyst was treated with oxygen at 500 º C, followed by purging with helium at the same temperature, then cooled and ammonia adsorption study was carried out. Ammonia was introduced by doses (0.5 ml) using the six-way tap-dosing device. Adsorbed ammonia amount was determined using the difference between the inputted and not adsorbed ammonia. After removal of ammonia at a temperature of adsorption was ceased, there was held programmable heating of the catalyst sample with the rate of 15 degrees per minute.

Ammonia kept on the surface of the catalyst, was desorbing with temperature increase.

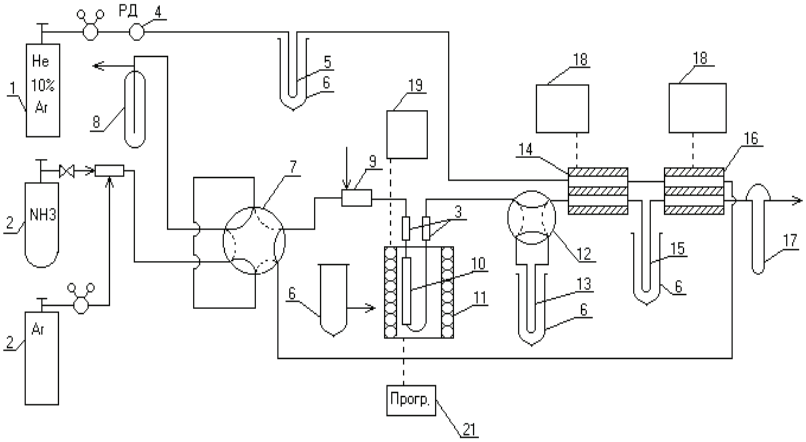

Fig. 1. Principle scheme of the experimental setup for determining the surface acid properties of catalyst:

1 - bottle of argon-hydrogen mixture, 2 - cylinder with ammonia or argon, 3 - socket for connecting the reactor, 4 - gas flow regulator; 5, 13, 15 - trap; 6 - Dewar vessel with liquid nitrogen, 7 - six-way tap-dispenser of calibrated volume; 8 - the release control vessel of ammonia; 9 - sampler; 10 - catalyst capsule; 11 - electric furnace; 12 - four-way tap-dispenser, 14 and 16 - katharometrs; 17 - rheometer; 18 - potentiometer; 19 - temperature rise programmer; 21 - two-coordinate potentiometer

Desorbed ammonia was collected frozen in a trap (15) and after subsequent thawing was analyzed with katharometr (16).

Surface acidity of the used catalyst and the results of rapeseed oil heterogeneous catalytic transesterification with ethanol are given in Table. 1.

The obtained results have shown the presence in the programmable thermal desorption spectrum of two peaks, indicating that the ammonia adsorption on the surface of Cr_2O_3/TS are occurred in two forms: first, at low temperature, corresponds probably to the physically adsorbed ammonia and the second corresponds to the coordination bonds with the Lewis acid sites.

Similarly to Cr_2O_3/TS results, programmable thermal desorption spectrum of WO_3/TS also has demonstrated two forms of ammonia adsorption.

Table 1

The acidity of the catalyst surface in relation with the conversion degree of oil

Catalyst	Specific NH_3 adsorption μmol / m^2	Oil conversion, %	Selectivity of fatty acids ethyl esters formation, %
Cr_2O_3/TS	3.0	72.8	40
WO_3/TS	4.4	81.2	60
ZrO_2/TS	5.0	98.3	95

Characteristically, the low-temperature form disappears, if before the programmed thermal desorption, the sample is blown at 373 K. Second peak in the spectrum corresponds to acidic sites, which bind ammonia more strongly. These acid sites are energetically no homogeneous which is shown by the fact that the temperature increase at the preliminary blowdown up to 403 K shifts desorption peak maximum to higher temperatures.

Results of ammonia programmable thermal desorption from the ZrO_2/TS surface show that the acid sites on the surface of ZrO_2 is very no homogeneous, and a significant amount of ammonia desorbs at high temperatures.

Conclusions

Zirconium catalyst acid sites, among other studied, have greatest strength, as the temperature desorption from them is higher than for the other catalysts.

Comparing the results of conversion degree of oil on different catalysts with the greater number of acid sites on its surface has shown that the catalyst ZrO_2/TS, for which this value is the largest, is also the most active.

Thus, the obtained results indicate that the oil tranesterification reaction occurs on acid sites that are quite strong.

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O.A. Spaska, assistant
(National Aviation University, Ukraine, Kyiv)

MINIMIZING OF PETROLEUM PRODUCTS NATURAL EVAPORATION BY ULTRALIGHT INSULATING SYSTEM

Natural evaporation of individual hydrocarbon liquids and their mixtures and efficacy of ultra-light protection coating system that prevents evaporation losses during storage were investigated. It was shown that the protective layer during its formation forms a molecular complex that is simultaneously insulating, coating and minimizes evaporation of hydrocarbon liquids.

During the storage of petroleum products, most of losses (80% of total) are a result of evaporation of most valuable light fraction liquid hydrocarbons.

A solving the problem of complete exclusion of natural evaporation from reservoirs of any construction in a reliable, safe and inexpensive way is important and requires immediate solution.

It is known that petroleum products are multicomponent complex mixtures of hydrocarbons with different boiling points. The compositions of the lightest petroleum products include hydrocarbons C_5-C_7, which are volatile and as a result are problematic at storage.

Therefore, the quality of gasoline is deteriorated at storage due to evaporation of these volatile compounds [1].

The problem of efficient storage of petroleum products remains nowadays actual, as it is caused by the insufficient knowledge of physical and chemical processes at evaporation in tanks and by the lack of effective means to minimize these processes.

Solving of these problems is possible through a targeted synthesis of surface-active systems with definite properties and a creation of a technology to protect the environment from the vapors of hydrocarbon liquids.

Notable developments [1] of the methods to protect evaporation on the bases of surfactants have not found any wide applications mainly because of the short duration of action, lack of mechanical strength, though in order to improve it there were attempts to add reinforcement fillers such as loosened cereal grains (rice, wheat, corn).

In our recent [2] work on the development of protective coating there were made a search of molecular structures and was established interrelation between the structure and the insulating properties of the molecular complexes.

In order to improve mechanical and barrier strength of the protective coating we haveused in this investigation and described in this paper a reinforcing material - glass microspheres produced by industry.

For experiments were used glass microspheres produced at JSC "Novgorod plant of glass fiber" according TU 6-48-108-94, type MS group A1 with a density 240 g/cm3 and hydrostatic compression strength of 8 MPa.

Microspheres were thin-walled hollow spheres, made of sodium borosilicate glass, average diameter of 25 microns with a bulk density 0.30 g/cm ^{3}.

For the beginning we have tested individual protective properties of microspheres themselves. To do this a cylindrical glass test vessel were filled with 100 ml of individual hydrocarbon liquids (C_5-C_{10}) that are common components of gasoline and diesel fuel. Then the surface of hydrocarbons was layered with various amounts of glass microspheres: 15%, 60%, and 100%, 200%, 300% calculated against the mirror of surface of evaporation. Then the opened glass vessel containing hydrocarbon was kept at 25 ^{o}C in thermostat. The loss of hydrocarbons by evaporation was determined gravimetrically over time.

For comparison there was also determined evaporation in absence of microspheres in similar conditions.

The protective layer composition was prepared as follows: 10 ml of 0.3% aqueous solution of “Tween-80" and 0.5 ml of 6% aqueous solution of fluorochemical surfactant (type "Unyversalny" (GOST 22567.5 - 93, Russia) was aerated and mixed to form a 30-fold volume of foam (solution 1). Simultaneously was prepared a 10% aqueous solution of polyvinyl alcohol (GOST 10779-78) (solution 2). Solutions 1 and 2 were mixed, there was added 0.1 wt.% of stabilizer (grade A 60731039, Germany), the mixed composition was aerated, thus was prepared the composition K1. This obtained K1 composition, was uniformly applied with thickness of 3 mm on the surface of a liquid hydrocarbon. Above the layer of the composition K1 were uniformly placed glass microspheres weighing 1.6 g and then reapplied composition K1 over the latter in the same amount as described above. Therefore was obtained the protective coating.

The layer of hydrocarbon liquid 13 of volume 100 ml was placed in the vessel 11 and its evaporation was studied at temperature 25 ^{o}C.

The desired temperatures were maintained with the thermostat. In order to reach saturation of air with vapor of hydrocarbon for the system, air flow speed over the surface of hydrocarbon liquid in the vessel was kept equal to 0.5 ml / min. Compressor submitted air at constant pressure, which was regulated by manostat .

The resulting air-hydrocarbon mixture was passed through thermostated volume connected through the dosage valve 4 to chromatograph. The air flow rate was measured by rheometer 8. Gas carrier helium from a cylinder 1 was fed through a dosing valve 4 to chromatographic column at which a separation of air-hydrocarbon mixture was held and then to the detector for thermal conductivity – catarometer .

The results of study of kinetics of evaporation of individual hydrocarbon liquids C_6 - C_{10} from the free surface. It can be seen that for all hydrocarbons C_6-C_{10} the same linear relationship was observed for the weight loss of the substance over time, and with the increase of its molecular weight (and hence the boiling point) evaporation slows down.

Insulating properties of microspheres were evaluated at applying them in different amounts on the surface of individual hydrocarbon liquids. It is remarkable that there has been obtained some unexpected results.

During the evaporation of hexane there were observed a retention of part of the beads on the walls of the vessel due to its adhesion to the lateral surface around the perimeter forming a continuous layer, which increases the surface area, and hence, by the action of capillary forces also evaporation.

The growth of the rate of evaporation with increase of the thickness of the layer of microspheres is determined most likely by thermal motion of the microspheres, its rotation and by increase of the resulted surface area of evaporation. This assumption is confirmed in an experiment, when 100 ml of hexane with an applied 6 fold layer of microspheres on the surface were evaporated for 10 min at temperature 25^{o}C.

Similar patterns are observed also for other homologues of saturated hydrocarbons: octane, nonane, and decane.

In contrary to individual hydrocarbons, for gasoline and evaporation decreases, due to the sorption of more hydrophilic compounds (oxygenates) on the surface of microspheres slowing down thus its rotation.

Evaporation of such liquids as common fuels is much more complex process than of individual substances as the common fuels are complex mixtures of hydrocarbons with different boiling points.

With growth of the hydrocarbon radical length, evaporation rate decreases, and anomalous effect of the microspheres diminishes. For technical mixtures of hydrocarbons (gasoline, diesel fuel) evaporation is reduced in proportion to the amount of microspheres – effect that were attributed to sorption, and to the growing interaction of fuels with the hydrophilized surfaces of microspheres.

Similarly to the gasoline evaporation results, we have obtained date on evaporation of diesel fuel from an open surface and from the surface coated with a layer of microspheres.

These analyze results indicate that microspheres should not be used as a protective barrier by their own, but rather as a reinforcing filler – an important component of ultra light technological systems in conjunction with surface-active substance in order to prevent the evaporation process.

The stability of such systems depends largely on the quality of composite selection, and such optimal choice is much more effective than a using of individual substances. First of all it concerns surface active compounds, their chemical structure and its structurizing in solutions of different polarity and concentration.

Based on experimental studies we have found the constituents of the compositions are capable of forming super-technological systems which are synergetic mixture of surface active substances, renewable vegetable raw materials, polyvinyl alcohol, water and hydrocarbons using a gas-filled glass, silica-alumna and polymer microspheres, stable at application onto the surface of hydrocarbons.

Qualitative and quantitative ratio of the components of the ultra-light technological system determines its stability on the surface of hydrocarbon liquids. The resulting complex which forms on the surface of hydrocarbon is a structured flexible film that can simultaneously become both a passive heat insulation and a protective coating, which minimizes the evaporation of petroleum products, has low density and thermal conductivity, suitable ductility and satisfactory adhesion to the walls of steel containers.

Modified materials containing microspheres are superior to the conventional ones for all the parameters considered. They have much higher levels of plasticity and stability.

The introduction of microspheres into ultra-light protection systems provides buoyancy of such systems together with a high level of structural and mechanical strength, reliability that can serve as a resistant protective barrier against vapor hydrocarbon liquids diffusion during storage.

For comparison with evaporation of gasoline A-95 after application of a coating of thickness of 10 mm were held a major change. First of all, evaporation was decreased by 2 orders of magnitude. Using the same scale, the most intense evaporation was observed for highly volatile compounds such as for pentane 0,094 g, which at the previous chart, because of low concentration, even was not marked, for 2.3 – dimethylpentane (0.83 g), cyclopentane (0,038), methycyclohexane (0,048) and trimethylcyclohexane (0.047), hexane, heptane and nonane (by 0,031), which in total is 0.001% for 5 h.

It was found that the nonappreted hollow spherical glass layers increase evaporation of liquid individual hydrocarbons C_5-C_{10}. Investigation of the influence of temperature has suggested that the phenomenon of increasing evaporation is due to the growth of surface area as a result of rotation of microspheres in the adsorbed layer under the influence of thermal motion and due to adhesion, e.g. the formation of a continuous layer around the perimeter of the storage tank.It has been found that the only way to ensure long-term stability (90 days) of aerated systems is a formation of three phase solidified systems by introduction to the composite several surface active substances as a polymeric structure-maker constituents.

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O. Titova, associate professor
(National Aviation University, Ukraine, Kyiv)

GELATION REACTION RATE OF SILICATE COMPOSITIONS

The influence of organic and inorganic additions on the formation rate of the silicate gels standard systems – sodium silicate solution in model fresh water was studied. As a result of the experiments were selected optimum concentrations of additives - gelation time regulators.

INTRODUCTION

It is known that the rate of gelation of silicate compositions depends on the concentration of silicate, salinity and temperature. The most important factor determining the formation of silica gel is pH of a composition that characterizes the ratio of soluble silicates and insoluble silicate acid in solutions.

It is also known that the gel formation is accompanied by an increase in viscosity of the composition. The dependence of viscosity on time is very well described by the hyperbolic function. A similar pattern is observed at hydrogel formation in polymer systems.

The initial stage of gel formation is characterized by a slow increase in viscosity while dependence of viscosity on time is almost linear.

Probably the increase in viscosity is determined by the increase in the number and size of microgel particles and can be described by Einstein's famous equation

$\mu = \mu_o (1+2,5\varphi)$

where μ - viscosity of disperse systems;

μ_o - the viscosity of the solvent;

φ - volume concentration of microgel particles .

With increase of particle size and formation of spatial grid the Einstein's law is not applicable, the viscosity of the system increases dramatically, exceeding viscosity of the solvent in hundreds and thousands times.

RESULTS DISCUSSION

Mention above patterns were taken into account at choosing the different compounds used, and which had significantly affected the kinetics of gelation. Primarily it was studied the effect of inorganic and organic compounds on the rate of gelation of silicate solutions.

During exposure the silicate to the layer as "crosslinking agent" is used mainly hydrochloric acid. Undoubtedly, the replacement of hydrochloric acid unto another, inorganic or organic acid will reflect in the kinetics of gelation. Selection of inorganic and organic compounds that could influence the kinetics of gelation of silicate solutions was carried out empirically, basing on general concepts of kinetic of regularities of gels formation in aqueous solutions. Thus the main objective was to find compounds that can significantly slow down the process of gelation. In the first stage of studies it was expected to find several effective additives.

The influence of various compounds on the rate of formation of silica gels study was performed on standard systems - solutions of sodium silicate in model fresh water. Gelation time was determined visually and evaluated by the loss of fluidity of the composition.

The range of investigated additives was quite broad and included more than 30 compounds. These compounds can be divided into several groups.

A. Organic substances.

1. Monobasic acids.
2. Two-and three basic acids.
3. Salts of organic acids.

B. Inorganic substances.

1. Mineral acids.
2. Hydrolysing salts.
3. Additives that are used for the synthesis of polymers.

Regarding the latter it should be mentioned that some randomly selected compounds (thiourea, potassium iodide, sodium nitrate) normally used as stabilizers at polymers degradation, have shown some interesting properties.

It should be noted also that the most of the investigated substances either accelerate the gelation formation compared with a standard "cross-linking" agent - hydrochloric acid at the same pH, or the gelation times in such systems and in the standard system remain the same.

Fig. 1 shows the kinetic parameters of gel formation in 4% silicate composition, where the "crosslinking agent" are fatty acids C_1-C_3. As it is known, these acids are weaker than the hydrochloric acid. In turn, the acid strength decreases with increasing number of alkyl constituents. In this case, formic acid is the most strong and propionic - the weakest.

From Fig. 1 is clear that the organic acids while neutralizing sodium silicate accelerate the formation of gel in comparison with hydrochloric acid. Moreover, with increasing length of the alkyl substituent (or decreasing acid strength) the rate of gelation increases. As a result formic acid reduces the gelation time in approximately 1.5 times in acetic in 2, and propionic in 5-6 times.

Perhaps this phenomenon is due to the fact that counter-ions (negatively charged alkyl groups) participating in the formation of the electrical double layer on the surface of colloidal particles affects the increase of its size. With increasing the size of counter-ions increases the size of the particles and thus accelerates the gelation.

Mineral acid - sulphuric, boric accelerate gelation only marginally. Kinetics of gelation in the presence of phosphoric acid is slightly different.

At using salts that undergo hydrolysis was mostly observed a negative effect on the rate of gelation. In particular, the introduction of silicate solutions of one-, two-, and theesubstituted sodium phosphate in an amount of 0.5-1% the rate of gelation was increased by 2-4 times.

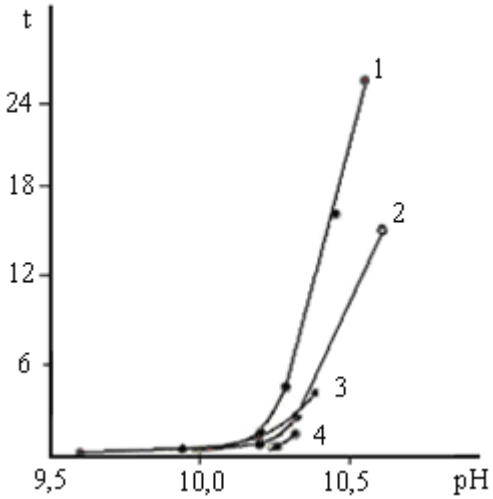

Fig. 1. Dynamics of alkaline solutions in contact with the rock pH changes
Rock composition: silica sand - 65%; clay - 30%; limestone - 5%. V - The volume of water that comes out of drill core

Adding sodium tetraborate in the same amounts lowers gelation time approximately in order of one magnitude. This fact complicates the use of these compounds in reducing of the extraction of sand from the oil-bearing rock layer

On the basis of the experiments it was found that quite promising additives - regulators gelation time are polybasic organic acids and inorganic additives - nitrates, iodides and thiourea.

Based on the experiments were chosen most promising additives - regulators of gelation time. Experiments show that neutralization of sodium silicate with simple dibasic acid - oxalic acid leads to an increase in gelation time compared to the standard system (Fig. 2.).

The rate of formation of gel in the presence of oxalic acid was in 1.5 -2 times smaller than in the standard system. Since oxalic acid is weaker than hydrochloric, then its spending was a bit greater.

When using citric acid as a "cross-linking" agent were obtained positive results, but an insufficient number of experiments can not categorically assert the efficiency of this reagent

Interesting results were obtained in the study of kinetics of gelation in the presence of salt additives - sodium nitrate $NaNO_3$, potassium iodide KI and thiourea CS $(NH_2)_2$.

In these experiments into solutions of sodium silicate the compounds mentioned above were introduced in different quantities, adjusted the concentration of additives in range 0,025-0,15%. Then in solution was added phosphoric acid to obtain the set value of pH.

Table 1

Time of silica gel formation as a function of pH in the presence of hydrochloric and oxalic acids.

Hydrochloric acid			Oxalic acid		
Conc., %	pH	Gelation time, min	Conc., %	pH	Gelation time, min
0,60	10,55	1500	0,95	10,46	1960
0,65	10,46	1080	1,00	10,31	560
0,70	10,29	280	1,05	10,15	180
0,75	10,20	80	1,10	9,94	70
0,80	9,94	25	1,15	9,78	20
0,85	9,59	8			
0,90	9,40	2			
0,95	8,97	0,5			
1,00	8,52	0,12			

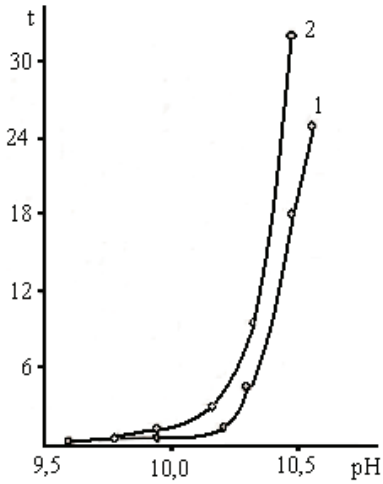

Fig.2. Kinetics of gelation in 4% solution of sodium silicate in presence of acid as "crosslinking agent." t - gelation time, hours. Acids: 1 – hydrochloric; 2 - oxalic acid.

It should be borne in mind that in the experiments with the indicated additives used another brand of liquid glass, which affected the position of the kinetic curves.

As it is known, the grade of sodium silicate, or rather its structure, greatly affects primarily the kinetics of the gelation. Mismatch of dependence of gelation time on pH in different experiments, in our opinion, is irrelevant, since in these studies the

role of modifying additives were evaluated in parallel experiments under the same conditions when comparing solutions, in comparison with the standard system.

Naturally, in the case of industrial application of a modifying additive there will be counted gelation time of a sample of sodium silicate to be used in the processing of wells. These trends are marked for all three additives in the study of the kinetics of gelation with viscosity metric method.

It should be emphasized that in all the studied systems based on sodium silicate, no matter which acid is used, the viscosity of the composition increases according hyperbolic law. The correlation coefficient in most experiments exceeded the value of 0.99. This dependence remains the same at addition in the silicate system some polymeric additives. In order to accelerate the process of analysing the influence of the studied additives on gelation, in some cases there were used a visual method of evaluation. Investigation have shown that the values of gelation time, which were determined visually, for the investigated systems are variable.

As it is seen, the gelation time in static conditions is approximately 1.5 times greater than in the dynamic, i.e. in this case we can assume that there is a dynamic structure forming of the systems

CONCLUSIONS

1. Organic acids accelerate the formation of gel in comparison with hydrochloric acid, and with increasing length of the alkyl substituent increases the rate of gelation.
2. A mixture of salts with phosphoric acid slows down the gelation processes compared with the standard "crosslinking agent" - hydrochloric acid.
3. The optimum concentration of additives that most slow down gelation, lies within the 0,025-0,05%. With further increase in the concentration of additives gelling process accelerates.
4. At addition of acid, viscosity of the compositions based on sodium silicate, no matter which acid is used, grows, according hyperbolic law.
5. When passing through a layer of rock in compositions based on sodium silicate proceeds a dynamic structuring of the system.

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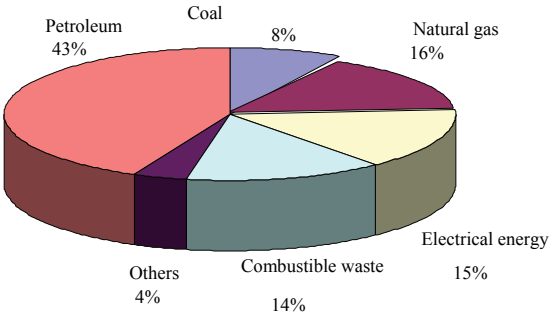
V.V. Yefymenko, Assoc.Prof
O.V. Yefimenko, PhD student
(National Aviation University, Kyiv, Ukraine)

OPTIMIZING THE PROPERTIES OF MIXED FUEL BASED ON COMPOSITIONS HYDROCARBON-ALCOHOL

Have been shown the major shortcomings of ethanol containing motor fuels. Described the search of stabilizers for guaranteeing the physical stability of mixed fuels at low temperatures including ethanol, methanol, isobutanol, methyl tert-butyl ether, diisopropyl ether and hexamine

Introduction

Stable supply of energy is required to make sure prerequisites for the economic development of any country. In the pie chart below is shown an approximate proportion values in the world energy consumption.



Today is observed reducing the rate of petroleum consumption and profitability in several countries, including Russia. This is the reason of increased cost of petroleum products and consequently it limits the development of national economies and the world economy as a whole. Considering that 80% of the mechanical energy that a person uses in its operations, is produced in the internal combustion engines, it makes today a turn to alternative energy sources namely of not of petroleum origin .

Alternative fuel under the general classification is divided into three groups:

The first group includes oil consumption of non-oil applications origin (alcohols, esters, etc..), which for operational properties is similar to conventional petroleum fuels.

The second group is synthetic liquid fuels, similar in properties to traditional petroleum fuels, but they obtained in the processing of gaseous, solid or liquid feedstock (natural gas, oil shale, etc..), also it is a processing of natural gas

into synthesis gas and then into methanol or hydrocarbons in the so-called technology GTL (Gas

The third group - non-oil fuels (alcohols, natural and associated gas, hydrogen, etc.). They significantly differ in physical, chemical and operational properties from the traditional fuels.

When using alternative fuels of the first two groups it is sometimes necessary to make minor changes in the fuel system of the vehicle for fuel use, while the third group requires a significant upgrade.

At introduction of ethanol which is a high-octane component of the resulting gasoline fuel, there can be lowered some harmful components content such as aromatic compounds or MTBE. Thus, ethanol is a valuable component for the preparation of high-octane unleaded gasoline, especially in the regulation of content in aromatic hydrocarbons and olefins. The actual octane number of ethanol at compounding is a complex index, as it varies according with those of the anti-knock properties of the base fuel. If the octane number of base gasoline is low, of importance becomes the higher octane number of the ethanol component .

Characteristics of ethanol as of a solvent are different from those characteristics of gasoline because of the polar nature of the OH functional group. Due to this, ethanol has the ability to dissolve dirt, rust and tar deposits in the components of existing fuel systems.

It is established that ethanol reacts with its hydroxyl groups, and the reaction proceeds at removal of hydrogen atom from the hydroxyl group of ethanol molecule. The hydrogen atom, having strong reductive properties destroys peroxides, thereby increasing fuel detonation resistance.

The advantages of fuels that contain alcohol include the following properties:

1.Ethanol vapor dissipates in air faster than of gasoline;

2.Ethanol is less toxic than gasoline, it does not contain carcinogenic components;

3.Ethanol vapor is less flammable than gasoline vapor with its lower selfignition temperature (423 ^{o} C compare to 257-300

4.The viscosity of ethanol is higher than of gasoline;

5.alcohol electro conductivity is higher than of gasoline, which reduces the possibility of accumulation of static electricity when pumping fuel

6.Octane number of ethanol is higher than of gasoline (108 vs. 75 - 98);

7.Addition of ethanol results in lower emissions of hydrocarbons;

8.Ethanol can be obtained from natural renewable raw material, which base is unlimited;

9.It reduces the content of the controlled harmful components vehicle exhaust gas, improves combustion completeness of alcohol mixtures and therefore the emissions of CO and CH are reduced;

10. There developed new methods of obtaining ethanol from green plants.

The disadvantages of ethanol as a fuel or a fuel component are:

1.Corrosion activity (incompatibility with a number of metals and other materials);

2.Changeability of component composition of ethanol containing fuel caused by evaporation of alcohol, and its extraction from fuel a commodity water against specified properties;

3.Increase of fuel consumption for 12% at 3% ethanol concentration in mixture ;

4.Increased carbon formation in the presence of alcohol, acids and aldehydes, even in trace amounts;

5.High cost of absolute alcohol (15-20% higher MTBE);

6.Slight increase in emissions of nitrogen oxide and acetaldehyde

Problem solving

Foreign experience with ethanol in gasoline composition has revealed a number of problems. These include: phase instability of gasoline-ethanol fuels (alcohols C_1 - C_3 is known to mix with water in any ratio and presence of the latest in gasoline that contains alcohol is the cause of the phase instability), corrosion activity against metallic materials of engine et al [3].

If water gets into fuel (from alcohol, which is in fuel mixture, from the atmosphere as a result of hygroscopicity of mixture that contains alcohols) homogeneity of alcohol solutions in hydrocarbons is eventually breaks. This leads to such fuels physical instability: separation during storage, deteriorating of engine starting properties, causes a freezing of fuel in pipelines, tanks, etc. [4].

Because of the said above the major problem at using ethanol as of a component that increases the octane number of motor gasoline is the low physical stability of alcohol-gasoline fuels at low temperatures [5].

Analysis of studies

Adding ethanol into gasoline requires compulsory includes in its composition some stabilizing additives that allow homogenizing the gasoline-water-alcohol systems and also requires including of anti-corrosion additives in accordance with EN 228-2000 [3].

There are several ways to solve this problem. According the international experience into alcohol-gasoline mixture is added as stabilizers the higher alcohols. But this way is economically disadvantageous because of the high cost of such stabilizer. The latter problem solving must be not only inexpensive but also it has to meet modern ecological requirements [5].

So much attention is paid to the stabilizers, which together with ethanol in blends with straight gasoline fuel will make satisfactory low-temperature properties.

In accordance with modern standards of qualification assessment the phase stability of motor gasoline clouding point temperature of winters type shall not exceed - 25 $^{\circ}$C, for summer gasoline type it should not be higher then - 5 $^{\circ}$C [5].

Analysis of the literature and patent data shows that as a stabilizer mixtures gasoline-alcohol is proposed are used: aliphatic alcohols normal and iso-structure, alkyl acetates, simple esters and ethers, its organometallic derivatives, ketones, amines, surfactants, glycols and their ethers, aldehydes, kethales alkyl carbonates, carboxylic acids and mixtures of these compounds. Addition of these compounds

prevents the separation of gasoline mixtures containing alcohol to temperatures down to -40 ÷ 23 $^{\circ}C$ [3].

Table 1 shows compositions based on ethanol, methanol, isobutanol, MTBE (methyl tert-butyl ether), DIPE (diisopropyl ether), and hexamine, which also allows to support stable phase of the fuel .

Amines also have some minor stabilizing effect, hexamine as a part of multi-component fuels based on aliphatic alcohols have shown a property partly substitute isobutanol, which is the known stabilizer of ethanol in gasoline mixtures .

Table 1

Compositions that provide phase stability of fuel

Composition	Composition,% (v)					
	ethanol	isobutanol	MTBE	DIPEA	methanol	hexamine
1	50	20,8	19	5	5	0.2
2	50	20,6	19	5	5	0.4
3	50	20,4	19	5	5	0.6
4	50	20,2	19	5	5	0.8
5	50	20,0	19	5	5	1
6	50	19,8	19	5	5	1.2
7	50	19,6	19	5	5	1.4
8	50	19,4	19	5	5	1.6
9	50	19,2	19	5	5	1.8
10	50	19,0	19	5	5	2

Depending on climatic conditions a motor fuel consumption with the introduction of this kind of stabilizers are allowed to use a cheaper azeotropic ethanol containing 6% of water.

While anhydrous ethanol in the compositions of car gasoline is potentially more promising direction than search of ethanol-gasoline blends stabilizers, it all does not rule out stabilizers line of prospecting .

Recent research results [4] have shown that the chemical and physical stability of fuel compositions at a satisfactory level (at the standard fuel oil), even in the presence of water up to 5% (by weight) provides also an acoustic treatment. Although it is not yet well scientifically grounded and not proved that this method of suppression of negative physical and chemical processes in fuel compositions is universal and without flaws characteristic for individual selection methods for each chemical stabilizer composition of the fuel composition or additives [4], it has its clear advantages.

Conclusions

There are several types of alcohol-gasoline blends alternative fuels, characterized by definite benefits and disadvantages

It has been shown the major problems of using of alcohol-gasoline blends of alternative fuels and methods to resolve these tasks by introducing of certain range of stabilizers.

A promising is also an acoustic treatment method in order to solve the problems of fuel blends phase instability.

In the future the research work on the selection of stabilizers to gasoline-ethanol fuels will remain actual.

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V.V. Yefymenko, Assoc.Prof
N.S. Atamanenko, PhD student
(National Aviation University, Kyiv, Ukraine)

USAGE OF HYDROTREATING PROCESS IN THE PRODUCTION OF JET FUELS

The features of hydrotreating processing of kerosene fractions are considered. Usage of more effective catalyst for the production of high-quality jet fuel is offered

Introduction

Jet fuels during their storage, transporting and using can cause corrosion of metals and alloys, used in the fuel systems of airplanes. The products of combustion of jet fuels are able to demonstrate corrosive action. The corrosive aggressiveness of fuel depends on character and amount of sulfur, nitrogen and oxygen compounds. As a result of high corrosive activity of mercaptanes, their quantity in jet fuels is strictly limited. It is also principal reason of low stability of jet fuels, that is why such fuels are undergone to hydrotreating process[l].

Analysis of researches and publications

Hydrotreating is a single-stage process which proceeds in most soft, in comparison conditions to hydrocracking and destructive hydrogenization. There is partially destructed mainly sulfur-organic and partly oxygen- and nitrogen-containing compounds. The products of decomposition by saturation with hydrogen are H_2S, water, ammonia and unsaturated or aromatic hydrocarbons.

The catalysts of hydrotreating are compounds of oxides and active components (nickel, cobalt, molybdenum and other) with a participation of transmitter for which most frequently useed the activated oxide of aluminium. A transmitter action is not only to be an inert diluent but it also takes part in forming of active phases, and also serves as structural promotor that creates a specific porous structure, optimal for processing of specific raw material [2].

A process proceeds as follows. Raw material is mixed with hydrogen-containing gas with concentration 85-95 % vol., that eners from the circulations compressors, which support pressure in the system.

The mixture is heated in a oven to 280 340 °C, depending on raw material, then enters reactor.

Reaction passes over catalysts, which contain nickel cobalt or molybdenum, at pressure up to 50 atm. In such conditions there occures destruction of sulfur and nitrogen compounds with formation of the H_2S, ammonia, and olefines. Mixture of products outflowing from the reactor, becomes separated from the surplus of hydrogen-contained gas in a separator, that returns into circulation compressor. Hydrocarbon gases are separated and the product enters fractional column from the bottom of which product is pumped out (cleared fraction) [1].

Industrial assembles have much general in apparatus design and to the construction of reactor blocks and they differentiate on capacity, sizes of detailes, technological mode and to the charts of sections of separation and stabilization of hydrogenization and also, by the variants of usage of hydrogen-contained gas, with circulation or without circulation «on a channel».

The assembly of service of hydrogen-contained gas «on a channel» is used only in the combined assembles of hydrotreating and catalytic reforming process (with the stationary layer of catalyst and hydrogen conducted under the higher pressure).

It is easy to support permanent correlation of hydrogen: raw material in a assembly with circulation of hydrogen-contained gas. The presence of circulation compressor allows to regulate required multipleness of circulation of hydrogen-contained gas, enables to conduct the gas-air regeneration of catalysts.

There are two methods of separation of hydrogen- contained gas which are used for gas-air mixture: cold (low temperature) and hot (high temperature). Cold separation of hydrogen-contained gas is used in assembles of hydrotreating, fractioning of kerosenes and sometimes for diesels of petrols; it consists in cooling of gas-air mixture which flow out from the reactors of hydrotreating. Hot separation of hydrogen-contained gas is used mainly in the assembles of hydrotreating of high-boiling fractions of oil; fuels of diesels, vacuum gas oils, oil distillates and paraffins.

On refinery are applied the followings two variants of regeneration of the saturated solution of monoethanolammonia:

-directly assembling of hydrotreating;

-the centralized regeneration in an the all-factory knot[2; 3].

Formulation of tasks

Hard requirements to quality of oil products , in the first turn on the decline of maintenance of sulfur and aromatic hydrocarbons, force to search more effective catalysts of hydrotreating.

Decision of task

Hydrotreating of kerosene is used with the purpose of production of jet fuel with contents of sulphur to 0,1 %. The process of hydrotreating is conducted on an active catalyst with pressure to 7MPa, in such conditions due to hvdrogening of aromatic connections and their contain notedly diminishes to the necessary value. The catalysts of hydrotreating show by itself compounds of oxides of active components (nickel, cobalt, molybdenum and other) with a transmitter. There are of special interest catalysts of firms of Criterion Catalyst (C-448), Haldor Topsoe (TK-554, TK-907, TK-908), AKZO Nobel (KF-752).

Assemble of hydrotreating consists of the followings blocks :

-Reactor block;

-Block of stabilizing of hydrotreating fraction of 140 - 280 °C with the section of preparation of fuel PT;

-Block of cleaning of hydrogen-contained gas. Hydrotreating of fraction of

140 - 280 °C is carried out on of TK-575 (Haldor Topsoe firm) at the temperatures from 300 to 370 °C and at pressure of 4,0 MPa and in the environment of hydrogen-contained gas. The reactions of transformation of sulfur-, nitrogen- and oxygen-contained compounds run across in a reactor with the stationary layer of catalyst [3].

Using this catalyst in the process of hydrotreating of kerosenes has next advantages:

-maintain excellent performance over a wide range of operating variables such as liquid and vapour loads;

-superior performance also when tray is not perfectly level during operation;

-sclf-cleaning nozzles require less maintenance and thereby improve performance;

-easy and fast installation to save time;

-minimum required reactor height provides more space for catalyst in the reactor;

-an unmatched number of drip points and coverage ensures improved utilisation of the catalyst, even at the reactor wall;

-innovative mechanical support system for tray plates so they are less likely to warp under load as compared to traditional beam supported trays.

The liquid distribution tray and quench mixers are the most crucial elements of reactor internals design in order to ensure efficient catalyst utilisation.

The vapour-lift distributor tray distributes the vapour and liquid evenly across the entire cross section area of the catalyst bed (fig. I).

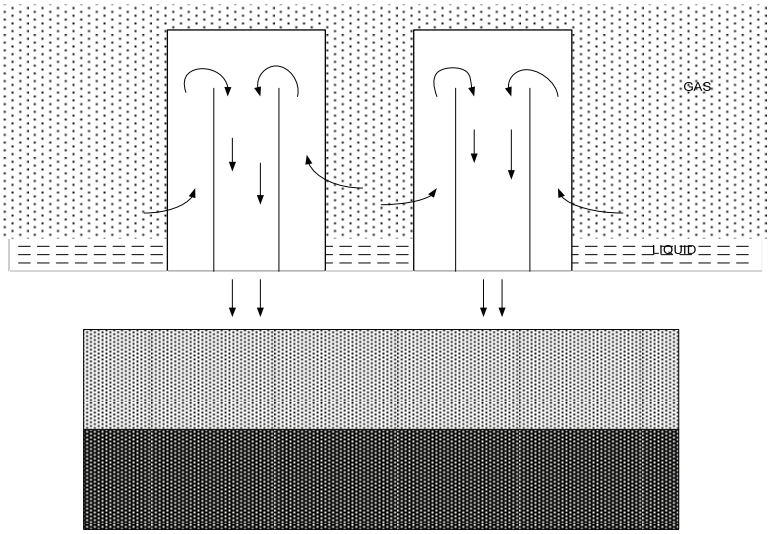

Fig. 1. The operational principle of Topsoe's VLT tray

These trays operate on a vapour assisted principle by which the vapour flow through the nozzles creates a pressure differential. This lifts liquid droplets from the tray and carries the liquid and the vapour up through the riser and down through the downcomer to the catalyst bed below. The vapour lift mechanism for liquid flow results in even flow distribution, because the liquid flow is not sensitive to the local liquid level at the nozzle.

In contrast to the VLT tray, a chimney tray achieves liquid flow by means of gravity. Thus, the flow through a chimney depends greatly on the liquid level at the chimney.

Comparison between the typical required vertical height for Topsoe's VLT tray of the previous generation design.

The design of VLT trays includes the capacity to retain fouling material without affecting liquid and vapour distribution and thereby catalyst performance (fig. 2).

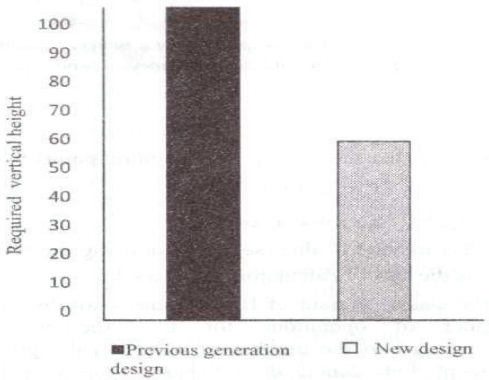

Fig.2. Comparison between the typical and VLT tray

The slotted nozzles are self-cleaning (fig. 3). By design, the velocities through the slots do not allow fouling materials to settle in the slot and thus always provide enough cross sectional area to ensure that the flow paths are kept clear for the vapour and liquid mixed phase flowln two-phase hydroprocessing reactors, a mixing device is required between the catalyst beds.

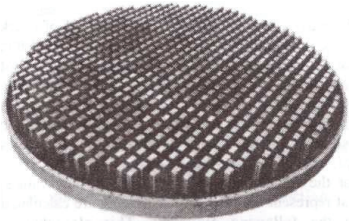

Fig.3. Self-cleaning nozzles of catalyst

A well-designed mixing device ensures good contact between the quench fluid and the vapour and liquid effluent from the catalyst bed above. This results in efficient heat and mass transfer with uniform composition and an even temperature profile in the bed below. Any non-uniformity created by a poorly-designed mixing device will result in loss of reactor efficiency. In two-phase hydroprocessing reactors, a mixing device is required between the catalyst beds. A well-designed mixing device ensures good contact between the quench fluid and the vapour and liquid effluent from the catalyst bed above. This results in efficient heat and mass transfer with uniform composition and an even temperature profile in the bed below. Any non-uniformity created by a poorly-designed mixing device will result in loss of reactor efficiency. The Topsoe Vortex-type quench mixer is used extensively throughout the refining industry. The Topsoe Vortex-type quench mixer is a state of the art design now being used extensively throughout the refining industry. Comparison between tray deflection at typical design loads for a traditional beam supported distribution tray and Topsoe's new design for a reactor with an inner diameter of 4,4 mm (illustration is not to scale). The new design ensures better flow distribution [5].

Conclusion

The process of hydrotreating of kerosenes, described higher, allows to get high-quality jet fuels, responding to requests of all specification parameters.

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O. Zaporozhets, Dr hab., Prof., Ia. Movchan, Dr. hab., Prof.,
V. Havrylenko, PhD, D. Hulevets
(National Aviation University, Ukraine, Kyiv)

AVIATION UNDER THE CONTEXT OF INTERNATIONAL LAW IN THE SPHERE OF BIODIVERSITY: GAPS AND NECESSARY STEPS

This article gives an preliminary overview of the current status of basic international law in the sphere of biodiversity in the practice and in legal documents of aviation transport policy.

The Earth biological resources are vital for economic and social development of mankind. Therefore gaining increasing recognition of the fact that biodiversity is a global asset of tremendous value to present and future generations. Biodiversity of the planet is represented by all life forms and ecosystems they form. This phenomenon makes our planet of habitable. The UN estimates that forty percent of the world economy depends on biodiversity.

At the same time, today more than ever, great threat to the existence of species and ecosystems. Scientists say about the beginning of the threat of the sixth in the history of our planet's mass extinction of species. Death of 75% of mammal species and 86% of bird species associated with human activities. As a result of human activities on biodiversity loss and destruction of natural landscapes immediate extermination make annually about 10 thousand species. Every year the green biomass on the planet becomes smaller by 1.6%. Over 20 years have lost 54% of poultry litter. E.g., after 20 years, the number of species of butterflies will be reduced by 70%. These facts talks about the alarming rate of extinction of species of animals and plants [1].

In 2010, Parties to the Convention on Biological Diversity (CBD) adopted the Strategic Plan for the conservation and sustainable use of biodiversity for the period 2011-2020, which is a structure, designed for 10 years, in which all countries and stakeholders will take steps to conserve biodiversity and the corresponding benefits to the people. Within the framework of the Strategic Plan was adopted 20 ambitious but achievable targets, known as targets for conservation and sustainable use of biodiversity, the Aichi [1,2].

In the Strategic Plan for the conservation and sustainable use of biodiversity include: Concept: "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people." Mission: "The adoption of effective and urgent action to halt the loss of biodiversity to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby guaranteeing the diversity of life on the planet, and contribute to the welfare of people and poverty eradication.»

To achieve this, pressures on ecosystems are minimized, bioresources are sustainably used and shared in a fair and equitable sharing of benefits from the utilization of genetic resources; adequate financial resources, expanding the potential issues and values of biodiversity are effectively implemented appropriate

policies and decisions are based on sound science and the precautionary approach [3,4].

Convention on Biodiversity calls on all parties to develop a national strategy and action plan for the conservation of biodiversity in order to ensure achievement of the objectives of the Convention at all levels and in all sectors of the economy of each country (Article 6) [5]. Actual task is the integration of biodiversity into relevant legislation, plans, programs and policies, such as sectoral (energy, transport, etc.), as well as in the national development plans, national sustainable development strategies, Poverty Reduction Strategy Papers, the strategy for achieving the Millennium Development Goals, national programs to combat desertification, national strategies for climate change adaptation and mitigation, and relevant policies in the private sector [6,7].

The situation concerning the implementation of demands of policy and politics documents in the sphere of biodiversity by the aviation is presented in the Table 1 below (internationally and nationally – case of Ukraine).

Table 1

Analysis of transport policy gaps Convention on Biological Diversity

Objective of a task	Obligations of Ukraine	Policy and legislation	Gaps (included or not)	Recommendations
Aviation				
Art. 6 **b) CBD** Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programs and policies. (conservation of ecosystems, conservation of individual species)		In the Air Code of Ukraine (ACU) and the documents of the State is no special regulation. At the national multisectoral plans, programs and policies are not taken into account.	not taken into account	Changes in legislation (ACU) plans. Recommendations and regulations documents of the State for airports
Art. 8 **h) CBD** on alien species		In ACU and documents of the State is no special regulation.	Partially	Additions to the regulations
Art. 10 **CBD** Sustainable use of components of biological diversity		In ACU missing. Law of Ukraine "On Ecological Expertise" SBR / EIA	Partially	Changes in legislation concerning environmental review of construction of infrastructure, noise vehicles, spread of alien species

Objective of a task	Obligations of Ukraine	Policy and legislation	Gaps (included or not)	Recommendations
Aviation				
Target 2. By 2020, the issue of biodiversity values integrated into national and local development strategies and poverty reduction and planning processes in finance, where appropriate, and reporting systems.		Air Code of Ukraine (ACU), and partly horizontal and sectoral (non-aviation) legislation	Not taken into account. In air transport policy is a gap to incorporate aspects of biodiversity (migratory routes of birds and bats) in the formation of a network airways, looking synthesis of research and development of methodical recommendations for minimizing threats to bio-components in the areas of airports	Required inclusion in national policies and specific measures NAP protection of natural ecosystems. Need research on the importance of factors and impacts of migration of bionts airways and capabilities of its incorporation
Target 8. By 2020, pollution, including from excess nutrients, has been brought to levels that do not cause disrupted ecosystems and biodiversity.		Air Code of Ukraine (ACU), and partly horizontal legislation	Not taken into account. Lack of attention to biodiversity issues in policy and regulatory documents. There is a need to improve the regulatory framework to prevent environmental pollution, especially the hydrosphere, as well as noise. There is a need to develop legal framework to minimize threats to bio-components in the areas of airports	We need research and development relevant documents regarding the impact of antiglaze reagents, fuel, waste in the area Catering, there is a need to improve the regulation of sewage systems and wastewater treatment, as well as funding for water-related
Target 9. By 2020, invasive alien species and their propagation paths detected, identified their priority, the priority controlled or destroyed, and the measures of management pathways to prevent their introduction and rooting.		Air Code of Ukraine (ACU), and partly horizontal and sectoral (non-aviation) legislation	Not taken into account. There is need to develop a systematic document on invasive alien species (alien species)	Implementation of research and development.

Thus, the legislatively regulated sphere of transport policy are missing or need improvement requirements biodiversity from the impact of air transport. There are no maps of concentration and migration of birds that could benefit designers and operators of airports and traffic control specialists, preventing direct adverse effects on biodiversity caused by large-scale production of biofuels, in particular for the

needs of the aviation industry, the public is not informed and not prepared to accept environmental problems around airports in particular regarding zoning, monitoring and implementation of appropriate measures to protect areas within the adverse effects of environmental pollution factors, surface drainage systems of airports and airfields. Their inappropriate maintenance, leading to uncontrolled distribution of rainfall, including contaminated food operation airfield and aviation equipment, and contamination of ground and surface waters from sewage during snowmelt after winter maintenance using antiglaze materials for improvement measures for threats related the spread of alien species.

Conclusions

The results of the analysis to eliminate gaps in the policy development of air transport in connection with the preservation of biodiversity, it is necessary: the legislative requirements set environmental balanced indicators of the airline industry. The main criteria should be determined taking into account the interaction of regional (local) and climatic characteristics of the adverse effects of aircraft, including the increasing consumption fuels, including biofuels, implement monitoring bird populations around airports and to map their migration, which often causes victims and AP, to improve legislatively regulated sphere of air transport policy requirements for sewage systems and wastewater treatment and funding actions to improve ecosystem services related to water.

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M.M. Radomska, PhD, O.M. Tykhenko,
O.V. Ryabchevsky, O.M. Dekhtiarenko,
(National Aviation University, Ukraine, Kyiv)

IMPLEMENTATION OF ENERGY-SAVING TECHNOLOGIES AT AIRPORTS TO INCREASE THE LEVEL OF ENVIRONMENTAL SAFETY

The main reasons and prerequisites of energy losses from administrative and productional buildings of airports have been considered in the paper. Energy-saving potential of Ukrainian airports have been analyzed. The most efficient methods and technologies providing conservation of energy at airports are presented.

Aviation is proved to be one of the industries posing a wide range of threats to the environment and human health. The diversity of technological operations, performed at modern airports leads to high variability and complication of environmental impacts. The most known and analyzed impacts of aviation include, but not confined to, air, noise and electro-magnetic pollution by aircrafts and ground transport, as well as airport equipment. Other components of the environment are also affected by air transport processes, namely they cause soil and water pollution, destruction of habitats and violation of atmospheric regimes. Therefore general environmental situation within the area of airport influence is formed under the influence of numerous factors. The volume and intensity of these impacts greatly depend on the efficiency of operations conduction and resources consumption at airports.

Inefficient exploitation of material and energy resources leads to:

- formation and accumulation of excessive volumes of wastes;
- overconsumption of water for technological processes;
- pollution of vast areas of fertile soils around airports not included into their industrial zone;
- intensified pollution of the atmosphere due to emissions from equipment and vehicles, power and heat generating facilities working over the necessary time;
- thermal pollution on the environment due to losses of heat from buildings.

Development and implementation of resource-saving action plans allow reducing usage and wasting natural resources, raw materials and energy carriers. The assessment of energy efficiency at airports could be conducted for airport buildings of administrative and production purpose. Such assessment will give information about ways of energy losses, methods of losses prevention and ways of reducing negative impacts on the environment.

Energy saving is obviously today one of the main trends of development both domestic and world economy. Taking into account current economic and political situation, the issues of energy resources conservation are on the agenda for Ukraine on a continuous basis, and this tendency is from now on the main vector of country progress. More and more Ukrainian producers try to introduce energy efficient solutions to the market. It is especially topical for capital construction, as this branch must not only raise the efficiency of constructed facilities, but also

modernize or replace existing installations with new equipment, meeting the modern requirements. Transport is one of the most important participants of this process, and first of all it is true for air transport. It is conditioned by the fact that aviation industry combines capital construction (airport and its facilities), developed infrastructure and high levels of energy resources consumption, including fuels.

During the last few years Ukraine has demonstrated high rates of development of aviation industry: in 2006 passenger turnover has grown 5,1 times, and the amount of carried passengers – 4,3 times by comparison with 2000. For next period to 2013 the growth rates made 4,8 %. Prognosis made by competent professionals show that general volumes of carried passengers at all air-ports of Ukraine in 2020 will attain 7–8 million passengers a year [1].

The volume of passengers transportated via unoperating air-ports, if they are passed to municipal property and function in 2020 year, can be up 120–200 thousand. The main national airport «Boryspil» will develop more rapidly: the volume of passenger transportations in 2020 will make 8300–10500 thousand passengers a year. As for the airport «Kyiv» (Zhulyani) the prognosis data for 2020 set the potencial volume of passenger transportations at the level of 355–857 thousand passengers a year [2].

The system of airports of Ukraine includes 72 air fields and 36 operating airports. From statistical information about activity of most domestic airports for the last three years, it is seen that the amount of both trips and passengers, transported through these air-ports, is growing. Therefore the need to increase energy efficiency of these objects is crucial for the improvement of environmental situation around aviation enterprises.

The level of energy efficiency could be assessed with the help of energy audit procedure and resulted in the form of “Energy Passport” for each of administrative or production buildings at the airport. Energy audit involves recording various characteristics of the building envelope including the walls, ceilings, floors, doors, windows, and skylights. For each of these components the area and resistance to heat flow (R-value) is measured or estimated. The leakage rate or infiltration of air through the building envelope is of concern, both of which are strongly affected by window and door construction. The goal of this exercise is to quantify the building's overall thermal performance. The audit may also assess the efficiency, physical condition, and programming of mechanical systems such as the heating, ventilation, air conditioning equipment, and thermostat.

When the object of study is a building under exploitation then reducing energy consumption while maintaining or improving human comfort, health and safety are of primary concern. Beyond simply identifying the sources of energy use, an energy audit seeks to prioritize the energy uses according to the greatest to least cost effective opportunities for energy savings.

Some of the greatest effects on energy use are staff behavior, climate, and age of buildings and facilities. The energy audit may therefore include an interview of the managers and workers to understand their patterns of use over time. So, in general assessment of energy efficiency will include:

- analysis of energy bills;
- survey of the real operating conditions;

- understanding of the building behavior and of the interactions with weather, occupancy and operating schedules;
- selection and the evaluation of energy conservation measures;
- estimation of energy saving potential;
- identification of enterprise concerns and needs.

The term energy audit is commonly used to describe a broad spectrum of energy studies ranging from a quick walk-through of a facility to identify major problem areas to a comprehensive analysis of the implications of alternative energy efficiency measures sufficient to satisfy the financial criteria of sophisticated investors. Numerous audit procedures have been developed for non-residential (tertiary) buildings (ASHRAE, IEA-ECBCS, RESNET). The most applicable for general analysis of the situation with Ukrainian airports is express-audit, which is based on the study of available data about airports structure, buildings parameters and energy systems, required to identify the need for further investigation, existing problems and offer the most efficient and cost-effective ECOs or Measures ECMs. Energy conservation opportunities (or measures) can consist in more efficient use or of partial or global replacement of the existing installations, as well as organizational and technological solutions.

The analysis of preliminary data has shown that the most intensive consumers of energy are the airports «Boryspil», «Simpheropol», «Donetsk», «Dnipropetrovsk», «Odesa», «Kharkiv», «Lviv», as they provide the biggest volumes of transportation. At the same time these airports has recently came through certain level of reconstruction, which has also included installation of energy efficient equipment. The rest of the airports at the territory of Ukraine are still far not that energy efficient as they must be to guarantee financial reliability and environmental safety of the adjoining areas.

The analysis of airport facilities resource consumption efficiency has been conducted with the help of score system, based on the energy efficiency scale. This scale ranges from 0 to 200, where 0 corresponds to the facilities, which do not consume energy at all, meaning that it doesn't loose energy and even produce it using certain alternative power installations. The opposite value is established for those objects which loose a lot of energy in all forms (electric, heating, hot water, conditioning steam etc.). Traditional aviation objects, constructed over 30 years ago, have rating close to 130-160, while newly rebuilt facilities tend to have rating around 100. Practically, obtained rating reflects situation with energy conservation practices at the study object, but it also gives clues to the direction of further improvement and shows the most problematic areas of energy system at the object.

Using available information resources from open databases the energy audit of airport buildings has shown the following results: «Simpheropol» - 133, «Donetsk» - 95, «Ivano-Frankivsk» - 153, «Kharkiv» - 124, «Lviv» - 125, Kyiv «Zhulyany» - 121. Thus, we can conclude, that the most efficient practices are applied at «Donetsk» airport, which could be considered a benchmark, «Kharkiv», «Lviv» and Kyiv «Zhulyany» have demonstrated moderate efficiency, while «Ivano-Frankivsk» and «Simpheropol» have to be considerably improved. The walk-through audit of these objects has detected a range of problems, much of which are common for all of them. Most of the issues are related with inside illumination,

climate control systems and heating. Nevertheless, «Simpheropol» airport has major problems raised due to behavioral patterns of the staff, while «Ivano-Frankivsk» has minimal volume of energy efficiency installations introduced.

The resulted figures are also informative about the reasons of environmental problems around the airports and shows among other, that «Lviv» airport must pay attention to the improvement of wastewaters collection and treatment, «Simpheropol» airport have urgent need to improve storage facilities for petrochemicals to reduce their emissions, «Kharkiv» and Kyiv «Zhulyany» are facing problems with waste management and «Ivano-Frankivsk» airport need to invest in modern heating system. The most common result of inefficient use of energy resources by the airports is air pollution, conditioned by fuels combustion in engines of transport and vessels of power generating facilities. It normally includes carbon dioxide, VOCs, nitrous oxides, carbon monoxide, sulfur dioxide, mercury, cadmium, lead, mercury compounds, cadmium compounds and lead compounds.

So, the level of energy efficiency of national airports is still not satisfactory in most cases and promotes seeking for new solutions. As practice shows, the basic users of energy in airports are the systems of illumination, vapour- and heatgenerators, climate-control and comfort-providing systems. The leading producers of energy saving equipment, such as Danfoss, ABB, Carrier, Siteco, have various solutions for airports. Thus, energy effecient solutions in the field of illumination include installation of daylight reflection systems, providing maximal efficiency of light usage from sunrise-to-sunset. Except of obvious economy of electric power, it helps create soft even illumination, comfortable for visitors eyes. This way power of the electric illumination depends on the level of natural illuminance and is regulated automatically in most premises. Centralized illumination control system also allows an operator of air terminal to watch over fields, ramps, terminals and adjoining areas and to light them up, when airplanes stand in a ramp, landing, taking off or some operations are being carried out. Airport holding zones could also be illuminated in accordance with the flights timetable.

Optimization of microclimate control is also possible with application of special cooling supply charts with variable consumption of cooling agent. It is supplied only to those areas, where the thermal sensors and sensors of CO_2 are fixing increased air temperature (due to illimination, equipment radiation, concentration of people), which is over the comfort level for visitors or personnel that moment of time. Moreover, up to 85% thermal energy could be removed in the process of cooling is then brought back to the system with rotor recuperators – currently the most efficient energy-saving appliances. This is important, as climate-control is impossible without reliable heating system. It could be provided with several independent heating sources instead of a single one, allowing their separate starting to regulate level of heating energy supply and to avoid its wasting. To provide the efficient distribution and use of thermal energy in heating and cooling system, it must be equipped with automatic balancing valves, which provide regulation of heating and cooling agent supply to different parts of building.

There is possibility to reduce power supply of terminals and safety systems, which must always be on. The conservation of 20% electric power could be provided with introduction of reactive-power compensation devices, those allow

decreasing the total load on transformers and supply lines. The use of lighting devices with electronic regulation also diminishes the losses of power by 10%.

Automation of terminal equipment generally allows reducing the amount of necessary operating personnel, to minimize number of errors, predefined by human factor, promotes reliability and safety of all airport systems. It also creates conditions for continuous record and control of energy consumption parameters.

The application of all the above mentioned ECOs and ECMs may reveal nonfunctional redundancy of power supply systems and reduce the power consumption at any object by up to 15%, which is huge relief both technologically and economically. Such a good example of successful implementation of the presented action list has been presented by airport Vnukovo, Russian Federation, when the object from 22 MW originally designed by the European experts reduced energy consumption to 18,7 MW, that is by 3,3 MW.

Conclusions

Conservation of resources in the process of airports functioning is an important element of their profitability improvement, safety enhancement and environmental risks reduction. Energy saving potential of airports is huge due to variety of energy consumers and high demand for permanent power supply. Implementation of ECOs and ECMs considered in the paper may provide conservation of 15% energy. Environmental effect is also considerable: reduction of emissions (emissions of greenhouse gases are decreased by 11-18%), minimization of thermal and electro-magnetic pollution leads to mitigation of microclimate fluctuations around the airport and improvement of general air quality.

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O. Zaporozhets, Dr hab., Prof., Ia. Movchan Dr. hab., Prof.,
V.Tokarev, Dr. hab., Prof., O.Grasko
(National Aviation University, Ukraine, Kyiv)

UKRAINIAN AVIATION UNDER THE CONTEXT OF INTERNATIONAL LAW IN THE SPHERE OF CLIMATE CHANGE: GAPS AND RECOMMENDATIONS FOR IMPROVEMENT

This article gives an preliminary overview of the current status of the issues in the sphere of climate change in the practice and in legal documents of aviation transport policy.

Ukraine as a State that has acceded to the Convention on International Civil Aviation (ICAO Convention), is responsible for the implementation of international obligations arising from this Convention and must guarantee and create the safety conditions for a society protecting their interests in proceedings of the activities in field of civil aviation and airspace usage.

In recent years (2000 - 2011) air passenger traffic market in Ukraine was developed very rapidly (except 2009). Gradually, for the 11 years whole the number of passenger increased by almost 6 times (relative to 2000 year). Significant factors that influence positively on the national airlines activities are further expansion of the route network, increasing of flights intensity and renewal of the fleet. Considerable attention is given to measures of increasing safety and improving the service quality. For a long time, the international and domestic transportation ratio of national air carriers was approximately 80-85% and 15-20% in favor of international ones. On international routes 6.3 million passengers were carried in the 2011 year (84% of total), on national -1.2 million passengers (16%), the growth rate was 23 and 22.3 per cent respectively.

The legal basis of the national civil aviation is "Air Code of Ukraine" [1]. Subjects of civil aviation are required in operation of aircraft on the ground and in the air to adhere the established standards on pollutants content in the exhaust gases and on effect of physical factors and to take measures to reduce emissions of pollutants, noise, electromagnetic and radiation. (Art. 83 [1]).

ICAO, as the lead United Nations (UN) Agency in matters involving international civil aviation, is conscious of and will continue to address the adverse environmental impacts that may be related to civil aviation activity and acknowledges its responsibility and that of its Member States to achieve maximum compatibility between the safe and orderly development of civil aviation and the quality of the environment. In carrying out its responsibilities, ICAO and its Member States will strive to:

a) limit or reduce the number of people affected by significant aircraft noise;

b) limit or reduce the impact of aviation emissions on local air quality; and

c) limit or reduce the impact of aviation greenhouse gas emissions on the global climate.

The severity of the problems at many airports and on flight routes has given rise to measures which limit aircraft operations and has provoked vigorous opposition to the expansion of existing airports or construction of new airports. International aviation emissions, currently accounting for less than 2 per cent of total global CO2 emissions, are projected to grow as a result of the continued development of the sector. To promote sustainable growth of aviation, a comprehensive approach, consisting of work on technology and standards, and on operational and market-based measures to reduce emissions is necessary. Particularly for noise management the balanced approach was developed by ICAO, it consists of identifying the noise problem at an airport and then analysing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source, land-use planning and management, noise abatement operational procedures and operating restrictions, with the goal of addressing the noise problem in the most cost-effective manner.

Concerning climate change ICAO is focusing on four key areas: 1. Governmental assistance in the preparation and implementation of the National action plans. 2. Environmental alternative fuels for aviation. 3. Market based measures (MBM). 4. The desired global objectives.

Significant technological progress made in the aviation sector, with aircraft produced today being about 80 % more fuel efficient per passenger kilometre than in the 1960's. Air traffic management (ATM) measures under the ICAO's Global Air Navigation Plan contribute to enhanced operational efficiency and the reduction of aircraft CO2 emissions. Assembly Resolution A37-19 requested the Council, with the support of Member States, to undertake work to develop a framework for MBMs in international aviation, including further elaboration of the guiding principles listed in the Annex to A37-19, first of all – importance of avoiding a multiplicity of approaches for the design and implementation of MBM framework and MBM schemes.

Addressing GHG emissions from international aviation the aspirational goal of 2 % annual fuel efficiency improvement is unlikely to deliver the level of reduction necessary to stabilize and then reduce aviation's absolute emissions contribution to climate change, and that goals of more ambition will need to be considered to deliver a sustainable path for aviation. A substantial strategy for capacity building was undertaken by the ICAO to assist the preparation and submission of States' action plans, including the holding of hands-on training workshops and the development of guidance material. Ukraine is among the 61 Member States that represent 78.89 % of global international air traffic voluntarily prepared and submitted their action plans to ICAO. National action plans are wonderfull forms of active engagement and cooperation of the States and the industry (collective commitments were announced by Airports Council International (ACI), Civil Air Navigation Services Organisation (CANSO), International Air Transport Association (IATA), International Business Aviation Council (IBAC) and International Coordinating Council of Aerospace Industries Associations (ICCAIA) on behalf of the international air transport industry) to continuously improve CO_2 efficiency by an average of 1.5 % per annum from 2009 until 2020, to achieve

carbon neutral growth from 2020 and to reduce its carbon emissions by 50 % by 2050 compared to 2005 levels.

One of the main points of Ukrainian action plan is the use of sustainable alternative fuels for aviation, particularly the use of drop-in fuels in the short to mid-term, as an important means of reducing aviation emissions. The need for such fuels to be developed and deployed in an economically feasible, socially and environmentally acceptable manner and the need for increased harmonization of the approaches to sustainability.

The agreement by the Committee on Aviation Environmental Protection (CAEP) of certification requirements for a global CO_2 Standard for aircraft in 2012 was an important step in preparation and following adoption (possibly in 2016) of this standard for aviatiopn industry as a whole. Being important globally to control the GHG emissions from international aviation it should be quite important for Ukrainian aviation industry, as for aircraft (Antonov Design Bureau), as for aircraft engine (Progress Design Bureau and "Zaporozh-Sich") enterprises.

As Ukraine has established this systematic way to estimate, report and verify GHG emissions, those procedures will be used to ensure that the estimation, reporting and verification of CO2 emissions in its action plan is undertaken in accordance with the ICAO Guidance on States Action Plans Appendix E recommendations (Fig. 1). Ukrainian air traffic is expected to grow as reported on EUROCONTROL Medium-Term and Long-Term Forecast, even on the lower growth scenarios. It is estimated that through the combination of measures included in this Action Plan, the accumulated emissions savings in 2020 could be around 1.000.000 tons CO_2 (Fig. 2).

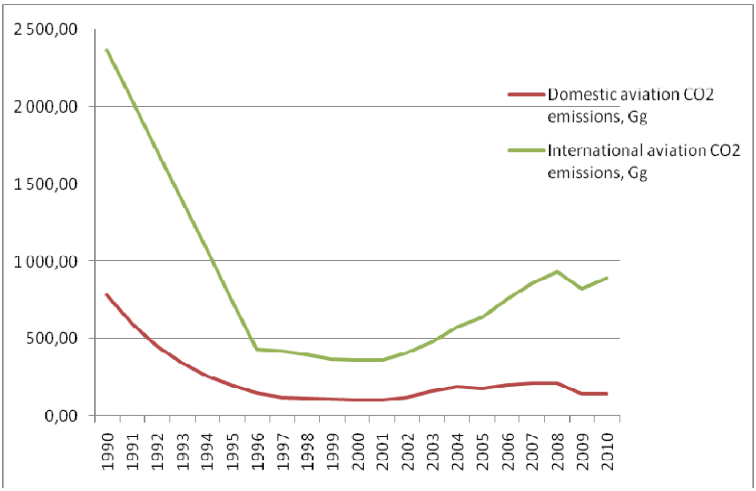

Fig. 1. CO2 emissions trend (Gg) from international aviation

The estimated expected benefits in terms of fuel savings and emission reductions of the basket of measures included in this plan are the following:

Aircraft related technology development: 1 % annual efficiency improvement (accumulated 8%) till 2020 (including RTK efficiency optimization, through adaptation of aircraft fleets to specific airlines needs);

Improved air traffic management and infrastructure usage: 5 % accumulated efficiency improvement in 2020;

Basket of possible operational or additional measures, according to the capacity of national key agents: 3% accumulated efficiency improvement in 2020.

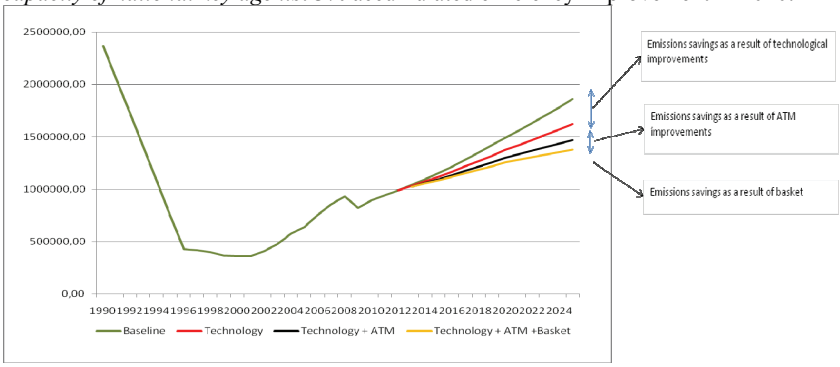

Fig. 2. Estimated emissions savings in 2020 through the combination of measures included in the Action Plan of Ukraine

Conclusions

To eliminate gaps in the policy development for aviation will be necessary: to overcome inconsistency with the legal regulations - usage of MBM for emissions reduction in the vicinity of airports and aircraft on flight routes inhibited by the existing tax rate for emissions from mobile sources of pollution, which is contrary to the MBM used for mitigation and reduction of the emissions. The lack of assessment of the current and future impact of aircraft noise, aircraft engine emissions and aviation fuel consumption prevents the development of sectoral policies as required by ICAO and other international organizations. There many aspects in links between aviation and climate change interfere huge with biodiversity and desertification, which are subjects of sustainability also.

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V.A. Glyva, Doctor of Science, V.V. Kovalenko, PhD,
N.N. Kichata (National Aviation University, Ukraine, Kyiv)
L.A. Levchenko, PhD (Kiev Polytechnic Institute, Ukraine, Kyiv)

ELECTROMAGNETIC LOAD ON THE AIRPORT STAFF AND BASIC METHODS OF ITS REDUCING

The work is devoted to investigation of electromagnetic load on the airport staff and providing practical, scientifically- grounded recommendations to minimize its impact.

Development of aviation communications in Ukraine, increasing the frequency of aircraft movements increases a pressure on service and traffic control staff. The result is an increasing the load on the psycho-emotional sphere of workers and increasing of impact of the physical environment factors. The last is caused by quantitative and qualitative composition of the equipment used in production processes; simultaneously working aircrafts and continuous work with high load of all airport systems. One of the main factors, that affect workers, are electromagnetic fields and emission of almost the whole frequency spectrum, which require a meticulous study of their quantitative values and determining the conditions to minimize them.

At the moment, the working conditions of the airport's personnel receive significant attention, however, most studies of this problem are devoted to such issues as reducing aircraft noise [1], emissions from aircraft engines [3, 4]. But these factors hardly affect the working conditions of air traffic control staff, and the main factors, that influence them and all other airport staff, are electromagnetic fields and emission, caused by arrangement of sources of their formation and high permeability. Studies of the impact of electromagnetic factor on airport workers are sporadic and concern primarily the high-frequency - microwave band (UHF RF) of mobile network objects, operating frequencies of which fall in this ranges [5, 6]. Nevertheless the specificity of the formation of the electromagnetic environment at the airport and its surroundings is a wide spectrum of electromagnetic emission, generated by radio equipment of air traffic control, navigation and landing.

Integral electromagnetic load is determined on the base of actual values of the electric and magnetic components of the electromagnetic fields and the energy flux density of electromagnetic emissions, generated by technical means, the principle of superposition and maximum permissible levels of these factors for each frequency range. [7]

Obtaining of the necessary baseline data is possible with the help of calculation methods, regulated by current method of determining of the electromagnetic fields of HF SHF ranges [8], and technical documentation for radio objects.

But experience of such studies showed significant differences between calculation methods and results of natural measurements, which are beyond the admissible errors. Typically, the calculated values of the quantitative characteristics

of electromagnetic fields and emissions are lower than measured. Moreover, the measured values of the characteristics of electromagnetic fields and emissions are different for similar radio equipment.

This is explained by several reasons: 1) unpredictability of intensity of emission of parasitic petals of diagrams of emitter orientation, consideration of which is mandatory, according to the requirements of public health planning and development regulations of populated areas [9]; 2) in many cases, in the points of determining the levels of electromagnetic radiation an effect of other techniques is observed, that cannot be predicted even on the basis of their location.

The feature of formation of electromagnetic environment at airports, located within settlements, is the influence of base stations and radio impact of the airport on the situation in the areas of residential development. Operating frequencies of radio equipment airports of UHF range and base stations are very close and are not divided by standard gauges. But the maximum permissible level of radiation of these frequencies for aerodrome equipment is 10 mkW/sm2 [3], but the corresponding figure for the base stations is 2.5 mkW/sm2 [7]. This necessitates a separate determination of the contribution of these sources to the overall electromagnetic background using precision equipment of calibrated high-resolution.

To get the correct data of the electromagnetic environment at the airport and its surrounding areas, using only instrumental methods is impractical. This is due to large amounts and timing of the required work. The most rational are field measurements at critical points around the radio facilities and use of the results to refine the necessary coefficients corresponding mathematical functions and calculation methods as boundary (initial) conditions.

Aim of the work is to determine the actual values of electromagnetic emission of radio equipment of the airport and to provide practical, evidence-based recommendations to minimize their impact on employees.

Almost all the airports in Ukraine use the same type of equipment to ensure safety. Some exception is the airfield of the airport in Lviv, which is combined with the military airfield "Skniliv", this is why the airfield "Lviv" was chosen for the research. It is characterized by the following composition of the fleet: civil aircraft - A-320, A-319, B-767, B-737, MD-83, ATR-42, F-100 and others. Military - SU-27 and MiG-29.

Specified aircraft fleet requires an increase in the number of sources of electromagnetic radiation.

The nomenclature of sources of electromagnetic emission of airfield "Lviv" is presented in Table 1.

Table 1.

Sources of electromagnetic radiation emitted by airfield "Lviv"

Type of facility, the magnetic declination, the type of operations	Denotation	Frequency	Work hours	Exceeding the transmitting antenna DME	Notes
VOR/DME	LIV	115,50 MHZ	H24	333.5M/1094FT	
LOC 13 ILS CAT II	ILO	109,50 MHZ	H24		
GP		332,60 MHZ	H24		3^0 , RDH 15.0 m
LOC 31 ILS CAT II	ILV	110,30 MHZ	H24		
GP		335,00 MHZ	H24		3^0 , RDH 15.0 m

Where:
VOR - directed on all tracks azimuthal radio beacon;
DME - directed on all tracks rangefinder radio beacon;
LOC - Course radio beacon;
GP - hlisadic radio beacon.

Also used ATCR (overview locator) and ARDF (automatic radio direction finder).

Preliminary evaluation of the level of electromagnetic mission of all radio equipment was performed by the method [8]. Calculated results allowed to determine the most critical points of the airfield working zone, where full scale measurements were performed. Measurements were performed by calibrated energy flux density meter PZ-31.

Measured levels of electromagnetic emission for radio equipment of flight at the height of 1.8 m above the ground and the distance 0-400 m from the foundations of transmit antennas are:

Radio beacon DVOR/DME - 8,22 - 0,31 V/m;

Course radio beacon (SP-200) – 9,0 – 0,17 V/m;

Glideslope radio beacon (SP-200) - 0,68 - 0,09 mkW/sm2;

Automatic radio direction-finder (ARP-75) – 0,36 – 0,04 mkW/sm2;

Surveillance radar (R-25Wt) – 10,48 – 1,13 mkW/sm2.

Whereas, according to the norms of planning of air traffic control objects, radio navigation and landing BCH-7-86 construction restrictions zones are defined within: course radio beacons - in working sector ± 30 ^{o} and in critical areas; glideslope radio beacons - 1000 m in working sector of ± 30 ^{o}; airport observation radars - 3000 m (limited angle 0,5 ^{o}; h - 5 m); radio beacon DVOR/DME – 600 m. the maximum permissible levels given [7], for radio equipment of flight facilities it is necessary to establish protection zones: for radio beacon DVOR / DME – sanitary protection zone of radius 25 m counting from antenna's blade; for a course radio beacon (SP-200) – sanitary protection zone of radius 25 m in the direction of the main emission; for glideslope radio beacon – sanitary protection zone of radius 25 m in the direction of the main emission; for the radio direction-finder (ARP-75) - sanitary protection radius of 25 m; for surveillance radar - sanitary protection zone of 30 m centered at the locations of the antenna. For buildings up to 25 m and above limiting radius of a residential building is 220 m.

The evaluated levels of electromagnetic emission lead to the conclusion about the possibility of reducing the impact of this factor on workers to levels lower than the norms. This is realized through the following measures:
- Antennas of station should be placed on embankments (trestles) or natural hills;
- The negative tilt angles of the antenna should be limited.

Service areas at the object's territory should be placed mainly in places, protected from electromagnetic fields ("radio shadow", "dead zone"), and orient them in way to prevent windows and doors from radiation, if necessary - to shield.

The routes of personnel at the object's territory should be set to prevent from radiation at levels that exceed the maximum permissible.

Emission zones with energy flux density above 10 W/m2 (1000 mkW /sm2) must be marked with special warning signs.

If necessary to work in the antenna emission area with levels of EMF, exceeding the permissible levels, must be used mobile shields and personal protective equipment (Table 2).

Table 2

Materials for production of electromagnetic shields

Name of material	ДСТ, ТУ	Dimensions, mm	Attenuation, dB
Metal sheets, 3	ДСТ 19903-74	20x1000x1,4	100
Aluminum foil roll	ДСТ 618-73	width 460…600	80
Copper foil roll	ДСТ 5638-75	width 20…..1500 depth 0,8	80
Steel woven mesh	ДСТ 5336-73	Depth 0,3..1…1,3	30
Radioprotective glass with semi-conductor coated on one or both sides	ТУ-21-54-41-79	1000x2000x6	20…40…40
Cotton with microwire, art.6911	ОСТ 17-28-70	Width 930	20…40
Amorphous metal alloy	ММ – 11N	Depth 20-50 microns	60…80

Conclusions

1. Rationalization of planning and implementation of airport personnel protection from effects of electromagnetic fields and emission is achieved as by calculation, as by experimental methods of evaluation of the emission capacity of airfield's radio equipment with the definition of integrated quantitative indicators.

2. Actual levels of electromagnetic emission of equipment, which is used in air traffic control system, can reduce their impact on working personnel through their appropriate placement and creation of zones for working people.

3. Personnel in close proximity to the source of generation of electromagnetic fields (such as magnetron radar) should be protected with the help of special electromagnetic shields (standard housing and doors of electronic equipment do not always provide their electrical sealing) the configuration and the material for the shield is selected in accordance with the actual level of emission).

The work done can be considered as first step of implementation of electromagnetic safety of all airport personnel.

Taking into account the wide frequency range of electromagnetic fields and emissions, as well as certain unpredictability of their distribution, it is reasonable to perform measurements of quantitative characteristics of these factors (including electromagnetic fields of industrial frequency 50 Hz) in the airport's control rooms and determine their compliance with sanitary norms and rules for this category of workers.

Such activities should be performed on integrated manner, ie, with simultaneous control of other physical factors (noise, air ionization, etc.), which is caused by a certain interdependence levels of electromagnetic fields and air ionization (deionization) and noise level and power of technology equipment, which is used by air traffic controllers. This is a subject for further research.

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B. Khalmuradov, Prof. (National Aviation University, Ukraine, Kyiv)
O. Evtushenko, N. Volodchenkova
(National University of Food Technology, Ukraine, Kyiv)

INFORMATION SUPPORT OF COMPLEX IMPROVING OF SECURITY LEVEL AT THE ENTERPRISE

In this article is shown a great need in creation automated information system – The State Register of victims which were injured during work or have got occupational diseases. Being built on the base of conceptual reasoning of the main tasks, structure and functions and also thanks to modern information systems, the Register gives a chance to follow the cause-and-effect relationships and to control the risks of injury during work. The program «Analysis_of_accidents 1.0» is developed for registration accidents and injuries in production according to the reports of form H-1 and it was built in C++.

It's clearly seen that reformation of the system of the occupational safety and health management in Ukraine can't be provided without usage of branch-wise computer network, Internet resources and implementation of uniform information technologies.

Nowadays we have got some experience in applying computers in the automated systems of the occupational safety and health management (ASOS&HM), but such experience is incomplete. Here is a great example: while in the 1990s the number of the confirmed occupational diseases (intoxications) had extremely increased among the food industry workers, there hadn't been any kind of analysis of the occupational diseases not on the workplaces, neither in the Ministry of Healthcare of Ukraine, that's why appeared a great need in the automation of process registration and further data processing. Time demanded urgent action, so according to the order of the Ministry of Healthcare of Ukraine, the Ukrainian Scientific-Research Institute of Industrial Medicine created a computer-based integrated at all levels the automated system of registration and analysis of the occupational morbidity (AIS «ProfMorbidity»). The other countries also have an interesting experience in this sphere. For example, in the Great Britain the usage of application packages for registration and analysis accidents is widespread, so different forms of monitoring safety precautions can be provided. In France the leading corporations and companies (metallurgical, of the transport equipment, engineering, mineral) are developing such AIS according to their needs. They contain complex and technical development for preventing accidents in the workplaces; in the implementation of these programs are actively involved committees of hygiene and the occupational safety.

Consider the experience of creating a cumulative database of accidents abroad and in some Ukrainian branches, there is need for the Ukrainian food industry in developing an automated information system of registration and exchanging of data banks about accidents on the food industry companies.

Management process is inseparable from the systematic exchange of information between the components of the control system (object management) and food enterprises. Information enables engineers of the occupation safety on the food technologies enterprises to have representation about the state of labor safety in various companies, so managing the security of the technical operations employees in the workplace includes registration and analysis of the information about accidents, their characteristics, and also gives a chance to analyze the primary source of their appearance.

To automate the processing of statistical data and reduce the time to process them, and also for rapid development of preventive measures was developed the computer program «Analysis_of_accidents 1.0» in «C++» medium. The program is based on data of accidents according to H-1 form acts.

Failure to comply injury prevention rules in a result causes traumas and accidents will eventually lead to injuries and accidents in the workplace, and usually the victims of these accidents are themselves employees of enterprises [1]. Accident at work law regards as a time-limited event or sudden exposure of an employee of the production factors or circumstances, that happened during the performance of work duties, which caused significant harm or death [4]. Therefore, the employer must consider the accidents at work, as a signal of poor state efforts to prevent injuries to one or another production site.

Materials of investigations and reporting data on accidents permit to evaluate the state of safety and provide a framework for actions to enhance efforts to prevent occupational injuries. The H-5 and H-1 forms of acts are the primary instruments for recording, analysis and development activities to eliminate the main reasons of injuries. The form of the accident's act is developed to make possible to analyze in depth the causes of injuries and on this basis to develop and implement effective measures to reduce it. Information in the act can reveal the real picture of the events and bring benefit only if they are made properly and objectively on the basis of properly conducted investigation of the accident. Even a small inaccuracy, omission and haste in the preparation of an act can lead to the wrong conclusion, and therefore the purpose of investigation will not be achieved.

Experience shows that even at the regional level it is rare where you can find that data to acts of H-1 is processed and analyzed, and the databank accumulates information on accidents. State inspectors also do not pay proper attention for supervision of work, though, according to [2-3] all the primary information should come to them. Because statistics clearly show that most accidents happen every year for the same reasons, under typical circumstances. [2-3]

To develop measures of reducing occupational injuries is crucial timely flow of reliable information about the accidents that have occurred in the workplace. The act of H-5 and the act of the accident of H-1 form, report about accident investigation according to form H-2, as well as annual reports are the main carriers of the knowledge base, as well as the primary statistical documents in the online account and analysis of occupational injuries.

Organization of information flow is adapted to the existing methods [2-3] of data accumulation on injuries. Accordingly, after the preparation and approval at company the acts of forms H-5 and H-1, they are sent by mail to the State

Inspectorate for Supervision of Labour Protection. The admission of acts is the main message of the accident, the additional H-2 message is sent after the close of sick leave of injured worker.

Social insurance against industrial accidents and occupational diseases and industrial control offices that monitor preventive measures in specific workplaces should obtain all the initial data.

The timely flow of information on the actual injuries is crucial for solving the tasks of injury reduction. We can observe that there is a great problem of delays processing and receipts acts from enterprises, which are also improperly designed.

Long delay in the administration acts and total ignoring of this measure or incomplete sending, incomplete, not correct and not an objective mapping of circumstances of accidents in the materials of the investigation do not give an opportunity to discover the real causes of injury and quickly resolve them.

The aim of project is to develop a software product for personal computers for the recording of accidents in the food industry. That will give the opportunity to create a data bank of information acts H-1 for further analysis of causes and circumstances of occupational injuries in the food industry and the timely flow of information acts H-5 and H-1 to e-mail for social insurance against industrial accidents and occupational diseases.

The aim 2. Improve the system of safety management for food businesses by developing and improving the automated collection and analysis of information on accidents.

To automate the processing of statistical data and reduce the time to process them, and also for rapid development of preventive measures was developed the computer program «Analysis_of_accidents 1.0» in «C++» medium. The program is based on data of accidents according to H-1 form acts [4-5].

System requirements to computer: OS Windows 98/Me/2000/XP/Vista/Windows 7, 128Mb of memory, 64Mb videocard.

To run the program you have to press twice left mouse button (or press the «Enter», which is on the keyboard) on the file «Analysis_of_accidents.exe», which brings up the main menu where you enter the initial data for the collection of information on injuries in the enterprise.

The program «Analysis_of_accidents.exe» provides for the creation of new records, edit the ones that already exist or remove (buttons "add", which control, "change", "delete").

For the accumulation of information in a database, you must click "add", a window appears in which laid a menu command. When you select a specific command opens a submenu where it operates a general description of the accident. Data for filling are divided into four categories: "Person", "Company", "Terms" and "People and events."

In the category of "person" are included: the personal data of the victim, the time and date of the accident, general information about the accident, including the equipment.

In the category "Enterprise" is shown the information about the enterprise of the employer, including the company where the accident took place, and in

accordance with [3, p. 8] must be selected the type of event, cause and type of accident.

The data about the passage of briefings, medical examination, diagnosis, and a sheet of inoperability is entered to the category "Terms". Information about witnesses of accident and offenders of legislation, and also measures to prevent accidents are included to the category "People and events".

After filling out the menu the screen appears that is designed to create a common list of data on victims in the enterprise.

One element of the toolbar is "Generate Report". For this you should select the row with information about the victim and to click on that element, as a result the report H-1 will be generated.

There are three active elements on toolbar: “Open”, “Save” and “Print a report”. The first element is “Open”. This element allows you to upload the needed report. Report files have the extension *.acr. The second element is “Save”. It’s displayed a dialog box asking for the input file name in which the report will be saved. And the last element is “Print a report”. It’s displayed a dialog box for selection of printer.

As a conclusion in the program is offered the opportunity to test injury, getting rates of incidence of injury, severity of injury, malfunction. Such data are necessary to process the quarterly report "Information on injuries at work."

Conclusion

The program «Analysis_of_accidents 1.0» gives an opportunity to: keep records of accidents in the food industry; create a data bank of information acts H-1 for analysis purposes and circumstances of occupational accidents in the food industry; prepare and publish acts on form N-1 and in a timely manner to email for social insurance against industrial accidents and occupational diseases. If it’s necessary, you can expand email addresses; to generate annual reports on Form № 7 TNV, given the information acts H-1.

Therefore, the 1st stage of performing the function "Planning and funding for health and safety" of the system of food safety management companies is to analyze traumatic situations.

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P. Wiesen, Prof., R. Kurtenbach Dr of Sciences
(Bergische University of Wuppertal, Germany)
O. Zaporozhets, Prof., K. Synylo, PhD
(National Aviation University,Ukraine, Kyiv)

MODELLING AND MEASUREMENT OF AIRCRAFT ENGINE EMISSIONS INSIDE THE AIRPORT AREA

Assessment of local and regional air pollution produced by aircraft engine emissions by measurement and modelling methods provides initial information for next steps of air quality regulations to calculate precisely emission inventory of aircrafts and concentration field for control of sanitary-hygienic zone sizes around the airport.

1. Introduction

During last decade a lot of studies are also focusing on the aircraft emissions impact on local and regional air quality in the vicinity of airport [7, 8, 9, 10, 11]. The basic objects of attention are NO_x and fine particle matter (PM) emissions from aircraft engine emissions as initiators of photochemical smog and regional haze, which directly impact human health [6]. This problem intensifies in connection with increasing air traffic (at a mean annual rate of 5 to 7%) and growing public awareness of local air quality around the airports [2, 3].

Analysis of inventory emission results at major European (Frankfurt am Main, Heathrow, Zurich and etc.) and Ukrainian airports highlighted, that aircraft (during approach, landing, taxi, take-off and initial climb of the aircraft, engine run-ups, etc.) is the dominant source of air pollution in most cases under consideration [4, 5].

Also, aircraft is special source of air pollution due to following features: moving source, result in velocity, direction and acceleration of aircraft movement has been changed in within the wide limits; presence of exhaust gases jet from aircraft engine near the ground; aircraft engine operation modes during landing take-off cycle have been changed from idle to maximum operation mode – correspondingly temperature, velocity of exhaust gases jet and emission characteristics of aircraft engine has been also changed within the wide limits.

So, local and regional air pollution produced by aircraft engine emissions must be assessed by measurement and modelling methods, which provides initial information for next steps of air quality regulations (**aircraft emission index and concentration of pollutant**) to calculate precisely emission inventory of aircrafts and concentration field for control of sanitary-hygienic zone sizes around the airport. Both methods for determination of air quality levels must taking into account expressed features aircraft, as special source of air pollution.

In the present study air pollutant emissions, e.g. nitrogen oxides (NO_x=NO+NO_2), were measured from passenger aircraft at Boryspol airport (Kiev) or existing emission data from Athens International Airport (AIA) were used for the improvement of the model e.g. PolEmiCa and Fluent 6.3/Gambit.

2.Complex model “PolEmiCa”

In the National Aviation University (Kyiv, Ukraine) a complex model “PolEmiCa” for assessment of air pollution and emission produced by aircraft activities inside the airport has been developed [13]. It consists of the following basic components:

1.engine emission model – emission factor assessment for aircraft engines, including influence of operational factors;

2.jet transport model – transportation of the contaminants by engine jets;

3.dispersion model – dispersion of the contaminants in the atmosphere due to turbulent diffusion and wind transfer.

As was mentioned before **the important feature of a researched** source of emission is the presence of exhaust gases jet, which can transport contaminants on rather large distances. The value of this distance depends on engine type, operational and meteorological conditions, fig.1.

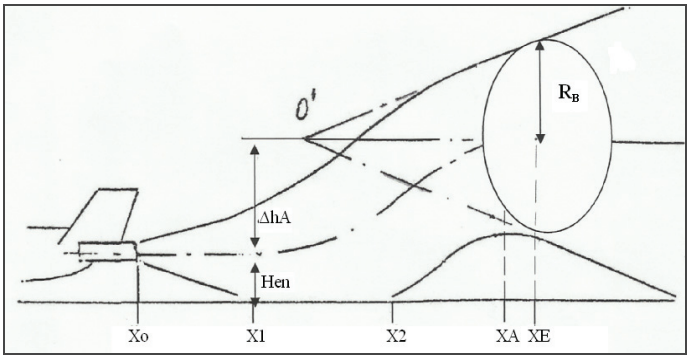

Fig.1. Structure exhaust gases jet from aircraft engine:

Δh_A – height of buoyancy effect, m; H_{en} – height of engine installation, m; X_A – longitudinal coordinate of buoyancy effect of jet, m; R_B – radius of jet expansion, m; X_E – longitudinal coordinate of jet penetration, m.

Puffs are created by engine jets of a moving (or standing) aircraft with initial dispersion parameters (σ_{0s}), which are the functions of the engine exhaust outlet parameters – diameter, velocity and temperature (fig.1). Temperature difference between jet and ambient atmosphere provides buoyancy effect for the jets and corresponded to it puffs rise on a height Δh_A, which is also defined by outlet parameters. All of them are prescribed by jet transport model, which is based on semi-empirical model of turbulent jets [13].

The most part of LTO-cycle the aircraft is maneuvering on the ground (engine run-ups, taxing, accelerating on the runway), it is subjected to fluid flow that can create a strong vortex between the ground and engine nozzle, which have essential influence on structure and basic mechanisms (Coanda and buoyancy effects) of the engine jet of exhaust gases. Complex model “PolEmiCa” has been improved in jet/plume transportation modeling by CFD code (Fluent 6.3). Using

CFD codes allow investigating structure, properties, and fluid mechanisms of jet and also giving deep understanding of contaminants transportation and dilution by jet from aircraft engine with taking into account ground impact.

Assessment of air pollution produced by aircraft engine emissions with taking into account dilution contaminants by jet and dispersion by wind and atmospheric turbulence is based on the decision of semi-empirical equation of turbulent diffusion (Eulerian approach). [13]

A basic equation of a complex model "PolEmiCa" for definition of instantaneous concentration from a moving source (from a single exhaust event) with preliminary transport on distance X_A and rise on altitude Δh_A and dilution (σ_{0s}) of contaminants by jet has a form [13]:

$$c(x,\ y,\ z,\ t) = \frac{Q\exp\left[-\frac{(x - x')^2}{2\sigma_{x0}^2 + 4K_x t} - \frac{(y - y')^2}{2\sigma_{y0}^2 + 4K_y t}\right]}{\{8\pi^3[\sigma_{x0}^2 + 2K_x t][\sigma_{y0}^2 + 2K_y t]\}^{1/2}} \times \quad (2)$$

$$\times \left\{ \frac{\exp\left[-\frac{(z - z' - H)^2}{2\sigma_{z0}^2 + 4K_z t}\right] + \exp\left[-\frac{(z + z' + H)^2}{2\sigma_{z0}^2 + 4K_z t}\right]}{[\sigma_{z0}^2 + 2K_z t]^{1/2}} \right\}$$

where current coordinates (x', y', z') of the emission source in movement during time t':

$$x' = x_0 + u_{PL}t' + 0.5at'^2 + u_w(t + t')\ ;\ y' = y_0 + v_{PL}t' + 0.5bt'^2$$

$$z' = z_0 + w_{PL}t' + 0.5ct'^2$$

(x_0, y_0, z_0) − initial coordinates of the source; (u_{PL}, v_{PL}, w_{PL}) – velocity vector components of emission source; (a, b, c) − acceleration vector components of emission source; K_x, K_y, K_z – turbulent diffusion coefficients depends on atmospheric stability and wind velocity.

Validation and improvement of complex model "PolEmiCa" has been implemented on the ground of experimental investigation in Athens and Boryspol airports.

3.Comparison of measured and calculated concentrations from aircraft emissions in Athens International Airport

Experimental investigation in Athens International Airport (AIA) was focused on concentration measurements of NO_x in plume from aircraft engine and estimation of emission indexes of NOx under real operation conditions (accelerating on the runway and take-off the aircraft) [12].

Complex model PolEmiCa (previous version and improved by Fluent 6.3) has calculated average concentration (1 min) of the contaminants, produced by aircraft engine emission during take-off in Athens airport. Appropriate model for

this case was defined as a puff-model (1). Puffs were assessed for each engine of the aircraft separately, because of their separate influence on averaged concentration at point of monitor installation. For every take-off different values of wind speed and wind direction were measured, so the different values for turbulent diffusion coefficients (K_X, K_Y, K_Z) were calculated and used for following concentration assessment.

Besides, results were defined for the cases with and without jets from the engines to show that with jets they are more equal to measured data, because impact of jet basic parameters (buoyancy effect and dispersion characteristics) on concentration distribution was estimated by complex model PolEmiCa, fig.2. Comparison between measurements and the PolEmiCa/Fluent 6.3 model is significantly better (on 20%), because lateral wind and ground impact on jet parameters (height of buoyancy effect, jet length penetration and plume dispersions) was included in the model. Good agreement between model results and measurements were found for most part of aircrafts, but in some cases large differences were found, e.g. B737-4Q8, B747-230, A321-211, A320-214, B737-33.

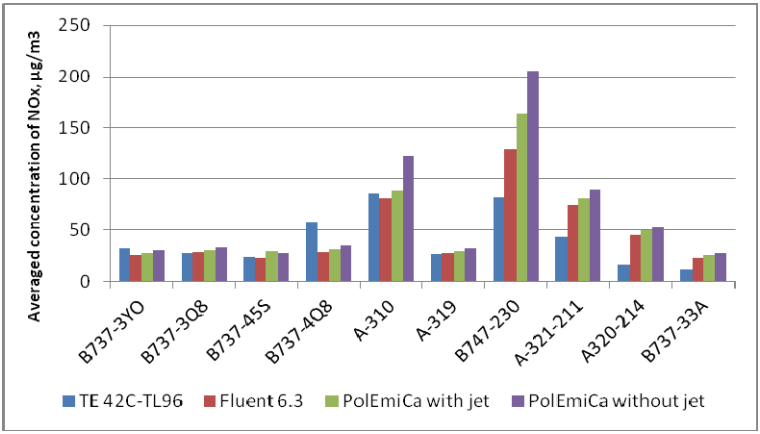

Fig.2. Comparison of measured and modeled averaged concentrations (period 1min) of NOx at take-off conditions (maximum operation mode of aircraft engine)

Possible reasons for observed differences between modeled and measured concentration of NOx**:**

1. quite big distance is between aircraft engine and monitoring station (1000±1500 m). As a result, the measured concentration of NOx in plume from aircraft engine is quite less due to previous dilution by jet and next dispersion by wind and atmospheric turbulence. So, it is difficult to estimate aircraft engine emissions contribution;

2. averaging period of measured concentration (1 minute) is quite big to detect separately maximum concentration in plumes from each engine of the accelerating (the)aircraft and include a contribution from each engine to measured result.

Only investigation of the plume-regime was possible during the AIA campaign. Both could be investigated during the Boryspol campaign.

4.Comparison of measured and calculated concentrations from aircraft emissions in Boryspol International Airport

Motivation for organization of measurement campaign in Boryspol airport was investigation concentration distribution in both the jet- and plume-regime to accurately assess aircraft engine emissions contribution to local air pollution.

According to expressed goal, scheme for disposition the monitoring (stationary "A" and movable "B") stations in airport was developed with taking into account modeling results (complex model PolEmiCa) of transportation and dilution contaminants by jet from aircraft engine for differential operational and meteorological conditions, fig.3 [14].

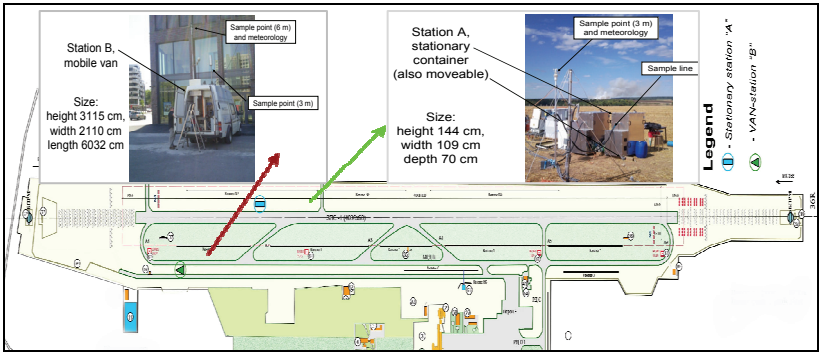

Fig.3. Location of stationary station A and movable station B in Kyiv Boryspol airport for prevailing south-east wind direction (170°)

Determined EINOx under real operational conditions compared with ICAO values for idle and maximum engine mode, Fig.4.

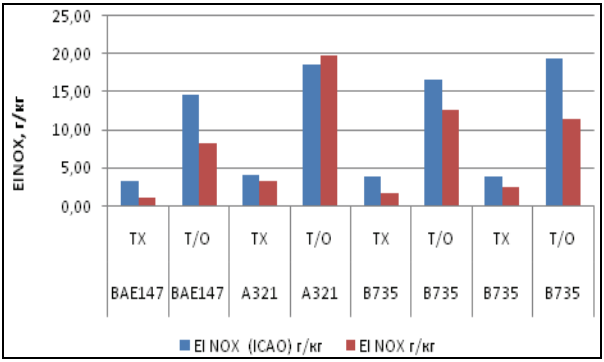

Fig.4. Comparison of measured EINOx under real operation conditions (take-off (T/O) and taxing (TX) with ICAO database

The observed variations between real and certificated EI are most likely caused by conditions under real circumstances which are different from well defined conditions during certification procedure, fig.5. Nevertheless these differences are important since the ICAO data is currently used to calculate emissions from airports.

The period 12:30÷13.00 from 13.09.2012 of time series measurements in KBA was chosen for validation task of complex model PolEmiCa (previous version and improved by Fluent 6.3). This period is characterized by 5 peaks of NOx concentrations and corresponding to 5 aircraft departures (BAE 147, A321, B735), fig.5. The modeling results for each engine are in good agreement with the measurements results by the AC32M system.

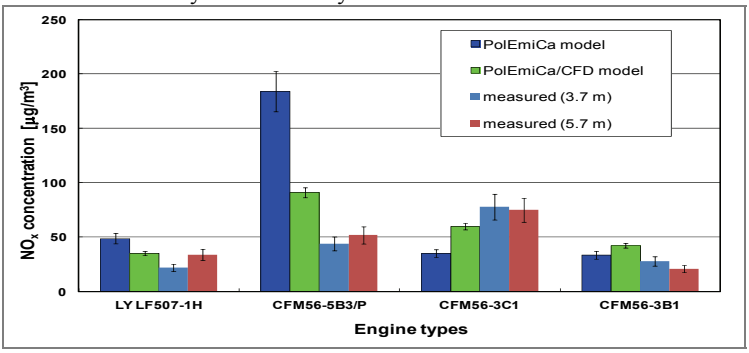

Fig.5.Comparison measured and calculated concentration of NOx produced by aircraft engine emissions at accelerating stage on the runway

Good agreement between measurements and modelling results is explained by:

- Taking into account the jet- and plume-regime during experimental investigation at Boryspol airport;
- Using CFD-code (Fluent 6.3) allow to improve results on 30% (coefficient of correlation, r=0.76) by taking into account lateral wind and ground impact on jet parameters.

Conclusions

On the ground of improved models to develop the practical recommendations for instrumental monitoring of aircraft engine emissions and the assessment of its contribution to airport air pollution. Combined approach of modeling and measurement methods provides a more accurate representation of aircraft emission contribution to total air pollution (local pollution) in airport area. Modeling side provides scientific grounding for organization of instrumental monitoring of aircraft engine emissions, particularly, scheme for disposition the monitoring stations with aim to detect maximum concentration which is characterized for jets/plumes from aircraft engines and at which height should be samples the concentration in exhaust with taking into account buoyancy effect and ground impact on jets behavior. Also which time integration should be installing in measurement systems fairly to detect maximum concentration in jet/plume and assess aircraft emission contribution to total air pollution inside the airport. Such approach has been realized in Boryspol airport. So, using CFD codes for modeling aims provides accurate tool to assess and control local air pollution produced by aircraft engine emissions.

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UDC 504.06:656.71 (043.3)

K. Kazhan, PhD (National Aviation University, Ukraine, Kyiv)

MONITORING OF AIRCRAFT NOISE

The practical issues of the aircraft noise monitoring were under consideration in the investigation on example of noise monitoring at Boryspil (Kyiv) airport.

Aircraft noise is the most significant cause of adverse community reaction related to the operation and expansion of airports. Limiting or reducing the number of people affected by significant aircraft noise is therefore one of ICAO's main priorities and one of the key environmental goals [1].

Monitoring of aircraft noise is targeted on the aircraft noise control and for the reduction of noise levels within the habitation areas. However the noise monitor station should also be located within the airport area to provide the accurate noise assessment of the efficiency of developed noise abatement (and emission reduction) procedures [2] and of the noise, and emission interdependencies. Thus, the monitoring of air pollution produced by aircraft emissions and noise is an actual task, providing evidence on the actual pollution for improving of air quality regulation systems.

Scheme disposition of monitoring stations. Noise monitoring was performed by moveable station equipped with sound level meter "Octave 110A". The basic principles of the location choosing of moveable station within the airport and outside: nearby the defined nominate departure/arrival aircraft routes; standard noise certification points in accordance with the ICAO standards' demands; defined sensitive points within airport area to correct assess of the efficiency of the noise abatement procedures and noise pollution in whole.

In results, there were 4 points for aviation noise control and 2 points for combined noise and emission monitoring, fig.1.

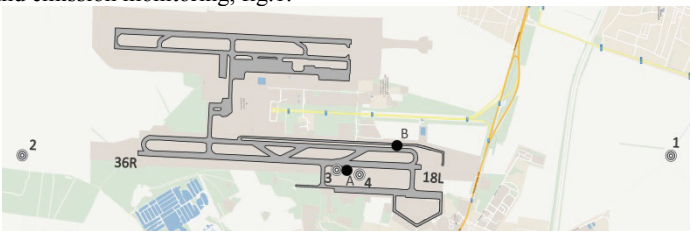


Fig.1. Location of monitoring stations at Kyiv Boryspil airport: A - air pollution monitoring stationary station A; B - air pollution monitoring movable station B; 1 -4 noise monitoring measurements

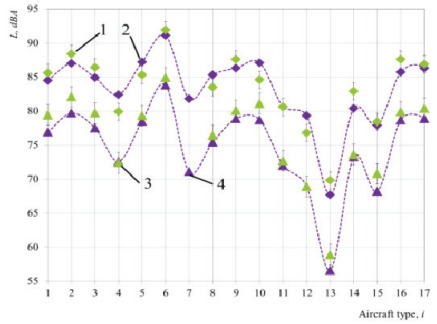
The assessment of noise and emission pollution is possible by means of modeling systems as well as instrumental measurements. The results of the measurements allow us to validate constructed noise and pollution models in the vicinity of the KBP created with help of Integrated Noise Model (INM, FAA, USA) and Emission Dispersion Modelling System (EMDS, FAA, USA). The comparison of measured

and modeled noise levels and concentrations of pollutants has shown that correlation coefficients are rather high (*KK*=0.9…0.99) (fig. 4)

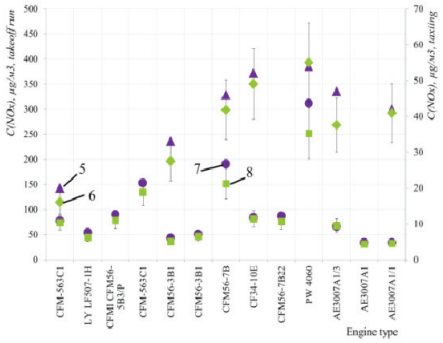
Measured data allow us to assess noise and emission interdependencies during taxing and takeoff run stages and confirm the linear dependence between noise levels, operational modes and emission indexes and possibility of the applying of Linear Interpolation to the ICAO Engine Emission Data (Fig.5).

The obtained functions are the following: SEL=1.1482**EI(NOx)*+67.196, R^2=0.8034; L_{AMAX}=1.4772**EI(NOx)*+60.236, R^2=0.8479.

The additional instrumental issues are required for assessment of noise and emission interdependencies during taking off and climbing and different types of profiles.



a)



b)

Fig. 4. Comparison of measured and modeled noise levels (a) and concentrations (b) of pollutants (points 1 and 3): 1 – *SEL*, modeling results, dBA; 2 – measured *SEL*, dBA; 3 – L_{Amax}, modeling results, dBA; 4 – measured L_{Amax}, dBA; 5 – modeled NOx concentration during taxiing C(NOx), modeling results, μg/m^3; 6 – measured NOx concentration during taxiing, μg/m^3; 7 – modeled NOx concentration during takeoff run C(NOx), μg/m^3; 8 – measured NOx concentration during takeoff run C(NOx), μg/m^3

On the basis of the MaxEnt Model [3] for the environmental airport capacity's assessment the algorithm (fig.6) and application programs were designed using the data for local conditions. It should be noted that during the third stage of the

algorithm – Impact Assessment – the results of noise and emission measurements and modeling are used to provide accuracy of the model. Due to the lack of the systematical noise and emission assessment data at real flight operations in the vicinity of airports in Ukraine, the first validation of the proposed algorithm was performed on the basis of modeling results such systems as INM and EDMS. Realizing weaknesses of existing modeling systems, for the validation of the proposed algorithm in real operational conditions, noise and emission measurements were held at the busiest airport of Ukraine (KBP). The results of the measurements allowed us to gain the next targets: clarification of the emission factors of engines and aircraft noise levels in operational conditions, especially for CIS-build aircraft; description of the noise and emission interdependencies during real flight operation, particularly for taking-off and landing modes.

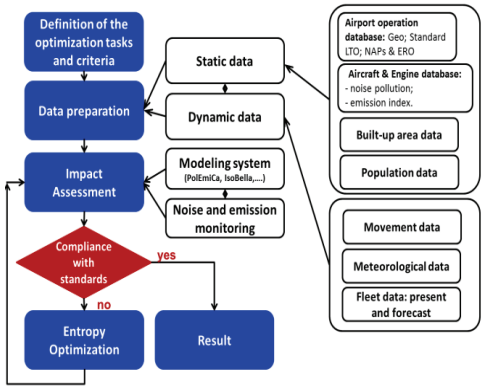


Fig. 6. Algorithm of the MaxEnt Model

Conclusions. Assessment of the noise and emission pollution and their interdependencies is one of the basic stages of the MaxEnt Model and it was performed on the basis of results of noise and emission measurements at KBP. The results will be directed on achieving the following objectives: further studying of the aircraft noise and emission interdependencies during real flight operations; definition of the role of all operating procedures in formation of total pollution in the airport's vicinity; development of decision making tool for aviation noise and emission reduction and effective monitoring system.

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V. Makarenko, V. Tokarev, Prof.,
(National Aviation University, Ukraine, Kyiv)

PASSIVE METHOD OF INBOARD NOISE REDUCTION FOR AIRCRAFTS

Passive and active methods of interior noise reduction in propeller-driven aircraft cabin are worked out. Passive method consists in fuselage panel sound proofing improvement with masses. Active method is based on compensation of noise by loudspeakers located in the cabin. To get the maximum benefit from added masses an optimization of their location and weight is done with the genetic algorithm.

Among the many factors that determine the level of comfort inside the compartments of aircraft noise parameters are of great importance. The noise has an adverse effect on the crew, since it interferes with transfer and recognition of information. Together with other adverse factors it can result in faulty actions of the crew and hence affect flight safety. The main noise sources in aircraft cabin include: the power unit, the turbulent boundary layer on aircraft surfaces, the avionics, and the air conditioning system (ACS). The noise caused by structural vibrations is also one of essential sources of noise in aircraft cabin. The noise from power unit, turbulent boundary layer is transmitted through the fuselage.

The reduction of interior noise levels in passenger aircraft has been researched for many years [1-5]. This problem is topical for propeller-driven aircraft due to high noise levels caused by propeller rotation. The contributions of the specified sources to the overall acoustic field depend on the aircraft design, the type and arrangement of its power unit, and the aircraft's operation conditions. Forward radiated noise from a jet engine fan inlet consists of broadband as well as of dominant tonal components at various frequencies.

As illustrated by Fig. 1 in the noise spectrum in the crew cabin of turboprop aircraft is dominated by discrete components.

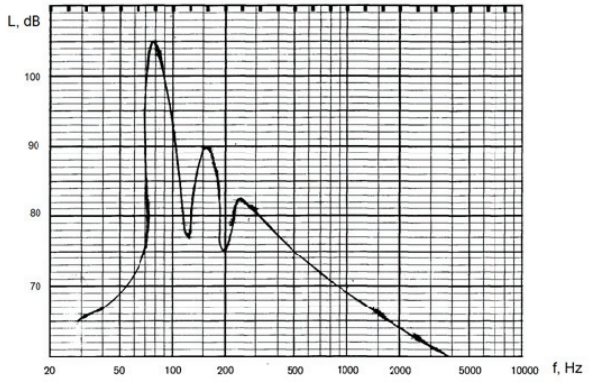


Fig. 1 The Typical noise spectrum of turboprop aircraft Antonov 24 in the crew cabin

As a rule noise spectrum of turbojet aircraft is broadband (Fig. 2). There are many uncorrelated sources in aircraft cabin, such as boundary layer noise and turbine-induced jet noise, ACS are involved in creating a broadband noise.

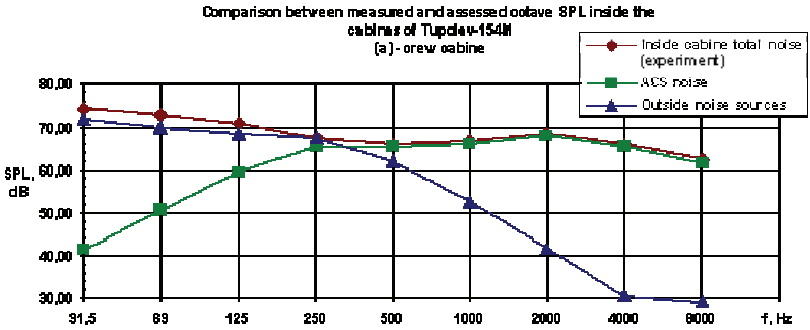


Fig. 2 Noise levels inside the cabins of Tupolev 154M in cruise flight at H=11000 m, M=0.85

Active method of noise reduction

The active and passive noise control in cabin of turboprop aircraft has also been focused on the decreasing of tonal disturbances. Figure 3 shows use of an active noise control system for crew cabin turboprop aircraft.

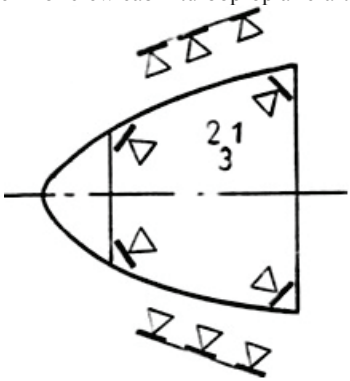


Fig. 3 Principles of decreasing polyharmonic acoustic fields in the crew cabin of aircraft Antonov 24

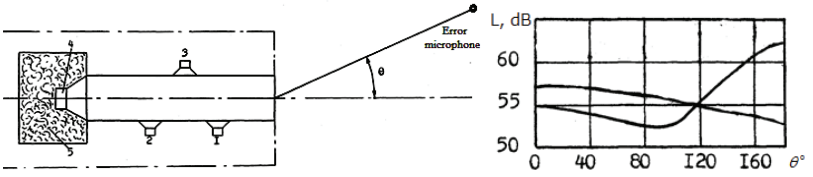
In order to reduce noise in the cabin of aircraft Antonov 24 two groups of loudspeakers are used. One group of loudspeakers simulates radiation of propellers, another group is located inside the cabin and it is used to compensate the sound field in the cabin of aircraft Antonov 24. Active reduction of interior noise in the cabin of aircraft Antonov 24 was carried out at three points at the head of the second pilot. The Table shows the results of studies on the compensation of the fundamental blade pass frequency and second harmonics of the propeller in the three control points.

Table 1

Implementation synphasing and feedback control system for decreasing of sound pressure level in crew cabin of aircraft Antonov 24

	Synphasing			Implementation feedback control and synphasing		
Decreasing of sound pressure level, dB	1	2	3	1	2	3
	2	4.7	5.6	3.5	5	10.4

One method of noise reduction in the cabin from the air conditioning system is the use of compensating loudspeakers near air distribution nozzles. In contrast, the simplest example of active control of a plane wave in the long duct, near open duct sound field is represented by two acoustic waves – the direct and reflected waves. Theoretical and experimental studies of the effectiveness of active noise reduction methods of air conditioning systems were performed in the National Aviation University. Experimental studies were carried out in an anechoic chamber using the open duct with diameter 0.1 m connected to the loudspeaker (Fig. 4a)).



a) b)

Fig. 4 Directional characteristics of sound radiation from an open duct, the frequency of 100 Hz: a) the experimental setup of active noise control, 1, 2, 3 are loudspeakers, 4 is actuator (loudspeaker), 5 is soundproofing; b) – efficiency feed-forward noise control, an error microphone adjust for angles: 1 - 0^0, 2 - 90^0, 3 - 135^0

It was found that the interior broadband noise will be globally reduced by 6.1 dB; the tone was reduced by 16.5 dB [5].

Passive method of noise reduction

Another method of inboard noise reduction consists in sound-proofing increase of fuselage panels. Such increase in sound-proofing can be obtained by modification of panels with concentrated masses. Mathematical model of rectangular cylindrical panel with reinforcement and masses was proposed by Makarenko [6]. This model allows the evaluation of transverse vibration and sound transmission through aircraft panel. For increase in sound-proofing transmission loss ($-10\lg\tau_d$) is maximized. Because optimization algorithm is designated for minimization, the objective function is sound transmission loss with sign minus:

$$\min \quad F_{obj} = 10\lg\tau_d,$$

$$\text{by mass parameters: } m_k,\ x_k, y_k,\ k = 1,2,\ldots,K\ ,$$

$$\text{with constraints } \sum_{k=1}^{K} m_k = \zeta M_{panel},\quad 0 + x_g < x_k < a - x_g, 0 + y_g < y_k < b - y_g;$$

where τ_d is sound transmission coefficient, M_{panel} is panel mass without reinforcement, x_g, y_g are gaps from the panel edges, which are related to complexity of ideal boundary condition implementation in practice, *a* and *b* are dimensions of panel.

Optimization results were obtained using a genetic algorithm (GA), because objective function F_{obj} has many local minima. Modern computers have a few kernels. Also parallel calculations can be implemented on a few computers that form a single cluster. Therefore GA has considerable advantage above other algorithms of optimization.

GA sends relative coordinates $\overline{x_k}, \overline{y_k}$ to the program of objective function, which performs their scaling to absolute coordinates x_k, y_k on the real aircraft panels prior to calculation. Individual genes are the relative parameters of the masses $\overline{m_k}, \overline{x_k}, \overline{y_k}$.

Distribution of calculation to threads takes place in the program of GA for the separate individuals of population. The quantity of the masses depends on how many modes have a contribution to the considered frequencies range. The more modes are in frequency range the bigger quantity of the masses is effective. With the increase of quantity of the masses, increases the dimension of parameter space, in which the search of global optimum is done. Therefore for the reliable localization of global optimum it is necessary to increase the population in GA. For the 2 masses (6 parameters of the masses) 100 individuals in a population are sufficient.

During optimization by means of GA it is necessary to maintain average distance between individuals in the range from 0,4 to 1 for first 20 generations for providing of uniform search over masses' parameter space and avoiding of the premature convergence of population to the local optimum. Maintaining of necessary average distance between individuals is carried out by the change of crossover and mutation functions, and ratio between crossover and mutation of individuals. The quantity of elite individuals was assumed as 8-10% of population size. After GA, as a hybrid function the pattern search is used, in which distribution of calculation on threads takes place at the calculation of points of net around a current point. I.e. every point of net is calculated in the separate thread. Points in masses' parameter space represent configurations of aviation panel with the set of the fastened additional masses.

Optimization of objective function is conducted for the 2 additional masses (4 parameters) on frequency 374 Hz. The size of the additional masses remained unchanged during optimization. The result of optimization is the optimal placement of the masses, that it is shown on fig. 5. Total weight of the used masses compose 24,9% of M_{panel}. For experimental researches loudspeaker was placed between panels in the test rig. The panels of test rig form the closed space, in which diffuse acoustic field is imitated. Outside of the test rig the microphone is set on the distance 2 m from a panel. Difference in sound pressure levels on an external microphone at measuring conducted on panels without the masses, and on panels with the masses, shows a change to the sound-proofing of panel.

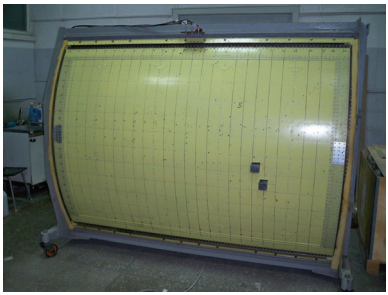


Fig. 5. An experimental stand for measurement of sound-proofing of aviation panel

Experimental verification of results of optimization showed an increase to the sound-proofing on frequency 374 Hz on 6.9 dB on the panel of airplane of Antonov-72.

Conclusions

The increase of total weight of additional masses' set results in the increase of sound-proofing of panel. The results show that an increase of total weight of additional masses' set on more than 10% of panel mass is ineffective. The usage of more than 2 additional masses results in the increase of time spent on optimization due to the increase of parameters space size, but does not give a substantial improvement to the sound-proofing of the panel.

It is shown that the total increase of sound-proofing of aviation panel diminishes at inclusion in objective function of greater quantity of frequencies.

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Kh.V. Pankiv (National University "Lviv Polytechnic", Ukraine, Lviv)
I. I. Paryliak (Kyiv National University of Construction and Architecture, Kyiv)
O.V. Sydorov (National Aviation University, Ukraine, Kyiv)
L.O. Levchenko, PhD, (National Technical University of Ukraine "Kyiv Polytechnic Institute", Ukraine, Kyiv)

ON THE ISSUE OF LIGHT AIR IONS NORMALIZATION IN THE AIR OF CONTROLLERS ROOM

The research results of light air ions in the controllers room have been given. The impact of possible deionization factors on the controllers room air has been analyzed and the main of them have been defined. The ways of light air ions normalization in the rooms have been analyzed and the application of deionization factors impact minimization approach for controllers room has been suggested.

Introduction. Operations stuff is responsible for control of many processes. It's obvious that high level of labour intensity requires creation of optimal conditions of labour on all possible factors for controllers. This task is partially solved with creation of optimal microclimate conditions, ergonomically organized work places, etc. But the normalization of other factors, namely light air ions concentrations, is the important and urgent task for today.

Deionization factors of the controllers room air. Measurements results of light air ions concentrations in the operations stuff rooms in the papers [1, 2] show very low light air ions concentrations, it confirms the urgency of the problem. Notably, the study [1] shows concentrations on the level 120-250 sm^{-3} and 200-380 sm^{-3} for light negative and positive air ions respectively on the work places in the operations stuff rooms. Also results of work places certification in the operations stuff premises have been given, according to mentioned results 65% of examined work places are characterized with concentrations low than minimal required level established in Russian sanitary regulations on light air ions.

According to research study [2] the concentrations in the operations stuff premises vary from concentrations lower than threshold of device sensitivity on the work places of operations stuff to 120 sm^{-3} and 160 sm^{-3} of light negative and positive air ions respectively near the boards of control equipment. These concentrations are also lower than minimal required level established in Ukrainian sanitary regulations on light air ions, therefore according to "Hygienic classification of labour on indices of harmfulness and hazard of work environment factors, difficulty and intensity of labour process" the conditions of operations stuff work are classified as harmful conditions of labour class 3.1.

Before analysis and determination of main factors which can cause deionization of controllers room air it should to remind the main factors which impact on light air ions concentration. The main factors which impact on the light air ions concentrations in the work rooms are included: 1) dust, aerosols; 2) smoking; 3) number of people in the work room; 4) the space of the room; 5) temperature,

humidity and speed of air; 6) electromagnetic and electrostatic fields; 7) ventilation and conditioning of air.

The analysis of given factors concerning their possible contribution in the deionization of controllers rooms air allows to neglect the factor of dust because everyday wet cleaning is conducted in these rooms, and the systems of air handling in these rooms exclude the possibility of dust air income. The smoking is forbidden in the controllers room, therefore it is also can't be considered as deionization factor. According to study [3] workers don't cause significant impact on the light air ions concentration. Usually, the controllers rooms have great space, that is enough for placement of great amount of control equipment and for providing of normal microclimate conditions, that's why in such case it doesn't play a great role in the deionization air processes. The parameters of temperature, humidity and speed of air are held in the standard range for such premises, the change of these parameters in the standard range doesn't lead to impact on the light air ions concentration. It's well known that systems of air ventilation and conditioning cause air deionization, but because of great distance from place of air income to controllers work places the contribution of this factor in the air deionization of room significantly decreases in general. Between factors mentioned above electromagnetic and electrostatic field are only distinguished. The study [4] show, that electrostatic fields are the main and crucial factor of air deionization in the rooms with computer technique, so the controllers room are referred to such rooms.

Analysis of approaches to normalization of light air ions concentration. Given above results of study of light air ions concentration in the operations stuff rooms prove the urgency of light air ions concentration normalization for such kinds of rooms. Two approaches can be applied for the task of light air ions concentration normalization. The first is classical, given in Sanitary standards 0.03-3.06-80, it means the application of air ionizers or installation of forced-air ventilation. The second approach means the minimization of air deionization factors impact.

Exactly the first approach is suggested for the solving of deionized air problem in the controllers room in the study [1]. The electrostatic filter-ionizer has been developed by authors of work [1] for normalization of air state. At the same time the efficiency of this device and practicability of its application are deniable. Because the device is equipped dielectric plates for dust deposition, these plates have local electrization and uncontrolled ozone and nitrogen oxides generation because of high voltage dischargers application. In general it should be noted that application of air ionizers for labour safety goals has own defects and limits. Indetermination of chemical composition of air and its changes at artificial ionization, unevenness of spatial distribution of air ions at air ionizers application, possibility of electrical breakdown in the result of charges accumulation on surfaces, any of mentioned factors can be barrier for air ionizers application. Also the artificial air ionization in the closed work rooms with high level of humidity and dustiness of air, great crowding without required air exchange causes increasing of heavy air ions number, dust stays on respiratory ways on 40% more, and in such cases the air ionization can bring only the damage. Application of air forced ventilation also doesn't gives the required effect for normalization of light air ions concentration.

The second approach is rarely meet in the scientific literature, but it suggested by authors, because it gives the possibility to normalize the light air ions concentration without costs for installation of special equipment. In the case of minimization of deionization factors impact, the prior task is distinguishing of the main deionization factors and determination of their contribution in the process of air deionization. The example of effective application of this approach in the rooms with computer technique is given in the study [4]. Application of complex measures, aimed on minimization of electrostatic fields levels allows to normalize the light air ions concentrations higher than minimal required level [4].

Conclusions

According to mentioned above such conclusions can be made:

1. Ionic composition of air in the controllers rooms is characterized with very low light air ions concentrations.
2. The main cause of mentioned above concentrations is triboelectric electrostatic fields, generated due working process of controllers.
3. Air ionizers application for light air ions normalization in the controllers rooms is not rational because of the list of defect and application limits.
4. The most effective and economical approach of light air ions concentrations normalization is the minimization of electrostatic fields impact on the light air ions with application of special complex of measures, that minimize the electrostatic fields levels on the workplaces of operations stuff.

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I.D. Borisov, N.N. Kizilova, PhD
(Kharkov National University, Ukraine, Kharkov),
E.V. Konovalova, PhD, (National Aviation University, Ukraine, Kyiv),
Yu.I. Rudnev, PhD, (Kharkov National University, Ukraine, Kharkov)

MITIGATION OF AIRCRAFT NOISE AND ACOUSTIC POLLUTION NEAR AIRPORTS

The methods of aircraft noise mitigation near airports are discussed. The discrete vortex method is developed for computations of the pressure and flow fields produced by the airflow over the blades of the propellers. The computational schema is explained. Some numerical results on the patterns of noise generated by the vortex flow are presented. The shape optimization procedure for the noise mitigation is discussed.

Introduction. Noise pollutions due to aircraft noise pose a very important problem because of direct harm to the activity and balance of human and animal life near the airports. Noise is produced by high pressure oscillations at working engines, propellers, fans and other mechanical systems and propagates as pressure waves [1]. Turbulent flows behind jets significantly contribute to the aircraft noise [2]. Low frequency speed-dependent aerodynamic noise is produced by the airflow around the aircraft rotors, propeller blades and body. Engine noise is mostly produced by jets engines and fans. Cabin noise is produced by on-board generators and other working devises [1]. High level aircraft noise can influence human cardiovascular system, arterial blood pressure, constriction of arteries contributing to development of coronary artery disease. In animals, noise can increase stress and risk of death, lost of hearing, communication and navigation in space. Noise mitigation in the vicinity of airports [3] can be achieved by landscape-depending windshield and canopy, but the most important problem is decrease the noise generation by optimization of the engines, jets, fans and other sources of noise [4]. Calculation of noise characteristics produced by propellers is an extremely complex problem due to time and resource consuming computations [5]. The complexity is even much more in the case of contra-rotating open rotors (CROR), because the computational scheme should take into account the noise produced in the interaction of vortex sheet trailing from the front propeller blades, with adjustable blades.

The existing methods are based on either analytical approaches that can not account for the factors such as the actual geometry of the blades or deviation of the incoming flow from the axis of the engine, or on heavy numerical calculation schemes of viscous flows in mobile meshes [6]. In this paper, the modification of vortex method which allows combination of a reasonable degree of accuracy in estimation of the aerodynamic noise and acceptable computational time is proposed.

Description of the method. The space is divided into two regions: region Ω that is immediately adjacent to the rotor, and the addition of this area to the whole space $\Omega_0 = \mathrm{R}^3 \setminus \Omega$. Sound vibrations are investigated only in Ω_0 at some distance from the border (far-field approximation).

Intensity of the sources of aerodynamic noise is determined by pressure fluctuations and velocity resulting from the unsteady flow over lattices of the rotor blades. As a method for solving the fluid dynamic problem the discrete vortex method (DVM) [7] is proposed. This method is applicable to relatively slow flows when the compressibility of air may be neglected. For the high-speed (but subsonic) rotation of the rotor when the air compressibility must be taken into account, this method can be upgraded by introducing Prandtl – Glauert transform [8] in the azimuthal direction.

The computed pressure and velocity distribution on the reference surface $\partial\Omega$ (the boundary of Ω) will define the acoustic oscillations in some reference points that can be computed from Farassat formulations [9] as approximate solutions of the exterior problem for linear acoustic equations. The proposed approach can be used to determine the tonal noise of the rotor. It is characterized by simplicity of implementation, high speed of computations, accounting for the noise caused by the interaction of the wake vortex coming down from the front of the rotor blades with blades of the rear rotor of the CROR (fig.1). In fig.1 the configuration with five blades is considered, while usually in CROR the number of blades is bigger that needs much more time for numerical simulations. The typical data and emerging regularities can be also estimated on the simplified models.

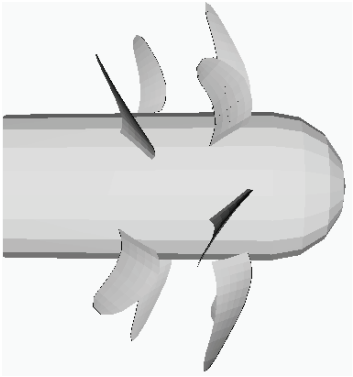

Fig.1. Geometric model of CROR for computations.

Problem formulation. Assuming that vorticity is zero everywhere in the flow region except the vortex sheet trailing from the rear edge of the blades, one can introduce the potential of the velocity field $\vec{v} = \nabla\varphi$. Then from the incompressibility condition $\operatorname{div}\vec{v} = 0$ the Laplace equation for φ is valid:

$$\Delta\varphi = 0 \tag{1}$$

On the rigid blades the inpermeability condition can be written in the form:

$$\frac{\partial\varphi}{\partial n} = v_{n0}(t) \tag{2}$$

where $\vec{n}$ is the unit vector normal to the wall, v_{n0} is the normal speed of the solid surface which is determined by the angular velocity of the rotor and supposed to be given.

The face velocity of the undisturbed flow is

$$\vec{v}_{r\to\infty} = \vec{v}_{\infty} \tag{3}$$

On the initially unknown vortex surfaces trailing from the rear edges of the blades the pressure continuity condition must be satisfied

$$p_{+} = p_{-} \ , \tag{4}$$

where the subscripts «+» and «–» mark the pressures at different sides of the vortex surface.

The pressure field can be found from the Cauchy – Lagrange integral:

$$\rho\left(\frac{\partial\varphi}{\partial t} + \frac{(\nabla\varphi)^2}{2}\right) + p = \rho\frac{v_{\infty}^2}{2} + p_0 \tag{5}$$

In that way, the hydrodynamic parameters (pressure and flow distributions) can be found as solution of the boundary-value problem (1) – (5). Here the DVM is used for numerical solution of the problem (1) – (5).

The idea of DVM is to represent the flow parameters in the flow region through the parameters distributed on the body surface. To do this, the surface of the blades and other solids as well as vortex surface coming down from the blades, is replaced by the continuous vortex surface. Then the aerodynamic problem is reduced to finding out the intensity distribution of the vortices, for which the velocity field induced by vortex surface layers satisfy the original equations of fluid flow and the boundary conditions.

We divide the vortex surfaces into separate elements, the so-called panels, replacing the continuous vortex layer by the system of discrete vortices. The main element is a horseshoe vortex frame associated with separate panels. Each frame consists of three infinitely thin vortex segments, which are located on the border of the panel. Velocity induced by each vortex segment is easy to calculate based on the general Biot – Savart formula:

$$\vec{v} = \frac{\Gamma}{2\pi}\int\frac{d\vec{l}\times\left(\vec{r}_0 - \vec{r}_l\right)}{\left|\vec{r}_0 - \vec{r}\right|^3} \tag{6}$$

Here $\vec{r}_0$ are $\vec{r}_l$ are radius vectors of the beginning and end of the vortex segment in the coordinate system with the origin at the point at which the speed is determined; Γ is intensity of the vortex segment. The integral (6) is easy to compute in the explicit form:

$$\vec{v} = \frac{1}{4\pi}\frac{\vec{r}_0\times\vec{r}_l}{\left|\vec{r}_0\times\vec{r}_l\right|^2}\left[\frac{\vec{r}\cdot\vec{r}_0}{r_0} - \frac{\vec{r}\cdot\vec{r}_l}{r_l}\right], \quad \left(\vec{r} = \vec{r}_l - \vec{r}_0\right) \tag{7}$$

Let's name the vortex frames associated with the panels on the solid surface as attached frames, while the frames through which the vortex sheets are modelled will be called free frames. The computation starts from absence of the vortex sheet. Let's define the intensities $\Gamma_i, i = \overline{1,N}$ where N is the number of panels, from the inpermeability conditions on solid surfaces. This condition will satisfied at certain so-called collocation points, which are located in the centre of each panel. As the frames have the horseshoe shapes, at the rear edges of the blades the Kutta – Zhukovsky condition of the finite speed [7] will be automatically satisfied.

The values Γ_i are determined as solutions of system of linear algebraic equations in the following form:

$$v_{n0i} = \sum_{k=1}^{N} a_{ik}\Gamma_k + (\vec{v}_\infty, \vec{n}), \quad i = \overline{1,N.}) \tag{8}$$

where a_{ik} are influence coefficients, i.e. normal velocities induced by *k*-th attached frame of unit intensity in the centre of the *i*-th panel according to (7), v_{n0i} is the normal velocity of i-th panel; for the immovable panels it equals to zero.

From the computed values Γ_i the velocity v at the rear edge can be determined. Then the first raw of the free frames at the rear edge must be deleted at the computed velocity v. The width of the raw is determined by the accepted time step Δt and equals to $v\Delta t$. The intensity of the free frames is considered to be equal to the intensity of the attached frames at the rear edge. Subsequently, in each successive time step (fig. 2) the free vortex frames are transferred downstream at the computed velocities and their intensity remains unchanged. The intensities of attached frames accounting for the descended free frames of the vortex sheet is determined at each time step as the solution of the system of equations

$$\sum_{k=1}^{N} a_{ik}\Gamma_k = v_{n0i} - (\vec{v}_\infty, \vec{n}) - \sum_{k=1}^{N^*} b_{ik}\Gamma_k^*, \quad i = \overline{1,N}, \tag{9}$$

where *N** is the number of vortex frames in the sheet, b_{ik} are influence coefficients of the free vortex frames.

The number of free frames *N** in the vortex sheet is determined from the condition of numerical convergence of the method. As a convergence criterion the rotor thrust is selected. The thrust is defined as the sum of the lift forces acting on the screw panels. Since each panel is modelled by the vortex frame, according to Zhukovsky theorem the lift force acting on the plate is

$$F_i = \rho v_i \Gamma_i h_i$$

where v_i is the face velocity of the air flow, h_i is the length of the panel measured along the blade.

The number N^*_{row} of the free vortex frames transferred by the flow is fixed when its further increase does not influence the lift force acting on the blade. It

means, the free vortex frame transferred from the blade at the time t_0 will be excluded from the computations at $t_1 = t_0 + \Delta t \cdot N_R^*$.

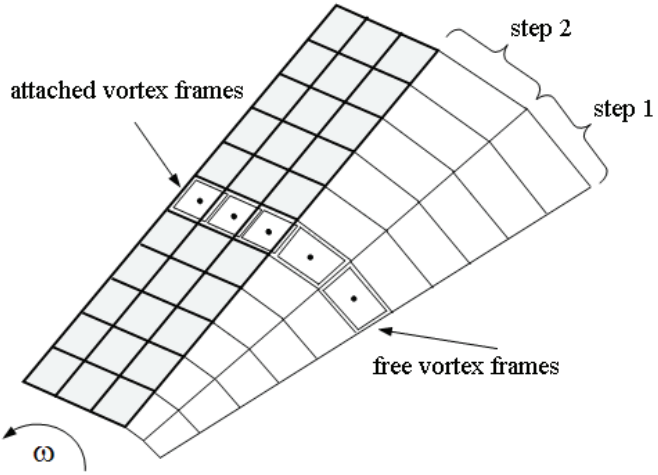

Fig. 2. Formation of the vortex sheet.

When the iteration process becomes steady, counting of pulsations of the acoustic pressure at certain places starts. To accomplish this, the unsteady pressure and flow fields are accumulated on the control surface $\partial\Omega$:

$$p(\vec{x}) = \frac{1}{4\pi}\frac{\partial}{\partial t}\int_{\partial\Omega}\left[\frac{\rho_0 v_n c + (\vec{L},\vec{e}_r)}{cr(1-M_r)}\right]_{ret} dS + \frac{1}{4\pi}\int_{\partial\Omega}\left[\frac{(\vec{L},\vec{e}_r)}{r^2(1-M_r)}\right]_{ret} dS$$

$$(\vec{L} = p\vec{n} + \rho_0(v_n - u_n)\vec{v}, \qquad \vec{r} = \vec{x} - \vec{y}, \quad \vec{e}_r = \vec{r}/r, \qquad M_r = (\vec{u},\vec{e}_r)/c)$$

Here $\vec{y}$ is the radius vector of the surface over which the integration is executed, $\vec{u}$ is the velocity with which the point moved along the surface, the subscript *ret* means the corresponding expression is computed at the moment of radiation [9].

Computation results. The noise pattern computed by the proposed DVM are presented in fig.3 together with the results computed for the same configuration using the open source NASA code which is recognized as a standard for the aeroacoustic computations. The axis 0x correspond to the angle measured from the rotor axis to the measurement place; all the places are located on the straight line which is parallel to the rotor axis and is located at 4.5 ft from it. The vertical line corresponds to the noise level measured in dB. The parameters of the configuration are presented in Table 1. The comparison shows very good agreement for different configuration studied.

Table 1. The parameters of the propellers in the computed configuration.

	Number of Blades	Tip radius	Rotation direction	Rotational speed (Rev/min)
Front rotor	4	0.313	CW	7633
Rear rotor	3	0.304	CCW	7695

The developed code allows detailed computations accounting for many geometric and mechanical parameters in comparison with NASA code. By way of illustration the influence of the angle of attack on the noise distribution is presented in fig.4. The sort of study is especially important for the noise mitigation at the airports and provides a reasonable approach for the take-off trajectory optimization.

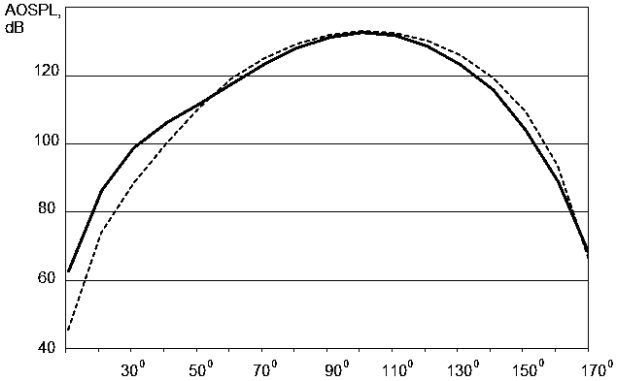

Fig.3. Sound pattern computed for the above described configuration computed by the DVM (solid line) and NASA code (dashed line).

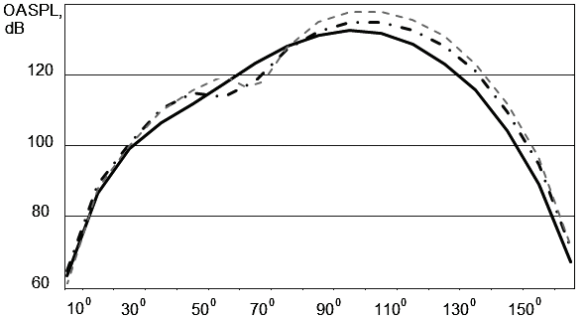

Fig.3. Sound pattern computed for different angles of attack: $\alpha = 0$ (solid line), $\alpha = 10^{\circ}$ (dashed line), $\alpha = 20^{\circ}$ (dash-dot line).

The proposed computational approach can be useful for the shape and take-off trajectory optimization aimed at the noise reduction.

Conclusions

Reduction of the aircraft noise in the vicinity of the airports is a very topical subject for computational aeromechanics. Simplification of the problems does not allow taking into account real geometry of the solid elements of the aircrafts, while direct numerical computations are time and resource consuming. The proposed numerical procedure based on the discrete vortex method allows quite fast computations for complex geometries. Application of the method to contra-rotating open rotors shows good correspondence to the computation results obtained by the NASA code. The method is promising for solving the shape optimization problems aimed at the noise reduction.

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I.V. Yakymets (National Aviation University, Ukraine, Kyiv)

RENEWABLE ENERGY - WIND, OVERVIEW

Continuous growth rate of wind power, in itself proves the relevance of the topic. He has long outpaced the development of traditional and nuclear power, and today is about 30% per year. But there are positive and negative aspects of wind power.

As a clean and renewable energy source, wind energy is seen by many as a way to partially solve our nation's energy crisis. Wind energy has grown by leaps and bounds in recent years.

Some highlights of the report are:

- Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth.
- There are two types of modern wind turbines: horizontal-axis and vertical axis.
- The average utility size wind turbine being installed today is 1.5 megawatts (MW).
- Coal is the leading source for electric generation (49%), followed by natural gas (20%) and nuclear power (19%). Wind energy accounted for just over 1% of total generation in 2007.

How Wind Turbines Work

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetation. Humans use this wind flow, or motion energy, for many purposes: sailing, flying a kite, and even generating electricity.

The terms wind energy, or wind power, describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity.

So how do wind turbines make electricity? Simply stated, a wind turbine works the
opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity. (1)

They are primarily working adversely affects the television network. That's what a curious example is in this regard. Several years ago, residents of the Orkney Islands (UK) began receiving unusual Zhadoba. It was found that when using wind plant built on one of the hills, there are such strong interference in the television network that on television goes blank. The solution was found in the building next to the installation of wind powerful television repeater that allowed amplify TV

signals. According to reports, the wind energy plant with a capacity of 0.1 MW can cause distortion of television signals at a distance of 0.5 km.

Another unexpected feature of wind turbines expressed in the fact that they were sufficiently intense source of infrasound noise, adverse effects on the human body, causing constant depression, severe anxiety and wanton life discomfort. As the experience of operating a large number of wind turbines in the U.S., this noise can not withstand any animals or birds, leaving the location of the station area, is territory of most wind station and adjacent to it are unfit for human, animal and bird life.

However, the main drawback of this type of energy, along with the variability of wind speed - it is a low intensity, which requires large areas to accommodate wind turbine. Conducted by the staff of the calculations that the optimal for wind wheel diameter is 100 m Under such geometrical dimensions and the energy density per unit area of 500 W/m2 wind wheel (wind speed of 9.2 m / s) of wind flow can be obtained by the electrical power close to 1 MW. An area of 1 km2 can accommodate 2-3 to the device with the power given that they should be one of the other by a distance equal to three of their heights, not to interfere with each other, and do not reduce the effectiveness of its work.

Let us take for an estimate that an area of 1 km2 taken 3 installations, ie 1 km2 can be removed 3 MW. This means that to accommodate wind station 1000 MW needed area of roughly 330 km2. If we compare the wind and thermal power for energy production during the year, then the value should be increased by at least 2-3 times. In other words, the size of the territory of the wind stations per 1000 MW to 2 orders of magnitude larger than the area occupied by modern plant.

This estimate consumption of land to accommodate the powerful wind farm, first demonstrates the need for careful selection of the site for it, referring to the use of wastelands, not suitable for agricultural traffic; second, raises the question of expediency facilities less powerful wind farms to power a small area or locality. Creating such power (battery power) can be useful for electrical supply of remote towns and villages, as well as various agricultural operations.

Advantages and disadvantages of wind energy:

- No effect on the heat balance of the Earth's atmosphere, oxygen consumption, carbon emissions and other pollutants,
- Possibility of conversion into various forms of energy (mechanical, thermal, electrical), but the low density of energy per area of the wind wheel - Unpredictable changes in wind speed. Diurnal and seasonal requiring redundancy wind station or storage of energy produced;
- A negative impact on the human environment and animals, on TV and the way the seasonal migration of birds;
- the visual impact. At present this is the most important and the impact it is difficult to assess. In most cases, this rejection of people changes in the landscape. This solved the install wind turbines on tubular towers (2)

Economic effect

Wind turbine produces enough energy at this point what can be removed from the wind flow. Power of the wind flow is directly proportional to the cube of its speed.

For example, if the wind speed of 4 m / s wind flow develops a power of about 40 W, it is already at a wind speed of 10 m / s capacity can reach 850 watts. All wind power can not be converted into useful. This value does not exceed 50%.

You can also take advantage of the economic criterion for selecting the design speed for the wind turbine, which is the ratio of energy produced per year to installed capacity, ie the number of hours of wind turbines for the year reduced to the installed capacity (reduced hours).

$$\tilde{A} = A / Ny\ [kWh / kW] / year$$

where A = ΣN (Vi) ti - total power generation during the year. Since the power of the wind turbine N (Vi) depends on the wind speed, the summation is over the duration of the latter. (3)

At the design stage it is necessary to:

- clarifying archaeological research planned placement of wind turbines and utilities and communications involving the licensed organization and in the event of there new archaeological artifacts, correcting placement of these wind turbines and networks;
- vegetation survey of land in areas planned location of utilities and communications with experts-botanists and, in case of there populations of rare species or groups, adjusting placement of these networks;
- specifying parameters, which should be monitored dovkilnyh and socio-economic impacts;
- Additional geotechnical investigations in areas where there is a risk of possible adverse geological processes and the planned placement of wind turbines. (5)

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A.V. Lukyanchykov, T.M. Lukyanchykova, S.I. Karasev
(National Aviation University, Ukraine, Kyiv)

RISK ASSESSMENT VS CONSCIENCE

We are increasingly introducing into our lives the risk based approach, but prevention and response to danger reason remain increasingly outstanding and every day like a snowball growing, as evidenced by the deterioration of human life in our society. Does the voice of conscience with the calculated risk and whether you can rely on it?

Prevented of asked for danger is armed. Risk-based approach propose to consider today culminating in reaching safety. Trying to introduce it throughout in all areas ranging from education students in some countries even to schoolchildren instill this skill. A Skill - is second nature sometimes becoming the first man.

Consider the following two steps, which risk-based approach includes:

1) hazard identification; 2) Risk assessment.

To understand what the hazard identification, for the first acquaintance consider existing state mechanism to identify emergencies. The main condition for the implementation of this mechanism is: there are at least three types of classifiers: the classifier emergencies, the classifier signs emergencies and the classifier emergencies levels. Carried identification is considered in the presence of each of these classifiers line which fits the description of the hazard. Such classifiers are being created everywhere at different levels and individual citizens and firms, and parties, public organizations, and multinational companies.

To justify any project situation and forecasting related to its development, after such a hazard identification risk assessment is recommended. The use of laws of natural science to predict the situation is not denied. Risk assessment includes: inlet analysis of possible scenarios of hazards, and the output the most appropriate risk management option for security.

Large amounts of structured knowledge in the form of knowledge banks with intelligent, search and expert systems provide not only economic, by law, the benefits, but also benefits for theft, deception, speculation, manipulation of society, etc. The mathematical aspect of human life - a product of the mind, or rather his rational thinking.

At school, one of the priorities is to ensure multiknowledges student.

In this case, the security sector should develop the student capacity of the inner "mental classifier dangers." If the student will develop even further thought, he could extend the discriminatory capacity of the mind to recognize the dangers. We also know that the biggest crime in the country and the world are people doing very smart, ie it is, as a rule, students who graduated. Today, for example, a lawyer with experience will tell you that the more you know the laws, so they are easier to get around. In the literature on the safety of life, in the pursuit of well-being in a person's life is a constant focus, you need to calculate all, be able to predict.

Whether a person is limited only by memory and intelligence? Other fundamental properties of man, completely relegated to a secondary plan and even

start to lose their relevance and importance in human life. To name a few: faith, reason, conscience, a word family.

Consider, for example, a fundamental property of the human conscience.

Regardless of thinking can occur in a person, as an idea, which approves or condemns. It is the court of conscience as a judgment of the deed or as evaluation by the moral dignity itself.

It is the voice of conscience yells: stop, and that will offend a person, not involved in this project, people will die, do not perform immoral orders or should be involved with blatant deception and so on. By hearing of the voice of conscience depends on the welfare and support and those associated with his decisions. That court of conscience knows what will happen and what the reason - decisive.

Committing the same act, for one - it is the duty of conscience, for another - the prohibition of conscience, that is, content that responds to the conscience, may be different. According to one of conscience can be killed by another conscience - not. According to one of conscience - can be deceiving, because he is not close person, on the other - it is impossible.

For some ethnic groups and some religious movements this concept is not used as a key in the pursuit of well-being. If you read the philological research, it is found that in many languages there are different filling of the word, and there are very detailed teachings on conscience.

So there are different ideas about welfare? There are external and internal. Property human intuition, based on knowledge, tells how to achieve well-being, but only external. Several researchers have reported problems of conscience, that intuition is part of conscience, so that a person is in a dilemma - do according to conscience or intuition? This is a single mechanism in which there is an arrow directing either the external world or in the world of conscience - in the world of well-being.

It turns out that the voice of conscience depends on the world, or rather the system of values in life in which a man sets himself and the relation between conscience and intuition.

Can result in the following example. At aboriginal asked what is good and evil? Good - this is when we subtract from a neighboring tribe cattle and women and evil - when for us. That is the voice of conscience is silent in terms of its attitudes, and not because he asked her. If a person decides to change their outlook, it drowns out the voice of conscience, brought up previous beliefs that sounded new. If he will not take the cattle and women, and regret than come into conflict with his conscience, which he brought up on the basis of their beliefs. Voice can overpower the will or simply or using alcohol, rock music, computer games, meditation.

Sources of education of conscience can be the family circle, the economic and political circles, the media, books, etc Atheists educat their consciences their beliefs, which are formed spontaneously from these sources. Soviet atheism, scientific announcement, taught that man has no conscience (it outlived archaism), but there is an "internal commissioner", which need to educate in line with Soviet values. You can talk about conscience agnostic about revolutionary conscience, the conscience of the Buddhist, that is what this mechanism is brought up, so is it for the owner.

You can appeal to the conscience, if conscience raised in the same system of values in life, and that crying out. In Jewish teachings of the property of the soul associated with human bodily organs. For them, conscience like the kidneys which purify water. For this reason, in the Talmud there is no word conscience. For the Jews, the main thing is education in law as a system of life values, conscience and then it show up.

Christians bring up conscience Divine criterion: the New Testament - for Catholics and Protestants, the Holy Scripture - the Greek Catholics and the Gospel (by Greek *ευαγγέλιο* translated as “good news”, by Slavonic and Russian translation «Благая Весть») Orthodox. After all, in a word the conscience (by Slavonic and Russian translation «со-весть») is the word news (by Slavonic and Russian translation весть). This distinction is very important in understanding the fundamental properties of conscience.

Christian teachings, as opposed to the Jews claim that conscience is the knowledge obtained through the senses of the "heart" instead of "kidney" and define the "heart" of the first inner source of moral knowledge (the moral law). So, for example, in Catholic teaching the word conscience (by Slavonic and Russian translation «со-весть») is filled with the contents of another word consciousness (by Slavonic and Russian translation «со-знание»). As we can see, in English, these words are not distinguishable. Among their theological works can be found works on working with consciousness, the content resembling oriental cults. In Catholic theology allowed position on the possible evolutionary development of the fundamental properties of human conscience and accordingly too.

Why do I know what conscience? You can breathe the air without knowing its formula or use inheritance without ascertaining the destination to leave a legacy. Therefore, Protestantism, Catholicism declared as splinter protest Catholic doctrine and thus the rejection of dogmatic doctrine of man, considering it is not paramount and giving everyone the opportunity to independently determined that the conscience is and how to use it, and most importantly - is to follow the moral law. By cleansing the conscience of complacency or implied presence of feelings of calm.

Totalitarian regimes, collective dishonesty accustom people think one thing, say another third do. Such a conscience called sly. It is characterized by insincerity and partisanship when sentencing. For example, the husband admits that hit his wife, and after self-justifying and said - she is guilty, she deserves. So in Orthodox theology reminded that conscience can not be equated with the voice of God, as wanting immensely magnify conscience eventually make it a god without God, that is, by some inner idol. It turns out that approval of "Conscience - a tool that makes human a godly man" may be false.

In Orthodox theology also emphasizes that a person with his own forces can not clean it. "Wash" conscience, "to create a pure heart" can only be the Lord, to the court that a person brings their iniquity and their sin ulcerated soul.

Infants still being dumb, have conscience from birth, but the realization of the act (its investment in the word) gradually begins to come after 5 years. This is the question, what is the difference between conscience and consciousness.

Conscience in the Slavic, Russian sound («Со-весть») can be compared with some subtle flair that live and deliver holy men, for the preservation of grace (rather, it is for all cultures Byzantine heritage). Man can know much, do everything according to the law and to be a real Satan. Not accidentally that the saint Tikhon Zadonskiy Orthodox said: "All in vain and pointless, if not lead the Christian life - the inner struggle against the passions." This pride, vanity, envy, anger, adultery, gluttony, and their derivatives. Arsenal spiritual weapon in the struggle itself has fundamental properties of man. Only when mastered weapon or tool you can effectively use it. A man with a conscience educated in society can be compared with the cell body. The live healthy cell has beneficial effects on other cells, and cancer cell degenerating infect neighboring cells.

The big difference between those who constantly teaches and admonishes others and those who live according to conscience. Encountering in a person's life with a clear conscience effect occurs pain. At the same time, depending on the eigenvector of conscience and either the effect of rejection in the form of hostility, which can reach up to hatred, envy, and other passions, and either born crying, shame, and most interesting, is born the joy of finding new meaning in his life. This effect is called repentance (μετάνοια – in Greek translated as "change of mind"), which leads to the purification of the conscience, heart and soul. Remember, even people who commit acts of dishonesty and accidentally notice that there are children nearby.

Man does not own conscience contrary susceptible spiritual contamination and consequently mental. For such people, even a sense of how humanity - have sensory condition that arises as a result of the perception of the external expression of pain and joy, we can say, as of expression of sympathy, as a phenomenon of mental contamination, and not from the experience of sharing the suffering and joy together. Next is the "humanity" develops depending on the altruistic tendencies "grows interlocking interests" and suggests in this development ideal goal (a state of "social balance"), excluding any sacrifice.

Conscience - a magnificent spiritual weapon that does not let anything get in undue soul. It literally protects the human soul. Saint Theophanes the Recluse wrote: “Conscience is the watchman, whom God has given for the preservation of its truth. That he acted well need him to first learned this truth, that he knew that he guards”.

As can be seen from this quote for mastering conscience need not doctrine of conscience, and the knowledge of its truth. This is possible only in the bosom of the Church, in her sacraments, liturgical life, community, which is built on love. In this nursery school of love, as in life-giving environment, they find and food and support for yourself, Christian love is not limited to brotherly love and freely poured out upon all to whom it may only be relevant. "There is no love in the world like the one on which man is capable of in the name of the crucified savior, like a flame, it captures the whole being of man, takes his mind and heart, becomes the soul of it, it's the only driving force, makes him forget himself, the world, to die for likely than not in the Father's love (1 John the 2.15) "

Knowledge of the truth of conscience is the acquisition of grace in the heart. Conscience as precisely translate the Greek compound of his testimony with the motivation or impetus, which comes from the heart, the impetus to commit good or

sly act. Kind of heart bringeth forth good things: and an sly man - sly. A few words about the fundamental properties of human faith and the word, and their connection with the conscience.

In all the Abrahamic teachings present position, that man was created in the image and likeness of God. From this position, it is clear that if you learn the attributes of God, we will know the person and property. And vice versa - a different understanding of human properties and attitudes to them implies a different vision of God and relationship with God - that means all serve different gods.

For example, in the unity of the people of Kyiv Rus many ethnic based on: 1) the unity of faith, that is, the knowledge of who God is and who is a man; 2) the unity of writing as a means of fixing these spiritual treasures of faith on paper.

Not a coincidence that Peter I have made many radical steps to break up the unity of the people, of whom two touched points discussed above:

1) In the educational system at all schools was abolished compulsory subject "theology", which not only clarifies who is God and who is a man, but to exploit the full arsenal of weapons of spiritual man, and this is the fundamental qualities of a man to become a man. People were so theologically educated, were not afraid of the people of other faiths, as often only one force fraternal selfless love that distinguishes Christians from other peoples, there was an appeal to the Christian faith of the people of other faiths. Boundless territory of Kyiv Rus demonstrate the unity of the peoples who lived and their love. It is not possible to unite peoples by force and hold millennium. This fact shatters any tampering of the Holy Prince Vladimir that he forcibly united the people with immeasurable bloodshed and got baptized.

Cancel led to spiritual blindness vision essence of other religions, to worldview chaos and endless search for bases of life, unrealized states and doom. This dealt a crushing blow to the inner core of human spirituality and the people, that is, has led to internal schisms spiritual man and society. History teaches us that for the next incarnation of the spiritual schism split. For example, the largest drop is the first of the Roman Empire, the second fall of the Roman Empire, which was called the Byzantine Catholics, in an effort to prove to everyone that did not have either the first and no, in general, fall, and that the world's center of true Christianity, that is dogmatic and spiritual moral standards, is in the European Union. Is it because the EU ignored the students study the history of the second Rome, and formed of relevance to it as children-troubled countries?

Subject of "theology" gave insight and clarity the most difficult things in life - spiritual, consideration of which made it possible to understand and information, and psychological. Today, talking about information warfare, psychological warfare, but the people spiritually disarmed. Cancel subject "theology" has generated favorable conditions for the growth of other forms of religion, which in turn led to more chaos and human away from the present Christian piety and corresponding lifestyle.

2) In order to facilitate the arrival of Western science and Western teachers were reforms in Slavic Literature simplified, more precisely trimmed alphabet and grammar. This has prompted some ethnic groups with their unique speech

developing his writing - is Ukrainian, Russian and Belarusian languages, and it opened the potential option to bring them to an apparent isolation.

By the end of the 19th century we have already accumulated a sufficient amount of scientific, philosophical and other Western writings that progressive elites have been translated into Ukrainian, Russian, Belarusian languages. In order to read it all began in 1905 in preparation for the upcoming 1917 revolution all administrative and territorial departments was given a decree on the termination off of the study of the Church Slavonic language in no need of, and transition to a study by the newly formed Ukrainian, Russian and Belarusian language. Enough for exactly 12 years to a new generation of young people, which is not kept in the hands of Slavonic writing books, as all spiritual Holy Fathers Heritage since the founding of Kyiv Rus was natural for the Church Slavonic language and Holy Gospel, too, any translation which to "abbreviated" classical languages were not approved of longer. After these events have ceased to appear great writers who have owned, except classical, great Church Slavonic.

As a result, today in Ukraine, according to official statistics there are 55 denominations and there are 36,500 religious organizations and Kyiv as the capital of the other capitals of the world occupies a leading position on this indicator. Such abundance may alienate the search for truth, and lead to dangerous ecumenical mix and confuse, and generally do not lead to the truth.

Deliberately composed classifiers hazards and do not deny the use of conscience in hazard identification and simultaneously offer strictly delineated selection field and precisely regulated calculation risk assessments. This applies to all levels of consideration. This unification simplifies business management and at the same time takes the opportunity to educate the public conscience and listen to it, that is to live conscience. The leadership as if all risks are deemed notified and all the formal aspect observed. The gradual substitution of natural security mechanism - an external conscience engineering calculation. Live without this inner protector, comforter conscience and not know it - put yourself in danger. Not only spiritual weapons conscience, but also all other types of weapons have different essence of Judaism, Catholicism, Protestantism, in the eastern cults and modern neocults.

Conclusions

Fundamental properties of the human can be spoiled. Such properties of human weapons to destruction of both himself and the world. Do not they make us human. But a billion people made decisions to ensure the safety of life and prosperity to live by the moral law, approved by the conscience and, if possible, to coincide with the moral law of the corporate culture and in agreement with the results of risk assessment, and believers - it is by faith in God.

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O. Kokhan, postgraduate
(National Aviation University, Ukraine, Kyiv)

MATERIALS OF AERIAL PHOTOGRAPHS AS PART OF MONITORING SYSTEMS OF ANIMAL -VEHICLE COLLISION

Materials of aerial photographs can help monitoring animal-vehicle collision.

Wild animals move along related areas (ecological corridors) that are crossed by highways, so they have to cross through dangerous highways. In this case animal-vehicle collisions (AVC) may happen. This provokes such consequences: loss of wild animals, injury/death to drivers and vehicle damage that requires risk management of AVC via monitoring system. Such a system as a database and GIS materials exists in the U.S. and Canada, where such accidents are recorded by Department of Transport, Department of Natural Resources, Department of Police and insurance companies in each state. These data can help researchers to reduce number of AVC and improve environmental safety: identify wildlife crossings through roads and develop measures to reduce the number of deaths, reduction of health costs of drivers and repair of vehicles.

Purpose and problem statement

The article provides justification of parameters for monitoring system of AVC of Ukraine similarly to systems used in the USA, Canada and Europe and prove assumptions of the parameters needed for system monitoring of AVC in Ukraine.

Materials and methods

Based on the analysis of the literature we will observe parameters used for the analysis of AVC accidents in the USA, Canada and Europe, which then could be used to prevent or reduce the number of accidents in Ukraine. In the scientific articles there are such parameters of an AVC accident: date, month, time, highway, kilometer of highway, kind of wild animal and cartographic materials and graphics. After studying of the research papers the following table could be built: the top row of this table is the names of the parameters are found in the references, and the rows will be numbers that correspond to the ordinal number of the source of the list of references. The bottom line counts the total numbers of reference sources. The parameters commonly used in the literature are the most informative and useful data for monitoring system of AVC accidents and therefore are to be used in the monitoring system for measures to reduce the number of AVC accidents.

Our analysis proposed to be used in the monitoring system of accident AVC for Ukraine following parameters (List 1): date (day), date (month), date (year), time, animal, number of road, highway kilometer (meter), car traffic (middle), general map, map (GIS), vehicle speed (limit)/amount of cars per day, amount of wild animals per 1 000 hectares, wild animals population amount, roadside

vegetation, animal death, damage to car (description), sex of the wild animal, age of wild animal, the rate of accidents, injuries to driver, deaths of driver.

The system also gives GIS map with such data: location of places where AVC accidents have occurred or places of most possible wildlife road transition - "hot points" (HP), to identify where it is advisable to use GIS maps such as Google Earth (Figure.1)

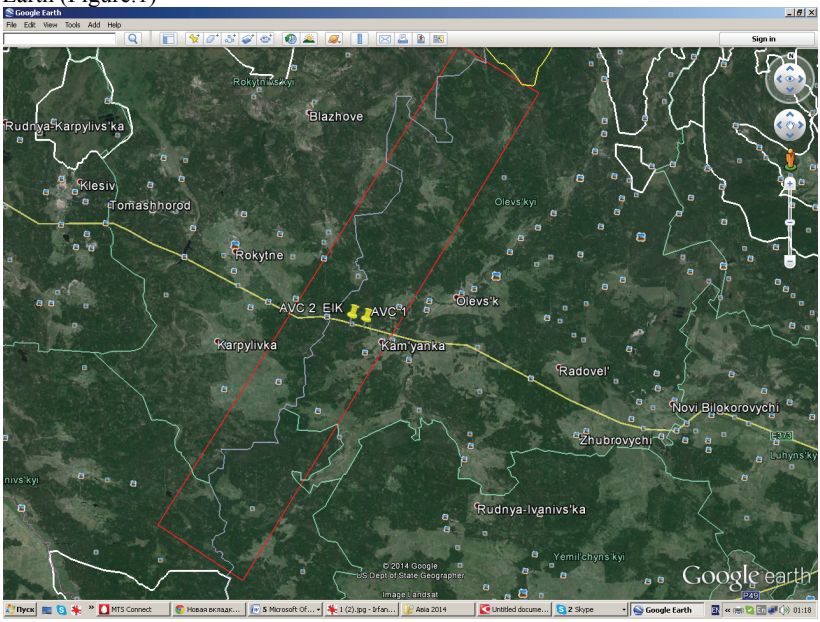

Figure.1. Determination of the AVC accidents on the roads of Ukraine.

Discussion

Table 1 "*List of parameters for description of AVC"* contains the parameters that are most often the subject of research and analysis of the reports and articles on the subject of scientific research of Department of Transportation, Department of Natural Resources, and is also used by the Department of Police and insurance companies, not only in the U.S. and Canada, but also in Europe. The most frequently used in the scientific literature, the parameters and characteristics of the AVC: speed of the vehicle, cartographic materials, analysis of date and time of the accident, the traffic of the vehicles and damage for the vehicle, injury or death to drivers used by the Department of Transport and the police. In this case, data from the death of wild animal and explore places with vegetation near the road or ecological corridors for migration that use by the Department of Natural Resources requires more research in the future.

Table 1. *List of parameters for description of AVC*

List of reference	Date (Day)	Date (Month)	Date (year)	Time	Model of the car	Name of animal	Amount of road	highway kilometer (meter)	Car traffic (middle)	General Map	Map (GIS)	Vehicle speed (limit)/the number of cars per day	The amount of wild animals on 1 000 hectares	The amount of populations of wild animals	Roadside vegetation	Animal death	Damage to car (description)	Sex of the wild animal	Age of wild animal	The rate of accidents	Injuries driver deaths	Deaths of driver
1	1									1		1										
2						1						1	1									
3																						
4																						
5									1													
6	1		1						1			1	1		1	2	3	3	3	3	3	3
7										1												
8		1						1	1	1		1										
9		1		1								1										
10	1	1	1	1																		
11												1										
12										1												
13				1								1										
14	1	1	1	1								1	1									
15	1	1								1	1						1	1	1	1	1	1
16																				1		
17			1								1											
18			1				1															
19																						
20									1	1												
21									1	1	1	1										
22		1		1						1												
23																						
24							1					1										
25	1	1	1																			
26	1		1							1	1											
Всього	7	7	7	5	0	1	2	1	5	9	4	10	3	0	1	2	4	4	4	5	4	4

Conclusions

1. Provide justification for the use of parameters for animal vehicle collision (AVC) monitoring systems for Ukraine.
2. Prepare table parameters commonly used in AVC (Table 1).
3. Prepare a list of parameters that can be used in a system for monitoring accidents with AVC in Ukraine. (List 1).

4. The amount of AVC has functional dependency on some parameters and they should be included in the monitoring system.

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M.G.Bagauri (*National Aviation University, Ukraine, Kyiv*)

FEATURES ESTABLISHMENT AND FUNCTIONING OF THE CADASTRE SYSTEM OF ESTATE OF SWEDEN

The article deals with the problem of creation the adequate governmental system of land and real estate registration in Ukraine. The article give special attention to the experience of countries, with highly developed land and cadastre system, such as Sweden.

Formation of Market Relations in Ukraine requires the creation of a state adequate inventory accounting system of land and real estate, which should contribute to the economy of the state. In developed countries, all costs associated with the creation of the inventory quickly recovered and profitable. In the development and perfection of the land cadastre system in Ukraine should take into account the experience gained in countries with developed land information and cadastral systems. Finding the most appropriate model of accounting and registration must largely focused on general international leaders in this field, one of which is Sweden.

A leading public institution with real estate accounting is the National Land Survey of Sweden (NLS). Prior to January 1, 1999 NLS was part of the Ministry of Internal Affairs, now it is under the Ministry of Environment. Areas of activity NLS are: development and implementation of land policy development and improvement of land laws and land use planning, surveying, formation of land and other real estate, registration of rights to land and other property assessment and taxation of land, land inventory , forests and other natural resources; creation and maintenance of land information and geographic information systems, conduct geodetic and cartographic works of national importance. [1]

From the list of activities NLS is worth noting that in Sweden the management and production functions related to real estate sold in one system under the control of public authorities. In the NLS system operating divisions of the national and local levels - regions (leniv) and administrative districts and municipalities (communes), private enterprises and private entrepreneurs. Thus, NLS is engaged as a real estate management as well as the organization and production of the land cadastre and land management projects.

Consider in more detail the organization of the NLS of Sweden as the Swedish experience in our opinion, is something that should be sought and what we must sooner or later come to the Ukrainian cadastral work.

The system consists of NLS: supreme body - the Board, CEO, internal audit, general office support as part of any IT department, planning policies and legislation, financing, training, marketing and media, the administrative department, the department of international relations. Three units engaged in productive activities: cadastral office, geographic and land information dimensions.

Cadastral Service has offices throughout the country and each of them performs functions of formation properties. Operates a single computer network with a central server in the main office. The formation and registration of the

property is fully computerized. Information "below" comes in the department of geographic and land information, the main task is to conduct Maps Register (cadastral maps) and update databases on the ground.
Land information system based on the methods of remote sensing, aerial photography materials and land bank information: geographic information systems are used to analyze the key information in the formation of land, land use planning, land evaluation, planning urban development, environmental protection, management of agriculture and forestry, utilities.

In Sweden, there are 4.5 million pieces of real estate, and all of them are registered in the Register property. Each property has a unique name that is used for legal identification. This system covers both private and public (municipal) land. Even rivers and lakes included in the registration system. Strand, 300-meter strip of sea and 5 largest lakes in Sweden belong to the estate and subject to registration. The main purpose of the registry is to determine the real estate property and provide an overview of the division of land on the property. More detailed and complete information on real estate located in the cadastral proceedings. They shall be kept by the office desk. Property Registry is a registry of rights to real estate, estate tax registry and registry population.

Registration of immovable property is made for individual units of real estate - land. Property unit may consist of one or more of land. Property includes not only land and water, but also "accessories" (buildings, perennial plants, roads, etc..). Directory of real estate - the main roster in the country. It serves key functions in society - credit, taxation, agricultural statistics, utilization, population registration, urban and regional planning, etc. Registration is carried estate agency real estate registration. In Sweden there are 53 such agencies. National Land Survey supervises these agencies and is responsible for their activities. The main goal is to provide land registration official status and legal protection for acts of buying and selling real property. The system of land registration, which is functioning well, there is a guarantee of safety and support economic transactions. Registration of land executed 93 agencies of registration of real estate rights. These agencies - part of the overall lower courts, which oversees the National Judicial Administration. Property registration process is fully automated. Systems EDP (Edp-system) completely replaced the registration books used until recently. Swedish system "database of real estate" - an interactive system created around a powerful central computer. Primary users - Register Real Estate Agencies and real estate registration using terminals linked to the host computer via the telephone network. Obtaining information from a database accessible via terminals for banking institutions, municipalities, agencies in real property, insurance companies and other major users of information. However, making changes to the registry entries are only entitled Agency for registration of land and real property. The information in the registry is always relevant. Changes are made to the registry after hours (currently no access to the system through the terminals). Access to information is almost unlimited and each terminal has access to any part of the system.

The "Swedish Land Data Babk System" (SLDBS) was established for efficient and effective land registration and real property and providing easy access to these data. Swedish system " Land Data Bank System " also offers a wide range

of opportunities for urban and regional planning, mainly based on the use of spatially referenced information.National Land Survey Systems is responsible for developing a database of real estate - SBDN or Register property and has the right to control the formation and registration of real estate. The entire property is registered and entered in the register of real estate, which is supported by the National Land Survey of Sweden, regional and municipal land and cadastral agencies, as well as the Register of real estate, which is on the register of bodies as well as the Register of real estate which is in registration authorities rights to property. The culmination of the national cadastral project was the creation in 2010 of the national registry Land Data Bank, which poyednuvaye property registry and registry of real estate rights. [2]

Unlike Sweden and several other European countries developed in Ukraine management and production functions in this area are divided between government at all levels, public and private enterprises and organizations, private businesses.

Thus, the development and implementation of land policy development and improvement of land law, planning and land use are called to engage in such public agencies as the State Agency of Land Resources of Ukraine, the Ministry of Ecology and Natural Resources of Ukraine, the Ministry of Agrarian Policy and Food of Ukraine, Ministry of Justice of Ukraine, government agencies authorities in the field of architecture and construction, and many others.

Cadastral surveys and other types of land cadastre activities, formation of land and other real estate, inventory, land, forests and other natural resources by the state and private enterprises and entrepreneurs, often without sufficient methodological guidance and control by the public authorities.

Registration of real estate objects - a function of public institutions of justice, as the Ministry of Justice for registration restrictions placed objects alienation of immovable property register of real rights to immovable property registry of mortgages. These registers are maintained in a single central database, and their co-ordination and maintenance provided by specialized state enterprise formation and land-registry provides the State Agency of Land Resources of Ukraine.

The organization of assessment and taxation of land, control over their conduct and approve their results involving other public authorities, depending on the category of land. While the direct perpetrators of these types of jobs are government and private enterprise. Over the conduct and execution of geodetic and cartographic works of national importance corresponds Service of Geodesy and Cartography.

Thus, in Ukraine issues and problems related to land resources and real estate are governed by a large number of agencies and organizations that often compete with each other narrow interests, protecting their own, to the detriment of the country's economy and ensure the rights of its citizens. In contrast to Sweden in our country there is no single body authorized to coordinate and lead single land and property policies, which greatly hinders the solution of many important problems, including associated with the establishment of common land and property complexes and single system inventory on their accounts.

In Sweden, the property registry is a database generated unit of property. In Ukraine counterpart Property Registry yet.

In Sweden, there is the principle of territorial cadastral register of land and common property objects. Thus the regular production units that are directly engaged in cadastral records are territorial authorities grassroots level, between service areas and are distributed throughout the state. These are territorial unit directly Databases legal land inventories, which means that the input and update inventory data is only in these local bodies. This experience exists in Ukraine, cadastral registration of land plots and real estate as their registration is on a territorial attribute. The essential difference lies in the fact that it involved a number of organizations with independent inventories and registries.

Land law Sweden has a long tradition. The first law of the land here was in XIII., And a nationwide land registry is from the XVI century.

Current Land Code, codified the basic legal act adopted by the Riksdag in 1971 he establishes the essential elements of the institution of private ownership of land, sale of real estate, his pledge, registration of land rights and others.

Three groups of laws develop basic provisions of the code. This is the law of the land and legal institutions, and ways to protect the rights of subjects of land relations. Further, the legislation on the operation of the State Land Cadastre. Finally, a group of laws that are not land regulations, but contain specific provisions concerning land relations.

Unfortunately, in Ukraine in recent years have slowed the process of preparation and adoption of laws related to inventory.

Compared with Sweden in Ukraine the right to property and the definition of these rights as clearly enshrined in law, there is some confusion in concepts, which inevitably leads to all sorts of irregularities and corruption. If the order of leveling land in Sweden and the procedure for granting land in Ukraine we see that in Ukraine departments and organizations "communicate" with each other not directly but through the consumer services. It is imposed on the consumer role in the transport of courier documents between departments. Consumers are important to system turnover Estate interacted with it in terms of its problems and challenges: buy, sell or donate property to a bank loan secured by real estate, etc.

Thus, for an account of property now requires a reliable system of registration of spatial boundaries of land and each item of property. Such a system is difficult to establish, but even harder to get it to operate throughout the state, so it is necessary to immediately consider a number of factors: access to information, media visibility and ease of use, the possibility of its actual use.

It can be concluded that Ukraine needs a comprehensive reform of the executive bodies of state power, directed, inter alia, to simplify the system of government involved in the process of recording the state property and state registration of rights to them.

The relevance of the creation, development and improvement of Cadastre of Immovable Property obvious and extremely important, because the design of the system should contribute to the solution of critical problems, such as the protection of the constitutional rights of property owners and other owners of immovable property; effective functioning of the registration of real estate by the same standards, classifications and technological procedures; land management; creation

tool constant updating of information on land users and land; effective monitoring and control of land use; promote best functioning land market.

Experience of countries gone a long way legal framework, technology, data collection, evaluation, use of information about real estate, land use planning is very important for Ukraine. Sweden has a perfect cadastral system and its study would help Ukraine to prepare professionals to land reform, creating a legislative framework, identifying future directions of land surveying and geodetic fields.

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Dankevich A.F., (National Aviation University, Kyiv)

ANALYSIS OF MODERN METHODS OF GEODETIC SUPPORT DESIGN AIRPORT

The article describes modern methods of analysis of geodetic software design civil aviation airports in today's scientific and technological progress.

Introduction. Airport, as well as any object has its infancy and function: research, design, construction, maintenance, repair and renovation, disposal. To perform each of these steps is performed a number of necessary surveying - geodetic work. Analyze features up survey work for the design of airports in modern scientific and technological progress in various fields of science and technology.

Designing airports. Planning of airports calls for diverse engineering research [1], which should ensure selection of the most suitable sites for the location of the airport in a given area and design the most optimal variant of its master plan.

In engineering and geodetic surveys performed airports geodesic support site selection for the location of the airport; building a basic planned altitude and the crew of geodetic networks for the selected site; removal of topographic areas where necessary for drafting scales; geodetic enforcement of other types of research; with the development of legal documents to land the airport and setting its cadastral surveying and other work [2].

Classic contents engineering and geodetic surveys in step site selection for the airport is in the air and ground reconnaissance area of work and a simpler tool or aerial mapping, method its topographic maps and plans scale
1:25000 - 1:5000. Under present conditions the most promising and cost-effective solution for a variety of tasks at this stage is to use the available satellite images of suitable scale to facilitate and accelerate the selection of optimal sites for future construction and operation of the airport.

In survey work at the site for the airport usually build geodetic network condensation, which must meet the requirements to perform large-scale surveys of land for the development of the working draft airport, as well as marking work performance when transferring the project to the airport area. The basic geodetic network thickening at the airport are often constructed in a building grid squares with sides parallel and perpendicular to the axis of the runway and the size of the grid squares of 400 m [2]. Currently, for the construction of building grid squares should use accurate and precision integrated rangefinder and goniometric geodesic instruments. Their use avoids the time-consuming step of reduction of grid points in the building design position.

If construction a building grid squares for various reasons, inappropriate, especially in the reconstruction of existing airports, the main routine geodetic

network condensation in modern terms should be built based on satellite technology [3] using the devices GPS.

The main high-altitude network to create a site for the airport traditional geometric leveling points grid squares or other points of the planned networks. in the state system heights.

In the process of large-scale land surveying scale 1:2000 - 1:500 to develop working drawings airport project expedient use of modern electronic tacheometer which enables coding of survey points. It is beneficial in the further processing of the results of field measurements, as when reading data from the drive in addition to the three coordinate the set point is assigned ownership to any object that corresponds to a conventional signs for topographical plan. It allows you to create topographic plan of conventional signs for "raw" data, brought the performer directly from the field. In turn, software, electronic total station requires a universal exchange format with computers to create with the help of a digital terrain model (DTM), which includes a picture of the situation and terrain.

For large-scale survey of the territory for future airport is effective aerial mapping using navigation GPS [4]. Aerofotokamera latest generation of GPS combined into a single system that allows you to automate the process of aerial mapping. In these systems use a dual-frequency GPS-receiver that operates on a DGPS; so in the area of the shooting facility established terrestrial base station. Modern GPS to record the position of aerokamera with high accuracy, which meets the requirements of large-scale mapping. Application of GPS in aerial mapping allows: to maintain aerial mapping routes according to the project; optimize the event the aircraft on aerial mapping route; record the coordinates of the center of projection during exposure with high accuracy (5-10 cm).

If the flight fixed spatial coordinates of the centers of projection, it substantially affects the facilitation of technology photogrammetric studies [4]. In this case, to build a network of block phototriangulation possible or no reference points (no field bindings aerial photographs), or with a small number of them (2 - 4 points on 100 shots), which significantly reduces the aerial mapping work.

Preferably combined with GPS inertial navigation system (INS). INS consists of a gyroscope (angular stabilization aerokamery performs during tilting aircraft) and accelerometer (defines the change in airspeed aircraft) .. Combining GPS and INS gives an additional effect: in short time intervals. INS "corrects" your GPS, and at long time intervals GPS compensates for systematic errors INS. Integrated navigation systems (GPS + INS) are an integral part of modern digital aerial mapping systems.

Studies of aerial mapping and create topographical plans possible using standard photogrammetric software packages (Delta / Digitals, DPS PHOTOMOD etc.).

Data engineering - geological, geophysical, hydrological, meteorological, environmental and other surveys need space - coordinate binding and this problem is solved in the course of modern topographic and geodetic survey [2].

Among the works are also noteworthy geodesic support the preparation of documents of title to land airport setting its inventory accounting, electronic airport

site plan, develop three-dimensional models of near by airport territory to secure the flight, environmental impact assessment of aviation on the environment [5].

Conclusions.

Under present conditions the most promising and cost-effective at the stage of selecting sites for the airport is to use satellite images of suitable scale.

For construction a building grid squares use accurate and precision integrated rangefinder and goniometric geodesic instruments Their use avoids the time-consuming step of reduction of grid points in the building design position.

If it is impossible or inappropriate grid of squares of building construction start scheduled geodetic network condensation in modern terms should be built based on satellite technologies using devices GPS.

The main high-altitude network at the site for the airport should create a traditional method of geometric leveling points planned geodetic networks using advanced levels.

When performing large-scale land surveying to develop working drawings airport project should be used modern electronic tacheometeres which enables to code surveying point and create a digital terrain model (DTM) which includes an image of the situation and relief of terrain.

For large-scale survey of the territory to the airport is effective aerial mapping, using GPS navigation and aerofotokamera last generation that can accelerate, automate and reduce the cost aerial mapping process and getting orthophotos**.**

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Kapelistaja I.M. (National Aviation University, Ukraine, Kiev)

GEOECOLOGICAL ASPECTS OF ENVIRONMENTAL MANAGEMENT GEOLOGICAL MONUMENT OF NATURE STOWS THE HAIDAMAKTSKYU YAR

In the article the problem of preservation of the environment, in particular - geological objects. Emphasis author focuses on the geological monument of nature - the tract "Haidamatskuy yar" and geo-environmental aspects of environmental management of this territory - ecological and scientific tourism.

In our country return to nature aside a significant place the development of natural reserve fund as part of the implementation strategy for the harmonious development of society. After the enactment in 1992 of the Law of Ukraine "On the Nature Reserve Fund" was a significant increase in the number, size, and objects of natural reserve fund (NRF) of Ukraine. Particularly important to create the high-level object of wilderness protection (nature reserves) and mixed-use (biosphere reserves, national and regional landscape parks). To stabilize the building process areas of land subject to special protection as a strategic objective for environmental sustainability of the country adopted the Law of Ukraine "On National Program of formation of national ecological network of Ukraine for 2000 - 2015 years."

According to the State Service of Ministry of Ecology of Ukraine, as of 01/01/2013, the current network of protected areas is 8032 units of areas and sites with a total area of about 3923 hectares, accounting for 6.05% of Ukraine. The structure of NRF Ukraine natural monuments occupy 28.8 hectares, it is 0.73% of the total protected areas in Ukraine

The largest in the Vinnytsia region, geological nature monument of national importance tract "Haidamatskuy yar" (Fig. 1) is located on the territory of the Ukrainian shield, within Yampolsky and Mogilev-Podolsky areas between the villages and the Bush Gomulivka. Coordinates natural monument: 48 ° 22 'North latitude - 48 ° 21' North latitude and 28 ° 07 'East longitude - 28 ° 06' east longitude

"Haidamatskuy yar" is a valley, canyon, about 2 km long and a width of 100 - 200 m, cut by river Bushankoy in feldspar-quartz sandstones Venda. In the riverbed near an abandoned quarry exposed pink and black grained granites Berdichev complex.

The object is of paramount importance due to the combination of the following factors:

- Geological - cut the bottom of the Mogilev Formation Venda in an abandoned quarry at the northern end of the ravine, the possibility of studying cross-bedding and other structural characteristics of sandstones (Fig. 2a);

- Geomorphological - typical canyon landslide processes, various forms of weathered sandstone, caves, waterfalls, etc. (Fig. 2 b);

- Historical - crop residues were found in the village of Bush: Trypilian, Chernyahiv, Cossacks. Was established historical and cultural reserve "Busha". Here

you can see the remains of a fortress and church, an ancient Cossack cemetery, abandoned rock temple (Fig. 2);

a

b

Fig. 1. Geological landmark - the tract "Haidamatskuy yar": a - Features stone sign at the entrance of the tract ; b - beautiful scenery with Vendian sandstones [5].

- Aesthetic - landscapes of exceptional beauty of the valley slopes, canyon walls; outdoor exhibition of more than 150 sculptures of sandstone Yampolsky (Fig. 1 g) [1,2].

In addition, in the "Gaydamatskuy yar" are habitats of rare plants such: pure white snowdrop, the common (Galanthus nivalis L.), monpeliysky astragalus (Astragalus monspessulanus L.) listed in the Red Book of Ukraine. [3]

By decision of the Vinnytsia Oblast Council №499 from 8. 12. 2007 the "Haidamatskuy yar" is recognized as one of the Seven Wonders of the Vinnitsa region. [4]

"Haidamatskuy yar" is on the balance of public utility "Vinoblagroles" carrying out activities related to the use and reproduction of forests, as well as compliance with environmental legislation in the territories of the natural reserve fund.

This object did not go unnoticed by the tourists and travel agencies. The internet is full of offers visit "Haidamatskuy yar." But the tourist infrastructure is not developed yet, so everything was a problem geological monuments new hiking trails, equipment, garbage cans and ensuring their timely cleaning, renovation of plates. But most importantly - prevent vandalism (Fig. 2e), which disfigures the original appearance of the rocks. And engaged in this enterprise "Vinoblagroles" in 2007: equipped stone steps to get down to the bottom of a steep canyon, the river Bushanka (Fig. 2 f). Across the river a wooden bridge, to be able to transition and become familiar with forms of weathered sandstone (Fig. 2 g, h) . It was also Resettled several viewing platforms with benches and tables where you can sit and relax, enjoy the indescribable beauty of the canyon (Fig. 2 i).

Geoenvironmental problems tract "Haidamatskuy yar" can be divided into two groups: natural geological and anthropogenic. Over the past half century on the territory of studies have shown active deluvial, proluvial, eluvial processes, as well as significantly increased dernovanost and forestland, which led to the loss of the

pristine beauty of a geological monument of nature. On the other hand, dernovanost and forestland have created a new landscape with a specific flora and aesthetics [5].

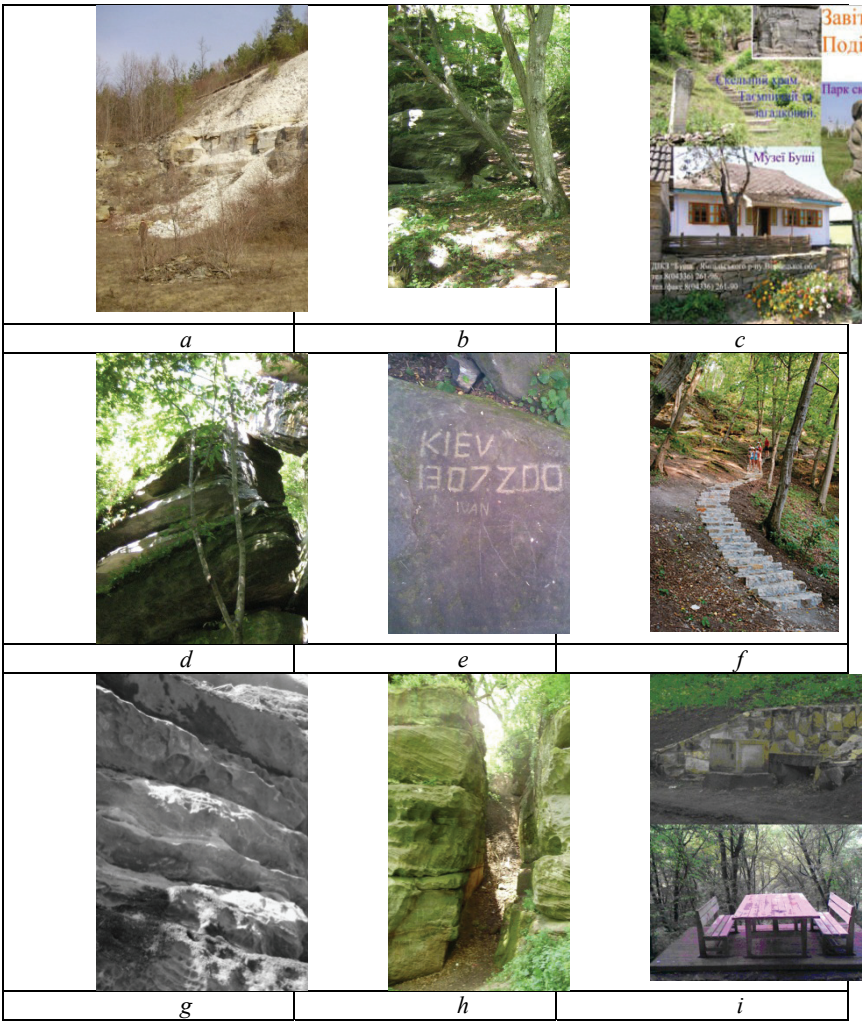

Fig. 2. Attractions Tracts "Haidamatskuy yar": a - section of sandstone Mogilev Formation Venda ; b - the valley of the canyon; c - historical monuments ; d - the canyon walls; e - an act of vandalism ; f - the equipped Bushanka descent to the river ; g, h - forms of weathering Yampol sandstones ; i - furnished recreation and viewing platforms. [5]

But the main problem is the rational nature of NRF noncompliance guarded; prevent acts of vandalism. During the most active vacationers (spring, summer, early fall) Onsite protection should be implemented around the clock, it is necessary to increase the staff of the season. This is primarily a question of financing wage one solution which is ecological and scientific tourism [6].

Eco-tourism is the type of covered services that allowed the territory of such objects NRF as a reminder geological nature [2]. But there is a problem of lack of necessary scientific description "Gaydamatskuy yar", which in its relief and landscape features is the unique beauty of geological object. In addition, a serious shortcoming of local environmentalists should consider the lack of description of vegetation "Gaydamatskuy yar", some representatives of which are unique.

Lack of information about the memo holding back the flow of tourists, which in turn hinders the development of eco-tourism and tourism infrastructure. To solve this problem, first of all, you need to conduct a comprehensive study "Gaydamatskuy yar" as geological object, investigate and describe its flora and fauna, get directions and nature trails to discover. According to the results of research to create the actual thematic maps. This will attract new tourist flows, which would increase the level of funding prirodozapovednogo object. Will have the opportunity and the need to increase the staff needed for the implementation of environmental monitoring, environmental, scientific and educational activities[7] .

As has been mentioned before - an integral part of ravine Haidamak ravine is a river Bushanka. In order to define the current geoecological state of the watercourse and ravine author has selected samples of bottom sediments of the modern river alluvium Bushanka for chemical, mineralogical and spectral analysis.

Conclusions

The geological nature monument "Haidamatskuy yar" is a unique object that needs protection and continuous environmental monitoring to maintain. There are a number of geo-ecological problems: natural geological and man-made, but the extremely low level of funding for NRF institutions complicates the situation. Geo ecotourism activity is a means to address these geo-problems, but requires the creation and maintenance of modern geo-ecological information system. This will attract new tourist flows will increase the level of funding natural reserved object. A possibility and the need to increase the staff needed to carry out environmental monitoring, environmental, scientific and educational activities.

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T.V. Kozlova (National Aviation University, Ukraine, Kyiv)

MODERN EU PRACTICE OF CREATING THE CADASTRE-REGISTRATION SYSTEMS

The experience and main trends of development, modernization and standardization of cadastral-register systems in Europe are presented. Current practice and European Union (EU) requirements for creation of cadastral-register systems are analyzed.

Historically, cadastre was made over 2000 years ago as primarily instruments of fiscal policy and registration of transactions with land. Society functions of cadastre development were also developed. The development of these functions has led to the existence of two related tools of land management resources: land cadastre (land registry) and legal registry (registration systems).

Formalization of land rights is extremely important for sustainable economic development and land resource management in both urban and rural areas, which are an integral component of an effective inventory system (UNO, Bogor Declaration of 1996). A system of property rights is meant as the combination of such elements:

– the means of identification and description of land and property (inventory);
– means of proof of land and property title (registry);
– the means of rights exchange (land market and real estate);
– financial institutions and financial instruments (banks, credit unions, mortgage and mortgage bonds);
– protective bodies of these rights and disputes (court system).

First of all two elements of the system acquire crucial meaning– cadastre and registry, because these elements can convert land into asset, that is fit for circulation in the market.

In some countries one component (only one) is built cadastre and registration system, so the functions of cadastre and registration of rights are provided by one institution (Albania, Armenia, Czech Republic, Greece, the Netherlands, Italy, Lithuania, Luxembourg, Slovakia, England and Wales, Sweden, Scotland). In other countries cadastre and registration is separated (two-component system):

– in Spain and Portugal the registration is made by private loggers, subordinated to the Ministry of Justice, under the Ministry of Finance of inventory and performs primarily fiscal functions;
– in France, Scandinavia, Poland, Slovenia, Croatia, Estonia and Bulgaria the registration is made by public institutions – courts or notaries who are under Justice, cadastres are led by different organizations under different mini or even municipalities by the Ministry;
– in Germany, Austria, Latvia, Switzerland the registration is entrusted to a special organization of public law (Pozemel book offices that have status equal to the court), cadastres are other organizations, which are subordinated to different ministries.

According to the UNO Economic Commission for Europe (UNECE UNO) in 38% of European registries under the Ministry of Justice, there are 23% – ministries of natural resources, 11% – Ministry of Finance, in other cases under different institutions. There are examples of unified cadastre and registration system under the legal authorities (courts, notaries, legal authorities).

So Europe is used as a single and two-component (dual) model building cadastre registration system, although lately it may be noted trend to unified cadastre and registry systems under the auspices of inventory (such reform is undertaken in Italy, Romania, Norway, Iceland).

The main principles of the unified system are:

– maintenance of registration of property on the basis of land records (land and immovable property is considered as a single property);
– registration of land and real estate rights in one register rights;
– registration of rights and cadastral maps by the same institution;
– registration of rights is an administrative function (state registration of rights to be separated from the court and/or notaries);
– service-oriented systems, primarily for the user;
– a system of title registration shall be self-supporting.

Despite the differences in registration systems in different European countries their common basic features are shown [1]:

1. Cadastral systems are constantly changing with the change of economic situation.
2. The system is based on carefully designed legislation.
3. Registration procedures are worked out in detail and legislated.
4. The system is centralized state and delegating certain powers to the field.
5. The system consists of cartographic and documentary (text) parts.
6. Registers are based on large-scale official maps.
7. Most systems support common standards for data exchange.
8. Routine work performed by self-financing, modernization - with the support of the state.
9. Registers are open to the public (although in some countries the available information on the cost and security).

The experience of countries that summarizes and extends UNECE UNO, services for the cadastral registration and registration of real estate rights are crucial for the functioning of outstanding land and property. In addition, each country shall create and ensure the system within their own social, economic and cultural environment, as each country has a unique history and experience.

Experience in establishing national systems of cadastral records, according to the Commission, firstly shows the superiority of the framework of laws over the laws, having a lot of technical details. Secondly, the «right to privacy» should be guaranteed. These cadastres shall be protected and accessible to users at the same time. Cadastre system shall take into account the need to balance between the right for information and the right for personal data protection.

The important issue is funding of cadastre and registration system. There is a common practice in the EU: the vast majority of systems are studied by UNECE UNO or fully funded by customer payments (56%), or combining customer

payments and government funding (42%) and only the bare minimum is funded entirely by the government (2%) [2].

However, despite the existence of significant differences between the cadastre and registration system of the EU, there are clear common basic practices:

– automatic registration of every transaction, available at the local level;

– systematically and automatically tied to inventory information about each section titles in the registration system which is operated by a single, self-financing institution of property management;

– a high degree of user friendliness, transparency, completeness, accuracy, availability, warranty.

Significant technical progress, changes in social life and increasing of globalization of business relations with their legal consequences and impact on environment have left their mark on the traditional cadastral systems, so many European countries have reformed their systems. Cadastral reform and requirements of modern cadastre and registration systems occur in accordance with recommendations of the concept of «Cadastre 2014: A Vision of future cadastral systems» [3], which is a result of Working Group of the International Federation of surveyors (FIG). «Cadastre 2014» has established the basic definition of land cadastral registration and land records. According to recommendations of land registration and cadastre they usually complement each other and they function as agreed (interactive) systems.

Special EU legislation concerning cadastre and registration system creation does not exist, and there is no law model or a set of guidelines for its construction and operation. However, certain provisions may be interpreted as some minimum standards of such systems.

EU legislation contains provisions to create more land cadastre, focusing on agricultural lands. Thus Member States should implement GIS based maps in order to create a tight control over the issue of subsidies for farmers, prepare a register that lists location, characteristics and applicable law and implement a System of integrated administration and control. Member States shall introduce a system of identification of land parcels as part of System of integrated administration and control in a way that they choose themselves.

One of the conditions for the admission of new countries to the EU is the establishment of a free market economy, which is parallel to those existing in Western Europe. One of the main tasks is land privatization and introduction of an effective land market [4]. Cadastre and registration system of the country shall be implemented in such a way as not to interfere with real estate market.

In recent years actively creation of a unified cadastre system in EU is discussed. EULIS – European Land Information Service (European Service Information about the Land) was created. One of the main goals of project is that EULIS levels the borders on services providing information about land, enables search for information via the Internet in a mode on-line in the cadastral registers of European countries. Hope to and easily accessible information on the ground – one of the reasons for development of the single market, EU free movement of goods, persons, services and capital [5].

EULIS system that was started in 2006, combining real-time cadastral systems of Sweden, the Netherlands, Lithuania, England, Wales, Norway, Austria, Finland, Scotland and Ireland. This website also includes background information storage, editing tools, which allows for all information up to date, and storage billing users.

To join EULIS it is needed to have a well functioning cadastre registration system, exhausting the list of requirements which does not exist, because in EULIS the working group of experts help to prepare cadastral registration system for integration.

In the nearest future such countries as Belgium, the Czech Republic, Estonia, Finland, Iceland, Italy, Latvia, Northern Ireland, Scotland, Serbia, Slovakia, Slovenia and Spain will join to this service.

Conclusions

On the basis of European experience in creation, standardization and modernization of cadastral and registration systems presence trends in the transition to a single-component model of their construction are demonstrated.

An effective cadastre registration system of registration has the following characteristics as simplicity, accuracy, timeliness, availability, warranty. The effectiveness of cadastral registration systems of the EU is determined primarily by availability and convenience of their services to the user, authenticity and openness of information that contains in database. The main characteristics of any cadastre registration system shall be transparent, quality and accessibility of information for landowners and land users.

There are existing conditions for establishment of effective integrated land information service of the European Union and provide comprehensive information on real estate on-line.

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I.O. Novakovska,
(Institute of Land Relations Ukraine, Kyiv,
National Aviation University,Ukraine, Kyiv)

LAND RELATIONS IN THE FIELD OF URBAN DEVELOPMENT

The paper reviews current state of land relations regulation in the field of urban development, flaws and contradictions of the existing land and urban development legislation in terms of urban development management, problems of developing land management and urban planning documentation, agreeing and approval thereof, as well as improvement of the legislative and regulatory acts.

The main legislative acts in the field of urban development comprise the following Laws of Ukraine: "On Local Self-Government in Ukraine", "On Basics of Urban Development", "On Regulation of Urban Development", "On Architectural Activity", "On Responsibility for Offenses in the Field of Urban Development."

Analysis of the specified legislative acts indicates that their provisions contain no unified interpretation of urban development (urban development activity) as a subject of social relations regulation. The Law of Ukraine "On Basics of Urban Development" stipulates that "urban development (urban development activity) implies a purposeful activity of state bodies, local authorities, enterprises, institutions, organizations, individuals, associations of citizens on establishing and maintaining comprehensive living environment with the activity comprising forecasting development of settlements and areas, as well as planning, building in territories and other use of land, design, construction of urban development facilities, construction of other facilities, reconstruction of historical settlements while maintaining traditional nature of the environment, restoration and rehabilitation of cultural heritage, provision of engineering and transport infrastructure".

The Law of Ukraine "On Architectural Activity" defines architectural activity as "an activity implying creation of architectural objects, which includes coordination of activities by all participants engaged in development of all components in terms of projects on planning, building and landscaping of territories, whereas architectural activity objects (architectural objects) imply territories (parts of territories) within administrative and territorial units and settlements". Thus, the same types of activities in the first case relate to urban development, while in the second case – to the architectural activity.

The Law of Ukraine "On Regulation of Urban Development" stipulates that planning and development of territories envisage the same basic directions as urban development under respective law.

In addition, certain provisions of the laws "On Regulation of Urban Development", "On Architectural Activity", "On Local Self-Government in Ukraine", "On Basics of Urban Development" are inconsistent. The issue of distributing authorities in terms of implementing the above activities has not been quite settled yet either. The latter concerns management in the field of urban

development, approval of urban planning documentation (especially by regional and district councils), competence of local state administrations etc. Contradictions and inconsistency of legislative provisions on distributing authorities of executive and local self-government bodies in terms of carrying out urban development activity entail violations and offenses in this field, as well as cause restriction or unreasonable expansion of authorities vested in the said bodies.

As defined by the Law "On Basics of Urban Development", the main directions of urban development cover an extremely wide range of issues, however, not all of them are balanced and grounded. It is difficult to accept the fact that **other** use of land (along with planning and building) is one of the main directions in terms of urban development. For instance, no one would characterize agricultural use of lands as urban development. Selection of lands for urban purposes is not included in the urban planning documentation (Article 17) and Article 21 of this Law on definition of lands for urban development purposes. However, the selection activity remains among the main directions of urban development (Article 2). Withdrawal (purchase) and provision of lands for urban development purposes cannot be referred to urban development or be one of primary directions thereof either. These are land tenure functions regulated by the Land Code of Ukraine and other legislative acts in terms of land legislation.

Despite the fact that the Law of Ukraine "On Basics of Urban Development" clearly and unambiguously stipulates that regulation of land relations in terms of urban development shall be carried out in accordance with the land legislation, certain legislative acts on urban development indicate a conflict of law principles. Besides selection of lands for urban development purposes and withdrawal (purchase) of land plots, this applies, in particular, to including certain types of land use documentation to the list of urban planning documentation, etc. Plans for land and economic organization of settlements, as a type of land use documentation, are considered an integral part of the general planning schemes of settlements under separate legislative acts on urban development. At that, it is not taken into account that such plans are stand-alone projects that can be developed either in accordance with the general planning scheme, or separately. A land management draft plan on territory harmonization for urban development needs is unreasonably suggested to be considered an integral part of the detailed plans. The said draft plans of land management beyond settlements are developed not based on detailed plans but according to the district territory planning schemes.

One of the main requirements in terms of development and implementation of urban planning documentation by urban development entities implies performance of tasks and activities aimed at ensuring **sustainable development of human settlements** and environmental safety of the area.

Until the moment of their withdrawal (purchase) and provision for urban development purposes the lands identified for future development of settlements or construction of certain facilities should be used by landowners being the land users in accordance with the land legislation.

Territorial communities represented by village, town and city councils have a **preferential right** to purchase land, buildings and structures for urban development needs identified by urban planning documentation for public needs.

A distinctive feature of land relations regulation in terms of urban development implies priority of the approved urban planning documentation when identifying territories for urban development needs. Both at the national level (General planning scheme of the territory of Ukraine), the regional level (Planning schemes of the regions, districts, Autonomous Republic of Crimea and parts thereof) and at the local level (general planning schemes, territory zoning plans, detailed plans) the said urban planning documentation is deemed the basis for territory planning in matters of territory allocation. The branch-specific schemes of facilities placement, territory management plans, organization of districts, technical and economic substantiation of use and protection of lands within administrative and territorial units developed based on the said urban planning documentation or related thereto must provide details of the expected and pre-design concepts by the documentation with a view to create a solid basis for selecting appropriate land plots and land allocation depending on intended use purposes, ownership patterns, types of use.

The competent authorities in issues of urban development and architecture approve identification of territories for urban development needs as well as consider and approve respective architectural planning and land management documentation on selection of land plots and construction of facilities

Conclusions

1. Regulation of land relations in the field of urban development is based on provisions of the Land Code of Ukraine as well as other legislative and regulatory acts, i.e. remains subject to land legislation and may not be double-governed by regulatory acts on urban planning and architectural activity.
2. Improvement of legislative acts in the field of urban development should focus on achieving interconnectivity and interdependence of land management and urban planning documentation; primacy of the approved national, regional and local planning documentation while resolving issues of development and planning of territories; as well as on ensuring compliance with the principle of autonomy and completeness of certain types of design, planning and land management documents.
3. The need for ensuring sustainable development of human settlements and observance of environmental safety requirements in terms of creating and maintaining comprehensive living environment necessitate simultaneous elaboration and implementation of integrated urban development and land use programs at the regional level.

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Nataliia Pashynska
(Institute of Geography of the National Academy of Science of Ukraine, Kyiv, Ukraine,National Aviation University, Kiev, Ukraine)

FACTOR OF TRANSPORT ACCESSIBILITY FOR SPATIAL PLANNING

The factor of transport accessibility for elaborate of spatial planning schemes is considered. The role of transport for territory development and spatial planning is defined. The conception of transport accessibility and its importance for spatial planning, the main parameters and characteristics of their definition are explored.

Introduction

To preserve the environment, achieving sustainable localization of the population, optimal placement of the main types of economic activity at the level of settlements, regions and countries is important spatial planning. Current, dynamic growth of mobility is accompanied by the rising importance of transport infrastructure and profound transformation of adjacent areas. In this regard, the increased importance of spatial planning in order to preserve the environment, achieving sustainable resettlement of the population, the optimal placement of the main types of economic activity at the level of settlements, regions and countries. In this process, an important place belongs to the investigation of the transport system, which has always played an important role in the spatial development of the territory. Transport should be treated with 2 positions: definition and rational allocation of transport infrastructure in the schemes of spatial planning and placement of other objects in relation to transport infrastructure. It is important indicator of transport accessibility.

Significance of transport for territory development and spatial planning

The transport system is an important component of the infrastructure in the economy of Ukraine, which creates and implements the conditions for the operation of production and life of the population. Level of transport services, the technical condition of transport infrastructure significantly affects the cost of freight and passenger, mobility, the accessibility of settlements and socio-economic development of the region.

Now in modern studies in geography transport to the fore qualitative aspects of the transport system are nominated, including mobility, accessibility, connectivity, transport discrimination population, behavioral geography, increasing its value in the spatial development of countries and regions [3; 4]. Along with this was a change of paradigm in regional planning and transport planning - a departure from the planning the volume indicators to of socio-oriented indicators that reflect a turn digression from manufacturers of transport services to their customers [2]. However, the Ukrainian geography almost no research on the issues of transport accessibility, this indicator is only used in city planning practice. Insufficient development of this area requires a thorough study of the concept of transport accessibility, models and methods of research.

City planners have continually emphasized the far- reaching effects that accessibility has on the development of land. The more accessible an area is to the various activities in a community, the greater its growth potential. Consistent with this general concept of a relationship between accessibility and land development, a land use model, based on a realistic measurement of accessibility, an be developed. Such a model would relate the accessibility of an area to the rate and intensity of the land development in that area.

The definition of transport accessibility

Transport accessibility is the main product of the transport system. It defines the geographic advantages of the territory (region, city) for all other territories. Indicators of accessibility measures the benefits received by people and businesses of the territory on the availability and use of transport infrastructure in the area. The important role of transport infrastructure for regional development in the simplest form is that areas with better accessibility to places of raw materials and markets, ceteris paribus, more productive and competitive and accordingly more successful than those that are remote and isolated [5]. Thus, the capacity and location of transport infrastructure are key elements in determining accessibility.

There are difficulties in the selection of indicators for measuring transport accessibility. Traditionally, for the determine of transportation development used area density coefficients and Engel's, Goltz's, Uspensky's coefficients, later - the index of the graph theory.

We can identify three steps in the complexification of the concept (of accessibility) (*Table 1*). Accessibility as a topological concept: physical measurement of the properties of space or the transport system. Accessibility as a relationship between opportunities of interaction and cost, based on the gravity model of spatial interaction. Accessibility as the net utility of the transport system, based on the neo-classical theory of consumer behaviour. The topological indicators of accessibility measure the differentiation of (physical) space created by the transport system. The gravity type indicators introduce weighting of accessibility by interest attached to a specific location. The utility type indicators further develop this model of spatial interaction by integrating the friction of space into the optimisation calculation of economic agents, not as distance in itself (or connectivity), but as the (negative) utility of distance [6; 7].

Table 1. The conceptual development of accessibility

Type	Measurement	Theoretical background
Topological indicators:	- Distance - Time - Transport cost - Connectivity	Topology of the transport network: Euclidean space Graph Theory
Economic indicators:	Spatial interaction (attraction function / impedance function) utility function (net utility: gross utility of nodes – transport cost)	Gravity model Neo–classical theory of consumer

Source: Bruinsma, 1998 [1].

In the EU as part of the project TRACC «Transport accessibility at regional/local scale and patterns in Europe " studies of the spatial distribution of indicators of transport accessibility at different territorial levels in order to improve the effectiveness of regional planning [8]. The main blocks of indicators studied and their characteristics are shown in Table 2.

Table 2. Dimensions of accessibility

Origins	Accessibility indicators may be calculated from the point of view of different population groups such as social or age groups, different occupations such as business travellers or tourists or different economic actors such as indus-tries or firms.
Destinations	Accessibility indicators may measure the location of an area with respect to opportunities, activities and assets such as population, economic activities, universities or tourist attractions. The activity function may be rectangular (all activities beyond a certain size), linear (of size) or non-linear (to express ag-glomeration effects).
Impedance	The spatial impedance term may be a function of one or more attributes of the links between areas such as distance (Euclidean or network distance), travel time, travel cost, convenience, reliability or safety. The impedance function applied may be linear (mean impedance), rectangular (all destina-tions within a given impedance) or non-linear (e.g. negative exponential).
Constraints	The use of the links between areas may be constrained by regulations (speed limits, access restrictions for certain vehicle types of maximum driving hours) or by capacity constraints (road gradients or congestion).
Barriers	In addition to spatial impedance also non-spatial, e.g. political, economic, le-gal, cultural or linguistic barriers between areas may be considered. In addi-tion, non-spatial linkages between areas such as complementary industrial composition may be considered.
Types of transport	Only travel or only freight transport, or both, may be considered in the analy-sis.
Modes	Accessibility indicators may be calculated for road, rail, inland waterways or air. Multimodal accessibility indicators combine several modal accessibility indicators. Intermodal accessibility indicators include trips by more than one mode.
Spatial scale	Accessibility indicators at the continental, transnational or regional scale may require data of different spatial resolution both with respect to area size and network representation, intra-area access and intra-node terminal and trans-fer time.
Equity	Accessibility indicators may be calculated for specific groups of areas in or-der to identify inequalities in accessibility between rich and poor, central and peripheral, urban and rural, nodal and interstitial areas.
Dynamics	Accessibility indicators may be calculated for different points in time in order to show changes in accessibility induced by TEN projects or other transport policies, including their impacts on convergence or divergence in accessibil-ity between areas.

Relationships among transport systems, accessibility, land use, and mobility

Accessibility is closely related to other geographic concepts. It can be modified by changes in transport infrastructure (e.g., the building of a new motorway) or in land use (e.g., the building of a new hospital or shopping center). Yet on the other hand, an improvement in accessibility favors changes in land uses,

and these in turn influence mobility. There are complex relationships between transport infrastructure, land use, accessibility, and mobility. In Figure 1, these relationships may be followed beginning with the transport infrastructure. The improvement of transport infrastructure brings about an increase in accessibility.

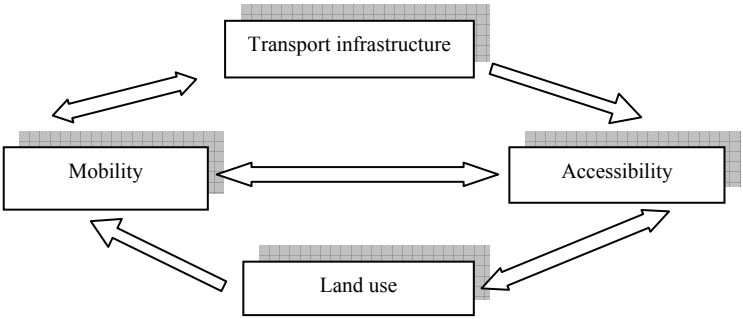

Figure 1. Relationships between transport infrastructure, land use, accessibility, and mobility.

Within the more accessible areas there may appear changes in land use (e.g., new residential areas or new facilities). As a result, the number of trips increases because there are now new areas of generation and attraction of trips. But accessibility not only acts indirectly through land uses, it also does so directly: the better accessibility conditions created by the improvement in infrastructures may modify the modal split (more trips in private transport, as a result of the building of a motorway), alter the routes of car users, or it may even generate induced demand (trips that would not be made if the new infrastructure did not exist). Finally, the existence of greater mobility in the area may, in mid or long term, produce congestion problems, which logically entail a loss in accessibility and worse conditions in the area for attracting more activities (land uses changes). Congestion problems can be solved by enlarging the capacity of the transport system, so that there would be an improvement in accessibility in the area bringing about new changes in land use and mobility.

Conclusions

Thus, accessibility is now not only one of the major research topics of transport geography, and spatial development since occurred the shift from planning of the quantitative amounts to improve of high-quality performance of the transport infrastructure. It defines the geographic advantages of the territory (region, city) with respect to all other areas because of the presence and use of transport infrastructure in the area. Research in this direction is necessary for the development of regional development programs and schemes of spatial planning.

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V.V. Putrenko,
National Aviation University,
WDC-Ukraine NTUU "KPI", Kyiv, Ukraine

USING THE OPENSTREETMAP IN THE CADASTRAL AND PLANNING WORKS

The paper studies the possibility of using OpenStreetMap data that are collected by volunteers in Ukraine for issues of the cadastral works and spatial planning. It was established that the main factor of using these data is the quality of cartographic information. The quality of the geospatial data was studied in comparison with the official cartographic materials for the territory of Ukraine.

OpenStreetMap (OSM) project development led to the creation of public user data in most part of countries in the world. The fundamental importance of the development of this project was described in the works [5], who considers the volunteers and map users as sensors that transmit geospatial information. In this regard, direct communications can be considered between users and mapping products and feedbacks when the mapping data is considered as indicator of human activity. Data are important significance in the performance of cadastral works and planning, because they have a free license and are often more relevant.

A lot of papers are dedicated the problems of relations between users OSM, volunteered geographic information (VGI) and territory, which identified certain trends in the process.

One of the trends of research related to the analysis of data quality OSM. A large number of tools and methodological approaches were developed to assess the quality of volunteer data. Most of them are based on a comparison of the OSM data with the official mapping data of state services or commercial sources [6, 7]. The methods and software were also developed for data evaluation on the basis cartometric methods independently of other sources of data [4]. Besides the quality and completeness of data researchers also are concerned the problem of the dynamics of formation of VGI [2]. The most part of studies indicate that OSM data is heterogeneous and weakly susceptible to such common mapping processes as scaling and generalization [1]. Such conclusions raise the question about the credibility of these data and their possible everyday use, as well as in scientific research. [3].

In order to study level of development OSM coverage on the territory of Ukraine, we compared these data with official geospatial data mapping agency of Ukraine. The polygon layer of settlements and a layer of points of interest in OSM were selected for a comparative analysis. Also, a comparative analysis of the number of buildings for the largest cities in Ukraine between OSM and official data was conducted.

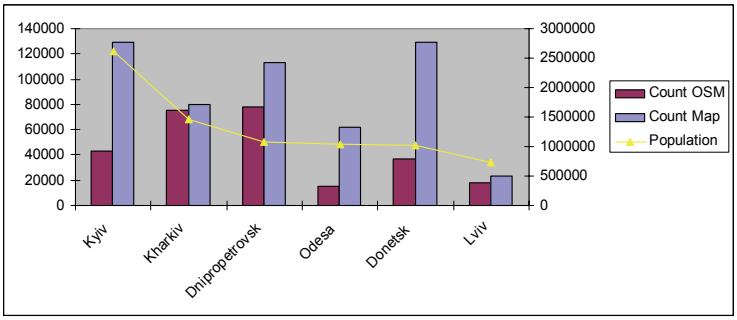

Fig. 1. Comparing the number of buildings on the OSM and the official maps for the biggest cities in Ukraine

Figure 1 shows a comparison of the number of buildings on the OSM and Ukrainian official maps for the six largest cities in Ukraine, which are presented in order of the number of inhabitants. In all cases, the number of buildings on the official maps exceeds the number of buildings on the OSM. Thus for Kharkiv, Dnipropetrovsk and Lviv difference between VGI and official data is minimum and it is maximum for Odessa and Donetsk. The capital of Ukraine - Kiev occupies an intermediate position. Many factors influence at this distribution: urban social community of volunteers, the percentage of young people and students in the city, update frequency official cartographic materials.

For the purpose of analysis, it was decided to use a raster model of representation of the density distribution of the geospatial data. This analysis allows us to select those areas that are not provided the OSM data and identify the main factors that influence on the content of crowd sourcing databases. As a result three raster coverage were obtained, which are calculated by method a dot density of objects with identical conditions. The first raster was constructed for the reference geospatial data by the settlements in Ukraine. The second raster was obtained for OSM data. Subtraction of two surfaces using the Raster Calculator gave residual surface, which evaluates the distribution of the completeness and accuracy of the OSM on the territory of Ukraine, taking into account the natural changes in the density of settlements related to relief, location of water bodies and woodland. The resulting map shows areas with insufficient coverage OSM data. Green colors indicates good coverage of VGI. Warmer colors indicate shortcomings OSM data [Fig. 2]. These areas include places with weak economic development, low population density, prevalence of rural inhabitants in the structure and distant from the main centers of the country. This includes a large part of the north of Ukraine with low population density, which refers to a natural mixed forest zone. Also large areas of Podolia and Pridneprovia regions with advance agricultural specialization relate to areas with low coverage by polygonal OSM data.

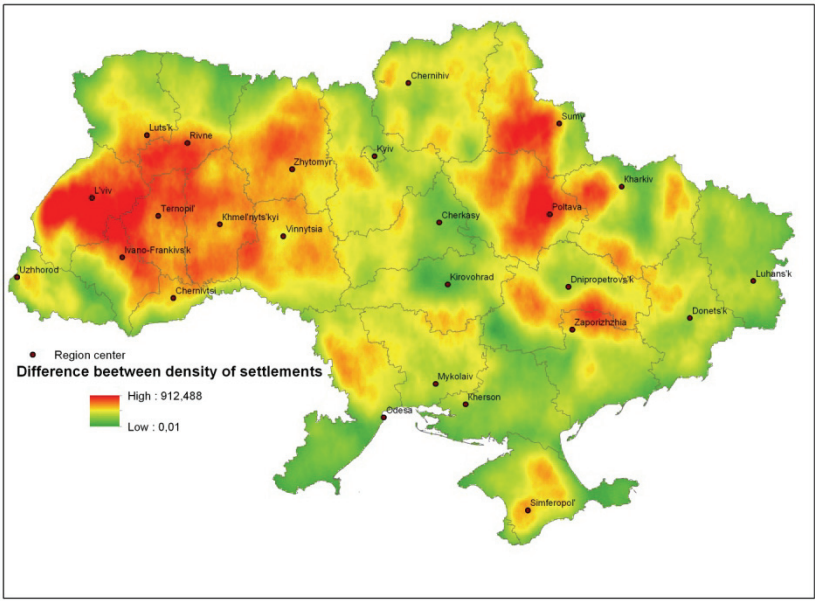

Fig. 2. The difference between the density of settlements in the OSM database and national data

Conclusions

Development of the OSM project as part of Web 2.0, building of social networks and Wikinomics led to new areas of research related to the study of the cadastres and territorial planning. Main directions of research include tassociated data quality analysis for possibilities the use of data in the cadastral works. The analysis of results show the possibility of effective use of OpenStreetmap data in large cities for the purpose of spatial planning. Using these data in the cadastral works limited indicators of the scale and precision.

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S.O. Yasenev (National Aviation University, Kyiv)

SATELLITES OF PLANETS – SELF-GRAVITATING FORMATION IN THE SOLAR SYSTEM

Theoretical background and preparation of space missions to explore the giant planets or planetary satellites, causing the need to study the past as self-gravitating entities. The purpose of this paper is to consider the satellites of the planets in the solar system and the definition of their self-gravitating entities.

Introduction

In the solar system today opened more than 180 satellites of the planets and the number of outdoor satellites continues to grow with the development of technology, but most of these satellites have insufficient mass and keep their shape only through the strength of the electromagnetic interaction. We are also interested in the satellites of the planets, which we may call self-gravitating entities, ie those due to its own weight and the resulting gravitational forces hold their shape and strive to bring them closer to equilibrium, these satellites of the planets we call the planetoid.

What are the criteria to the more than 180 satellites of the planets identify those belonging to them? The first of them - a mass, so as to ensure that the body has sought to acquire the equilibrium shape of its weight must be no less than 10^{19} kg. The second - a form understandable to the satellite was planetoid he should have a form that is close to spherical, and the third - the size as the minimum radius shall not be less than 190 km. Satellites of the planets as planetoid - a space spherical body with a mass of 10^{19} kg and a minimum radius of 190 km. Body weight less remain firm and retain their shape indefinitely.

Formulation of the problem

During the development of new forms of description potential attraction, it is advisable to consider at least two obvious factors "best definition" and "optimum utilization" models of the gravitational field of the planet or satellite. Depending on which model parameters determine the potential attraction, or another model has advantages when it is used to study the structure of the gravitational field of the satellite, its internal structure and in predicting the orbits of spacecraft.

With respect to weight and size, the satellites of the planets, we can be attributed to self-gravitating structures are divided into three groups: one with a mass of $\mathbf{1481.90 \cdot 10^{20}}$ (Ganymede) to $\mathbf{214.00 \cdot 10^{20}}$ kg (Triton) and the corresponding average radii 2 634.10 i 1 354.00 km; second with a mass of $\mathbf{35.27 \cdot 10^{20}}$ (Titania) to $\mathbf{6.18 \cdot 10^{20}}$ kg (Tethys) and the corresponding average radii 788.50 and 531.20 km; third of the weight of $\mathbf{1.10 \cdot 10^{20}}$ (Enceladus) to $\mathbf{0.38 \cdot 10^{20}}$ kg (Mimas) and accordance medium-range 252.20 i 198.60 km.

Analysis of research and publications

Analysis of the literature showed that the optimal model representation companion planet formation is a self-gravitating triaxial ellipsoid, and such models

[1-4] are widespread.

But is the work of scholars such as K. Holshevnikov, A. Orlov, V. Panteleev, L. Lukyanov, G. Shyrmin, A. Philip, N. Pytyev, V. Titov, I. Nikiforov, A. Martynov, A. Rubinov, L. Sokolov, V. Antonov, V. Malinikov, J. Oberst, V. Orlov, D. Uchayev, I. Prutov and others. In Ukraine study gravity field shapes and internal structure of celestial bodies engaged J. Dejneka, P. Dvulit, P. Zazulyak, A. Zajac, V. Kyslyuk, V. Kozlenko, O. Marchenko, G. Mescheryakov, V. Starostenko, M. Fis, J. Jackiw, E. Shen, A. Zheleznyak, A. Zavizion, A. Tereshchenko, V. Zahozhaj, S. Andrievskiy, N. Yarema, K. Churyumov, L. Chubko, M. Kiselev, A. Vidmachenko, A. Morozhenko and others.

Introduction of the main material

In the formation and evolution of planetary satellites play significant role gravitational fields. Due to gravity appear self-gravitating entities. Gravity has a direct impact on the shape and size of satellites, physical properties, their dynamics and the dynamics of spacecraft [5].

When we consider the shape of a celestial body, its free surface in general is not the only object of study. In the study of planetary satellites figures as self-gravitating entities, usually assumed that the density is a growing function of the distance to the surface of the body.

An individual planetary satellites is studied as spatial, self-gravitating object that performs motion in the gravitational field of the planet. Modern scientific theories have a physical orientation [1-2].

It is evident that theoretically possible shapes are determined by a set of conditions that may apply or physical condition of the mass of a celestial body or its kinematic state, or form a group associated with the dynamic state of the gravitational field and dynamic figures in general. There may be other important conditions relating to some regular type strain. This group of conditions include pulsations, vibrations, etc.. In the third group of conditions should mention especially the law of attraction and influence of other bodies [4].

Under the form usually means one of the layered surfaces due to gravity, and the body, this limited level surface gravity, called planetoid.

Level surface planetoid is very difficult to imagine any regular geometric figure, and make them a precise mathematical description.

Currently, the complete data of the shape and size planetoid there. For practical purposes, as a first approximation can be taken as a sphere as the second approach - an ellipsoid of revolution (spheroid). The third approach is considered to be a triaxial ellipsoid.

Satellites of the planets deviate from hydrostatic equilibrium condition and have shapes that differ from spheroids and asymmetry with respect to the axis of rotation and with respect to the equatorial plane.

In solving problems of celestial mechanics and the gravitational field is considered as a source of strength, causing accelerated motion of bodies, both surface positions to determine the distance of the object from the surface.

Satellite can be formed if the planet is a lot of gas from the protoplanetary disk. Then as leading the process of further increase in mass accretion begins to speak. A

complete system of equations describing the process:

$$\frac{dr}{dm} = \frac{1}{4\pi\rho r^2} \quad (1)$$

$$\frac{dP}{dm} = \frac{G(m+M_{core})}{4\pi r^4} \quad (2)$$

$$\frac{dL}{dm} = \epsilon - T\frac{\partial S}{\partial t} \quad (3)$$

$$\frac{dP}{dT} = P(T) \quad (4)$$

Meaning issued the following equations (1) - assumed spherical symmetry and homogeneity, (2) provides that there is a hydrostatic equilibrium (3) heating is the interaction with other objects, and cooling is only due to radiation (4) - gas equation of state [6-7]. Satellites, unlike asteroids are objects developing, they are: the inner core, the magnetic field, the correct form, spiraling away from his planet, orbiting around the planet in the same direct appeal as the planet around the Sun.

Satellites of the planets are bodies that revolve around its axis, so the point of the surface has two forces: gravity and centrifugal force, so the potential is defined in terms of these two forces.

Resultant of the force called gravity, and the potential is called potential gravity. The gravitational field is a potential field for the description of which is convenient to use the concept of gravitational potential U, differential which dU in its physical content is the work it takes to move a point with unit mass at a distance dr considered in the gravitational field. Vector of gravitational field g is associated with the potential expression:

$$g = grad\ U \quad (5)$$

or in a rectangular coordinate system $Oxyz$:

$$g = \frac{dU}{dx}i + \frac{dU}{dy}j + \frac{dU}{dz}k \quad (6)$$

For a spherical body with evenly distributed weight capacity of the gravitational field is defined as follows:

$$U = \frac{GM}{r} \quad (7)$$

where M – mass of the body drawing, G – universal gravitational constant; r – distance from the center of the body to a given point.

Vector gravitational force is in this case through a given point and the center of the drawing of the body, and this area is called the geocentric vertical.

In fact, satellites of the planets and most of the planet is not a sphere, and in terms of their weight is distributed evenly. Therefore, an accurate analytical description of the gravitational field is difficult to implement. Just as the description form here using different models. For example, assuming the distribution of mass within the body symmetrical about the axis of rotation, then we can write the expression for the potential of a celestial body through the spherical functions:

$$P_{no}(x) = \frac{1}{2^n n!} \cdot \frac{d^n}{dx^n}(x^2-1)^n, n = 1,2, \dots . \quad (8)$$

in the form:

$$U = \frac{GM}{r} \cdot \left[1 + C_{20}\left(\frac{R}{r}\right)^2 \cdot P_{20}(\sin\varphi + C_{30}\left(\frac{R}{r}\right)^3 \cdot P_{30}(\sin\varphi) + \cdots\right]. \quad (9)$$

Coefficients C_{no} determined by weight, level surface and the angular velocity of

the Earth.

The expression for the potential of the first term is the potential scope of evenly distributed weight M. The following members of equation (9) take into account the effect of the pole, lateral compression of the heavenly bodies, dissymmetry northern and southern parts of its gravitational field. Direction of the gravitational force in this case determines the gravitational vertical, which does not pass through the center of mass of a celestial body, strength of the gravitational field is numerically (and in dimension) is the acceleration due to gravity in this field.

Conclusions

Based on the analysis, the following conclusions:

1. In the solar system with the whole set of planetary satellites is 20 planetary satellites that are self-gravitating entities. Such satellites of Saturn - 7, Uranus – 5, Jupiter - 4, Neptune – 2, in the Earth - 1 and Pluto - 1.
2. These satellites have a radius approximately equal to 0.04476 radii of the planet (from 0.002 to 0.270). Exception satellite of Pluto - Charon. For most of the planets (except Earth and Pluto), this limit is rather small, ranging from 0.002 to 0.04 radius of the planet.
3. Satellites of the planets can be divided into 3 groups. The first group includes: Ganymede, Titan, Calisto, Io, moon, Europa, Triton. To the second include: Titania, Oberon, Rhea, Iapetus, Charon, Ariel, Umbriel, Dione, and Tethys. The third consists of: Eytselad, Miranda, however, and Mimas.
4. Analysis of the known methods of creating models of dynamic shape and gravity field of celestial bodies can provide some features to consider: size planetoid; multi-layered nature of the gravitational field; influence of other celestial bodies.

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V.I. Karpenko, candidate of biological science, V.G. Lazariev, A.V. Drazhnikova
(National Aviation University, Ukraine, Kyiv)

BIOLOGICAL TECHNOLOGIES FOR SPACE: RANGE OF PROBLEMS AND NEW PROSPECTS

Historical background of the development, achievements and current research directions in space biology and the possibility of using biological technology to improve the safety of space flight and exploration of outer space are considered. Also presents an analysis of the experience in the field of biological experiments using extraterrestrial material as the substrate.

Increasing interest in the 21st century to the study of the Solar System planets and their satellites is stimulating the development of techniques and technologies. Manned and unmanned spacecrafts explore the growing number of objects of Solar System, including direct contact with their surface.

Of the various issues of space exploration today we can distinguish two main areas: the continuation of space exploration and improvement of safety in near and far space.

In the study of space, increasing attention is paid to the existence of living organisms in space.

New cosmobiological directions arise in the scientific community.

Thus the need to develop methods for detect signs of life on other planets has given impetus to the development of science of such a as Astrobiology. The term “exobiology” was suggested by Nobel laureate geneticist Joshua Lederberg in 1960 [1].

Today this area is called “Astrobiology” and exploring a wide range of issues, including:

- The evolution of the planet Earth during the first billion years of its existence;
- Origin of prebiotyc molecules;
- Remains current and past forms of life inside of the Solar System and outside of it;
- Search for microorganisms-extremophiles that are able to survive in the conditions of other planets;
- Search for exo-solar planets [1].

Also, results of research in astrobiology can be used for solving problems in evolutionary biology [2]. All these questions are now being studied in the NASA Astrobiology Institute [1].

Scientists from different countries studied and other biological questions of the cosmos. For example, questions about the possibility of settlement of terrestrial life forms space near space. The object of study is the probability of mutation and appearance of dangerous forms of terrestrial organisms and ecosystems. Great work on such studies done by scientists from different countries, including scientific teams from Ukrainian research centers.

Issues of environmental safety during the development of new space objects of Solar System will continue to be relevant. Today, the question of the likelihood of entry of microorganisms with terrestrial spacecraft and astronauts to other planets. If there are available sources of carbon and energy for reproduction possible will flash the number of microorganisms and, consequently, the complete destruction of residual prebiotic synthesis on other planets. To prevent removal of microorganisms on Earth has developed and implemented standards for sterilizing spacecraft.

One of the actual problems of biological research is the detection of existence of living organisms outside the Earth. However, to date, none of the numerous studies failed to conclusively prove this possibility, although established that many microorganisms can survive in the hostile space environment. This is the most extreme environment for microorganisms. Experiments to study the response of microorganisms to the space environment after exposure in Earth orbit have constantly been reported. Spores of *Bacillus subtilis* were exposed to selected factors of space (vacuum, solar UV radiation, heavy ions of cosmic radiation), and their response was studied after recovery. There are other bacteria that thrive under near-vacuum pressure on the Earth today [1, 3, 4].

Certain successes achieved EU, U.S., Russia, Japan, China in the launch of spacecraft and use on them the closed loop systems of life support for astronauts. However, these systems provide safety in space exclusively on the use of physical and chemical approaches and technologies [5].

The further flight safety scientists attributed to broad involvement and the use of biological systems, especially in deep space missions. In such circumstances, any pressing issues of astronauts all necessary for the existence of natural resources in space and waste disposal issues in closed life support systems. In connection with this intensively conducted research on modeling the use of a variety of biological systems to ensure the safety of prolonged operation of closed systems of life in terms of aircraft and space centers. Simulation is carried out under conditions the closed water and rocks. In the scientific laboratory of the Department of Biotechnology of NAU conducted a study on the possibility of using microorganisms to enhance safety and clean-of the gas mixture from harmful components. Scientific results indicate the possibility of using biological objects for this purpose.

Spacecraft of recent years are made sterile, but it was not always so. The problem of contamination by people of new territories was occurred in the early stages of their exploration. Whenever during a new settlement, settlers brought with them crops, domestic animals and parasites. Such actions sometimes lead to serious consequences. Therefore, issues of environmental safety during the land development will remain open during the exploration of the Solar System objects.

However, strict prohibition does not mean the total absence of microorganisms – potential contaminants of space objects.

Therefore from the point of view of the idea about artificial settlement of planets by terrestrial organisms, their associations and ecological communities – establishment of artificial ecosystems outside the Earth today looks more realistic.

We consider conception in which the study and further colonization of Solar System objects should be accompanied and even be preceded by biotechnological component.

The authors believe it expedient to hold a series of biological experiments on modeling the conditions of the planets and satellites to study the activity of organisms in such conditions.

Modeling substrates using natural materials from other planets of the Solar System and their satellites is not yet possible, however, relying on the spectral data, such substrates can be simulated artificially [6]. Some areas of the earth's surface with extreme conditions may be accepted as analogue of extraterrestrial environment [7-10].

Particularly noteworthy experience of work with meteorite substrates. While many researchers focus their work on finding evidence of traces of the activities of living beings in meteorites [11], even Louis Pasteur for the first time undertaking such attempts, initiated experiments on the cultivation of microorganisms on the meteorite matter. In our time, similar experiments have positive results [12-14]. However, the most interesting we find no work associated with finding traces of extraterrestrial life, but the study of various aspects of the interaction of terrestrial organisms with extraterrestrial matter. In this sense, interesting and classical approaches of biotechnology, such as bioleaching or biosorption and study of extraterrestrial influence of the substrate as a source of carbon and other elements on the genome and biochemical activity of terrestrial organisms.

Conclutions

Summarizing all above mentioned, we can conclude about the growing scientific interest in space biology in general and in studying the potential of using terrestrial organisms for assimilation of extraterrestrial substance with formation of oxygen, water and other molecules.

Due to the increasing commercial interest in space exploration authors propose to extend the scientific and technical work at the Department of Biotechnology NAU that considered the usage of biological objects for increasing safety of space flights and bringing economic benefits in space projects. Authors will develop training course "Ecobiotechnology for aviation and cosmonautics" for the first time for universities of Ukraine.

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O. M. Kovalev, candidate of biological science,
N.V. Nikolaieva, PhD-student,
(National Aviation University, Ukraine, Kyiv)
O.O. Linnik,
(Institute of Physiology named after A.A. Bohomoltsia NAS Ukraine, Kyiv)

STRESS ACTIVATION OF FREE RADICAL OXIDATION

Article deals to data on stress, homeostasis, physiological rest. The characteristic of free radicals summarized the characteristics and mechanisms of action of reactive oxygen species in important physiological and metabolic processes in normal conditions and under stress. Attention is paid to pathogenic role of excessive amounts of reactive oxygen species. Recommendations are resulted for overcoming stress.

In English the stress is the voltage, reaction is a response to a variety of unusual influences, external and internal, to some new situations, both positive and negative. Stress is an attempt to restore the body's balance changes under the influence of unusual events to keep the constancy of the internal environment parameters against agents infringing act [1]. Outstanding French physiologist Claude Bernar gave the name of this constant internal environment is homeostasis.

Physiological rest very often and easily, almost constantly violated under both external and internal factors, agents, desires and needs. Hunger and thirst, cold and heat, fires, earthquakes, floods and hail, large predators or hostile tribes violated the peace of our forefathers, they have caused periodic or constant voltage. With the development and progress of humanity, most of these problems were somehow solved (though hunger, fires, wars, natural disasters, disease and epidemics did not disappear). But with the development of civilization appeared a lot of new challenges, obstacles, conflicts – at work, in the home, on the streets, transport and so on. So difficulties enough and to overcome them need good health, endurance, patience, will, self-control, robust immune system and more. All these qualities are not required under conditions of physiological rest, but in real life they desperately need [2].

Effects of each factor are a specific response physically hard work causes fatigue. But trains and strengthens muscles. Attack of the pathogens leads to fever, headache, runny nose, nausea. The cold causes tremors and muscle tension, increased of heat production. Heat is accompanied by facial flushing, sweating. At first glance it is a completely different reaction. But in reality this is outside manifold replies significant single mechanism, reaction pressure of life processes is stress.

The biological nature of these reaction-responses is extremely important: the mobilization of reserve forces and the restoration of the body to homeostasis, to repel harmful effects. The stress-reaction provides increase stability of living systems (cells, organism) in the adverse conditions survive in a hostile environment. The transition from rest to stress requires some adjustment of the body, sometimes

even some victims of him – in the name of adaptation, adaptation to changing living conditions. From here another name for stress is general adaptation syndrome [3]. Stress is not only a necessary response to the living system on the difficulties that have arisen. Periodic stress (of course, mild, no traumatic) required every living being, because they will support in an active state, train and improve the functioning of all organs and systems – cardiovascular, nervous, endocrine, immune, respiratory, increase their resistance, endurance and performance.

Tranquility is a pleasant condition, but dangerous. Bodies that do not work or are minimal (heart, muscles, lungs, glands, organs of immunity), decrease, diminish their performance declines. This condition is called "atrophy from inactivity." At rest it invisible. But the meeting with difficulties, threats immediately reveals weakness, helplessness body. So frequent periodic stresses – mild and medium strength, not too long – support the organs and systems of the body in a state of vibrant life, train and retain them in a constant state of readiness, gradually increase their power. These stresses are not only harmless; they are useful and even necessary. For such stress, Hans Selye, a prominent Canadian pathologist, founder of theory of stress, suggested the name evstres (good stress), and for heavy, exhausting stress was given the title of distress (bad stress) [1].

Free radicals O_2 (superoxide) and OH (hydroxyl), NO (nitric oxide) and linked them hydrogen peroxide and other reactive oxygen species – a constant companions normal living tissue of humans, animals and plants, essential mediators of many physiological and metabolic processes [4]. In particular, they always occur in the mitochondria, and their respiratory chain in the process of oxidative phosphorylation as intermediates of oxygen reduction. This respiratory chain implements transport of four electrons on every molecule of oxygen from the conversion of a molecule of water. Moving first electron intermediate is formed first – peroxide, the second – hydrogen peroxide, third – hydroxyl radical, fourth – water. Portions energy being released at this transfer, go on synthesis macroergs – the three molecules of ATP that carry energy in their makroergs connections to places where they are needed [5].

In a normally formed moderation active intermediate products perform other important functions: signal transduction molecules in the command of hormones, cytokinins, neurotransmitters; second messengers. NO is involved in the regulation of vascular tone and other physiological processes. Excessive potential undesirable amounts of reactive oxygen species formed under stress: hard work the electron transport chain of mitochondria during inflammatory reactions – in the process of phagocytosis and others. Excess reactive oxygen species play a pathogenic role in all cases of severe stress in his stage attrition in the occurrence and development of atherosclerosis, neurodegenerative and neuropsychiatric diseases, coronary heart disease, cancer, rheumatoid arthritis, diabetes, etc., in the processes of physiological and pathological aging [6]. This is a peculiar Pandora's box from which the numerous damage biological membranes, mitochondria, DNA, lipids, proteins, and as a consequence – cardiovascular disease, cancer and the aging process. Free radical theory of aging (O. Harman, 1952-1956) comes from the fact that radical damage caused by the structure of DNA and proteins can’t be fully repared, they eventually accumulate and provoke the aging and death.

In summary, we emphasize again that reactive oxygen species that occur in normal physiological and metabolic processes essential for cell and organism as a whole, but at the same time act (usually in increased quantities) as factors of degradation of biological structures, and moreover – as the main endogenous factors breach of cellular homeostasis (Fig. 1, 2). Answer living system is always the effect of stressors combined with increased and accelerated metabolism, increasing production and consumption of energy. This inevitably means increasing the number of reactive oxygen species – in the mitochondria (where they may come into the cytosol, membrane attack) in phagocytes, activated macrophages and lymphocytes in cell signaling cascades – so determines an increased risk of negative effects of stress [7].

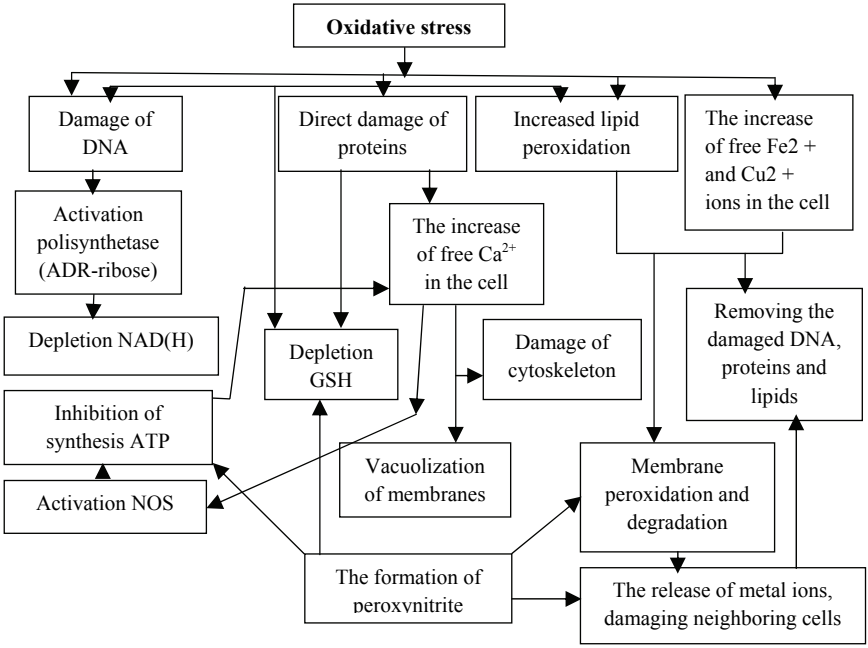

Fig. 1. Multiple metabolism of cells in oxidative stress.

Direct damage to DNA, proteins and lipids. Secondary injuries develop when oxidative stress causes an increase in free metal ions (Ca^{2+}, Fe^{2+}, Cu^{2+}). Ca^{2+} stimulates the activity of nucleases and protyaz, damaging DNA and cytoskeleton, enhances the synthesis of macro No inhybuye synthesis in mitochondria and promotes the formation of peroxide, nitrite. Conversion of xanthine oxidase ksantyndehidrohenazy increased production of reactive oxygen species [7].

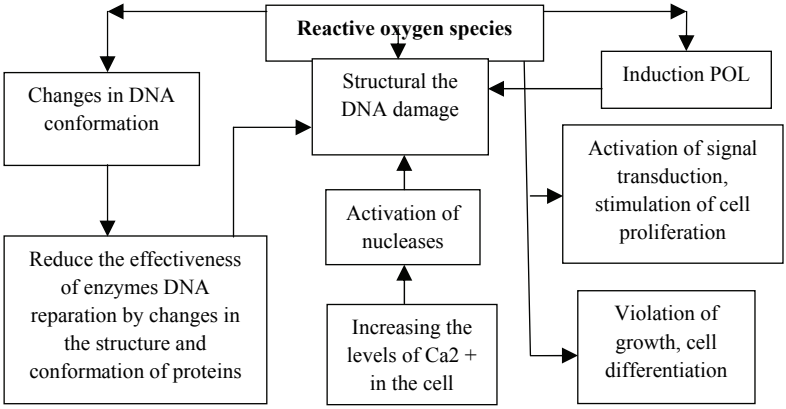

Fig. 2. Mechanisms of action of oxidative stress on DNA

Another source of intracellular superoxide radicals and is rough endoplasmic reticulum – microsomes containing as electron-transport chain, where the neutralization and disposal of various xenobiotics and toxins by the specialized groups of enzymes – cytochrome, P450, cytochrome oxidase, and hlutationtransferazy. The catalytic activity of these enzymes is realized with radicals as intermediates [8]. All living systems from cells to humans, have a number, a hierarchy of systems and mechanisms to protect from excessive stress mechanisms to overcome it. These mechanisms and systems in detail illuminated a variety of special papers, textbooks, monographs and books; therefore confine ourselves to their list [9, 10].

A. Peripheral mechanisms.

1. Antioxidant Protection: antioxidant enzymes; proteins interceptors heavy metals; fat-soluble and water-soluble antioxidants; hormones; steroids bioflavonoids.

2. Protection from toxins and xenobiotics: cytochrome P450; membrane proteins of multiple himiorezystentnosti; hutation - S-transferase.

3. Stressful proteins: ubiquitin, heat shock proteins BTSH8-10-20; HSP 40, 50, 60, 70, 90, 100 (110).

B. The central mechanisms.

1. Central brake gamma-aminobutyric acid (GABA - system).

2. Opioid peptide system.

3. Hormones, neuropeptides, neyrosteroyidy.

All these anti-stress protection mechanisms are very effective especially in terms of short-term and not too severe stress. They actually keep this physiological stress in the normal range, as they operate oxidative processes. They provide a successful adaptation to the most common types of stress.

Conclusions

Oxidative stress with the formation of radicals and peroxides are a major cause of the emergence and accumulation of point mutations and chromosomal aberrations, which are factors in germ cells of fetal death, spontaneous abortion and genetic diseases, and somatic cells – the source of information of malignant cancer and apoptosis.

Reactive oxygen species (ROS) are chemically reactive molecules containing oxygen. Examples include oxygen ions and peroxides. ROS are formed as a natural byproduct of the normal metabolism of oxygen and have important roles in cell signaling and homeostasis. However, during times of environmental stress (e.g., UV or heat exposure), ROS levels can increase dramatically. This may result in significant damage to cell structures. Cumulatively, this is known as oxidative stress. ROS are also generated by exogenous sources such as ionizing radiation.

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O. M. Kovalev, candidate of biological science,
V.V. Gorupa, senior lecturer,
(National Aviation University, Ukraine, Kyiv)
O.O. Linnik,
(Institute of Physiology named after A.A. Bohomoltsia NAS Ukraine, Kyiv)

STRESSFUL FACTORS OF SPACE FLIGHT

Article deals to modern notion of "Stress" and the adverse environmental pressures on humans during spaceflight. Generalized the certain types of stress, some results of research work on the problem of experimental hyperkinesia and recommendations for coping with stress and outputs from stress state.

The word "stress" became parts all the languages of the world and is one of the most common, not only in science but also in everyday life. The relevance of the study of mechanisms of stress and prevention of distress of searches as an important factor in disease over time even increases due to complications of the human condition. [1] Increased adverse environmental load arising natural disasters and man-made disasters, sick and dying close people not being completely as in different parts of the world, deepening social, political, financial and economic crisis rages life in cyberspace, which is a carrier not only positive, but and negative information. If classify types of stress, then first of all need distinguish two main classes of stress reactions: physiological stress (called somatic, physical) and psycho-emotional, psychosocial stress [2]. Examples are given in Table. 1.

Hide in the "shell" completely isolate themselves from the outside world to avoid undesirable effects impossible.

We consider it necessary to note that in the classical sense stereotypes stress is a complex physiological systems reaction to very strong internal and external irritants. This reaction is adaptive in nature and is implemented mainly sympathetic-adrenal and hypothalamic-pituitary- cortical adrenaline systems. However, in modern scientific literature commonly used concepts such as cellular stress, mitochondrial stress, endoplasmic reticulum stress, and endoplasmic reticulum-stress. Some formation is realizing [3]. Interim brain (diencephalon) consists of the thalamus and hypothalamus. Talmus (thalamus) pair formation, which are all (except olfactory) sensory subcortical centers. All information in the cerebral cortex must pass through the thalamus. The hypothalamus (hypothalamys) – this vegetative brain, there are subcortical autonomic centers. The pituitary gland (hypophysis) has a mass of 0.5 – 0.6 grams, is in hipofizialniy fossa of the sella turcica sphenoid bone. The function of the pituitary is hormone production, regulation of the endocrine glands and the autonomic nervous system. Adrenal gland (glandula suprarenalis) paired organ. Weight of one gland is 12 – 13 g.

The internal structure. Outside the adrenal gland is covered by a fibrous capsule. By the fibrous capsule is adjacent cortex, which consists of three zones: glomerular, beam and mesh. In the center of the adrenal gland is the brain formed by large cells of two types: epinefrotsyty (the bulk of the brain), norepinefrotsyty (scattered in small groups in the brain).

Table 1.

Types of stress (for V.A. Barabayem and O.G. Reznikov)

Physical, physical	Psycho– emotional, psychosocial
1. Mechanical: injuries trauma, surgery, fractures, shock, bleeding. 2. **Physical**: overheating, hypothermia, frostbite, burns, noise, UV, ionizing radiation, weightlessness, acceleration, muscle load, hypokinesia, immobilization, high– altitude hypoxia. **3. Chemicals:** thirst, poison, pesticide action, toxic waste, industry, radionuclides, contamination air, water, soil, and lack of excess oxygen. **4. Biological:** bacteria, viruses, pathogenic fungi, toxins, pregnancy, accouchement, bleeding, menopause.	**1. Household:** dissatisfaction with living conditions, shortage of water supply, light, broken household appliances, elevators, noise from neighbors planes, transport, television, music and more. **2. Transport:** "plugs" accident vehicles, overcrowding in public transport, conflicts between passengers late for work. 3. **Other:** being in a crowd, loneliness, isolation of people (prison, area, lack of friends, life in the polar winter, on a desert island). **4. Labor:** physical and mental overload, a great responsibility, the need for rapid decision making level, dissatisfaction with conditions, wages, monotone, treacly, uninteresting work, conflicts with colleagues, superiors, subordinates, envy **5. Family:** illness and death of parents, relatives, children, relatives, fightings, marriage, divorce, unexpected visit, pregnancy, childbirth wife, birth and child illness, betrayal of his wife or friend, jealousy, envy.

Function: production of hormones.

The bark produces hormones:
- Corticosteroids, which are divided into three groups;
- Mineralocorticoids (aldosterone) - produced by cells of the glomerular area;
- Glucocorticoids (hydrocortisone, corticosterone, 11-dehydro-and 11-desoxycorticosterone produced in the the beam zone;
- Sex hormones (androgens, estrogen, progesterone) - produced by cells of netted area.

The brain produces hormones – adrenaline and noradrenaline. Epinephrine reduces glycogen stores in the muscles, increases the amount of carbohydrates in the blood, enhances and accelerates the contraction of heart muscle constricts blood vessels, increases blood pressure.

Stress is caused not only by the action and adventure of new agents, and in the absence of the usual components of the environment: gravity, microbial environment, food, water, etc. [4]. Hnotobionty – organisms are grown in a sterile environment, devoid of natural microbial environment characterized by low capacity to adapt to new conditions, profound immunosuppression as a manifestation of immune deficiency and chronic stress. Hnotobionty killed during the transition to non-sterile environment.

Weightlessness is almost absence of gravity (microgravity) – a condition from which people met for the first time when exiting a spaceship into orbit flight around a stationary Earth. This stressor is stronger than hyperkinesia. It acts in combination with the strongest psycho-emotional arousal. And the active leg of the route – Take-off and landing – there are acceleration hiperhravitatsiyni loads that exceed the Earth's gravity 1.5-3 times or more, and in emergency situations in 4-12 times. Armchair astronauts to the ships made so that during take-off and landing force of gravity acting on the body along the short axis "chest-back"; it provides the least hemodynamic changes. Space Flight is a powerful stress. Yuri Gagarin after landing level of hydrocortisone and its metabolites in urine exceeded the norm by 10.3 times.

Man phylogenetically and ontogenetically acquainted with conditions | reduced gravity by staying in the water. During embryonic development the fetus is partially protected against gravity amniotic fluid. Under normal terrestrial conditions, gravity is always causes the pressure of the fluid column in the vessels, and the heart is constantly working against the force pushing blood through the vessels.

Gravity compresses tissue, cartilage, stretching of tendon. The muscles of the neck, trunk, which support normal posture, are in a constant state of tonic tension holding the body in the direction of the vector of gravity. Each step at the ground are the work against the forces of gravity. All gravitational deformation of the body organs, tissues are a constant source of afferent information from the Inter-, proprio- and mechanoreceptors.

In weightlessness as she disappeared force of gravity and the consequent deformation and corresponding afferentiation. Reduced muscle tone, brain centers. Falls to a minimum load on the heart, bone structure changes – decreased mineralization develops osteoporosis.

According to our data, the main reason demineralization of bone while limiting motor activity was the destruction of the organic matrix, increased breakdown of collagen and glycosaminoglycan [5]. In addition, there are deeply inhibited oxidative metabolism, tissue respiration and oxidative phosphorylation, energy production. Activation of free radical oxidation arose during takeoff, for some time stored. Reduces hydrostatic pressure in the vessels, eliminating the feeling of support, disrupts the normal operation of the machine balance (loss of orientation in space, dizziness). The heart until it reconstruct their work, pursue blood in the upper half of the body – hence the rush of blood to the head, flushing, headache in the acute phase of adaptation to weightlessness. [6] Other manifestations of "space sickness" – an illusion to "upside down" perspire, salivation, lethargy, drowsiness, loss of appetite, nausea. All these symptoms disappear after 1.5-3 nights flight and reappear when you return to Earth. Back perceived by the body as hyper gravitational stress: increasing levels of stress hormones, blood pressure, oxidative stress, reduced weight of lymphoid organs, the number of lymphocytes in the blood [7, 8, 9].

On Earth, the heart is programmed to distribute blood evenly throughout the body. The heart must do more work to supply the upper body, because blood is naturally drawn downward by the force of gravity. The lower limbs do not have this problem, as the blood coming to them is gravity-assisted.

In space, bodily fluids no longer flow back down naturally by gravity. The heart is still programmed the way it was on Earth. So, under the pressure of the heart and the veins and arteries, the blood rushes to the person's torso and head, and they then experience *"puffy face syndrome*." The veins of the neck and face stand out more than usual; the eyes become sometimes even headaches. Astronaut's legs also grow thinner, because instead of dropping effortlessly down to the lower limbs, the blood has to be pumped there by the heart.

In the long space flights is greatly increased radiation risk. In orbital flight is negligible: the road spacecraft around the earth are laid so as not to enter the Earth's radiation belts. These zones are due to the Earth's magnetic field that captures and holds the charged particles (electrons, protons, mesons) of different energy. Radiation belt situated 500-50.000 km above Earth at the poles are close to the surface. The highest concentration of energy and charged particles are at altitudes of 1500-5000 km. Therefore, the road are paving orbital flights are at altitudes of less than 400-450 km. For travel outside the Earth's magnetosphere astronauts waiting for solar cosmic rays and galactic origin. During solar flares, periods of high solar activity from the interior lights at high speed (1-4 thousand km/s) emitted streams of solar plasma (protons and electrons of high energy). If the spacecraft (center) gets into a stream, its shell will not protect people. Because spaceflight plan, anticipating the time and direction of solar explosions. Power galactic origin of cosmic rays is very small, but each piece of beams carrying a giant energy penetrates through the ship and only slightly reduces its speed. When flying people to Mars and other planets radiation dose 10-20 times can surpass the acceptable and it needs special protection.

Conclusions

Prefligh tphysical training, alpine adaptation, training, special space suits and suits, exercise aboard the ship during the flight (Creeping track, expanders, etc.), drug prophylaxis to prevent the development of unwanted changes [10, 11].

With increasing duration spaceflight become effective yield of calcium and phosphorus from the bones of astronauts, which creates additional difficulties when landing. Astronauts have to undergo post-flight rehabilitation lasting first 2 times superior to the duration of the flight (the need to re-learn to sit, stand, keep your head, spoon, walking, etc.). Improving the training and medical support flight greatly reduced and facilitates rehabilitation.

Severe and prolonged stress especially accompanied by depletion of domestic reserves and anti-stress mechanisms. In these cases the need for outside help in the form of antioxidant, sedative, membrane protectors, vitamin, metabotropic and other drugs, and dietary antioxidants.

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I.O. Kolomiets stud., I.V. Samofal stud., V.V. Gorupa senior teacher
(National Aviation University, Ukraine, Kyiv)

USE OF HIGHER AQUATIC VEGETATION IN THE SYSTEM OF «BIOPLATO» TO REDUCE CONCENTRATION OF POLLUTANTS IN SEWAGE

In this article highlights features of work existing treatment facilities to clean sewage, analyzed their functional flow block diagram. Established the basic steps to be taken to reduce the cost of maintenance of treatment facilities. Investigated the possibility of using higher aquatic plants to use them in the "Bioplato» on the last stages of purification treatment plants..

The problem of sewage treatment in Ukraine is extremely relevant. In the production process, enterprise produce large quantities of wastewater, getting them into the environment leads to negative consequences. Purification scheme, i.e. sequence of use different methods, depends on the state of pollution, on the composition and quality of pollutants.

All existing methods of wastewater treatment can be grouped into six major groups (Figure 1) [1]: mechanical, physical, physio-mechanical, chemical, physio-chemical, and biological. Purification scheme, i.e. sequence of use different methods, depends on the state of pollution, on the composition and quality of pollutants.

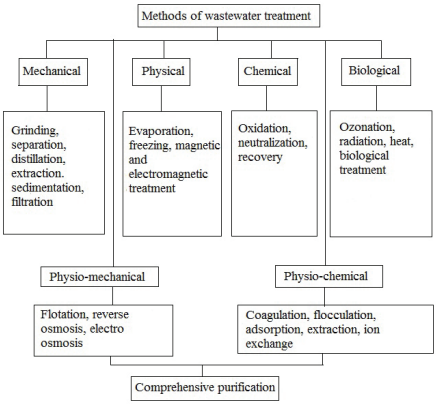

Figure 1 Classification of methods for wastewater treatment

To reduce the impact of wastewater on the environment it's necessary to make high-quality their cleaning, which is usually implemented using a variety of constructions, or used mechanical and physio-chemical methods, which is not always environmentally friendly. It is therefore necessary to create a treatment plant

that would provide a high degree of cleaning without the use of chemicals and energy.

Waste water treatment without chemicals can realizing by the "Bioplato." The uses of advanced wastewater treatment technologies using higher aquatic plants nowadays are environmentally acceptable and economically most advantageous.

Bioplato – this is artificial treatment systems that resemble lakes located and constructed cascade on the basis of optimal physical, chemical and biological factors of the cleaning process (Figure 2) [1].

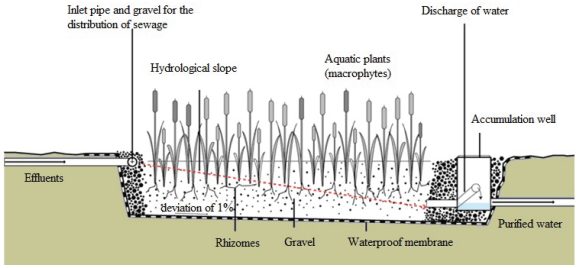

Figure 2. Scheme bioplato with horizontal filtering

There are different classifications of wastewater treatment facilities bioplato. In terms of engineering design, taking into account the distribution of the hydraulic fluid flows distinguish constructions bioplato on categories: superficial infiltration (vertical and horizontal) and mixed type. Different type's bioplato have their own characteristics, which creates the possibility of treating different categories of waste water.

In the system of bioplato is undergoing complex mechanisms, removing contaminants from wastewater. In this complex system (plants – microorganisms – download) occurs aerobic and anaerobic biological processes, involving filtration, adsorption, precipitation, absorption and transformation of nutrients by plants and others compounds [2].

To clean the polluted water from organic substances primarily use aquatic plants with relatively high purifying ability and speed growths. These include common reed, narrowleaf cattail, curly-leaf pondweed, mannagrass, cladophora ball, sagittaria sagittifolia, water lilies and others.

Common reed – its height is 5m, length of rhizomes a few meters, they penetrate to a depth of 1m in the substrate. Rhizomes live an average of 6 years and can grow up within 10m at a speed of 1meter per year. Common reed grows on different types of substrates: mineral, sand and gravel, silt. Good withstand seasonal fluctuations in water level, planted by rhizomes and stems. Common reed oxygenize

not only water but also the soil and thus contributes to the process of oxidation. Oxygen circulating in the plant by its empty stems and place the roots in air leading shoots. Thick roots of plants as a kind of mechanical filter retains particles suspended in water and clears the water them from. His deep roots absorb from water the many chemical elements and accumulate in their body mass. It is also very valuable that the reed can detoxification various harmful compounds and high concentrations of ammonia, phenol, nitric acid, lead, copper nitrate sulfuric not affect its vital functions [2].

Narrowleaf cattail - very high wetland herb with a powerful rhizome, leaves are flat, very narrow which reach a height of 2metre. The root systems of cattail have high accumulating ability relative to organic matter. The root systems of cattail, able to absorb organic matter. [3].

Aquatic plants in ponds perform the following functions (Table 1):

- Filtration (promote settling of suspended solids);
- Absorption (absorption of some nutrients and organic matter);
- Accumulated (ability to accumulate certain metals and organic matter);
- Oxidizing (in photosynthesis water is enriched with oxygen);
- Detoxification (plants can accumulate toxic substances and convert them into non-toxic) [2].

Table 1

Functions of higher aquatic plants in constructions of bioplato

Elements of higher aquatic plants	Functions of higher aquatic plants in the purification of polluted water
Surface of the plants	Eclipse of the water surface (reduced growth of phytoplankton); partially insulated surface (air-conditioning, protection from the wind); utilization and accumulation of nutrients; aesthetic function
Part the plants immersed in water	Sedimentation and filter effects; reduction and alignment of flow rates; transport of photosynthetically the received oxygen; assimilation and accumulation of nutrients and xenobiotics; surface for the attachment of aquatic organisms
The root system	Transport of oxygen in bottom sediments, waste and accumulation of nutrients and xenobiotics, separation of biologically active substances, sediment stabilization (reducing erosion), soil protection against pollution

High ability to remove from the water and accumulate in their biomass heavy metals characteristically for higher aquatic plants [4, 5]. Many plants have the

ability to absorption, transformation and accumulation of heavy metals, such as Al, Fe, Ba, Cd, Co, Cr, Cu, Mn, Pb, V, Zn, and others. The more biomass plants the better cleaning results. Best assimilate inorganic substances such as higher water plants as: water hyacinth and cattail. The concentration of metals in the root systems of cattail, reached (mg / kg): iron – 199.1; manganese – 159.5; copper – 3.4; Zinc – 16.6.Their specific absorption from an aqueous medium reaches significant values, g / g dry matter of plants: calcium – 3.95; potassium – 10.3; sodium – 6.3; silicon – 12.6; zinc – 50.0; manganese – 1200; boron – 14.6 [4,7].

An accumulation higher aquatic plant of nitrogen is 200 – 250 kg N / hectare per year and phosphorus – 30 – 350 kg P / hectare per year [5].

Much attention in many countries attracted the heat-loving plant - water hyacinth [9]. It is known as the fastest growing plant, able to remove from water kg / hectare per day: nitrogen – 22 – 24; Phosphorus – 8 – 14; Potassium – 22 – 44; Calcium – 2 – 4; Sodium – 18 – 34; Copper – 2.4 [10]. Removing from wastewater silver, phosphorus compounds and nitrogen in accordance is 100; 53.9 and 92.9%. The proposed method made it possible to abandon using sorption methods [6].

Toxic compounds such as phenols may be captured with waste water in high concentrations and in large quantities, they are a dangerous pollutant. Some aquatic plants can exist in contaminated by phenols in aqueous medium, and neutralize them [5].

Bulrush is able to grow in a solution of phenol concentration of 1000 mg \ l, absorbing it and 20 of its original environment. Concentration of Phenol 10 mg \ dm3 in volume 5 l, at temperature of 18-20C, and 900 grams of cane biomass withdrawn 2 days [7].

Wastewater treatment systems using bioplato favorably with traditional cleaning methods that do not require electricity costs, reagents, is simple to use, provide a minimum service personnel. On the process of cleaning technology bioplato not affect the sharp fluctuations in the costs of wastewater arriving at the cleaning.

Among other advantages bioplato – environmental (there is no accumulation of hazardous waste) and is habitat for many wild organisms. Another advantage is that the system bioplato are more economical compared to the traditional methods of wastewater treatment.

The main drawbacks of bioplato include: the need for large areas, in autumn and winter performance bioplato somewhat reduced, but the quality of treatment is not worse [8].

Engineering structures for additional cleaning of waste water "Bioplato" introduced engineering center "Potential-4" at many enterprises of Kiev (Factory on manufacture chips of "Kraft Foods Ukraine", "Center Volvo-Ukraine"), Donetsk

(plant for processing sunflower seeds company "Cargill ") and other regions of Ukraine [10].

Conclusions

Higher aquatic plants such as bulrush, reed, cattail, possess ability remove pollutants from water: nutrients (nitrogen, phosphorus, potassium, calcium, magnesium, manganese, sulfur), heavy metals (cadmium, copper, lead, zinc), phenols, sulfates, petrochemicals, synthetic surface-active agents (surfactants), and to improve such indicators of organic pollution of wastewater as biological oxygen demand (BOD) and chemical oxygen demand (COD).

Application of bioplato in the final stages of sewage treatment allows improving the efficiency of wastewater treatment plants, reducing the cost of their operation, and allows you to make them safe for the environment.

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V. Kudas, O. Vasylchenko, associate professor
(National Aviation University, Ukraine, Kyiv)

ANTIMICROBIAL PROPERTIES OF BIOLOGICALLY ACTIVE SUBSTANCES OF GINGER ROOT EXTRACT

This work considers the investigation of biologically active substances of ginger root extract antimicrobial properties and assessing the feasibility of ginger root extract using as antimicrobial agent. Main characteristics of ginger root biologically active substances and ginger effect on human body are explained.

Herbal medicines occupy an important place among the drugs used in various human diseases. The relevance of such drugs usage has increased significantly in recent decades, particularly due to the increase in allergic diseases associated with treatment by synthetic means. Interesting plant for the study is ginger – *Zingiber officinale*, which is known in folk medicine due to its healing properties. Biologically active substances of ginger root have antimicrobial activity. Ginger rhizomes contain a complex mixture of pharmacologically active substances, the most important of which are gingerol, shohaol and their derivatives that have antibacterial and antifungal activity.

Man's acquaintance with the medicinal properties of plants is of great antiquity. Ginger was one of the first spices that reached the Mediterranean coast, China and India in ancient times. Ginger grows in warm and humid climate. Ginger belongs to family *Zingiberaceae.* Now it is cultivated commercially in India, China, South East Asia, West Indies, Mexico and other parts of the world. It is genus of perennial herbaceous plants of the ginger family. Ginger root has the form of roundish pieces, located mainly in one plane. The ginger of commerce consists of the thick scaly rhizomes (underground stems) of the plant. They branch with thick thumb-like protrusions, thus individual divisions of the rhizome are known as «hands». Rhizomes are 7-15 cm long and 1-1, 5 cm broad and laterally compressed. The branches arise obliquely from the rhizome are about 1-3 cm long and terminate in depress scars or in undeveloped buds. The outer surface is buff-colored and longitudinally striated or fibrous. Ginger juice is the juice of the root.

Fig.1 *Zingiber officinale*

It is consumed worldwide as a spice and flavoring agent and is attributed to have many medicinal properties. Originally rhizome used only in medicine. Ginger is a powerful anti-inflammatory herb and there has been much recent interest in its use for joint problems. It has effect on cholesterol level and blood pressure and aid in preventing internal blood clots. Ginger has been well researched and many of its traditional uses confirmed. It is a warming remedy, ideal for boosting the circulation, lowering high blood pressure and keeping the blood thin in higher doses. Ginger is anti-viral and makes a warming cold and flu remedy. Ginger root is well known as a remedy for loss of appetite, chills, poor circulation, menstrual cramps, dyspepsia, and indigestion. Ginger has a pronounced antimicrobial action. Some constituents of ginger inhibit the growth of bacteria like *Escherichia coli*, *Proteus* species, *Staphylococci*, *Streptococci* and *Salmonella*. Ginger extract had the broadest range of antifungal activity measured either by the fungi inhibited or as the average diameter of inhibition zones.

Ginger root has 1-3% of essential oils, which are concentrated mainly in the rhizome. Its main components are: zingiberene, starch, gingerol, shogaol, zingeron, camphene, linalool, phellandrene, bisabolen, cineole, caffeic acid, capsaicin, β-sitosterol, β-carotene, curcumin, lecithin, limonene, selenium, vitamins A, B_1, B_2 and C, micro and macro elements (zinc, sodium, potassium, iron, magnesium, phosphorus and calcium), sugar and fats. Ginger also contains all essential amino acids.

Table 1

Characteristics of main biologically active substances of ginger root

Gingerol	It is an active constituent of fresh ginger. It is a phenolic compound. It is normally found as pungent yellow oil, but also can form a low-melting crystalline solid. Gingerol has been investigated for its effect on cancerous tumors in the bowel, breast tissue, ovaries, the pancreas, among other tissues, with positive results. It has anti-inflammatory and antimicrobial activity.
Shogaol	It is a pungent constituent of ginger similar in chemical structure to gingerol. It is a phenolic compound. Shogaol is produced when ginger is dried or cooked. Shogaols are artifacts formed during storage or through excess heat, probably created by a dehydration reaction of the gingerols. It has different clinical actions, including antimicrobial properties. Although shogaol has a number of pharmacological activities including antipyretic, analgesic, antitussive and anti-inflammatory effects.
Zingerone	It is a key component of the pungency of ginger. Zingerone is a crystalline solid that is insoluble in water, but soluble in ether. It is a phenolic compound. Zingerone is similar in chemical structure to other flavor chemicals such as vanillin and eugenol. It is used as a flavor additive in spice oils and in perfumery to introduce spicy aromas. Fresh ginger does not contain zingerone; during cooking the ginger transforms gingerol, which is present, into zingerone. Ginger compounds have been shown to be active against bacteria *Escherichia coli*. Zingerone is likely the active

	constituent responsible for the antidiarrheal efficacy of ginger
Zingiberene	It is a monocyclic sesquiterpene that is the predominant constituent of the oil of ginger, from which it gets its name. It can contribute up to 30 % of the essential oils in ginger rhizomes. This is the compound that gives ginger its distinct flavoring. According to research studies, zingiberene has the following properties and may be able to help fight infections caused by viruses, protect against stomach ulcers, ease the pain and discomfort caused by stomach gas.

100 grams of raw ginger root provides about 80 calories, a minimal amount of protein, fat and sugar, about 18 grams of carbohydrates, 2 grams of dietary fiber. It also provides a small percentage of daily requirements for vitamin C, phosphorus and potassium. Ground ginger has more significant amounts of these minerals as drying concentrates it in a smaller quantity. Due to the many health benefits of ginger, it is actually contraindicated in people with gallstone problems as it promotes the production of bile. People taking blood thinners are also advised against excessive consumption.

The medicinal preparations that are got from plants occupy a deserving place among facilities of prophylaxis and treatment of many diseases. Phytoextracts are the oldest official medicine. Antimicrobial agents are presented in plants. Essential oils of various plants do not represent individual chemicals. They include carbohydrates (aliphatic and aromatic), mono- and polycyclic terpenes and sesquiterpenes, alcohols, esters, aldehydes, phenols, phenol ethers, ketones, organic acids, and sometimes lactones which can act as antimicrobial agents. Published data indicate that almost all essential oils have a greater or lesser extent expressed bacteriostatic properties. It is possible that the use of antimicrobial substances takes place in the food industry, as many condiments contain antibacterial activity of essential oils (ginger, nutmeg, cinnamon, oregano, laurel, allspice, cloves, coriander, and anise). In many cases it will be useful to prepare phytoextract of ginger root with strong antiparasitic properties.

A number of chemical agents slows down or completely inhibits the growth of microorganisms. If a substance inhibits the growth of bacteria, and then removes it again resumed growth, it is spoken about bacteriostatic effect. Bactericides cause cell death. Most sensitive to the antibacterial substances of plant origin are Gram-positive organisms and less sensitive are Gram-negative. For many antimicrobial agents succeeded in one way or another to find out sub cellular target and mechanisms of action like damage of surface structures or layers of cells, damage of enzymes and metabolic disorders, competitive inhibition of structurally similar inhibitors in TCA cycle, disruption of cellular components synthesis, suppression of protein synthesis, inhibition of nucleic acid and inhibition of cell wall synthesis. Phenolic compounds are widely distributed in plants. They are formed in each plant in varying amounts, to a greater or lesser diversity. At the cellular level phenolic compounds are localized in a cell wall, vacuole and plastids. Plastids serve as a center for the synthesis of phenolic compounds rather than their place of storage.

The mechanism of antimicrobial activity of plant phenolic compounds is explained by their ability to denature proteins, leading to increased permeability of the microorganisms' cell membranes and leakage of the cytoplasm components. Thus, phenolic compounds belong to surfactants.

Based on the results of the experiment a moderate antimicrobial action of 40 % and 60 % extracts of ginger root (inhibition zones are up to 2 mm) and a pronounced antimicrobial effect of fresh juice of ginger root (inhibition zones are up to 7 mm) were observed. Usage of ginger root (both juice and extracts) as antimicrobial remedy is appropriate.

Conclusions

Ginger is one of the best-known medical plants, that is used and in medicine for treatment of different diseases, and in cookery for giving the dishes of the special, piquant taste. Ginger consists of a lot of essential and phenolic compounds. Characteristics of ginger as antimicrobial agent are due to presence a mixture of gingerol, shohaol and zingeron and essential oils, which are one to three percent of the weight of fresh ginger.

The mechanism of antimicrobial activity of plant phenolic compounds is explained by their ability to denature proteins, leading to increased permeability of the microorganisms' cell membranes and leakage of the cytoplasm components. Ginger rhizomes contain a complex mixture of pharmacologically active substances that have antibacterial and antifungal activity.

40 % and 60 % extracts of ginger root have a moderate bactericidal and fungicidal action; fresh ginger root juice has a pronounced antimicrobial effect. Usage of ginger root (both juice and extracts) as antimicrobial remedy is appropriate.

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N.N. Nikolaieva, PhD-student, K.G. Garkava, DSc., V.V. Khrobust, assistant,
(National Aviation University, Ukraine, Kyiv)

THE ISSUE OF AIR POLLUTION BY TOXIC SUBSTANCES AND THEIR EFFECT ON POLLEN OF WOODY PLANTS

There are described main aspects of air pollution emissions from aircraft engines, as well as their impact on pollinations of trees. Is noted the impact of pollutants on the surface of pollen grains.

Today there is a hypothesis that modification pollen under anthropogenic factors can cause unforeseeable disturbances in a specific immune response. Allergenic action of pollutants is enhanced by their adsorption on any surface. In this case, the contaminated pollen acts on the type of hapten [1, 3-7, 9-14].

Pollen of trees an important component of air spray. It can cause allergic symptoms in sensitized individuals early in the season pylkuvannya plants [6]. Therefore, knowledge of the spectrum aeroalerhennoho pollen and its terms palinatsiyi in some regions facilitates the diagnosis and prevention of seasonal allergies in the population. However, in Ukraine, where the saw aerosposterezhennya conducted sporadically in the 30s and carried on more or less permanent basis since the 90s of the last century [4], is still not clear palynological composition of air content, including all cities of regional subordination. Therefore, any data obtained in this area with the possibility of extrapolating the neighboring area is useful in the prevention of hay fever, the number of patients which in Ukraine is recognized as the largest in Europe. [3] As the tree pollen appears in the air after a period of winter dormancy, it causes the first symptoms of seasonal allergies in the population, causing both physical and psychological discomfort. [7]

The number of people allergic to plant aeroallergens has substantially increased in big cities and industrial areas [3, 7, 9]. Thus, monitoring of the pollen counts in the atmosphere of cities is of relevant medical importance. There are significant differences in the number and quality of pollen grains in the air of particular regions of Poland. Therefore, long term monitoring of the composition of aeroplankton in different sites has been undertaken in order to provide the current data to allergologists and to establish tendencies characteristic for a given region [7, 19, 21, 24].

At present, action of anthropogenic pollution on different plants are part of our lives. The priority pollutants include SO2, NO2, CO and other fluorides. These substances violate various biochemical and physiological processes, structural organization of cells. First of all damage manifested at the biochemical level, then are violated ultrastructural and cellular [2].

As a result, there is air transport of air pollution, and the impact of specificity found in significant emissions of various pollutants. The highest emissions accounted for carbon monoxide, which is more than half the total number of emission. By contrast the proportion of particulate matter of less than 1% of total emissions. Air ships pollute surface layers of the atmosphere by exhaust gases of

aircraft engines. Aircraft engine exhaust gases account for 87% of all emissions of civil aviation that include atmospheric emissions as special vehicles and stationary sources. Indicators of gross emissions of pollutants is 152 thousand tons. In general Ukraine the volume emissions of harmful substances civilian aircraft in the surface layer of the atmosphere (to a height of 900 m) were 50 thousand tons (33% of total emissions), of which 29 tons of carbon monoxide, 11 thousand. tons of hydrocarbons, unburned, 8 tons of nitrogen oxides and 2 tons of sulfur oxides. At an altitude of 900 m emission of harmful substances estimated at 103 thousand tons (67% of total emissions), including 38 tons of carbon monoxide, 7 tons of hydrocarbons not burned, 46 tons of nitrogen oxides and 12 tons of sulfur oxides. To ensure the passage of air transport processes mainly use fuel produced from oil. The composition of organic matter fuel oil includes the following chemical elements: carbon, hydrogen, oxygen, nitrogen and sulfur. Not combustible portion of fuel includes moisture and mineral impurities. The products of complete combustion are carbon dioxide, water vapor and sulfur dioxide (for cash and expert estimates, 2000.).

Toxic pollutants from movable and stationary sources are divided on the degree of danger into 4 classes:

1 – extremely dangerous (tetraethyl lead, lead, mercury, etc.),

2 – highly dangerous (manganese, copper, sulfuric acid, chlorine, etc.),

3 – moderately hazardous (xylene, methanol, etc.),

4 – low-hazard (ammonia, diesel fuel, kerosene, carbon monoxide, turpentine, acetone, etc.).

The main components which pollute the environment are: carbon monoxide, unburned hydrocarbons, nitrogen oxides and soot. At idle and when driving on rulivnyh tracks, while landing in the exhaust gases is significantly increased content of carbon monoxide and carbohydrates, but decreases the amount of nitric oxide. In standby steady flight when the engine is working without reloading 35-50% of its capacity with optimal parameters, carbon monoxide and carbohydrates decreases, but increases emissions of nitrogen oxides. The largest emissions of soot and fuming occurs during takeoff and climb when the engine is running with an overload of 1.1-1.2 times relative to its nominal power and is usually to enriched fuel mixture.

So, as pollen is surrounded by two membranes sporoderma – ekzyna (external) and intyna (internal). By chemical components are sporopolenin consisting of oxidized carotenoids that protect it from chemicals, temperature, agents that cause damage. Intyna composed of polysaccharides – cellulose. That is, pollen of genetically protected from environmental influences.

Change pollen morphology is a modification of allergenic properties [13]. Combustion products and benzo-α-pyrene are changing sculpture of pollen particles through adsorption on exyne [3, 5]. Substances of inorganic nature cause damage: changing surface pollen grain fragmentation.

The air pollutants are complex effect on pollen, increasing the synergy effect. In contaminated pollen inversion occurs ions, $Cl^- > K^+$ [3-5]

One of the properties alerhennosti – the ability of pollen to be modified in terms of increased anthropogenic pressures.

Conclusions

Environment, specially the atmosphere, is polluting carbon monoxide, various hydrocarbons and heavy metals. The components planes fuel can be adsorbed on the surface of pollen during pollinations trees. Products of combustion are modifying sculpture of pollen grains. For wood allergens such types of anthropogenic pollution exacerbate allergenic pollen.

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M. Skuratovska, student, M. Baranovsky, professor
(National Aviation University, Ukraine, Kyiv)

IMPROVING EXTRACTION OF BIOLOGICAL ACTIVE SUBSTANCES OF *SAMBUCUS* SPP.

In this work considered comparing of known methods of extraction of biologically active substances of Sambucus spp. Main characteristics of how elder substances effect on the human body. And evaluation of the opportunity to improve and enhance the extraction of biological active substances of Sambucus spp.

Extraction – one of the oldest methods for the isolation of biologically active substances (BAS) from natural plant sources and currently remains the primary method for obtaining BAS.

Many plants are real treasure of biologically active substances that have a strong physiological effect on the human body. These crops include elderberry (*Sambucus*), natural reserves which allow them to harvest not only for local needs , but also on an industrial scale .

However, existing to date technology of the extract of the fruit of elderberry have several disadvantages (energy, labor, duration of extraction process) and need of improvement based on the use of modern methods of production and strengthen the basic rules of extraction

Flowers and fruits of *Sambucus* are used in folk medicine since ancient times. This is a valuable food and medicinal raw source of vitamins, carbohydrates, proteins, organic acids, minerals and other essential substances to man. On the healing properties of elder people knew long ago. In medieval Europe, the elder tree was considered sacred and valued as a means of prolonging life.

Elder is a provider of highly deficient polyphenols have antihypertensive and capillaries firming action of pectin substances with radio protective properties and contribute to the removal of our body salts of heavy metals. This suggests to use the fruit for the production of dietary supplements to obtain product functionality. Also, due to anthocyanins in these fruit, *Sambucus* and used as a raw material for food colors with a wide color range - from violet to red.

Sambucus (elder or elderberry) is a genus of flowering plants in the family Adoxaceae. Stems gray-green with yellowish lentils and white heart. Leaves are opposite, imparipinnate with sharply serrated leaves. The flowers (fig. 1) are small, right, creamy white inflorescences in the thyroid. It flowers in May-June. Fruit - black and purple spherical drupe. The fruits ripen in August-September. It grows in the forests of the Carpathians, in bushes, on rocks.

Fig. 1 Elder flowering

The elferberry leaves contain a glycoside sambunigrin (0.11 %), broken down into glucose, hydrocyanic acid and benzaldehyde. Also contains a resin having laxative properties, essential oils (0.27-0.32 %) is also choline, rutin, acetic acid, malic acid, chlorogenic acid, caffeic acid, and valeric. In fresh leaves found ascorbic acid (200-280 mg / %) and carotene (0.014 %) . In the bark of branches contains a volatile oil, choline, phytosterol. In berries found ascorbic acid (10-49 mg/%), carotene, sambutsin, hrizantemin. Along with this, there are tannins (0.29-0.34 %). Berries contain more tyrosine. In seed fatty oil found in the flowers - a semi-essential oil (0.027-0,032 %) sambunigrin, choline, rutin, valeric acid, acetic acid and malic acid.

Furthermore, the inflorescence contain macronutrients (mg/g) K – 41.6; Sa – 8.0; Mg – 4.6; Fe – 0,.2; and minerals (mkg/g) M – 53.4; C – 9.2; Zn – 36.2; Co – 0.88; Mo – 0.88; Cr – 0.24; A1 – 63.36; Se – 0.22; Ni – 0.96; Sr – 2.64; Pb – 0.96.

Elderberry preparations used as a rinse for respiratory diseases. Decoction and powder of the bark is also used for kidney and bladder. The infusion of the root elderberry extracts water well in dropsy and cleanses the kidneys. It is perfectly valid for stomach ailments.

Elder flowers have diaphoretic, diuretic, anti-inflammatory actions and antifebrific for colds. Cora has diuretic properties. Berries have diaphoretic and laxative properties. Main therapeutic action listed in table 1.

Table 1. Types of therapeutic action

	Anti-inflammatory	Antimicrobial	Vasodilators	Antihypoxanh	Diuretic	Sedative	Expectorant	Diaphoretic	Choleretic	Laxative
Flowers	□	□	□	□	□	□	□	□	□	□
Bark	□	□	□	□	□	□	□	□	□	□
Fruits	□	□	□	□	□	□	□	□	□	□

Harvesting of medicinal plants plays an important role in folk medicine and cosmetics. Many of these plants in dried form (fig. 2) can be bought in pharmacies. However, in their fresh form can only be found in nature. Furthermore, among the recommended plants are those who are used in scientific medicine are very limited, and on the shelves of pharmacies are not available. While traditional medicine they are used quite extensively. So medicinal properties has about 2,500 plants, of which the official medicine is used less than 250 species. Consequently, it is useful to be able to find themselves and herbs and harvest them for future use. Collection must be carried out with great care, avoiding material collected in different impurities or other parts of the same plant. The presence of impurities reduces the quality of raw materials and sometimes makes it completely unusable. Should not collect too much dust or anything contaminated plants and plants damaged by insects, rust or fungal diseases. You cannot take herbs growing in the city, along roads, in areas recently treated with pesticides and chemical fertilizers.

Fig. 2 Dried form of plant

Most commonly used in the performance of simple and effective methods: maceration, percolation and circulation extraction. It is significant task to make the right choice of type of extraction, comparison in table 2.

Table 2.

Comparison of most popular types of extraction

Type	Principle of the method	Time
Maceration	To 1 part herb add 5 or 10 parts extractant. Leave on for 7 days. Spin (press), defending.	10-14 days.

Percolation	Continuous filtration, filtration through a layer of extractant material. Carried out in special containers, which is a cylinder with a false bottom and tap the bottom.	From 2 days depends on the capacity.
Circulating extraction	The method is based on the circulation of the extractant.	Depends on the circulating apparatus.

Very often it is necessary to extract one or another substancefor this used different type of extraction. According to these there are some features of extraction for biological active substances.

Glycosides can be extracted by the use of acids and alkalis, enzymes which decompose glycosides. Treatment of alcohol in the presence of alkaline agents, then extracting at the appropriate temperature.

Essential oil by method of hydrodistillation. It is based on the ability to extract water vapor readily volatile tiny droplets of essential oil from the plant.

Flavoniods by qualitative reactions in aqueous or alcoholic extracts. The most frequently used for this purpose cyanidin reaction.

Resins by evaporation juices that flow naturally from plants.

Organic acids by extraction with chloroform, dried. Pouring sulfuric acid. After extraction, washing and drying machine Soxhlet extracted in absolute ether.

Extraction is enhanced by: grinding of raw materials; increasing the temperature of extraction; addition of surfactants; stirring; shaking, etc.

The extraction temperature. Raising the temperature generally accelerates the extraction process only (for all the extractants). Many extracts lose their medicinal properties, if their preparation is heated above 50 ° C. It recommended to leave at room t (18-20 °C).

Flowers don't cut, leaf cut in 10x10 mm. You cannot cut plant to powder, so that during extraction raw goes on the bottom.

Optimal concentration of ethanol. For the *Sambucus* is 60%.

The efficiency of extraction may change several time for different types of materials (for example, fruit - is 70% and for the roots – 30%). To ensure a uniform and large extraction efficiency requires the use of different processing conditions of different parts of plants, or extracting them separate. But this requires experiments.

Conclusions:

Determined that extraction is one of the oldest methods for the isolation of biologically active substances (BAS) from natural plant sources and currently remains the primary method for obtaining biologically. There are many methods of extraction. Most popular: maceration, percolation, circulating extraction.

Elder is rich in BAS. The fruit is an elder lemon and organic acids, tannins, sugars, traces of volatile oil, the amino acid tyrosine, mineral salts containing iodine, anthocyanin glycosides, retinol and ascorbic acid.

Determined that the elder has a wide range of action on the human body. Preparations from elderberry have diuretic, anti-inflammatory, diaphoretic and laxative effect.

Extraction can be improved by: cutting in 10x10 mm; regime of room t (18-20 °C); concentration of ethanol 60%; for drinks - the addition of citric acid.

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K.I. Fedulova, student, L.O. Kosogolova, candidate of technical science,
(National Aviation University, Ukraine, Kyiv)

COMPARATIVE ANALYSIS OF ANTICANCER DRUGS ON BASIS OF GEMCITABINE

The problem of cancer control is one of the most important for modern society. Ukraine is on the second place in Europe in the rate of cancer extension. According to Institute of cancer we can point following statistics: more than 160 000 people become oncology patients every year, and 90 000 people die from cancer, 35% of them are people of working age [1]. The result is that the search of treatment modalities becomes an absolutely essential task for both scientists and practicians.

In that context, we put emphasis on anticancer drugs, which are used for cancerous growth treatment.

A great place in the range of cytostatic drugs, which are used in clinical practice, is given to gemcitabine. It has got an evident anticancer activity on such growths as non small-celled lung cancer, pancreatic cancer, bladder cancer, breast cancer, ovarian cancer; satisfactory acceptability, and also the possibility of successful combination with other anticancer drugs.

By its nature, gemcitabine is an analogue of natural deoxycytidine and it is 2-desoxy-2'2'difluorocytidine monochloride. During pre-clinical studies this medication showed anticancer activity on people's models of lung cancer, breast cancer and colon cancer [2]. The study of its pharmacogenetics showed that under the influence of deoxycytidine ferment the medication transforms in two active metabolite-triphosphates and diphosphates, which arrest replication and renew DNA in tumour cell. Thus, the first medication on the base of gemcitabine was "Gemzar"; which was created in laboratories of Indianapolis in 1980. Later, its analogues were created; one of them is Onkoril («Pliva», India) and Onkogem («Alembic», India).

Thanks to advantages in cancer disease control, gemcitabine is one of the most high-demand medications. Although during the study of its pharmacokinetics, it was proved that effectiveness depends on the dose of medication. Consequently, this capability is very important in choosing of the dose and requires a special focus on quantitative and qualitative content of active material in medication.

It is essential to use generic substitutes today. Considering that generic contains the same active material just as original drug, it doesn't differ from original drug by its clinical activity on conditions that bioavailability, but in its turn it has got smaller value. However, there is no dead certainty that such changes won't effect on clinical effectiveness and safety of therapy [4]. For example, there are known cases, when generic medications have got not only corresponding effectiveness, but also it causes danger for patients [5].

The aim of this work was to compare medications by means of examination using physicochemical, microbiologic and toxicologic indices and definition of storage conditions of these medications.

Two medications Onkoril («Pliva», India) and Onkogem («Alembic», India) were involved in this analysis. Examination was pursued according to American Pharmacopeia [3]

Definition of gemcitabine was pursued on UV spectrophotometer with continuous wave using measuring cell in 1 cm and temperature (20±1) ℃ in comparison with the same dissolving agent, where material was dissolved. By comparison absorption spectrums of examined liquid and comparison liquid in this spectrum confluence of maximum location, minimum location, and intersection points were observed and it is evidence of gemcitabine presence in both medications (Figure. 1, 2).

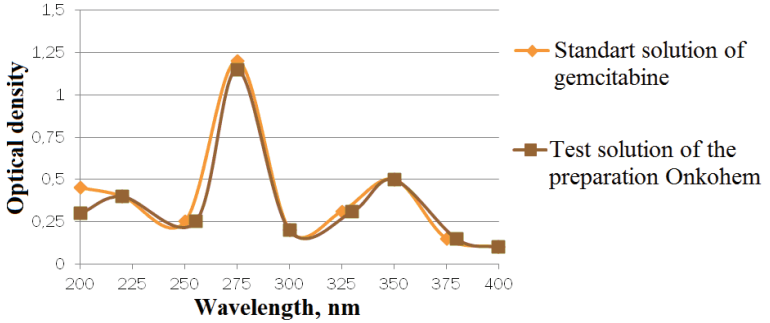

Fig.1. The results of UV spectrum of Onkoril

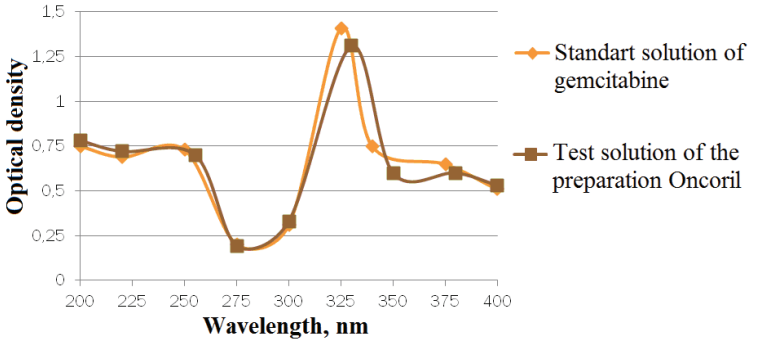

Fig. 2. The results of UV spectrum of Onkoril

The indice pH was defined for examination of storage conditions during 24 hours after preparation of the material. Measure pH is a stability factor of injection during its storage. Substitute of pH in process of ampoules preservation can be provoked by slow hydrolysis of medicinal substance and material accumulation of acid and essential nature (Figure 3, 4).

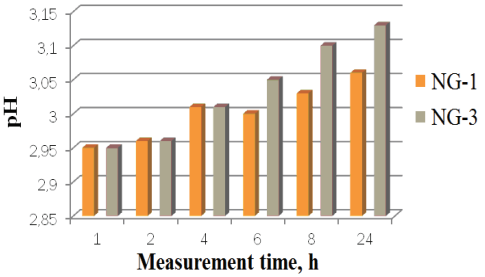

Fig. 3. Substitute of pH by Onkogem depending on quality of glass

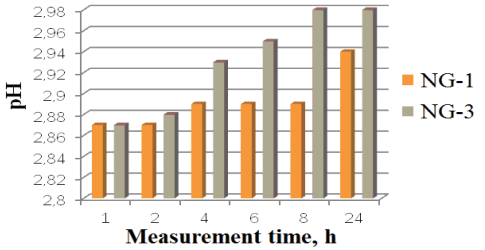

Fig. 4. Substitute of pH by Onkogem depending on quality of glass.

Examinations showed that upon contact of watery solution with glass during preservation skeletonization is present. Proceeding of sodium ion and potassium ion in solution causes move of pH to alkaline side. This, in its turn, influences on stability of medicinal substance, causing appearance of mud, coloration and other changes in solution. That's why glass for keeping of ready-made solutions must be chemically resistant. Medical glasses of neutral brands HC - 1, HC -3 satisfy such demands.

During this examination we came to conclusions that such generic medications as Onkoril and Onkogem satisfy the requirements of American Pharmacopeia procedure.

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M. Radomska, PhD (National Aviation University, Ukraine, Kyiv),
L. Chernyak, PhD (National Aviation University, Ukraine, Kyiv)
W. Reschetilowski, Dr. Sc. (Institute of Industrial Chemistry, Dresden University of Technology, Germany, Dresden)

MODERN WAYS OF SOLVING THE PROBLEM OF GASOLINE VAPORS EMISSIONS FROM STORAGE TANKS

The most important environmental properties of solving the problem of gasoline vapors emissions from storage tanks have been defined and considered in the paper.

Air pollution is becoming a serious problem at many urban areas of the world and stricter regulation of air pollution is anticipated due to the fact that air pollution can have a serious effect on human health and the environment. This has resulted in the increased interest to the researches aimed at addressing issues that influence air pollution at urban areas [1].

In oil operations such as storage, loading and unloading, there are many chances for oil vapor to be emitted from tanks, tankers or truck tanks into the air. Oil vapor emissions (OVE), having serious harmful effects on people and the environment, are always an important research topic for scientists, engineers or managers engaged in the fields of oil production and transportation, fire prevention, and environmental protection.

Oil is transported from oil fields, to refineries, and then to various terminal users by pipeline, railway, water, or road. In this paper, oil is used as a broad term, including crude oil and oil products such as gasoline. Oil is composed of a variety of hydrocarbons, some of which have strong volatility. During conduction of oil operations (e.g., storage, transportation, loading and unloading) at oil refineries, petrochemical factories, oil depots, oil terminals, and gas stations, there is always high possibility for oil vapor emittence from tanks, tankers or truck tanks into the air, because the oil operation process is difficult to be conducted under full airtight conditions and part of oil components evaporate easily. The primary and direct harmful effect of OVEs will be energy resource wastage and the relevant economic loss [2].

Scientific problem. The analysis of quantitative fuels losses from evaporation has shown, that the most of fuel losses from evaporation take place at the gasoline refuelling stations [I]. Volatile organic fuel compounds (VOCs) are easily evaporated and discharged from everywhere into the atmosphere, especially in various operations with gasoline. The emission of VOCs is always a significant environmental problem, and the control of VOCs pollution has been a hot topic in the field of air cleaning [4].

Volatile nature of gasoline is the prime reason for various kinds of losses, which occur during the course of retailing operation. Standing storage or breathing loss, the expulsion of hydrocarbon vapors, occurs during tranquil condition from the gasoline storage tank. Estimation of breathing loss is vital as it occurs endlessly, consequently affecting the environment and economy of the nation. Gasoline is a

vital source of automotive fuel widely used all over the world. It is as vital to the economy of a country as blood for a human being. The supply of gasoline from refinery to end users involves its transfer from refinery to depots/terminals through pipeline, where it is being stored in the storage tanks. The distribution of gasoline from depots/terminals to the retail outlets (ROs) involves its transportation through tank lorries to the underground storage (UGS) tanks. Finally the end users are getting this fuel in their vehicle from UGS tanks through dispensers. During this whole mechanism several kinds of stock losses of gasoline appear (fig. 1).

Problem solving. These losses categorize as standing storage loss or breathing loss, vapor displacement loss and handling loss. Breathing loss, the expulsion of hydrocarbon vapors from the gasoline storage tank, occurs during tranquil condition. The reason behind this is the climatic variation resulting in the changes in the temperature and atmospheric pressure. These changes affect the available vapor space inside the storage tanks due to contraction and expansion of gasoline. Another kind of stock loss is displacement loss which appears during decantation of gasoline from tank lorries to the storage tanks as well as during dispensing of fuel to the vehicle tanks. The third category is handling loss which happens during filling operation at retail outlets. Among the above three losses, breathing loss is continuous loss as it occurs constantly throughout the day where as displacement and handling losses are instantaneous and occur only during filling operation [5]. Filling losses in tanks due to the expansion of the liquid into the tank and the vapors that are forced out of the tank are generally called displacement losses [6].

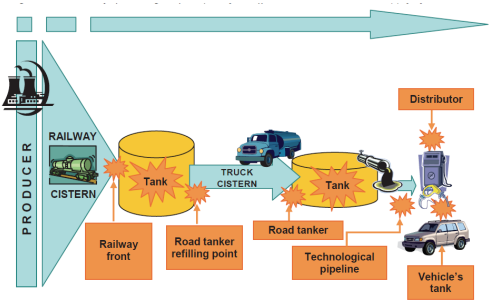

Fig. 1. Illustration of typical gasoline vapour emissions in the transportation process [2]

The evaporation properties of motor gasoline are expected to change markedly with the progress of evaporation because gasoline is a multi-component fuel [7-8]. It is a complex mixture containing hundreds of different hydrocarbons derived from the distillation of petroleum. Due to the strong volatile properties of most hydrocarbons, VOCs and hazardous air pollutants (HAP) are emitted during major gasoline transfer operations. In general, gasoline needs to be loaded and unloaded at least 5 times from refinery to vehicle gas tanks, including production process in refinery, transportation to the fuel depot, loading and unloading at fuel

depot and oil station, and refueling of the vehicles. Due to its powerful volatility and wide applications, gasoline vapor emissions can cause serious gaseous pollution, especially, photochemical smog in summer, and VOCs that serve as ozone precursors and contribute to ground-level ozone. Petroleum is one of the most important energy which can't be regenerated. During the increasing development of world economy, petroleum has become significant energy to keep a county's economy survival. Many developed countries started their strategic petroleum reserves (SPR) from the 1970s. To this point, Japan of which petroleum import and consumption rank the third place can be considered as the typical model. Because of almost no domestic production, all petroleum needed by Japan depends on import. Building SPR system is the only pathway to keep the Japanese economy survival and to resist the threat from international crude oil market.

Conclusions

In the process of light petroleum products loading, storage, transportation or distribution, a great deal of petroleum vapor mixture with air is emitting from tanks. The emitting vapor will lead to problems such as petroleum losses and air pollution and hidden fire hazard. Therefore the new types of recovery systems should be developed and introduced as soon as possible.

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M. Svirid, PhD (National Aviation University, Ukraine, Kyiv)
I. Trofimov, PhD (National Aviation University, Ukraine, Kyiv)
A. Plotnykov (National Aviation University, Ukraine, Kyiv)
A. Kolomiiets (National Aviation University, Ukraine, Kyiv)

TRIBOLOGICAL PROPERTIES OF FRICTION PAIR IN MAGNETIC FIELD

In the article the processes, going during friction in the undirected magnetic field and in the impulsive magnetic field are considered, frequency of impulses is regulated. Optimal parameters for friction pair renewal are determined. Investigation of paramagnetic material tin was carried out in different MF-s: a constant magnetic field; 1-pulsed unidirectional, 2 - 6 Hz pulse modulated.

During machines and mechanisms exploitation they lose the working capacity, and wear is one of the primary factors, negatively influences on friction knots work. Machines service life increasing straightly depends on the effective and rational using tribopairs, that shows up in support of it calculation parameters and such cases gathers over 80%. In many cases details of weighing in a few kilograms change a size from several to 300 microns, pass to the state of unserviceable, but the main it's part is fully working.

There are many methods of friction pairs renewal: galvanic, plasma, detonation, electrochemical. In the given work the method of renewal with the help of magnetic field is considered.

Thus, the most perspective way of mechanism capacity support will be it's renewal and it is desirable in the conditions of without disassembly of the unit technologies

The effectiveness of the technique rational and constructive tribological friction units manifested as far as replacing old equipment. Thus, the most promising will increase wear resistance by acting on the surface of the friction constant magnetic field using additives to lubricants.

Research of authors [1] have shown that at passing of magnetic lines through contact zone wear resistance of steel surfaces increases.

Also work is known [2] where it is experimentally proved that the electromagnetic field promotes selective carrying.

Also recently magnetic impulse processing is widely applied for reliability of cutting tool work.

Increasing of mechanical and tribological properties of tool steels after processing by impulse magnetic field [3] is known.

Large attention was always spared for operating reliability and problem of machines and mechanisms longevity. An increase of wearproofness is an actual task that can be decided on the base of deep scientifically-reasonable decisions.

Repair and renewal of precessions pairs working details of pumps differ in high labour intensiveness, exactness of details making, that in a turn affects an a

price. The prospective knot is a cylinder-piston by hard requirements on admittances to 3-5 microns.

Technical progress complicates the machines work terms, the specific loadings and tribopairs exploitation terms increase [1], moreover aspiration to decrease weight of aggregate is important task.

Process of exploitation requires the increase of tribopair work, extension of resource due to the choice of rational method of renewal. Relevant technology becomes recovery- place machine parts that decreases the price of machines life resource. The work purpose: to investigate condition of tribological system in unidirectional MF and impulse unidirectional magnetic fields. To define conditions of working capacity and renewal parameters of friction pair. The task of this work is determination of the magnetic field influence on friction surfaces.

Object - the study of the processes of friction on zone under the influence magnetic fields.

The subject of the research is to determine the patterns of influence between the MF and the transformation of the surface material in friction. (processes of interaction of physical objects)

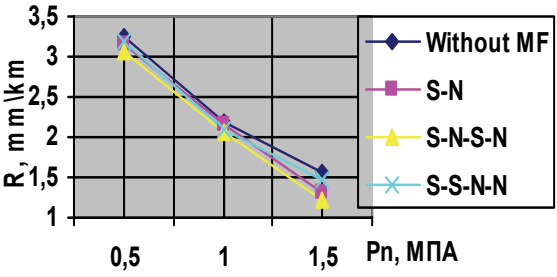
Thus, perspective direction of renewal in the exploitation process problem decision is the most not studied way of the magnetic-field energy using for the change of the system state to the reparation level. Taking into account, that lubricating materials are component part of tribosystem, the study of friction knot tribological parameters becomes perspective by the magnetic field influencing the on oil. So, as tribomagnetic renewal technologies include for itself intercommunication of working environment, oil with working materials (products of wear, oil modificators), then in the process of friction micromagnit processes will be realized in the wear products particles, that magnetize and design properties of magnetic liquid that consists of oil and wear products.

Work mechanism of magnetic liquids, that consist of magnetized metallic powder small particles, the nearest represents the friction knot work conditions in lubricating environments and surfaces wear processes under the action of force magnetic lines. [1-3]

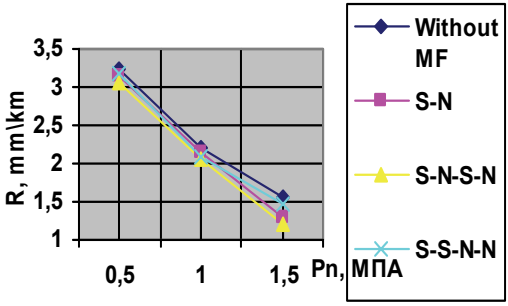
Materials and methodic of experiment carrying out.

Researches were conducted with the help of tribological complex [4] (finger-plane scheme friction circumferentially) with the speeds 0,5m/s, 1 m/s and 1,5 m/s, loading changed from 0,1 to 5 MPa. ШХ15 served as a standard and ЛС59-1 – as a rider, working environment: М10Г2к (mineral) and 5W40 (synthetic) motor oils. For quicklier study of paramagnetic material influence mechanism on the friction conditions of ferromagnetic standard on a diamagnetic rider oil modificator, tin paramagnetic powder was used.

Tribologichni parameters of ШХ15 steel ferromagnetic on diamagnetic ЛС59-1 in the environments of М10Г2к and 5W40 with tin paramagnetic powder addition under the magnetic field action are presented on fig 1.



a)



b)

Fig. 1. Tribological parameters of feromagnetic ШХ15 steel on diamagnetic ЛС59-1 in the environments: a) М10Г2к and b) 5W40 with tin paramagnetic powder addition under the magnetic field action due to the load

During use of force lines direction in accordance with S-S-N-N direction, paramagnetic tin comes out from the magnetic field action area in a working environment, thus, the products amount for protective tapes formation is greater (fig. 2d) and 2h), accordingly the renewal level is higher (fig. 1). On fig. 1d) and 1h) the friction surfaces are shown at magnetic field S-S-N-N direction and magnetic induction 0,3 T, that more intensive covered by the protective tapes. Reason of it is that according to this magnetic field direction tin partly came out from the magnetic field action zone in an oil environment. Then tin gets on the friction surface where accepts active part in creation of protective tapes. Thus, it is needed to notice that renewal level is higher and equal 1,5…3,5 mkm/km (fig.2). However, if to talk about quality of protective tapes, it is evident that when magnetic field influences on a working environment, protective tape, which creates on the friction surface more thin, but it's tribological quality is better (fig. 1b and 1f): 1,5..2mkm), it is more elastic and has a higher level of capacity than without magnetic field influence, which thicker (fig. 1a) and 1e): 4…6 mkm), but peels very quickly, as is not elastic, thus, owning the low level of capacity.

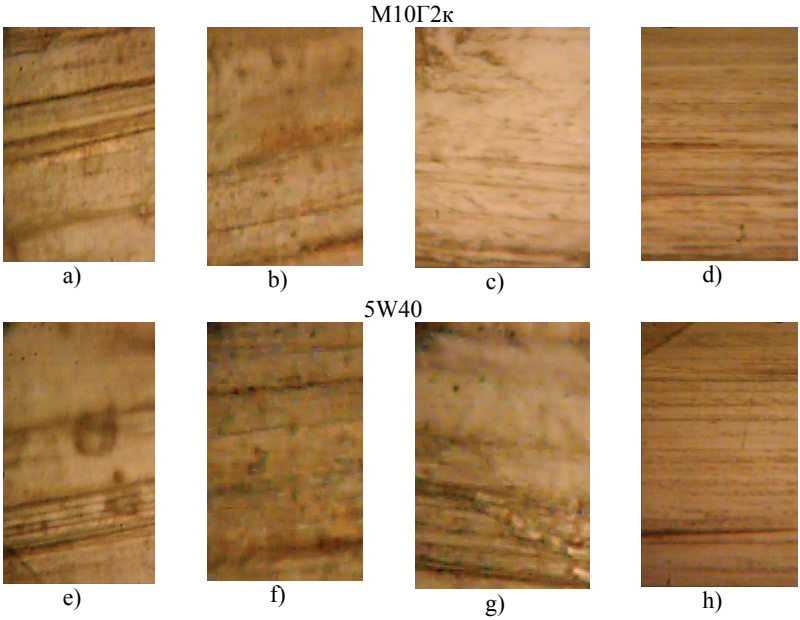


Fig. 2. ШХ15 standards friction surfaces topography on the rider ЛС59-1 in treated by the magnetic field environments of M10Г2к and 5W40 with tin powder addition with different direction of magnetic lines and size of magnetic induction

In the process of experiment in friction zone modifying powder was added, powder of paramagnetic class – tin (Sn – fraction to 20 microns).

The next stage of research conducted at the facility with reciprocating, scheme finger plane. For research specimens from steel 65Г, tempered on martensite are used, for rider used copper alloy ЛС59-1. As the working environment mineral oil M10Г2к served, in friction zone paramagnetic powder of tin was added. Researches were conducted at speed 0,12 km/s, normal loading 3,5 MPa and magnetic induction 0,19 Tl on tribological installation [4]. Installation consists of the power supply, oscillograph, the breaker, the ampermeter for current registration in friction zone, the ampermeter for registration of current passing through the coil of inductance, the coil of inductance, capacities for working environment, loadings element, friction knot.

At direction S/N magnetic power lines are directed in the specimen, and paramagnetic is involved in a magnetic field, hardness Sn (5HB) it is much less, than steel 65Г (66HB) and brass ЛС59-1 (30HB), therefore working specimen surface is renewed (fig. 3 – 1).

At MF N/S direction (fig. 3 – 3, 4) process of recovery of both friction surfaces is explained by common action of deformation component and the positive

gradient direction MF. Without MF total wear is maximum, and plus on working specimen is explained be mechanical component of friction (fig. 3 – 5, 6).

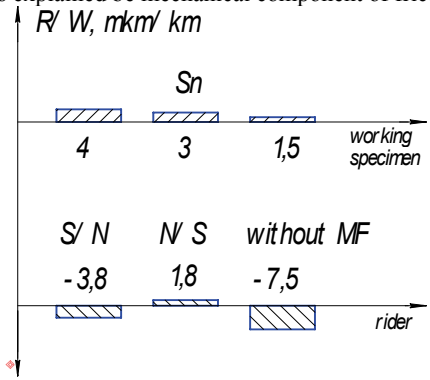


Fig. 3. The dependence diagram of tribological characteristics in a uniform magnetic field in the environment of М10Г2к

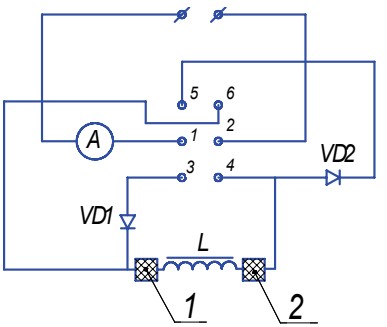


Fig. 4. The electric scheme of installation connection: 1 – arrangement of the breaker for creation of MF with N/S direction, 2 – arrangement of the breaker for creation of MF with S/N direction.

For creation of impulse magnetic field to the electromagnetic coil connected the breaker, depending on magnetic field direction its location concerning the coil has to be changed, fig. 4 position 1 or 2.

It is known that paramagnetic by the action of magnetic field is displaced in the area of magnetic lines positive gradient. So, tin, which is paramagnetic, powder using, for tribomagnetic renewal of ШХ15 steel and 65G friction surface by adding of this powder to the working environment, namely in М10Г2к and 5W40 oils, and wear researches during different directions of magnetic lines [5] and different magnetic induction size enable by quicklier method to define system tribological parameters. According to the tasks researches conducted at different magnetic field directions in accordance with which on fig. 1. the friction surfaces topographies are got with the tribological complex using [4].

Proof of it are researches on «micron-alpha» device, noncontact 3d profilograf [6], that show surfaces topography and tapes thickness analysis during renewal with the paramagnetic tin using without magnetic field action (fig.5a) and during SN><SN magnetic field direction (fig. 5b).

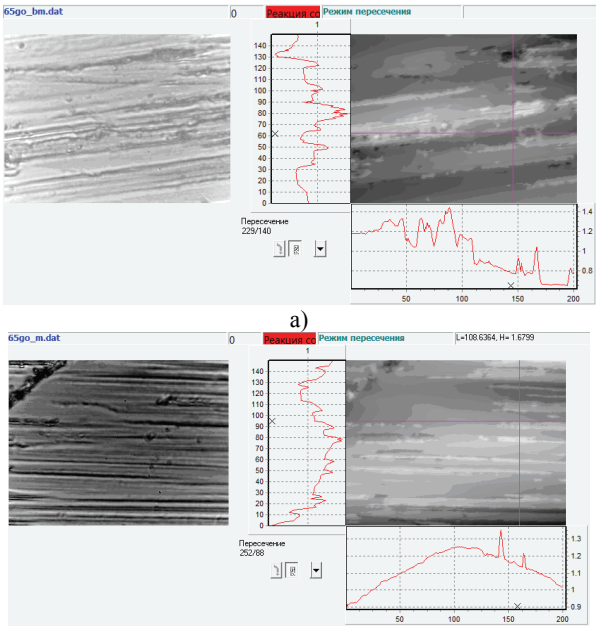


Fig. 5. ШХ15 steel friction surface profilography on diamagnetic ЛС59-1 1 in М10Г2к environment with tin paramagnetic powder addition a) without magnetic field, b) S-N- S-N magnetic field direction

Conclusions

1. It is determined, that when magnetic field acts on the working environment, surface film, which appears on the friction surface has higher level of capacity than at a friction without magnetic field influence.

2. It is set, that in the case with paramagnetic tin powder in oil composition, at the magnetic field influence on a working environment at the friction, the greatest renewal level is at S-S-N-N magnetic field direction and equals 1,5…3,5 mkm/km.

3. Influence of unidirected magnetic field and unidirected impulsive magnetic field is considered due to tribological characteristics of friction pair, also determined, that surfaces are the most capable in the conditions of the straightened signal of electric current, which creates impulsive magnetic field. Due to these parameters of outsourcing there are the tribological tapes, with small quantity of oxygen, it characterizes formation of servo tapes.

4. It is determined that during the straightened signal of MF and impulsive breaking with frequency 6,25 Hz tribosystem is restored, with using the elements of renewal powder and working environment.

5. It is established that the arrangement of friction surface on S/N pole during reversive movement of specimens is a preferable direction of MF for renewal.

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L.M. Chernyak, PhD (National Aviation University, Ukraine, Kyiv),
M.M. Radomska, PhD (National Aviation University, Ukraine, Kyiv)

THE ASSESSMENT OF ENVIRONMENTAL PARAMETERS OF CONVENTIONAL AND ALTERNATIVE FUELS

The most important environmental properties of conventional and alternative fuels have been defined and considered in the paper. The contribution of alternative jet fuels into improvement of environmental situation around airports and health risks associated with them have been analyzed.

Development of national economy and improvement of living standards of citizens are the questions of primary importance for Ukraine. These trends are closely connected with progress of transportation, including growth of vehicles number and demand for fuels supply. Under current economic situation it is obvious that our country is highly dependent on oil, just like all other developed countries of EU and the world. Currently, oil accounts for 97 percent of fuel use in transport sector. In the past oil has been cheap and plentiful, but the last decade proved the need to reconsider energy security of the country. Apart from these, petrochemicals use raises major environmental concerns regarding local pollution effects and the global climate change potential of carbon dioxide emissions.

Two options for reducing the petroleum dependence problem of the transportation sector exist, other than reducing travel demand: efficiency improvements and use of alternative fuels. Alternative fuels can be considered in two categories: non-petroleum fossil energy resources and non-fossil energy resources and fuels. Many research efforts in the whole world are concentrated on seeking for efficient "ideal" alternative fuel both economically and environmentally.

Economic issues include cheap resource base, low-cost production, ability to work under the same technical conditions as conventional fuels and compatibility with constructional materials of engines and storage vessels.

Environmental concerns are also complex enough to pose serious challenge for the researchers. Any fuel that displaces petroleum in the transportation sector will have to perform well relative to numerous environmental safety criteria, such as sustainability, contribution to greenhouse gas (GHG), emissions on a life-cycle basis, contribution to emissions of criteria pollutants produced in the process of fuel combustion, toxicity, and effect on land use.

For many, the sustainability of future transportation fuels is a major concern. Sustainable fuels are defined as long lasting (e.g., resource availability is indefinite), and they have low carbon content. In other words, a sustainable fuel consumption, vehicle emissions, safety, congestion, and social and economic access characteristics do not result in great or irreparable harm to future generations.

The climate change effects of carbon from fossil fuels are seen as a potentially serious environmental problem. Carbon dioxide is the predominant contributor to the increased concentration of GHGs. Combustion of fossil fuels accounts for two-thirds of global anthropogenic CO_2 emissions, with the balance

attributed to land use change. This is the reason why alternative fuels are required to have low-carbon content. Unfortunately most of those have organic structure and therefore are not able change the situation and sometimes even worsen the carbon dioxide parameters of engine emissions. Thus, most alternative fuels play virtually no part in reducing GHG emissions and they will have to go for the same limitation as conventional fuels, especially in accordance with Kyoto protocol [1]. Recently, a number of analyses have been published on the life-cycle GHG effects of different fuels and showed that only hydrogen fuel has serious potential to reduce the output of CO_2, but instead it produce additional volume of water vapor – another GHG.

In the past 30 years, the EU has made major efforts to limit criteria pollutant emissions from the transportation sector (sulfur and nitrogen oxides, particulate matter). Although great gains have been made in reducing emissions on a per km basis, increasing travel due to population growth and rising income threatens the benefits achieved in the past 20 years. As a result, EU regulatory authorities plan to impose increasingly stringent emissions standards. It was once thought that only alternative fuel vehicles would be able to meet such stringent standards, but technological advances have made it possible for vehicles burning conventional fuels to meet some of these standards, dimming the prospects for widespread, commercial alternative fuels use for environmental purposes.

The following substances can be found in the air around an airport: Freon 11, 12, Methyl Bromide, Dichloromethane, cis-l,2-Dichloroethylene, 1,1,1-Trichloro-ethane, Carbon Tetrachloride, Benzene, Trichloroethylene, Toluene, Tetrachloroethene, Ethylbenzene, Xylenes, Styrene, Trimethyl-benzenes, o-Dichlorobenzene, Formaldehyde, Acetaldehyde, Acrolein, Acetone, Propinaldehyde, Crotonaldehyde, Isobutylaldehyde, Methyl Ethyl and Isobutyl Ketone, Benzaldehyde, Veraldehyde, Hexanaldehyde, Ethyl Alcohol, Acetone, Isopropyl Alcohol, Butane, Isopentane, Hexane, Heptane, Butyl Alcohol, n,n-Dimethyl Acetamide, Dimethyl Disulfide, m-Cresol, n-Heptaldehyde, Octanal, 1,4-Dioxane, Methyl Phenyl Ketone, Vinyl Acetate, Phenol, Octane, Anthracene, methylnapthalenes, Flouranthene, Naphthalene, Phenanthrene, Pyrene, Benzo(a)pyrene, nitropyrenes, 1,3-Butadiene, sulfites, nitrites, nitrogen oxides, nitric acid, sulfur oxides, sulfur dioxide, sulfuric acid, urea, ammonia, carbon monoxide, ozone, particulate matter. Possible diseases induced by these chemical includes various types of lung and nasal damages, skin injures, heart, kidney and liver problems, neural and psychological disorders. Some of the components are proven to be cancerogens [2]. The Federal Agency for Toxic Substances and Disease Registry states that volatile organic compounds in jet exhaust, precisely 1,3-butadiene, formaldehyde and benzene pose increased health risks in the exposed populace for leukaemia, brain tumours and thyroid cancer.

Such a complicate air pollution caused mostly by burning fuels in aircrafts engine, but considerable contribution into pollution levels is made by the same fuels before they are burned. This refers to aviation fuels lost within the technical processes and maintenance procedures and the most important source of pollution is fuel storage tanks and refilling operations. Storage leakages and inappropriate condition or handling the refilling equipment leads to considerable lost of aviation fuel to the environment. As a result not only air pollution, but soil and underground

waters pollution should be concerned about. Investigations show that at least 3-8% of aviation fuel used by any aircraft is lost in the storage and refilling system. Nevertheless this type of pollution in the airports is often neglected. Even though aviation fuels are mostly volatile substances and up to 75% of surface leakages turn into vapors contributing to air pollution discussed above, residual soil pollution and underground tank leakages deliver aviation fuels to humans directly or via waters.

As for alternative fuels, their VOC emissions are lower relatively to conventional. The gaseous fuels demonstrate reductions in excess of 60%, while the alcohol fuels offer close to 20% fewer VOC emissions. Even the conventional, reformulated fuels show reductions in VOC emissions of about 20%. All alternative fuels demonstrate significantly lower emissions of benzene and butadiene. However, the ethanol fuels cause significant increase in acetaldehyde and formaldehyde emissions relative to conventional fuels.

Besides criteria pollutants, alternative fuels will be evaluated on their direct toxicity in case of human exposure. Toxic effect of such pollution depends on the route of human exposure and of course on chemical composition of materials stored and used in the airport. Their names and basic composition and properties wary greatly in different countries. But there is now only one basic type of jet fuel in civil use world-wide; the kerosine type. Under normal conditions of use, exposure to aviation fuels likely to be confined to inhalation of mists or vapours generated during handling or incidental skin contact within the group of airport workers. The oral toxicity (LD_{50}) of kerosene in a variety of laboratory animals is of the order 20 – 30 g/kg [2,3]. Intra-tracheal dosing of kerosene liquid (which models the aspiration of vomit in humans) results in a substantial (10- to 150-fold) increase in toxicity and is consistent with known human health effects.

The principal adverse effect of acute exposure arising from ingestion of kerosene is chemical pneumonitis secondary to aspiration of vomitus. Whilst kerosene vapours may be mildly irritating to the respiratory system, exposure is not likely to be fatal as the low volatility of kerosene limits air concentrations to below 100 mg/m^{-3}, which is the approximate NOAEL (no observable adverse effect level) [3]. Ingestion of kerosene or acute exposure to vapour may lead to general signs of intoxication such as mild CNS symptoms (dizziness, headache, nausea) and vomiting. Related survey dealt with children having survived ingestion of up to 1.7 g/kg, but instances of fatal poisoning were recorded associated with doses ranging from 2 to 17 g/kg [3, 4].

Acute dermal exposure may result in local irritation, but it is not considered to be a skin sensitiser. Kerosene is belived to be a mild, transient ocular irritant that may produce conjunctivitis, hyperaemia and lacrimation. Acute exposure to kerosene in humans is also associated with a variety of CNS effects, including irritability, restlessness, ataxia, drowsiness, convulsions, coma and death; these are generally considered to be secondary effects resulting from hypoxia. Lethargy and other CNS complications were reported in 5% of volunteers ingesting 10–30 ml [3].

Chronic skin exposure to kerosene may result in dermatitis through the extraction of endogenous skin lipids. Dermatitis developing over a long period may result in skin which is thickened and scaly. Occupational contact dermatitis commonly affects forearms, backs of hands and between fingers, but may affect any

exposed areas of skin. Once contact dermatitis has developed, the skin does not always return to a normal healthy condition even if all contact with the offending material(s) is avoided. Oil folliculitis (blocking of hair follicles) and/or oil acne (blocking of sebaceous and/or sweat glands) may develop as a result of prolonged skin contact with mineral oil products (particularly where oil soaked clothing has been allowed to remain in prolonged contact with the skin). Chronic exposure may also cause non-specific CNS effects such as nervousness, loss of appetite and nausea. Whilst kerosene is not considered a direct-acting dermal carcinogen, chronic skin exposure may result in tumours genesis. Some surveys reported stomach and lung cancer caused by chronic exposure to kerosene, although LARC hasn't included kerosene into the list of recognized cancerogenes. Kerosene also does not have a measurable effect on human reproduction or development [3, 4].

Toxicological profile of alternative fuels having non-petroleum fossil origin is basically similar to those of aviation fuels even though there are no extensive studies of this question. Thus, exposure to high concentrations may cause irritation of the respiratory tract. In common with many hydrocarbons, exposure to high vapour concentrations may cause drowsiness or loss of consciousness. Vegetative oils used as the basis aviation fuels are also mixtures, which can contain small amounts of dangerous components. Inhalation, therefore, presents a potential hazard in that this could result in absorption into the bloodstream and possibly systemic damage. Overheating of the products may, however, result in hazardous decomposition products being evolved, especially trans-isomeric compounds known to be carcinogenic, and hydrated or oxidated organic substance, which produce more serious health effects comparing with initial substances.

Separate health concerns are raised by alchohol components of jet fuels. ethanol and methanol are known to be highly toxic materials, which effects range from CNS disorders, cramps, visual and hearing problems, moving disability to even lethal outcome in case of considerable dose ingested of inhaled. Methanol has a high toxicity in humans. If as little as 10 mL of pure methanol is ingested, for example, it can break down into formic acid, which can cause permanent blindness by destruction of the optic nerve, and 30 mL is potentially fatal, although the median lethal dose is typically 100 mL (i.e. 1–2 mL/kg body weight of pure methanol). Reference dose for methanol is 0.5 mg/kg/day. Toxic effects take hours to start, and effective antidotes can often prevent permanent damage. Methanol itself is not highly toxic, but its metabolites formaldehyde and formic acid are. Pure ethanol will irritate the skin and eyes. Nausea, vomiting and intoxication are symptoms of ingestion. Long-term use by ingestion can result in serious liver damage. Atmospheric concentrations above one in a thousand are above the European Union Occupational exposure limits.

Land use is a concern for many of the renewable fuels (e.g., ethanol from biomass resources such as switch grass, and electricity from wind and photovoltaics). For example, the production of 1 t of corn ethanol requires about 2000 m^2 of land. However, some ethanol can be produced from resources with minimal land use effects, including municipal waste, agricultural waste, and forest waste. Another part of this issue is biodegradability of alternative fuels.

Conventional jet fuels are known to have long life in the environment and go through a range of transformations. First of all part of them evaporates and transforms into carbon oxides and methane. The rest may react with component of the housing medium (soil or water), or form long-living pollution of the environment with the heaviest fractions. In some case income of hydrocarbons produce nourishing effect on soil microorganisms, but it is soon transformed into depressive. Water organisms have strongly negative reaction to the pollution with petrochemicals. As for alternative fuels, vegetable oils are quite quickly transformed in the environment, but they still have negative impact on water ecosystems. As for alcohol compounds they are toxic to living organism at all levels and considered to be hazardous. Although alcohols are miscible in water; do not adsorb nor volatilize, but their biodegradation is more simple and goes in the direction of hydrolisis and reaction with the elements present in housing medium.

Conclusions

In general, substitution of alternative fuels for conventional ones often has favorable effects on criteria pollutant and carbon dioxide emissions and is forecast to maintain and in most cases decrease the atmospheric levels of GHG, CO, SO_x, NO_x, volatile organic compounds and particulate matter. However, ethanol, methanol, and compressed natural gas use has practically no effect on VOC, CO, and NO_x emissions, whereas hydrogen use produces the greatest decrease in these pollutants, but increase water vapor production, contributing to global warming processes. Human exposure to alternative fuels cannot be considered totally safe, as there remains a knowledge gap concerning the actual toxic effect both for humans and other groups of living organisms. Unclear biodegradability of alternative fuels, issues od land use and safety of their storage and application prevent scientists to make final decisions about environmental benefits of alternative fuels.

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S. Boichenko, Dr. Sc. (National Aviation University, Ukraine, Kyiv)

A NEW PARADIGM OF USE OF TRADITIONAL AND ALTERNATIVE FUELS AND LUBRICANTS. FORESIGHT OF CHEMMOTOLOGY

This article gives representation about history, development and modern state of Chemmotology science. The main problems and tasks of the Science are discussed. The fundaments of Chemmotological scientific and pedagogical school of the National Aviation University, its main positions, goals and activity are described in the article.

Today humanity has reached the level, when it possesses huge scientific & technical potential. However it still doesn't manage to use this potential economically and rationally. Processes of fuel use still faces problem of highly effective fuel burning with production of maximum useful energy. Argument for this is the modern state of energy efficiency, and fuel efficiency in particular, efficiency factor of internal combustion engines. Fuel consumption by car engine is determined by its energy efficiency, in other words, quantity of heat produced during combustion of 1 kg of fuel. It was calculated, that today only 12% of energy produced during fuel combustion is used for car movement. Today about 10 ton of fossil fuels per capita is extracted during one year. And only 1% (100 kg) is efficient. All the rest pollute atmosphere, soils and water bodies. Efficiency of fuel use can be shown as energy balance of a car (table 1).

Table 1

Energy balance of a car

Energy of combusted fuel (100%)	
12%	88%
2,4% – rolling resistance 3,2% – air resistance 6,4% – inertial forces	42% – cooling system 22% – exhaust gases 13% – friction in engine 9% – friction in transmission 2% – engine accessory drive

Today efficiency factor of modern gasoline engines is about 35 – 36%, diesel engines – 42–44%, gas engines – 38–45% (table 2).

Table 2

Efficiency factor of some engines

Wat heat engine	~ 2,8%
Internal combustion engine	~ 20–40%
Steam turbine	~ 35–46%
Diesel engine	~ 44%
Jet engine	~ 47%

Total efficiency factor of engine is divided into main constituents:

- ***fuel efficiency***. It shows what quantity of fuel that was efficiently burned in engine and was turned into the volume of power gas of high temperature and pressure, and what part of fuel was not burned and was emitted as unburned hydrocarbons, carbonized particles (soot, smoke, fly ash, etc). Nowadays only 75% of fuel is completely burned and transformed into heat in existing engines. Two-stroke engines provide even less amount of completely burned fuel;

- ***thermal efficiency factor***. It shows what amount of heat, produced after fuel burning is transformed into useful work and what amount is uselessly wasted in environment. Let us consider that piston engine has 30% efficiency factor on average. Then 70% of produced heat is emitted uselessly into environment through cooling system and together with exhaust gases;

- ***mechanical efficiency factor***. It shows what quantity of mechanical work is transformed into torque force at the main axle and transmitted to the consumer, and what amount is uselessly wasted for friction or used for other driving supplementary mechanisms of the engine (figure 1)

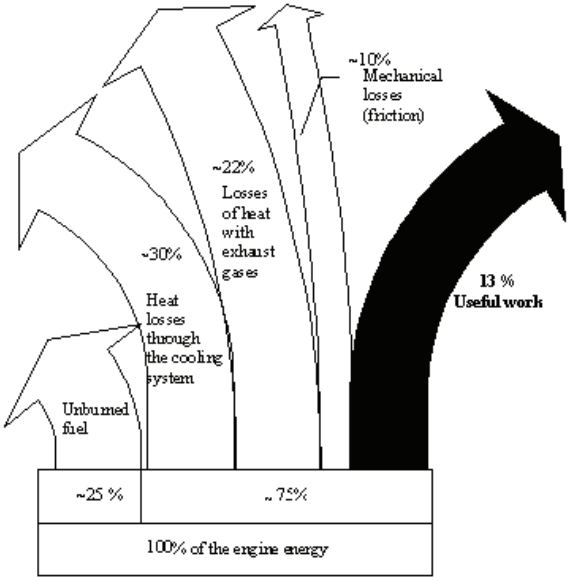

Fig. 1. Energy balance of internal combustion engine

The above arguments suggest that mankind has a significant amount of energy from the point of view of the opportunities and the need to improve the technical means, when the source of energy is products of oil refining.

The current state of natural resources and the environment causes change of point of view on the future economic development and technological progress and evaluate it considering environmental priorities, environmental risks and state of environmental safety. Rapid industrialization and urbanization together with quick

development of transport infrastructure, strengthening of other impacts on environment have disturbed the life cycle of substances, natural metabolic energy processes and regeneration mechanisms in the biosphere. As a result progressive destruction has begun. Air, water and soil are polluted, landscape and biological diversity are depleted; these facts cause negative effect on living organisms and humans.

In order to eliminate this danger, existing environmental management practices should be revised, production and economic activities and environmental systems should be radically restructured, taking into account social and economic needs of society and the biosphere opportunities.

According to the forecasts of the World Energy Council, energy consumption will raise on 55% till 2020. According to the data of Organization of the Petroleum Exporting Countries, oil takes more than one third in word balance (table 3)

Table 3

World energy balance

(OPEC forecast, data of World Oil Outlook 2010, p. 48)

Name of energy source	Volume, mln m BOE per day				Part, %			
	2008	2010	2020	2030	2008	2010	2020	2030
Oil	80,9	80,4	89,9	97,6	35,7	35,0	32,7	30,2
Coal	64,8	66,2	80,1	92,1	28,6	28,8	29,2	28,5
Gas	51,4	52,1	64,5	79,1	22,7	22,7	23,5	24,5
Nuclear energy	14,4	14,7	16,9	20,7	6,3	6,4	6,2	6,4
Hydroenergy	5,5	5,8	7,3	9,0	2,4	2,5	2,7	2,8
Biofuel	8,6	9,2	12,9	17,5	3,8	4,0	4,7	5,4
Other renewable energy sources	1,3	1,5	3,2	6,8	0,6	0,7	1,2	2,1
Total:	226,8	229,9	274,8	322,9	100,0	100,0	100,0	100,0

* Per unit of fuel (coal equivalent) accepted the calorific value of 1 kg of coal = 29.3 MJ or 7000 kcal. The International Energy Agency (IEA) has adopted a unit of oil equivalent, usually abbreviated as TOE (born Tonne of oil equivalent). One tonne of oil equivalent is equal to 41.868 GJ or 11.63MW•h

It is also used barrel of oil equivalent (BOE). Ratio: 1 toe = 7,11, 7,33 or 7,4 boe

Despite the fact that in the future share of crude oil in total primary energy consumption will be reduced in absolute terms, oil consumption (as well as other energy sources) will only increase. Being an exhaustible and non-renewable natural resource, crude oil requires its rational use. Even Mendeleev paid attention to the rational use of raw materials: "Oil is not a fuel, you can heat by assignats."

Growth in use of natural resources, their depletion and degradation necessitated development and implementation of strategies and tactics for

sustainable environmental management and continuous monitoring of changes in the natural and anthropogenic processes for the integrated management of natural resources and environment.

There are no alternatives to environmental management, which is based on considering laws of nature and forming of safe conditions of human life and living organisms. Therefore, humanity has already generated and implemented strategy and tactics of natural resources use, ensuring systematic (integrated) management of natural resources and their rational use, protection from pollution and depletion. It also applies constant monitoring of natural and anthropogenic processes changes in environmental systems.

Chemmotology as an independent science today can systematically solve complex environmental and energy problems, for example, in the transport sector. Today there is a new stage in the development of this science and its role in the overall system of knowledge.

Chemmotology firstly comprehensively solved such important practical tasks as design and production of machinery, equipment maintenance, development and use of fuels, oils, lubricants and fluids. Chemmotology unites and embodies the efforts of developers and manufacturers of machinery, oil products, oil refineries and operators of technique.

The origins of Chemmotology date back to 1964. The separation of Chemmotology into the independent applied science united scientists and practitioners of engineering, oil and chemical industries along with the companies which operate the technologies for Chemmotological problems solving.

Over the last several years Chemmotology being an applied science, has found its broad scientific and social acceptance. The results of the research have been presented at the World Petroleum Congresses (Mexico City, 1967; Moscow; 1971, Tokyo, 1975, Bucharest, 1979), at the Mendeleev's Conventions for General and Applied Chemistry, at Chemmotological seminars and conferences in Moscow, Sankt-Petersburg, Berdyansk, Dnepropetrovsk, Drogobych, Kiev, Chelyabinsk, Tashkent, and Tbilisi.

Historical prospective of Chemmotology shows that in order for the new science to develop, the government of U.S.S.R. passed a resolution under which the State Chemmotology research institute in 1968. This decision was followed by the one to establish Chemmotological centers in different sectors of economy in 1970, and, in 1984, about mandatory agreement of nomenclature for fuels, lubricants and technical fluids with the main Chemmotological organization – the State Chemmotology research institute (based on the 25th State research institute of Ministry of Defense of Russian Federation).

As any other field of scientific activity, Chemmotology is based on specific fundamental knowledge of which the main terms and conceptions are the important parts. Without them the further development of any science is not possible. The high level of language culture and technological (Chemmotological) one in particular, characterizes in its way the level of scientific and technological advance. The analysis of literature sources shows that the variant reading of the term "Chemmotology" exists. Therefore, the objective need for more accurate definition and standardization of this term exists.

The definition and the main problems of Chemmotology are stated in various reference books and encyclopedias. The Etymology of the definition of Chemmotology shows that K.K. Papok in his 1964 article proposed to use this term for the first time and defined the science as "*a new science that studies chemical, physical-motor properties of fuels, lubricants and special fluids as well as their service performance, and develops the way for their rational use in technical equipment.*" At a later date, the science definition was specified as "*a science about properties, quality and rational use of fuels, lubricating materials and specific fluids in technological equipment*." Further, the definition of science was developed in a new version as "*theory and practice of rational use of fuels and lubricants.*" The monograph of 1985 by colleagues and followers of K.K. Papok Chemmotology was defined as "*an applied science about service performance, quality and rational use of fuels, oil, greases and specific fluids in technological equipment.*"

The newer and more specific definition of Chemmotology, its subject, methods and goals was proposed in 2005 in accordance with previous publications. It is "*a technical applied science about properties, quality and rational use of fuels, lubricants and specific fluids in technological equipment.*"

To the author's point of view, the more accurate formulation of Chemmotology is the following. It is "*a science about technological processes, properties, quality and methodology of rational use of fuels, oils, greases and specific fluids*." The Big Soviet Encyclopedia defines science as a sphere of human activity that has a development and theoretical systematization of objective knowledge about reality as a function. According to the source, the immediate goals of science are description, explanation and prognostication of the processes and the phenomena of reality, i.e. theoretical reflection of reality. All these signs are possessed by Chemmotology, too.

For the modern science it is the transition from subjective to problematic orientation that becomes more typical. The new areas of knowledge arise because of advancement of some major theoretical or practical problem. This is the reason for the edge sciences to appear, and, Chemmotology, as a problem science being at the edge of Chemistry, Physics, Engineering, Economics and others, in particular. It is even possible to use such word combination as "technical Philosophy," since its describes the essence of this science.

The role of Chemmotology as an applied science is supported by the importance of the problems it solves: securing energy safety of economy of a country, rational use if traditional and alternative fuels, lubricants and specific fluids during the operation of modern and prospective technologies.

The analysis of publications for the last seven years gives a possibility to distinguish three main directions of development of theoretical fundamentals of Chemmotology:

- Study of local mechanisms performance of components and various functionality additives in fuels and lubricants;
- Search for more general patterns in Chemmotology based on the use of fundamental laws of Physics, Chemistry and other sciences;
- Study of Chemmotological processes for prognostication of fuels and lubricants performance in technological equipment at various conditions.

The main goals of Chemmotology are the following:

- Optimization of requirements for quality and composition of fuels, lubricants and technical fluids, their service performance taking into account the primary energy sources reserves, achievements of scientific and technological advance in the development of technology, peculiarities of technological equipment and the conditions of its performance, ecological and economic requirements;
- Development of recommendations as for unification, interchangeability and determination of conditions of rational and economic use of fuels, lubricants and special fluids;
- Improving of oil product supply systems and quality management during production, storage, transportation and application of fuels, lubricants and special fluids;
- Modernization of compliance assessment system (certification, testing, permission to production and application), modernization of methods of qualifying tests for fuels, lubricants and special fluids;
- Unification of local standards for testing methods of fuels, lubricants and special fluids with international ones;
- Development of new highly efficient kinds of fuels, lubricants and special fluids that ensure the improvement in technical and ecological performance of technological equipment;
- Disposal and recycling of the off-grade and worked-off fuels, lubricants and special fluids;
- Building grounds for conducting logistic measures for preserving the quality and decreasing the losses of fuels, lubricants and special fluids during their storage, pumping and transportation;
- Developing methods for service performance and quality control assessment of fuels and lubricants, along with disposal of worked-off, unmarketable and off-grade fuels and lubricating materials;
- Improvement of the existing and development of the new technologies for fuels, lubricants and special fluids production.

The processes of interdependency and interaction of chains of Chemmotological system (figure 2) are the main research subject and the essence of Chemotology.

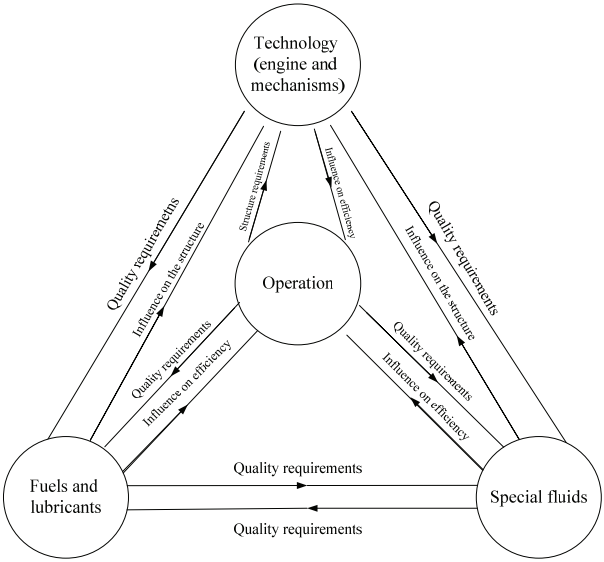

Fig. 2. Universal four-link Chemmotological system

The **subject** of Chemmotology is service performance of fuels, lubricants and special fluids.

The **main scientific and practical goal** is rational use of of fuels, lubricants and special fluids during equipment operation.

Economical meaning of Chemmotology is achievement of maximal economy of raw materials, of fuels, lubricants and special fluids through optimization of balance and quality of products, their rational and efficient use.

Theoretical fundamentals of Chemmotology consist of development of general theory and establishing laws that bond the quality of fuels, lubricants and special fluids together with reliability, durability, ecological compatibility, economy and efficiency of technical equipment; substantiation of optimal requirements for the quality; selection (development) of the new grades; unification of types and grades; ensuring the quality preservation; study of physical, chemical, and ecological properties during the storage, transportation and distribution; decreasing specific consumption and normed loss; decreasing the overall volume of quality control; development of quality regeneration methods; solving the problems of interchangeability of fuels, lubricants and special fluids grades produced in different countries; developing methods, equipment and service performance testing systems and quality parameters tests; protection of the environment from the influence of Chemmotological system (figure 3).

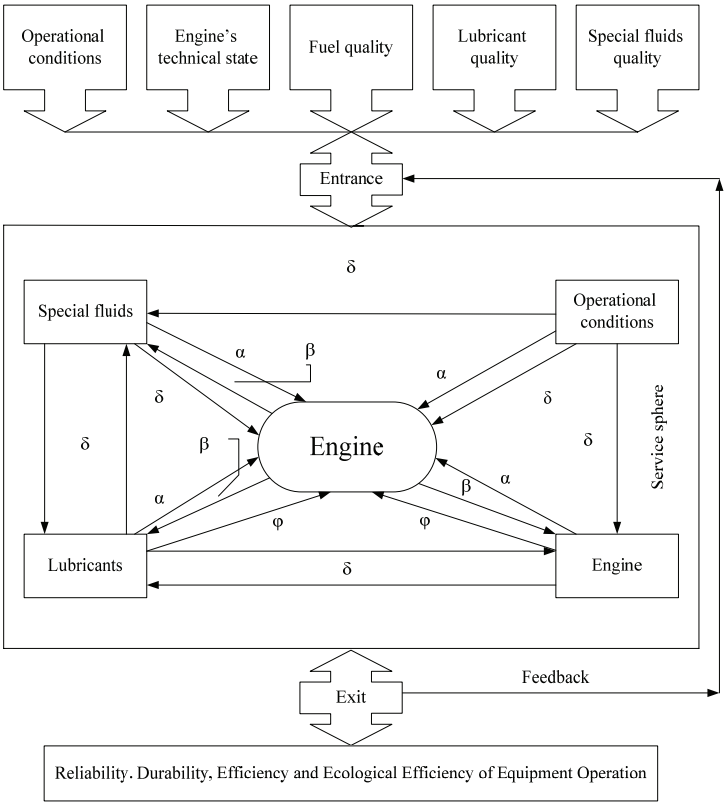

Fig.3. Chemmotological model of "engine-fuel-lubricant-special fluid" system functioning during equipment operation

α –influence of fuels, lubricants and special fluids on working characteristics of engine; β – requirements for fuels, lubricants and special fluids quality from the engine side; δ – influence of operation conditions on characteristics of engine, quality of fuels, lubricants and special fluids; φ – influence of fuels, lubricants and special fluids on the engine operation efficiency.

Chemmotology creates the necessary "basement" for ensuring optimal conditions of oil products rational use and modern requirements of their quality. The structure and content of the science of Chemmotology can be described by figure 4.

A special role in Chemmotology is played by quality control of fuel on the way from producer to consumer. The use of fuel with too high quality level leads to cost overruning in their production. At the same time low quality level leads to increasing costs of expenses for engineering and operating the equipment.

On the example of the role of the octane number of gasoline in the piston engine with spark ignition of air-fuel mixture it can be seen that the increase in the octane number of gasoline has allowed designers to develop engines with higher performance of dynamics, the better weight and size and reduced fuel consumption.

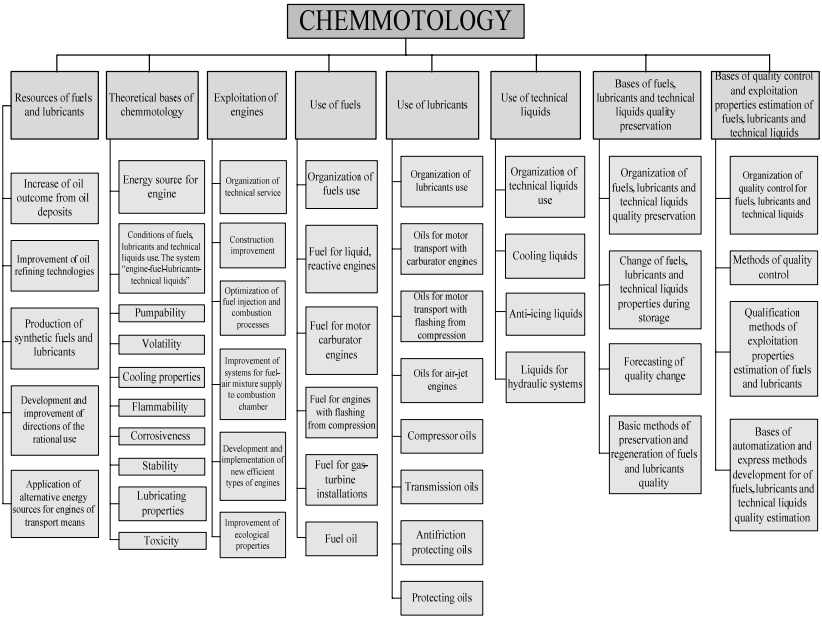

Fig. 4. The structure and the contents of Chemmotology

Choosing between good anti-wear properties and high thermal stability of jet fuels, as well as improved environmental properties (content of sulfur) of diesel fuel has led to the creation of high pressure aviation fuel pumps that are not sensitive to anti-wear properties of applied fuels.

Considering aspects of Chemmotology, we can identify specific issues related to the operation of equipment.

One of such aspects is fuel & lubricants purity, i.e. the presence or absence of solids, water, microorganisms and other contaminants that must not be present in fuel when transported from the place of manufacture but that may accumulate during transportation, storage, pumping and other operations.

Operation of equipment is also characterized by deterioration of fuel & lubricants quality in a result of evaporation, accumulation of oxidation products, precipitation of certain additives, blending of different fuel grades etc.

The main theoretical sense fuel & lubricants Chemmotology lays in dependence of properties of individual substances or mixtures used as fuel,

lubricants and fluids from their composition. The primary role is played by the substance constituting the bulk of a particular type of fuel. Thus, the base of hydrocarbons mixture determines such important properties as density for aviation kerosene, initial octane number for gasolines, diesel fuels properties at low temperatures, viscosity of engine oils, etc. However, pure form of a basic substances is used in fuels & lubricants only in specific cases, for example, a liquid propellant components (O_2, H_2, H_2O_2, etc.). But even they, not to mention hydrocarbon mixtures, are dependant sometimes on the presence of impurities or special additives. The greatest influence of impurities and special additives is revealed in hydrocarbons mixtures. Thus, sulfur compounds in hydrocarbon fuels determine their corrosion and environmental properties, oxygen containing compounds determine thermal stability of jet fuel, toctane number of gasoline, anti-wear properties of jet and diesel fuels.

The study of nature, patterns, connections and processes, during the use of fuels, lubricants, and technical liquids in aircraft engineering with special methodological tools is the base of aviation Chemmotology.

Aviation Chemmotology is the section of Chemmotology that solves problems of provision the required quality and conditions of fuels and lubricants use during the operation of aircraft.

The methodological approach of aviation Chemmotology includes the following major components:

- Four-link system "fuels & lubricants - technology - operation", which is a theoretical model of reality connections, compiled on the basis of hypothetical assumptions and idealization, which allows to unleash a wide range of issues of theoretical and practical problems in the study of numerous factors in the system (Fig. 2);

- Exploitation characteristics that are the way to display the main part of aviation fuels & lubricants quality, in relation to the technique, which they interact during operation;

- Physical-chemical properties that are the way to show stability of aviation fuel and lubricants quality according to normative documents regulating their production, testing and use;

- Qualification methods are the means for evaluation of exploitation characteristics of aircraft fuels & lubricants and revealing complex interactions between the elements of four-link system in order to solve applied and theoretical problems during their testing, rational and effective use;

- Reliability of aircraft, which is dependent on the quality of aviation fuels & lubricants (chemmotological reliability). It is a property of technique to maintain a high level of efficiency during application of different grades of aviation fuels & lubricants together with maintaining an economically viable level of quality;

- Economic entity means achievement of maximum economy of raw materials for aviation fuels & lubricants through optimization of the balance between the quality of end products during production and efficient their use of aircraft engineering.

The generalized function of utility of oil products as products useful for society can not be described with the single set of corresponding design papers and

engineering drawings as opposed to the generalized function of utility of vehicles. It is this principal distinction of oil products from the products of engineering industry that has created an objective ground for the origins of Chemmotology.

The use of fuels and lubricants with overstated quality parameters (quality level) leads to exceeding in costs of their production, and, in the case of their underestimation – to increasing costs in engineering and equipment operation.

The general diagram of connections between the steps of development, production, quality assessment, multi-level testing and use of fuels, lubricants and special fluids is shown in figure 5. As well as figure 6 shows the generalized universal model of the chemmotological system with interconnections and inter-impacts between engines, machines, their exploitation and fuels, lubricants and technical liquids.

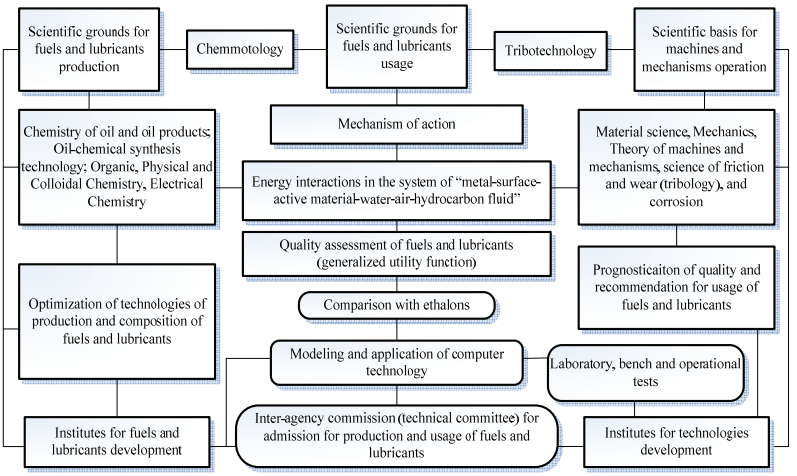

Fig. 5. The diagram of development, quality assessment and usage of fuels and lubricants

At the National Aviation University, the fundaments of Chemmotological scientific and pedagogical school started to form at the end of 1950s when laboratories of tribology under the supervision of Professor B.I. Kostetzkiy and Professor N.L. Holego were organized. In these laboratories, the processes of physical and chemical mechanics of materials under friction were studied with the help of unique equipment; and the recommendations as for the increase in longevity, reliability of machines and mechanisms along with improvement of fuels and lubricants quality were based on these research. Many staff and students took an active part in this research later becoming significant scientists and the founders of the science (Prof. A.Y. Alyabyev, Prof. V.V. Zaporozhetz, Prof. P.V. Nazarenko and others).

The studies in the field of theoretical and practical research of hydraulic drives and their elements were started under supervision of Prof. T.M. Bashta at the same time, too.

The department of details of machines and mechanisms (Prof. M.V. Rayko), department of aeronautic engineering (Prof. Z.S. Chernenko), department of Physics (Prof. A.N. Solovyev), department of electrical engineering (Prof. A.L. Groholskiy) and other subdivision also joined the solving of Chemmotological problems.

The clear orientation of Chemmotological research toward solving problems connected with ensuring working reliability of aircraft fuel, oil and hydraulic systems appeared in the 1960s. It then, when the special scientific group for solving the problems of fuels, lubricants and special fluids use was created under initiative of Professor Alexander Aksenov at the department of technical operation of aircrafts and aircraft engines (head of the department – associate professor Vasiliy Sukharikov). Different scientists including V.P. Belyanskiy, V.I. Teryohin, A.A. Litvinov, A.I. Kozachenko, Y.G. Nekipelov, A.E. Borodin, and A.Y. Shepel participated in the research conducted by this school.

Chemmotological scientific field was formalized at the National Aviation University of Ukraine under scientific advisory of Rector Alexander Aksenov in order to coordinate all research works and analysis of their results.

The activity of scientific school is inseparable from teaching. An independent department of Chemistry and Technology of fuels and lubricants was created in 1968. It was followed by the creation of the faculty of fuels and lubricant a year after (the head of the department and the first dean – associate professor Alexey Litvinov).

The first graduation of specialist in the field of testing and use of fuels and lubricants was in 1975. All the graduates (around 50 specialists) were in high demand and were hired by different operation companies, research institutes and educational institutes for civil aviation.

The majoring department of testing and usage of fuels and lubricants created by Professor Litvinov trained specialists in the field aviation Chemmotology. As a result, there was a significant increase in a professional level of quality control system of fuels and lubricants.

The department of Chemmotology, created in 2007, is seen as an official successor of that department today.

Phenomenon of scientific and pedagogical school is realized in the prospective of informational supply for the study process in the conditions of integration of science and higher school with the goal of research institute creation. The meaning of classic research institute, as first defined by W. Humboldt in the 19th century, is in integration of study process with fundamental scientific research. The motto of the University of Berlin, founded by William von Humboldt in 1809, was “Devotion to science” phrase. Informational supply being a constituent of integrated scientific supply of study process is aimed for the creation of organizational and substantial basis of informational and educational space which meets the level of society’s informing.

In general scientific and pedagogical schools are the centers of crystallization, concentration, and production of scientific and educational information and its application. These centers increase stability, determinancy, predictability and manageability of educational systems and processes. Being open self-managing systems these scientific schools are flexible and active in their interaction with external informational environment; they also constantly support and renew the scientific potential of their representatives and followers including students familiarized with science.

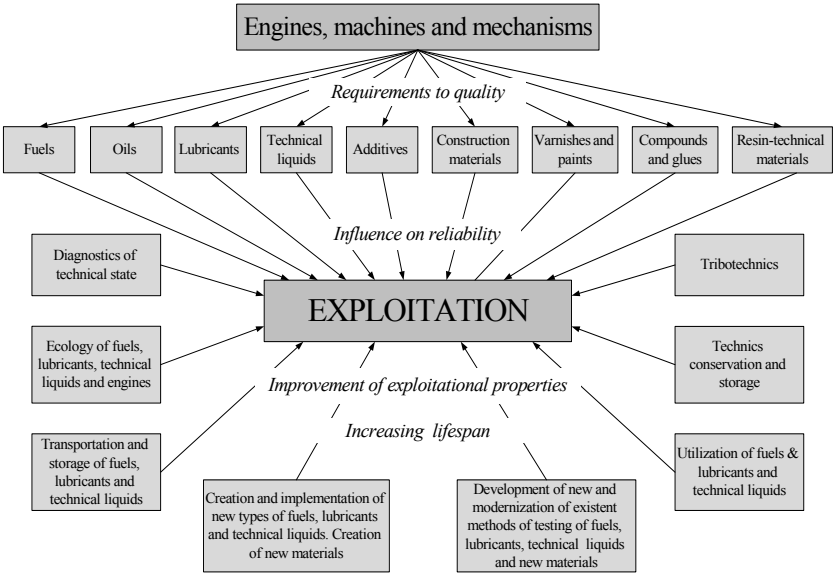

Fig. 6. Generalized universal model of the chemmotological system

V. Vernadskiy, Ukrainian natural philosopher and naturalist, when describing the appearance of scientific schools, noted that "tzar Peter I established the scientific research in Russia understanding its benefits for the state. And this scientific work has quickly found its place in public minds and didn't stop in the long decades of government not supporting the scientific activities. It was formed by the intellectuals of the state, their personal efforts, personal initiative or through the organizations created by them."

Leading positions in Chemmotological movement today belong to the department of Chemmotology and the Ukrainian research and training center of Chemmotology and certification of fuels, lubricants and special fluids of the National Aviation University.

The Ukrainian research and training center of Chemmotology and certification of fuels, lubricants and special fluids created at the National Aviation University is the successor of Ukrainian center of aviation Chemmotology and certification of products (created by Professor Belyanskiy in 1994).

In the modern conditions when requirements for all types of products and services including consulting and educational ones, have significantly increased and the conditions of collaboration and relationships between participants of the oil supply system have changed, the role of Chemmotological scientific and pedagogical school is gaining an extremely important meaning in the system if informational supply.

Extension courses for the specialists of gas-transporting companies of Ukraine and petroleum and chemical laboratories of Ukrainian oil supply companies including aviation fuel supply have been organized based in the centre in cooperation with the department of Chemmotology and the Institute of post-graduate training.

The centre's testing equipment allows conducting the research of most of the oil products at the level of requirements of standards including the international ones. The laboratories of the centre received the accreditation of international standards of 17025 and 9001 series. Educational activities aimed for training and professional development of personnel involved with production, usage and quality control of fuels, lubricants and special fluids is also being realized in the centre, along with development of educational, methodological and normative literature and documentation.

The centre and the department of Chemmotology participate actively in scientific and educational activities of the university together. This includes the organization of domestic and international scientific conferences, seminars, symposiums; carrying out a number of researches and engineering works for both, domestic and international customers.

In conditions when modern society tends toward sustainable development, alternative energy sources enter more and more spheres of human activity. During last decade the share of alternative fuels and lubricants has increased in several times.

The history of alternative or biofuels dates back to XIX century when Samuel Morey invented his engine that used alcohol or turpentine as fuel. Analogous inventions had appeared during thecentury. But huge oil deposits discovered at the beginning of XX century provided industry with cheap and efficient energy source. However in the second half of XX interest to biofuels has raised. It is explained by that fact that oil deposits are exhausting and finally will come to the end. Another reason for alternative fuels use was worsening of ecological situation on the planet. Scientists reconsidered relationships between human and nature. It was thought that natural resources should be used rationally, doing as less harm to environment as possible. Since that time various kinds of alternative become more and more popular and today makes about 5% from all energy sources used in the world. Thus studying of alternative fuels properties, development of technologies for their production and storage should be developed along with traditional oil-derived fuels and lubricants.

Keeping up with times Chemmotological scientific school sees development of this new research area as inseparable part of Chemmotology science. The main scientific and applied problems that are being solved by the representatives of the school include the following:

- Development of competitive resource- and energy-efficient technologies for storage, transportation of fuels and fuelling;
- Development of alternative fuels for vehicles;
- Study of physical, chemical and exploitation properties of alternative fuels, peculiarities of their application in modern techniques;
- Study of physical, chemical and service properties of fuels, lubricants, and special fluids during conduction of different technological operations;
- Development of express methods and methodologies of quality assessment of fuels, lubricants, and special fluids;
- Development of organization, technical and norming activities for preserving the level of quality of fuels, lubricants and special fluids;
- Development of new competitive additives for fuels and lubricants;
- Creation of a complex of methods qualifying tests of fuels, lubricants and special fluids.

The concept of development of Chemmotological scientific school at the National Aviation University is oriented toward the innovative model, the one that allows to collect and multiply the achievement of our staff in the conditions of today's crisis situation in the fuels and lubricants market; the one that lets to increase the level of developments and discoveries to the competitive level and to implement them practically in a short term; and also to create a basis for improvement of working conditions of scientific and pedagogical staff of Chemmotological school, realization of their scientific and educational programmes, finding and developing talented creative persons among the students youth, and preparation of top qualification specialists.

The goal of Chemmotological scientific school is the stimulation of scientific researches and experimental-design works along with training (professional advancement, extension) of specialists in accordance with international laws and standards for the solving of actual and prospective problems of Chemmotology, specialists in testing systems, production and usage of fuels, lubricants and special fluids, for aviation industry in particular, and also conservation energy-efficient innovations.

The strategic goal of activity of Chemmotological scientific school is the achievement of modern level of research and training of scientific and pedagogical personnel of the highest qualification.

The main mission is the carrying out of fundamental and applied research, scientific and experimental-design research in accordance with scientific specializations of the university, notably: Chemmotology, Tribochemistry, Tribology, Environmental protection and life safety, certification and quality

management, testing, diagnostics, permission for production of fuels, lubricants and special fluids with the goal to solve priority problems of science and practice.

Social and economical impact of Chemmotological scientific school comes in the shaping of highly-educated specialist which could meet modern level of highly-technological production and service in the first place. The role of this kind of specialists is constantly increasing in many countries since as of today deep knowledge and superior technologies become the new strategic resources.

Chemmotological scientific school of the National aviation university through the stimulation of spreading of knowledge and skills ipso facto ingenuously promotes:

- Integration and coordination of researches of creative groups in the field of Chemmotology of fuels, lubricants and special fluids;
- Carrying out scientific and experimental-design research;
- Training (professional advancement) of personnel for solving Chemmotological problems, certification, and quality management in compliance with international standards;
- Development of new materials and products;
- Increasing competiveness of products and services at the world level;
- Changing the culture (technical in particular), world outlook and modern way of life, etc.

Conclusions

Hereby, the Chemmotological scientific and pedagogical school of the National aviation university influences different sides and spheres of social life of the university, especially the ones connected with basic training of specialists in the education field, and also with research activities (oriented toward rational use of fuels, oils, greases and special fluids, for aviation equipment in particular). The school being an important constituent of informational supply of educational process furthers the inclusion of informational medium of the university into the worldwide informational system. The activity of the school in the structure of the university serves as a joining link between the university and world scientific environment, worldwide Chemmotology scientists community. It also ensures the need level of training of specialists in the field of oil products supply according with the social needs.

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A.U. Stelmakh, PhD (National Aviation University, Ukraine, Kyiv),
R.E. Kostyunik, (National Aviation University, Ukraine, Kyiv),
A.V. Stelmakh (National Aviation University, Ukraine, Kyiv)

TRIBO-CAVITATION FOR AVIATION KEROSENE

For example, the linear contact tribo system slide shows that fuel systems together with hydraulic and acoustic cavitation arises "tribo cavitation" occurring in diffusion areas of friction units and downward pressure on local pressures to lower pressure values and cavitation threshold.

Analyzing the current state of Tribology, U.M.Luzhnov monograph [1] points out that «in view of the complexity of the processes that form the friction, there is currently no consensus yet on its nature». To date, friction and wear are considered from the perspective of disparate terms and notions about the nature of friction.

In 2008 was hypothesized compression-vacuum friction nature [2], which was his first experiment and demanded more reasoned evidence, part of which is presented in [3].

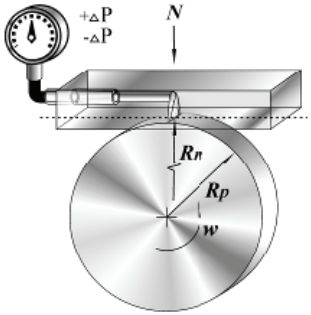
Established laboratory machine friction one-way linear sliding contact (fig. 1) implementation of optically transparent contact. You can adjust the speed and axle load compression rubbing surfaces that enables basic modes of friction (hydro, elasto-hydro dynamical and friction in the face of marginal lubrication).

As a rotating counter body reproducing the shaft, made Teflon video (outer diameter is 80 mm, width of roll-9 mm) flat fixed parallelepiped was made of optically transparent material (disoriented Acryl glass).

In the air, without lubrication, the surface forming vertical cylinder flat face clear movie box forms a linear contact in the form of a narrow rectangle. The length of the zone of such contact is clip 9 mm and the width of the axial force compression 4 N 0.7 mm and 40 mm h-about 0.8.

As a working environment has been used lubricating kerosene or TS-1, as a transparent, low-viscosity where friction sliding speed (0.2 ... 0, 8 m/s) and small loads (1…10 v) occurrence of hydrodynamic contactless friction is unlikely.

Experimental Conditions varied: linear speed gradually changed from 0.2 0.9 MPs, axial load changed between 4 and 200 m. after the linear contact around a symmetrical relative to line contact spot kerosene by wetting those surfaces (fig. 1).



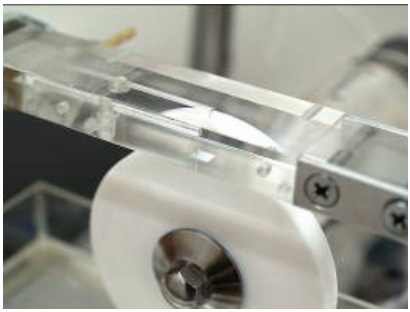
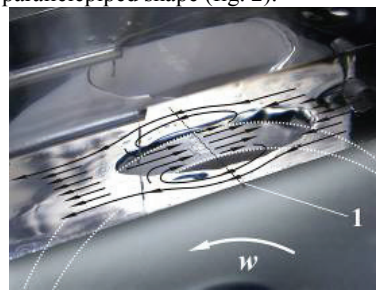


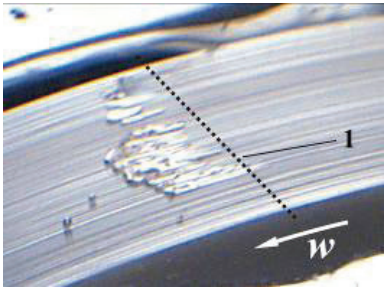
Fig. 1. Diagram of machine friction with the top position of the contact (s) and the emergence of linear contact lubricated kerosene, visible through the side edge of the box

Roughness of the surface of the roller set sufficiently broad and technically implemented in industry range from the r option $_{and}$ from up to 0,8 μm 20nm.

Visual phenomenon.When you turn on the drive roller casting.cylinder Surface friction slip on the bottom edge of the transparent parallelepiped shape is flat in the perpendicular line contact direction. viewing kerosene made roller contact, in a certain light, revealed, regular and natural behavior layer of kerosene simultaneously in two ways: through the side and the top edge of the transparent parallelepiped shape (fig. 2).



a)



b)

Fig. 2. The current liquid surface friction sliding clips on flat edge of the box (a) and the formation of cavitation bubbles in cavities and linear contactdiffusion area (b), where 1 is the center line of contact surfaces

Sufficiently thick layers Caught roller kerosene delivered contact, along the edges of it started wrapping obstacles formed the contact, then these surface fixed prisms for macroflows meshed contact. While there has been a shift towards the most stains, soak the reverse direction. After establishing a permanent operating speeds, when the contact area under a certain angle, there has been a very intense, visually seamless fluid bolus passage of kerosene from the contact area for input clip into contact with the bottom surface of the box in the direction opposite to rotation.

On exiting the working surface of contact visually observed intensified and continued for kerosene from wetting surface prisms of kerosene-contact, i.e. the slip road. The current kerosene when slide shown in Figure 2.

Increasing speed of sliding clips on the surface of a 3D box led to greater offset pin spots of kerosene in the direction opposite direction of rotation. When the monitored heterogeneity of kerosene "from the contact area of the sign-clip in touch, and" contact "in the area access clip from contact became more intense. The same happened when you increase the load, at constant speed.

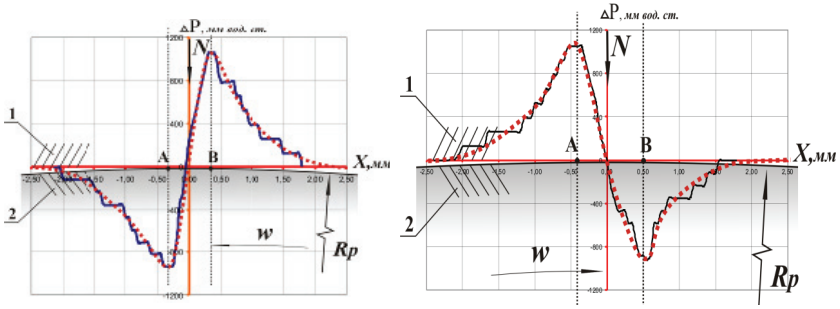
Gradual bring speed to 0.3 m/s, in the area access clip from contact in layers of kerosene was the emergence of gas bubbles which moved in the direction of slip, they made a moving surface generatrix clip over a distance of about 5 mm from the contact and then disappeared. Traffic generated gas bubbles (fig. 2 g) about contact took place against Jet currents of kerosene to "contact us" on the clip. These bubbles were randomly over the full width of the linear contact due to cavitation of kerosene. For kerosene TC-1 at 20 ^{0}, vapour pressure, in a State of dynamic equilibrium with the liquid phase is 919.9 PA at the liquid to the steam volume 4: 1. Hence, the vacuum in the area access clip from contact with speed 0.3 MPs and slight axial load of 4 h. That is, in the case of vacuum pressure boundary layers to below 919.9 PA. Further increases in speed resulted in an increase in the intensity and the number of bubbles that are merged and the eruption of steam-gas cavities. The latter took shape, similar to "flames" (fig. 2 g) with base in the middle of the field contact oscillating towards sliding on land-clip out of contact.

When you change direction sliding kerosene closely observed flows, also changed its direction in the opposite direction of the skid, "contact" in the field of log clip into contact with the surface of the box and "contact" in the area access being rubbed surface out of it. Change the direction of gliding almost symmetrical diversion caused contact currents.

Thus, there has been a regular postback visually track friction currents kerosene near contact zone. The emergence of such currents caused by increased pressure in the resulting convergent channel in the direction of rotation of the cylinder and symmetrical relative minimum gap intake-diffusor channel, i.e. friction is a deformation resistance: its compression and evacuation operations.

Measurement of pressure distribution in contact: For pressure distribution measurement in contact area, inside the box are the channels that the contact surface came out as a hole or slot, probe (receiver) sphygmomanometers in lubricating layer to the side of the box via the choke off the brink joined pressure gauge to measure static pressure in contact and near contact areas by means of scanning contact appropriate probe

Measuring pressure in layers of kerosene near contact zone in the middle pane contact to the midline using resistive sensors pressure MDD-0-1. Sensing was step 0.05 mm.



a) *b)*

Figure 3: distribution of pressure Δp at boundary layers of kerosene TS-1
Depending on the coordinates of the scan, perpendicular to the contact with slip-x, where AB is the width of the linear contact parallelepiped shape 1 and clip 2 with a radius R $_p$,ω-rotational speed, N-thrust compression, X-axis scanning
a) clockwise rotation; b) counter clockwise rotation

Measurement results (fig. 3A) showed that the pressure in the kerosene for login clip in touch increases of 2 mm to contact parallelepiped shape with rotating roller. Then, the front edge of the input pins, reaching a peak of over 1000 mm water column pressure dropped rapidly and declined to about the middle of contact atmospheric. A further shift of holes in the area access clip from contact resulted in diluted pressure reached extreme (about 1000 mm water column), but now below atmospheric and also on the edge of contact area output movie out of it. When you move the probe from the contact pressure kerosene, remaining below the atmospheric reliably began to gradually increase and atmospheric also leveled approximately 2 mm.

Conducted a similar measure, other things being equal, but in the opposite direction sliding (fig. 3) almost symmetrical inversion data demonstrating a plausible connection contact currents of boundary layers on the sending of slip. That is, as happened at the entrance to the contact pressure kerosene, and leaving him down on the air.

When you change direction sliding ceteris paribus pressure boundary layers of kerosene or TS-1 grades have changed for the middle of contact as well as visually observed lines (fig. 3). In the field of log clip in touch with parallelepiped pressure kerosene has edge contact has reached its maximum, and about the middle of contact has decreased to air. Then also jumps occurred in downgrading pressure kerosene layers that are scanned to a minimum, and in the area access clip out of contact, remove the probe from it fades in the measured pressure began to ambient pressure.

Consequently, adhesive force of friction (99% of the total friction force) that occurs at the edge-polymer tribocontact with lubrication as a result of the downward pressure environment between surfaces, moving towards diffusor of contact. Vacuolization environment between being rubbed surfaces, is one of the

fundamental physical processes that are causing wear and friction surfaces. Averting a decrease of pressure between surfaces of friction in the lubricant, the edge, such as the various techniques described in the paper [3], tribosystem slip can become almost wear-free.

Conclusions

1. Set a gradient aviation kerosene pressures on both sides of the contact type "tribosystem sliding shaft-sleeve" and, when entering in contact pressure is increasing, and by its withdrawal – falls on barometric pressure. These pressure differentials are causing Jet currents environment against the direction of rotation shaft.

2. it is shown that higher axial load and sliding velocity increases compression kerosene "at the entrance to the «contact» and its degree of dilution," contact ". These areas of high and low pressure kerosene symmetrical in relation to the maximum contact strain that exceed the length of the contact.

3. the example tribosystem slip with linear contact shows that fuel, oil or other hydraulic systems together with hydraulic and acoustic cavitation, there may be «tribo-cavitation» occurring in diffusor areas of friction units and downward pressure on local pressures to lower pressure values and cavitation threshold.

4. Confirmed the hypothesis coherent nature of friction and wear of the vacuum in aviation kerosene, which can be comprised of three sections of Tribology flowing, elasto-hydro dynamical and friction in boundary lubrication.

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O.U. Stelmakh, PhD (National Aviation University, Ukraine, Kyiv)
A. T. Ibraimov (National Aviation University, Ukraine, Kyiv)
V. A. Radzievskii (National Aviation University, Ukraine, Kyiv)

EXPERIMENTAL COMPARISON OF DIFFERENTIAL-PHASE METHOD AND METHOD OF DYNAMIC FOCUSING IN DEFINING OF ROUGHNESS PARAMETERS OF SURFACES

In this work you can find information about differential-phase method and method of autofocusing, which are used on differential-phase laser scanning profilograph-profilometer (DFLSPP) and microscope «MICROSCAN» correspondently. Also is considered experimental comparison of defining of 3D micro- and nano-geometrical surface conditions and standardized roughness parameters of surface with the help of those methods.

Almost all modern machines and mechanisms consist of friction nodes, which realize contact interaction of details with working surfaces in relative motion between each other. From tribology of boundary greasing it is known that there is great influence of surface roughness on tribological properties of rolling or sliding tribosystems. Due to this fact during production of details different quantitative methods for determination of roughness parameters are widely used (such as profilograph-profilometer CALIBR-201, "TEYLOR HOBSON", "SURTRONIC-10". Contac methods allow describing micro-geometrical surface structure only according to single profiles and they can't give information about volumetric surface condition, which is very important during friction in dependence of direction of exploitation and influence on wear resistance of tribosystem.

Nowadays contactless optical methods and equipment such as laser contactless differential-phase method and method of dynamic focusing (in DFLSPP of Ukrainian production [2] and microscope "μscan" of German production correspondently) are used instead of contact, less informative and destroying methods. This new equipment and methods can give essentially new, qualitative and quantitative information about volumetric 3D micro- and nanometric geometrical surface condition. In this work are presented results of experimental investigations of rough surfaces done with a help of DFLSPP and "μscan".

Today for controlling of working surface roughness of details with friction nodes contact methods still are used. In contact method needle with a circular diameter 2…4 mkm slides on a surface of sample in a linear direction. This method can be used for determination of wear traces after tribotechnical tests.

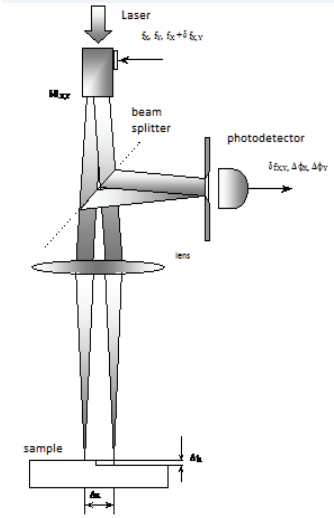
After experiments done on friction machine with a constant linear contact radial deviations are more then 1 micrometer, axial- 0,1 micrometer. That is why we can say that one of the main factors, which influence on results of tribological experiments of lubricating materials, is external structure of working surface of samples after friction.

But usage of contact method can provide us with necessary information about structure of surface, and can't give full information about surface, such as

roughness in a direction of sliding. This information have influence on character and value of wear [1].

Moreover, equipment which is based on contact method can scan surface only in one linear direction. In such conditions it is very hard to make volumetric estimation of surface structure. Indentor (needle) which is used for estimation of friction surface have circular radius (approximately 2 micrometers). That is connected with technological features and design of equipment and sensitive elements, which realize this contact method. Because of that we have such consequences like that hardware can't fix geometrical character of surface if it has roughness less than diameter of needle. That is why only contactless optical method can provide us with full information about 3D volumetric surface structure.

DFLSPP of Ukrainian production was created for reception of true information about surface structure and reception of differential-phase picture. Principle of action of this equipment is based on acoustic-optical scanning of object with the help of laser beam, which is divided in two orthogonal directions in crystal of parateluryte. During scanning this beams are reflected from surface creating 3D differential-phase picture (fig. 1).



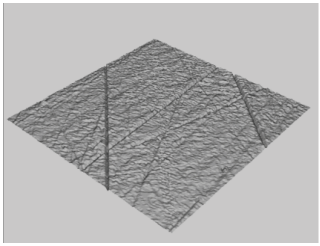


Fig.1. Laser contactless differential-phase method

For investigation of phase changing from reflected light waves in surrounding is used differential-phase method. This method allows creating optical scheme tolerant to vibrations.

Method is based on reception information about local difference of phases of two beams (basic and alarm), from which we can receive information about local curvature of wave front surface by scanning and integrating of defined values [3].

METHOD OF DYNAMIC FOCUSING Microscope μscan of German production by firm NanoFocus [4] was created for the same purposes as DFLSPP. But principle of action of this microscope is not the same. It has focusing sensor and movable lens, which provide auto-focusing by moving of lens along measurement scale (fig.2).

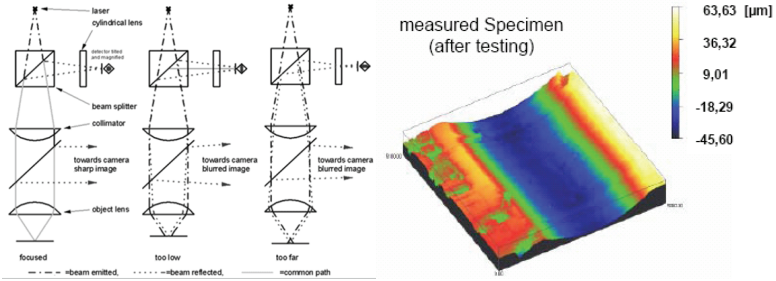


Fig. 2. Method of dynamic focusing method

Investigated object moves under laser beam with the set speed and information about moving of movable lens in dependence of height of surface relief goes to computer. The more focused points we will have the better picture will be received. The maximal investigated area is 10x10 cm^2.

Important peculiarity of DFLSPP and microscope μscan is possibility to define and calculate volumetric structure of rough surfaces. Software of that equipment allows defining main roughness parameters of investigated surfaces of samples. Both microscopes have different methods of calculation, that is why they also have different technical characteristics. Thus on DFLSPP can be calculated standardized roughness parameters of samples in a range 0,005…0,320 micrometers and on μscan in a range 0,025…1250 micrometers (Table1). But on microscope μscan this calculated roughness parameters are also compared with international standards ISO, which can be chosen for different materials.

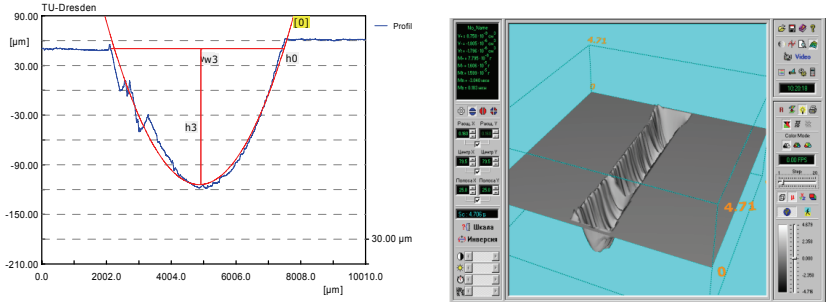
Also it has to be mentioned, that very important parameter during investigations of the sample is its reflection ability. For DFLSPP can be also investigated objects with reflection ability less then 50%, bun in this case lenses on profilograph-profilometer should be changed.

Microscopes Nanofokus and LDFSPP are used for definition size of deterioration of modeling bearings of sliding after friction in laboratory conditions. In the pic. 3 are presented profile of trek after friction, received on a microscope Nanofokus in the laboratories of the Tribotechnics of ILK TU Dresden and 3D image of a trek after friction received on LDFSPP in laboratories Nanotribotehnology NAU Kiev.

Table 1.

Technical characteristic of microscopes

№	Technical parameters	Microscope			
		DFLSPP		μscan	
		Type of objective lens			
		PLAN, F=6,3, A=0,65	PLAN, F=16, A=0,3	autofocus	
				AF2	AF5
1	Max.scanning area, mm	2,5×2,5 0,8×0,8	5×5 3×3	100×100	
2	X, Y- resolution, mcm	0,8	0,6	1	1
3	Curvature of surface, degree/mcm	20	8	26	19
4	Reflection coefficient of the surface, %	≥50		0…100	
5	Height of measured step of relief, mcm	≤0,32		≤1500	
6	Resolution for relief, nm	≤10		≥25	
7	Type of scanning	Acousto-optical		mechanical	



a) b)

Fig. 3. Profile of trek after friction by NANOFOCUS (a) and 3D view of trek after friction by LDFSPP (b)

Conclusion

Choosing equipment for estimation roughness parameters consumer need technical and economical comparison of this equipment to decide which one is better for purchase. Comparison of technical abilities had shown that differential-phase method has next advantages:

- Is insensitive to vibrations;
- Microscope can provide measurements of surface parameters to 1 nm on height of relief;
- Investigated object is immovable;
- Object with any size can be investigated.

But in this method we don't have autofocus and have not so big working range (height of relief can be measured in range 1…320 nm). Disadvantages of differential-phase method are realized in method of autofocus. And we can name its advantages:

- Wide measurement range;

Autofocus;

- Sample with surface with any reflection coefficient can be investigated.

In method of dynamic focusing we have next disadvantages:

- Sensitivity on height of relief is smaller then in DFLSPP;
- Mechanical scanning, which lead to vibrations and decrease sensitivity of microscope.

Comparison of all this advantages and disadvantages, general technical characteristics and price of this equipment show that such investigations are very important for consumers for making of an optimal choice of microscope for work in definite conditions.

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A. Iakovlieva (National aviation university, Kyiv, Ukraine)
K. Lejda, Dr. Sc. (Rzeszowska Politechnika, Rzeszow, Poland)
S. Boichenko, Dr. Sc. (National aviation university, Kyiv, Ukraine)
H. Kuszewski, PhD (Rzeszowska Politechnika, Rzeszow, Poland)
O. Vovk, PhD (National aviation university, Kyiv, Ukraine)
O. Martynova (National aviation university, Kyiv, Ukraine)

IMPACT OF RAPE OIL ETHYL ETHERS ADDITIVES ON SOME CHARACTERISTICS OF JET FUEL

Today oil is still traditional raw material for the production of aviation fuels. However, fuels obtained via processing of coal, oil-shales and natural gas became widespread in some countries. In addition, jet fuels derived from renewable resources such as biomass, vegetable oils, animal fats, oils, micro-and macroalgae, various agricultural residues, wood industry and others are actively developed and implemented. In future use of raw materials of biological origin will solve the problem of dependence on non-renewable energy sources and minimize the impact on the environment

Today, synthetic aviation kerosene derived from various biomass as well as synthetic paraffin kerosene obtained via hydrogenation of vegetable oils and animal fats are well known. Such alternative aviation fuels are of high quality, but getting into the environment, they cause adverse effects on the environment, similar to traditional oil-derived jet fuel.

Since the mid-1980s the technology of aviation biokerosene has been successfully developeding. It's a mixture of traditional petroleum kerosene and biocomponents in certain concentrations. Today biokerosene is the most promising type of alternative jet fuel in Ukraine. Usually, the raw material for the production of biocomponents is different oily plants, the choice of which depends on the geographical and climatic conditions. For conditions of Ukraine the most promising and sustainable raw material is rape.

Biocomponents are a mixture of fatty acids esters obtained during etherification of plante oils or animal fats. Methyl or ethyl alcohols are used as etherification agents. For several reason, the use of methanol is not justified. Today, most scientists tend to think about the feasibility of ethanol.

Considering the discussed material, biocomponents obtained via etherification of rapeseed oil by ethyl alcohol are used in this paper. The aim of this work is to study the influence of additives of biocomponents on physical and chemical characteristics of jet fuels.

Modern fuels for civil aviation should meet a number of requirements related to efficiency, reliability and durability of the aviation technics as well as their environmental safety. Among the general technical requirements for fuels forgas turbine engines are the following:

- High level of volatility;
- Good low temperature properties;
- Chemical and thermal stability;
- Absence of negative impact on metal and non-metal parts of the engine fuel system, equipment for storage and transportation of fuel;
- Good lubricating properties;
- The optimal level of electrical conductivity;
- Absence of toxic components, impurities and additives, the minimum content of sulphur compounds.

All these properties are primarily determined by the origin and properties of raw materials used for fuels production, the method of basic fractions obtaining, the methods of purification and mixing, properties of the additives applied.

In this work, the research has been done using jet fuel of grade TC-1. This fuel is for subsonic aircrafts and supersonic with limited duration of flight. Quality of fuel TC-1 is defined by industry standard ГСТУ 320.00149943.011-99 "Fuel TC-1 for jet fuels. Specifications".

As already mentioned, the complex of requirements for jet fuels is determined by a number of properties. In this work properties of fuel TC-1 was investigated according to the number of physical-chemical parameters such as density, viscosity, freezing point and flash point.

In order to study the impact of bio-components on physical and chemical properties of jet fuel ethyl esters of rape oil, modified by vacuum fractionation were used. Properties of mixtures containing 10%, 20%, 30, 40% and 50% of biocomponents were investigated and compared with the characteristics of TC-1 fuel and standard requirements to fuel TC-1. Table 1 shows the results of the investigations of fuel TC-1 sample, biocomponent sample and requirements of standard to these parameters.

Table 1

Values of basic physical-chemical characteristics of jet fuel TC-1 and biocomponent

№	Characteristics	Norm according to standard	Sample of fuel TC-1	Bio-component
1	Density at temperature 20 °C, kg/m^3	Not less than 775	792	869
2	Kinematic viscosity at temperature 20 °C, mm^2/sec	Not less than 1,25	1,29	7,27
3	Freezing point, °C	Not higher than minus 55	minus 63	minus 18,5
4	Flash point, °C	Not lower than 28	39	186

Investigation of mixtures of biocomponents and jet fuel TC-1 density was carried out according to the standard method ГОСТ 3900-85 Oil and oil products. The method for determining density. The measurement results are presented at the figure 1.

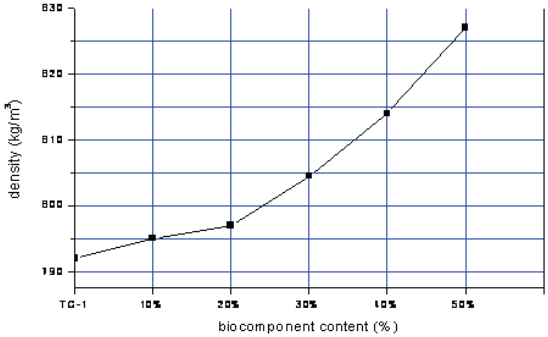

Fig. 1. Density of jet fuel TC-1 and its mixtures with biocomponents

Investigation of mixtures of biocomponents and jet fuel TC-1 viscosity was done according to the standard method ДСТУ ГОСТ 33-2003 (ISO 3104-94) Oil. Transparent and opaque liquids. Determination of kinematic viscosity and calculation of dynamic viscosity ((GOST 33-2000/ISO 3104), IDT). The measurement results are shown at the figure 2.

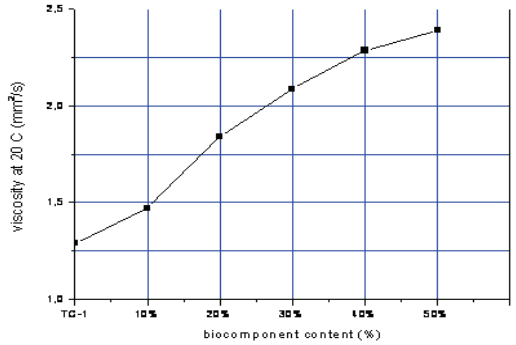

Fig. 2. Viscosity of jet fuel TC-1 and its mixtures with biocomponents

Investigation of the freezing point of mixtured biofuels was done according to the standard method GOST 5066-91 (ISO 3013-74) Motor fuels. Methods for determining cloud point, freezing point (method B). The measurement results are shown at the figure 3.

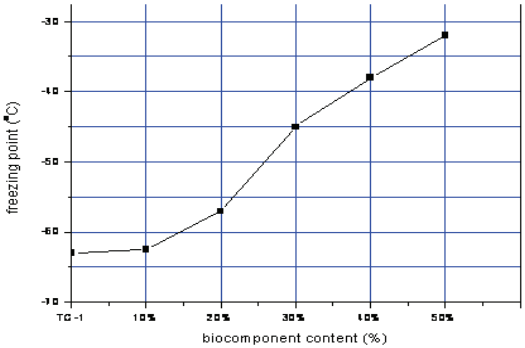

Fig. 3. Freezing point of jet fuel TC-1 and its mixtures with biocomponents

Investigation of flash point of mixtured biofuels was done according to the standard method GOST 6365-75 Oil products. The method for determining flash point in closed vessel. The measurement results are presented at the figure. 4.

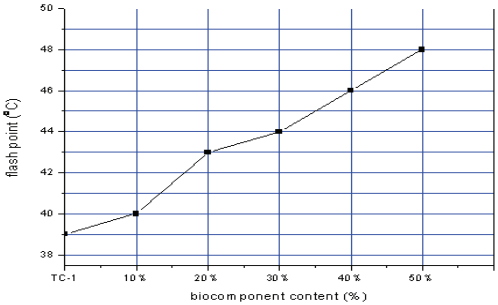

Fig. 4. Flash point of jet fuel TC-1 and its mixtures with biocomponents

Conclusions

Increasing of biocomponent content in jet fuel increases such physical-chemical properties of mixtures as density, viscosity, freezing point and flash point. The change of these characteristics is explained by the chemical structure of biological components. Crude oil jet fuels are composed of hydrocarbons with 5 – 16 carbon atoms in molecules. Unlike them biocomponents are composed of a class of compounds that contain 15 to 20 carbon atoms in the molecule. As a result, molecules of biocomponents are much longer than most of kerosene and have bigger molecular weight. With increasing of biocomponents content in mixtures concentration of molecules with high molecular weight increases and thus physical-chemical properties of mixtures change.

UDC (043.2)

O. S. Shtyka, PhD student (National Aviation University, Ukraine, Kyiv)
T. I. Bilyk, Cand. of Biol. Sc.
(National Aviation University, Ukraine, Kyiv)

ASSESSMENT OF ALLELOPATHIC ACTIVITY WITHIN PROCESS OF AIRPORTS TERRITORY DECONTAMINATION BY APPLICATION OF PHYTOREMEDIATION *IN SITU*

Phytoremediation ("in situ") as a low-cost soil recovery technology has some limiting factors that are supposed to influence on this process decreasing its effectiveness. One of them is manifestation of allelopathy activity of both introduced and indigenous species caused by introduction of phytoremediation plants into a phytocenosis of the contaminated area. This research work focuses on assessment of allelopathic activity of the selected introduced phytoremediation plants on biotest species i.e. Lactuca sativa L.

Phytoremediation is one of the effective soil recovery technology grounding on using of living organisms. It is frequently applied to decontaminate soils on the territories of industrial objects specified by extra concentrations of organic compounds, heavy metals, oil derivatives etc. Phytoremediation was also proposed for soil decontamination on the area of standing airports. Despite many advantages, its efficiency may depend on some factors, among which is an allelopathic interaction that is regarded to control and regulate species distribution in a phytocenosis and cause limitation of population. Allelopathic interactions are based on bio-physiological phenomena of a living organism to produce the specific organic chemicals that effect on the target organism by means of depression of its growth rate, inhibition of development and reproduction [1]. In the case of phytoremediation *in situ*, the allelopathic activity can be manifested both by indigenous species and introduced phytoremediation plants.

The purpose of present research work was to estimate the ability of the selected phytoremediation plants to release water-soluble inhibitory compounds. The investigated species were as follows: *Amaranthus caudatus, Amaranthus paniculatus*, and *Helianthus annuus L.* The experiments were provided to investigate allelopathic activity of water-soluble extracts exhausted from the mentioned species. This approach allows to distinguish allelopathic effects caused by the abiotic factors (e.g. mineral composition of soil, acidity and humidity levels etc.) that also affect growth rate and organism development.

The investigated plants were selected with roots during florescence period. Biomaterial was dried, then reduced to fine particles and finally pounded. Distilled water was used in proportion 1:10 for the preparation of extracts. During the next 24 hours the extraction process occurred.

Allelopathic effects of the obtained extracts were investigated by means of germination test with *Lactuca sativa L.* This method having low threshold limit of various chemicals influences is defined as an appropriate for the analysis.

The seeds germination is regarded as the most vulnerable stage of growth and minimal resistance to different negative factors is observed. The main criteria of

allelochemicals effect investigation are: 1) rate of seeds germination; 2) parameter of shoots and root; 3) morphological changes [2, 3].

The germination test was conducted in Petri dishes covered with cellulose paper at temperature 22 ± 1^0C for 120 hours. The amount of aqueous extract in a dish was equal to 5 ml. Each experiment had four replications (25 seeds per replication) under identical conditions and with the same concentration of the extract. Seeds of *Lactuca sativa L.* grown in potable water were used as control.

The screening-test fulfilled after period of incubation provided the ability to define the effects of allelochemicals presented in the extract. The germination percentage was calculated according to the following expression:

$$G_{\%} = \frac{\sum G}{n} \times 100\%,$$

where $G_{\%}$ is the germination percentage; G is the number of the germinated seeds; n is the number of seeds [4].

The visual morphological changes of roots and shoots (e.g. appearing of defects and undeveloped parts, change of roots form) were also taken into consideration within screening-test.

The results of the germination test are presented in Table 1.

Table 1

Results of the germination test using of *Lactuca sativa L.*

Investigated species	Parameters investigated within screening test			Visual morphological changes, [%]
	shoot length, [mm]	root length, [mm]	germination percentage, [amount/ %]	
Amaranthus caudatus (sort 1)	27±0.10	50±0.08	24/96	- non observed
Amaranthus caudatus (sort 2)	28±0.10	48±0.11	23/92	12% twisting of root
Amaranthus paniculatus	28±0.30	49±0.14	25/100	- non observed
Helianthus annuus L. (sort 1)	21±0.20	31±0.13	18/72	52% divarication and twisting of root
Helianthus annuus L. (sort2)	22±0.01	45±0.21	19/76	48% twisting of root, withering of roots
Control	30 ±0.09	51 ±0.11	25/100	- non observed

The experimental data showed that aqueous extracts of *Helianthus annuus L.* (for two sorts) had impact on growth and development of the biotest species (see Table 1). According to obtained results the germination rate decreased significantly. Thus, in the case of *Helianthus annuus L.* (sort 1) germination percentage was equal

to approximately 72% and for sort 2 this parameter was near 76%. The negative influence revealed also in decreasing of shoots and roots length in comparison with control sample (for sort 1 the average values of parameters were 31±0.103mm and 21±0.200 mm, while for sort 2 they were a few higher: 45±0.210 mm and 22±0.014mm). The morphological changes were also observed and majority of them was represented by withering of roots endings, shoots drying, divarication and/or twisting of roots.

Slight affects were observed in the case of *Amaranthus caudatus* (sort 1). They revealed in lower germination rate in comparison with other investigated species of *Amaranthus* and control. The twisting of roots was character for 12% of investigated species.

Conclusions

1. The allelopathic activity of the introduced phytoremediation plants used for soil decontamination on the territories of standing airports was investigated. This analysis is the important stage of *in situ* technology development due to high risk of allelochemicals influence on the effectiveness of plants introduction as well as on the whole recovery process.

2. According to the received results, water-soluble extracts of *Helianthus annuus L.* affected germination of biotest species *Lactuca sativa L.* The suppressing effects manifested as: decrease in germination percentage, roots (11 – 40% less comparing with control) and shoots length (27 – 30% less); morphological changes (e.g. roots twisting and withering).

3. The results of current investigation proved our data concerning relatively high level of *Helianthus annuus L.* allelopathic activity received earlier by means of "yield-density relationship" method. Thus, *Helianthus annuus L.* should not be recommended to be used as phytoremediation plant for soil decontamination.

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UDC (043.2)

J. Sęk, Dr. hab. Eng. (Lodz University of Technology, Poland, Lodz)
O. S. Shtyka (Lodz University of Technology, Poland, Lodz)

THE EFFECTIVENESS OF KEROSENE-WATER EMULSIONS REMOVAL USING POLYPROPYLENE SORBENTS WITH IMBIBITION PROMOTERS

This publication focuses on investigation of a process of porous media imbibition with "oil-in-water" emulsions. The current research was conducted to evaluate the imbibition effectiveness of six different polypropylene materials with kerosene and its 10% and 20% emulsions with water. The investigated materials have different porosity and their structure was modified by promoters of imbibition.

Over a last few years contamination of the environment with oil and its emulsions has become a serious ecological problem. These contaminants cause a wide range of negative impacts, e.g. bioaccumulation in food chains, carcinogenic and mutagenic effects on living organisms, disrupt their biochemical or physiological activities, deterioration of the environmental quality in general. The mechanical removal of oil-derivatives from the environment by application of various sorbents is defined as a main recovery method due to easy implementation, high efficiency, low-cost and ability to reuse of the sorbing material.

The purpose of this research work was investigation of the imbibition efficiency of synthetic porous media having a different structure imbibed with kerosene and its emulsions. The used media were "oil-in-water" emulsions consisting of kerosene and water with adding of nonionic surfactant. The dispersed phase concentrations (DPC) in emulsions were 10% and 20%.

The main properties of the emulsions and their basic components are shown in Table 1. The investigated emulsions exhibited the same properties as Newtonian liquids, because their viscosity was not depend on the shear rate as shown rheometric data.

Table 1

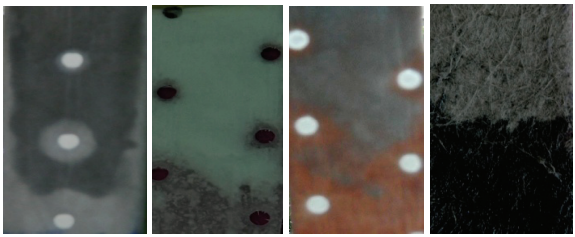
Properties of the prepared emulsions and their basic liquids at T=25.5^{0}C

Type of medium	Density, [kg/m^3]	Viscosity, [mPas]
Emulsions:		
DPC of 10% (surfactant 2%)	0.898±0.002	1.214±0.002
DPC of 20% (surfactant 2%)	0.845±0.001	1.522±0.001
Basic liquids:		
Kerosene	0.762±0.003	1.685±0.003
Water+Rokacet O7	0.998 ±0.001	0.904±0.0012

The porous media were represented by six types of polypropylene sorbents which differed in structure. Three of them were the materials (marked here as "specific") which were able to sorb oil-derivatives, and the other three (marked as "universal") absorbed water and all other liquids (marked as "universal").

The effectiveness of the porous medium imbibition with emulsions and kerosene was determined experimentally by submerging of a strip of the sample of each material into the liquid. A strip of porous material had a size of 20cm × 3.5 cm and the thickness of 0.19 cm. The square of contact area was equal to 7 cm^2. The process of imbibition was observed from the moment when the polypropylene material was put in contact with the investigated medium. Measurements were carried out till the process reached equilibrium and amount of the imbibed mass stopped to change.

Figure 1 represents fragments of the materials which were imbibed with kerosene and emulsions.



a) b) c) d)

Fig. 1. The fragments of the investigated materials imbibed with: a) 20% emulsion (specific type with one row of promoter); b) kerosene (specific type with two rows of promoters); c) 10% emulsion (universal type with two rows of promoters); d) kerosene (universal type without promoters)

The defined values of grammage and porosity of sorbents as well as results of the calculations of the imbibition process efficiency are represented in Table 2.

Table 2

The properties of the investigated polypropylene materials

Type of material	Grammage [g/cm^2]	Porosity average	Level of the imbibition process efficiency (E_{im})			
			kerosene [in time]	WRO7 [in time]	10% emulsion [in time]	20% emulsion [in time]
Specific 2P*	0.0212 ±0.0002	0.707	7.673	16.320	7.381	7.956
Specific 1P	0.0212 ±0.001	0.713	7.761	14.010	7.759	7.601
Specific 0P	0.009 ±0.0002	0.662	8.524	15.744	10.868	8.026
Universal 2P	0.0203 ±0.0014	0.735	6.630	7.205	6.559	7.844
Universal 1P	0.0203 ±0.0031	0.713	6.670	3.412	6.955	7.974
Universal 0P	0.009 ±0.0021	0.850	8.768	12.585	8.253	8.086

A parameter of the effectiveness of a material imbibition allowed to find how many times the mass of an absorbed liquid per one square centimeter is higher than

the grammage of dry sorbent. The effectiveness of imbibition was calculated according to such expression:

$$E_{im} = \frac{(m_{im}/h_{im} \times a)}{G_m},$$

where E_{im} – is the effectiveness of imbibition; m_{im} – is the mass of liquid imbibed by a material [g]; h_{im} – is the height of liquid front [cm]; a – is the width of a material strip [cm]; G_m – is the grammage of an investigated material.

One can notice that defined process of efficiency was similar for 10% and 20% emulsions and kerosene practically for all sorbents as shown in Table 2. The significant differences in the sorption efficiency can be observed for water mixture with surfactant (denoted as WRO7) in the case of both groups of polypropylene strips (see Table 2).

The process of polypropylene sorbents imbibition with investigated media is represented in Fig. 2 – 4 as the values of dimensionless imbibed mass versus time.

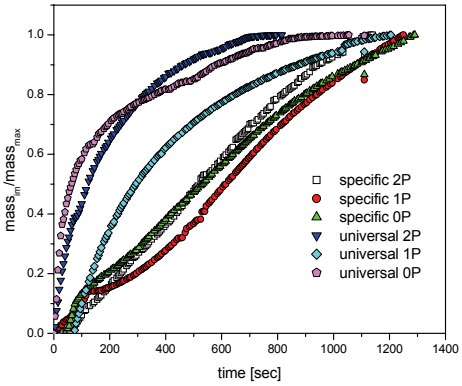


Fig. 2. Processes of the materials imbibition with 10% emulsion

The dimensionless masses were calculated as the ratio of $mass_{im}$ of the absorbed liquid to the maximal mass ($mass_{max}$) which was soaked into the sorbent strips.

One can find that in the case of 10% and 20% emulsions, all samples of "universal" type of the polypropylene sorbents were characterized by higher rate of the investigated media absorption, while strips of "specific" type had the higher value of imbibed mass.

According to the obtained results, in the case of kerosene investigation, the the sorbent "universal without promoters" exhibited the highest rate of imbibition in comparison with other samples, but in the same time had the lowest value of

absorbed mass. The promoters caused enlarging of the mass of imbibed kerosene (see Fig. 4).

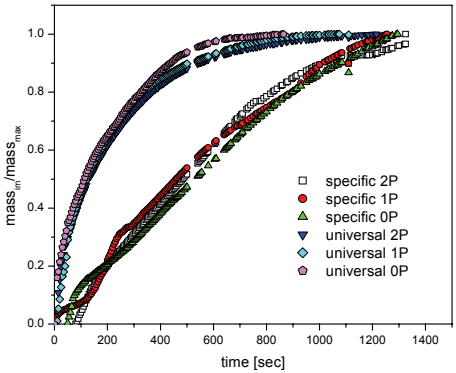


Fig. 3. Processes of the materials imbibition with 20% emulsion

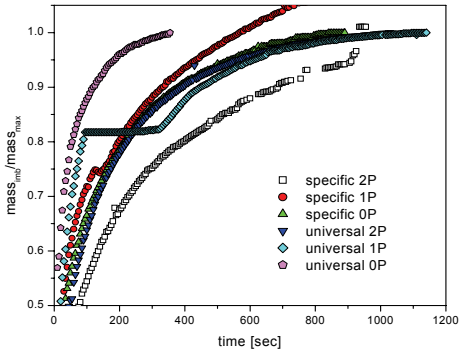


Fig.4. Processes of the materials imbibition with kerosene

Conclusions

The efficiency of porous media imbibition with kerosene and its 10% and 20% emulsion with water was investigated experimentally. In accordance with the received results, modification of the sorbents structure with promoters of imbibition gave opportunity to increase volume of imbibed liquids and cause no effect on the rate of process. The concentration of the disperse phase of emulsion had non significant effect on the efficiency of the imbibition process.

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A. Rüfer, A. Werner, W. Reschetilowski (Institute of Industrial Chemistry, Dresden University of Technology, Dresden, Germany)

QUALITY BOOSTING OF DIESEL FUELS BY THE ISOMERIZATION OF N-PARAFFINS ON MESOPOROUS SUPPORT BASED CATALYSTS – DESIGN OF EXPERIMENTS IN COMBINATION WITH KINETIC MODELING

The isomerization of medium-chain paraffines to their mono-branched analogs improves the low-temperature characteristics of diesel fuel while retaining the high ignitibility required for diesel engines.

The reaction is catalyzed by a bifunctional catalyst, which contains both an acidic and a hydrogenation/dehydrogenation function, and has already been extensively studied for the isomerization of paraffines, especially on metal-loaded zeolitic material [1,2]. The current work deals with the investigation of the isomerization reaction on bifunctional catalysts based on mesoporous silica supports, which are modified systematically in a Design of Experiments (DoE) [3]: screened parameters include the calcination temperature, metal dispersion and surface acidity. The ambition of this work is to apply experimental design in connection with kinetic modeling to derive a detailed understanding of the individual reaction steps in the isomerization reaction of linear alkanes. The combination of experimental data drawn from both the model reaction of n-decane and the solid-state characterization of the specific catalysts provides the basis for in-depth scientific interpretation and optimization of the investigated process.

To fulfill the requirements of the experimental design, 18 different bifunctional catalysts were prepared. This included the synthesis of the porous, silica support material followed by post-synthetic alumination. Then the noble metal was incorporated by incipient-wetness technique and in the final step, dopant and second metal (if designated) were introduced simultaneously by incipient-wetness technique. A more detailed description of the applied procedures is provided in [3]. Surface area estimation of modified support materials was performed via nitrogen physisorption experiments on a Carlo Erba Sorptomatic 1990. Surface acidity was determined by temperature-programmed desorption of ammonia, and metal dispersion by CO pulse chemisorption on a Thermo TPDRO 1100, equipped with a thermoconductivity detector. Catalytic testing was carried out in the gas phase using a tubular flow reactor with standardized process condition. The catalyst bed consisted of 1.00 g of catalyst powder, mixed with 3.00 g of comparable inert quartz breakage. H2 flow was set to 10.0 l/h, liquid n-decane feed to 6.00 ml/h, and reaction pressure was fixed at 3.0 MPa. Temperature was monitored continuosly by a thermocouple located directly in the catalyst bed. All catalyst samples were reduced in flowing H2 (10 l/h) at 450 °C (4h) directly prior to catalytic testing.

Results and discussion. A new reaction scheme is presented (Fig. 1), which includes a reaction path of direct di-branching originating from the linear reactant,

and validation thereof is provided via mechanistic considerations and kinetic modeling. [4]

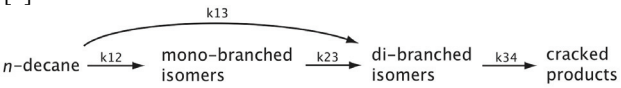

Fig. 1. Proposed reaction scheme of the isomerization of n-decane with reaction path of direct di-branching k13

The determination of the corresponding rate constants via kinetic modeling (Fig. 2) provides precise insight concerning each individual reaction step, reaching from n-decane to the final cracking products.

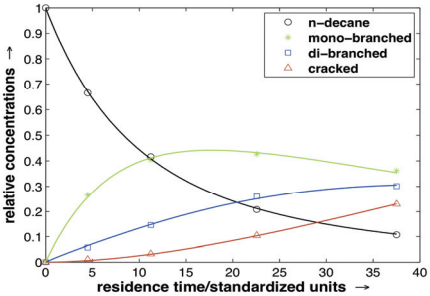

Fig. 2. Kinetic modeling of a reference catalyst sample for the experimental design

The systematic approach with application of an experimental design (containing 8 individual catalyst samples) allows for the calculation of main- and interaction effects in terms of the calcination temperature, metal dispersion and acidity on every individual rate constant, rather than merely addressing selectivity for the overall process.

Conclusions

In conclusion, the influence of calcination temperature was found to be negligible, as opposed to metal dispersion and acidity. High dispersion increased the primary reaction rate to mono-branched products and, at the same time, decreased cracking tendency. Low acidity decreased all rate constants, but the cracking reaction was unexpectedly affected to a far greater extent. Therefore, selectivity issues concerning the generation of mono-branched isomers could be explained at considerably greater detail than before, due to the combination of the systematic DoE-approach and the application of kinetic modeling.

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UDC 665.753.4.038

O.B. Shevchenko, PhD , P.Y. Lemish, V.M. Kamenieva
(Ukrainian State University of Chemical Technology, Dniepropetrovs'k)

INFLUENCE OF FUELS WITH ALTERNATIVE COMPONENTS ON LUBRICATING MATERAIALS

The paper deals with fuels with alternative components application issues. There have been presented the results of studying the fuels impact on physical and chemical, and performance properties of engine oils of different nature.

Both oils derived from rapeseed, sunflower, soybean and flax, as well as the products of their processing have become of big interest recently. Ukraine has a promising source of raw materials for the production of bio-ethanol and biodiesel. Application of esters of fatty acids not only expands the resource base of fuels obtaining, but also helps to solve such chemmatological issues as improving of operational and environmental characteristics of the engine.

The main task of the researchers was oil major properties defying with diesel fuels, esters of fatty acids and low temperature component addition. The object of the studying covers M-8V engine oil, synthetic PAO oil and hydrocracking oil. There have been added mixtures of fuels (biodiesel, virgin diesel, and hydrocracking diesel) and low temperature component to each of the oils mentioned above to study their impact on the properties of the latter. The following properties have been defined for each sample: Density at 20°C, Kinematic Viscosity at 40°C, Flash Point in an Open Cup, and Acid Value before and after oxidation. The concentration of fuel component added to the oil (i.e. an alternative component with virgin diesel in the oil) made up 10, 15, and 20 %. Such ratio has been chosen for the maximum proximity to probability of fuel mixtures entering into lubes during the engine operation.

Conclusions

The results of the research have shown that with the fuel content increase in the oil its oxidation stability, flash point and lubricating properties decrease. Sample mixtures of oils and fuels under analysis have presented the significant deviation from the current standards, with the exception of hydrocracking oil samples. Only the properties of the latter in spite of fuel oil entering into it stays within the range of established standards.

UDC 665.765

J. Lyubinin, Ph.D (State enterprise «Scientific and Research Institute for Refining and Petrochemical Industry "MASMA", Ukraine, Kyiv),
M. Kurbatova, Ph.D (State enterprise «Scientific and Research Institute for Refining and Petrochemical Industry "MASMA", Ukraine, Kyiv),
L. Kulikov, Dr.Sci. (Frantsevich Institute for Problems of Materials Science of NASU, Ukraine, Kyiv),
K. Grinkevych, Ph.D (Frantsevich Institute for Problems of Materials Science of NASU, Ukraine, Kyiv),
N. Konig-Ettel, Ph.D (Frantsevich Institute for Problems of Materials Science of NASU, Ukraine, Kyiv),
I. Tkachenko (Frantsevich Institute for Problems of Materials Science of NASU, Ukraine, Kyiv),
L. Mordel (Frantsevich Institute for Problems of Materials Science of NASU, Ukraine, Kyiv)

AIRCRAFT LUBRICANT MATERIALS WITH ADDITIVES OF MOLYBDENUM DISULFIDE AND DISELENIDE GRAPHENE-LIKE NANOPARTICLES

The study is devoted to the influence of Molybdenum Disulfide and Diselenide graphene-like nanoparticles (2H-MoS_2, 2H-$MoSe_2$) on tribological characteristics of aircraft lubricant materials

Increased demands are put forward to aircraft lubricant materials such as an increase of the load-speed range, operation temperatures and lifetime. The development of the multifunction greases and oils effective for most of friction units with the advent of new, modern aircraft becomes complicated. It is expected that high-temperature oils and greases with additives of a new generation solid nanolubricants of Molybdenum Disulphide and Diselenide graphene-like nanoparticles (2H-MoS_2, 2H-$MoSe_2$) will have a number of advantages in tribological characteristics at extreme operating conditions compared to well-known analogs of leading world manufacturers.

Systematic investigations of tribological characteristics of aircraft lubricant materials – the high-temperature greases (complex-calcium, complex-lithium and bentonite) and aircraft oils (BP Turbo Oil 2380, MS-8p and IPM-10) with functional additives of 2H-MoS_2, 2H-$MoSe_2$ solid nanolubricants are carried out for the first time.

Laboratory nanotechnology of graphene-like 2H-MoS_2, 2H-$MoSe_2$ nanoparticles ("inorganic graphene-like nanostructures", "two-dimensional (2D) nanoparticles") was developed at Frantsevich Institute for Problems of Materials Science of NASU.

The graphene-like 2H-MoS_2 nanoparticles (with average sizes in crystallographic [013] and [110] directions $d_{[013]}$=3,7(2) nm, $d_{[110]}$=9,4(6)–10,7(7) nm) were used as additives to the high-temperature greases. Tribological

characteristics of proposed lubricant materials were investigated by widespread methods: GOST 9490 (ChMT-1 friction four-ball machine – anti-wear and anti-seize properties), ASTM D 5706 (SRV friction machine – anti-seize properties), ASTM D 2266 (Falex Four-Ball Wear Test Machine – friction coefficient), (Table 1). The addition of graphene-like 2H-MoS_2 nanoparticles to the high-temperature greases led to improvement of anti-wear and anti-seize properties (20–30 %) with comparatively small increase of friction coefficient for all studied lubricant materials.

Table 1.

Tribological properties of high-temperature greases

Simple of grease	GOST 9490			ASTM D 5706	ASTM D 2266
	Critical load, H	**Welding load, N**	**Fretting index, H**	**Highest Non-Seizure Load, *H.NS.L*, H**	**Coefficient of friction, *f***
Complex-calcium (base)	1040	2320	380	350	0,164
Complex-calcium with 2H-MoS_2 additive	1230	2930	641	380	0,179
Complex-lithium (base)	969	1650	742	320	0,150
Complex-lithium with 2H-MoS_2 additive	1170	2070	947	356	0,164
Bentonite (base)	1570	1960	643	282	0,167
Bentonite with 2H-MoS_2 additive	1960	2450	1071	320	0,182

The changes of surface wear of steel ball after tests on the ChMT-1 friction machine for the base bentonite grease and with additive of graphene-like 2H-MoS_2 nanoparticles were studied (Fig. 1).

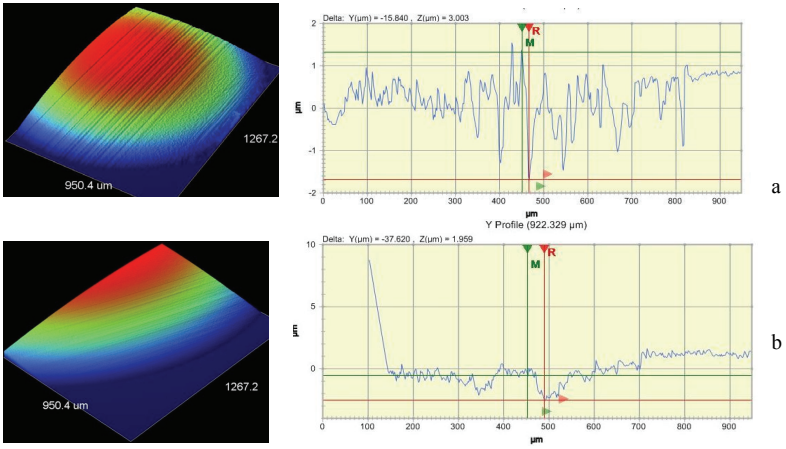

Fig. 1. 3D-images of wear path of movable ball of four-ball friction pair and surface profiles for: a – base bentonite grease; b – bentonite grease with additive of graphene-like 2H-MoS_2 nanoparticles.

There is observed the wear reduction of friction surface of steel ball for bentonite grease with additive of graphene-like 2H-MoS_2 nanoparticles (the maximum height of profile deepenings are 1,9 μm) in comparison with the base bentonite grease (3 μm).

BP Turbo Oil 2380, MS-8p and IPM-10 that wide use in gas-turbine engines of military and civil aviation have been chosen for study the possibilities to improve the tribological properties of lubricant materials on the basis of aircraft oils. The industrial I-20A oil as a basis for comparison was investigated too. The use of graphene-like nanoparticles 2H-$MoSe_2$ (with average sizes $d_{[013]}$=5,5(3) nm, $d_{[013]}$=26,8(1,7) nm) was proposed as functional additives.

For the first time the effectiveness of these additives to universal aircraft oils was studied in a wide range of speed-load modes, including dynamic loading. The experiments at the original tribocomplex CATC were carried out. The CATC is tribocomplex of module type that consists of multipurpose tribotest machine, friction unit with the dynamic loading, computer and complex of electronic devices which provide the multi-parameter control and information processing in real-time.

The CATC allowed to conduct tests of three types: (i) all modes of lubricating action from boundary to hydrodynamical at “plane – generatrix of cone” scheme depending on loading and speed regimes, (ii) quasi-static wear test with reciprocation sliding indenter by the “plane – sphere” scheme performed at quasi-static load (30 N) applied in a normal direction to the tested surface and (iii) so-called dynamic wear test, which consist in applying both the quasi-static and alternating components of load.

Amplitude of load alternating component was approx 10 % of quasi-static one. Friction force, wear, electrical contact resistance, triboelectromotive force of samples were studied *in situ*.

The proposed test schemes allowed to evaluate the influence of oil and additive on tribological (including tribophysical) characteristics of lubricant materials for studied lubricating modes (Fig. 2).

The addition of graphene-like 2H-$MoSe_2$ nanoparticles reduced wear for all studied lubricant compositions in 1.25–6 times in comparison with the base oils depending on the load-speed test conditions (Fig 2). Significant properties differences of lubricant compositions may be due to the nature of the organic components of the studied oils and their possible interaction with graphene-like 2H-$MoSe_2$ nanoparticles.

The influence of rotation frequency on the tribosystem parameters have shown that the lubricant compositions, especially based on BP Turbo Oil 2380, had a higher lubricity (the smallest wear and speed up to the establishment of the hydrodynamic regime). Less viscosity of MS-8p oil and its compositions provided less lubricity (Fig. 2 a, mode i), as evidenced decrease by an order of the electrical parameters in comparison with more viscous other oils (Fig. 2 c, d).

However, the additive of graphene-like 2H-$MoSe_2$ to MS-8p oil was more effective at boundary lubrication conditions (Fig. 2 a, mode ii, iii).

In general, in these tribosystems wear protection determined by the interaction of nanoparticles with components of oils and possible formation of

nanocomposites, and closely linked to tribophysical properties of nanoparticles, lubricating capacity and physical-chemical properties of base oils.

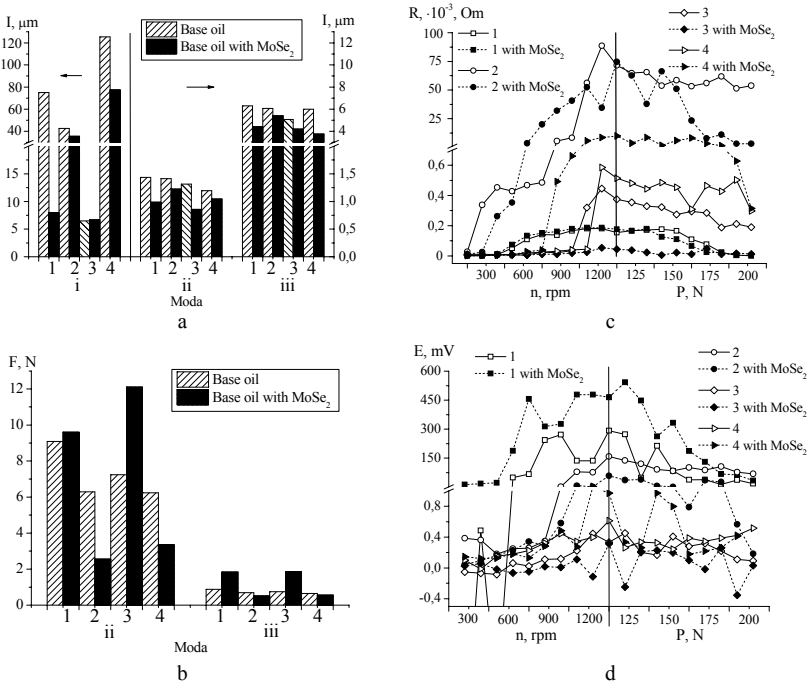

Fig. 2. The average wear, I, (a), friction force, F, (b) and the dependences of electrical resistance, R, (c), triboEMF, E, (d) vs. rotation frequency, n, and loading, P, at tests for lubricant compositions based on: 1 – I-20A; 2 – BP Turbo Oil 2380; 3 – MS-8p; 4 – IPM-10.

Conclusions

The obtained test results of greases and oils with additives of Molybdenum Disulphide and Diselenide graphene-like nanoparticles indicate the prospects of their use for design of aircraft lubricant materials of new generation.

UDC 665

A. Gawdzik (University of Opole, Department of Process Engineering, Opole, Poland),
J. Gawdzik (University of Technology, Faculty of Civil and Environmental Engineering, Division of Waste Management, Kielce, Poland),
B. Gawdzik (Jan Kochanwski University of Humanities and Sciences, Faculty of Mathematics and Science, Institute of Chemistry, Kielce, Poland),
A. Gawdzik (University of Opole, Department of Process Engineering, Opole, Poland)

MODEL OF HYDROCARBONS TRANSPORT THROUGH THE POROUS GROUND MEDIA

Dispersion model of hydrocarbons transport in porous media has been presented. Mathematical description of this process allows to estimate whether the menace of ground waters can occur as a result of hydrocarbons transport through the soil. The convection term in the mass transport equation is taken into account due to the higher velocity of propagation in vertical direction. Additionally, introduction to the balance equation the biosorption link allows to take into account microorganisms influence on impurities concentration, especially on heavy oils derived compounds. To verify the theoretical model series of the experiment in the soil filter has been carried out.

Industry development stimulates the growth of request for products derived from rock oil. Unfortunately, many different kinds of harmful substances of varied constitution are included in these products, so they are the source of threat to the environment, especially because they may be transported from the surface of the ground to the surface of the underground waters [1]. Rock oil derived substances introduced into the ground are initially driven in perpendicular direction by dispersion forces through the ground aeration zone in which some amount of rock oil products is absorbed while other filters through the ground and often even reach the groundwaters mirror [2].

Transport of organic substances in the ground was analysed by several authors [3-8] but the problem of the mathematical description of this phenomenon is still opened. So the purpose of this paper is to present the method of analytic solution of the equation describing transport of organic substances being reduced to one direction.

Mathematical description of the hydrocarbons transport through the ground matrix

Let us consider the parabolic partial differential equation of the form

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial z^2} - \frac{\partial (vu)}{\partial z} \tag{1}$$

In order to solve the above equation we may use the well known method of solving the similar problem existing in the field of unsteady heat exchange. It is known that solution of the equation

$$\frac{\partial u}{\partial t} = \frac{1}{2}\frac{\partial^2 u}{\partial z^2} \tag{2}$$

has the following form:

$$u(z,t) = \frac{1}{\sqrt{2\pi t}}\exp\left(\frac{-z^2}{2\cdot t}\right) \tag{3}$$

Let introduce an auxiliary function of the form:

$$\tilde{u}(z,t) = u(z,\alpha\cdot t) \tag{4}$$

It is easy to calculate that:

$$\frac{\partial \tilde{u}}{\partial t} = \alpha\frac{\partial u(z,\alpha t)}{\partial t} \quad , \quad \frac{\partial^2 \tilde{u}}{\partial z^2} = \frac{\partial^2 u}{\partial z^2} \tag{5}$$

Combining the Eqs. (2) and (5) we may get the formula:

$$\frac{\partial \tilde{u}}{\partial t} = \frac{1}{2}\alpha\frac{\partial^2 \tilde{u}}{\partial z^2} \tag{6}$$

from which it is easy to show that the function:

$$\tilde{u}(z,t) = u(z,2Dt) \tag{7}$$

performs the equation:

$$\frac{\partial \tilde{u}}{\partial t} = D\frac{\partial^2 \tilde{u}}{\partial z^2} \tag{8}$$

which solution may be presented in the following form:

$$\tilde{u}(z,t) = \frac{1}{\sqrt{4\pi Dt}}\exp\left(\frac{-z^2}{4Dt}\right) \tag{9}$$

Let us check what the equation is additionally fulfilled by the another auxiliary function of the form:

$$\hat{u}(z,\,t) = \tilde{u}(z - vt,\,t) \tag{10}$$

In a such case after combining eqs. (8) and (10) we obtain the following equation:

$$\frac{\partial \hat{u}}{\partial t} = \frac{\partial \tilde{u}}{\partial t} - v\frac{\partial \tilde{u}}{\partial z} \tag{11}$$

$$\frac{\partial \hat{u}}{\partial t} = D\frac{\partial^2 \tilde{u}}{\partial z^2} - v\frac{\partial \tilde{u}}{\partial z} \tag{12}$$

and finally:

$$\frac{\partial \hat{u}}{\partial t} = D\frac{\partial^2 \hat{u}}{\partial z^2} - v\frac{\partial \hat{u}}{\partial z} \tag{13}$$

So, the function $\hat{u}$ described by the equation of the following form:

$$\hat{u} = u(z - vt, 2Dt) = \frac{1}{\sqrt{4\pi Dt}}\exp\left(\frac{-(z - vt)^2}{4Dt}\right) \tag{14}$$

is the searching solution of eqn. (1), for v = const.

Mathematical description of the hydrocarbons transport through the ground matrix with taking into account their mass decrement caused by the biochemical reaction

Let us consider the equation of the form:

$$\frac{\partial u}{\partial t} = D\frac{\partial^2 u}{\partial z^2} - \frac{\partial (vu)}{\partial z} - \alpha z \tag{15}$$

Searching for the solution of the above equation, being the developed form of eqn. (1), we may consider the following function:

$$\overline{u}(z,t) = \hat{u} \cdot \exp(-\alpha t) \tag{16}$$

The derivative of this function in respect of t is described as follows:

$$\frac{\partial \overline{u}}{\partial t} = -\alpha \hat{u} \exp(-\alpha t) + \frac{\partial \hat{u}}{\partial t}\exp(-\alpha t) \tag{17}$$

The above equations may be presented in the forms:

$$\frac{\partial \overline{u}}{\partial t} = -\alpha \overline{u} + \left(D\frac{\partial^2 \hat{u}}{\partial z^2} - v\frac{\partial \hat{u}}{\partial z} \right)\exp(-\alpha t) \tag{18}$$

or

$$\frac{\partial \overline{u}}{\partial t} = D\frac{\partial^2 \overline{u}}{\partial z^2} - v\frac{\partial \overline{u}}{\partial z} - \alpha \overline{u} \tag{19}$$

So, the function $\overline{u}(z,t)$ described by eqn. (16) is the searching solution of eqn. (15) which may be presented in one of the following forms:

$$\overline{u}(z,t) = \exp(-\alpha t) \cdot \frac{1}{\sqrt{4\pi Dt}} \exp\left[-\frac{(z-vt)^2}{4Dt} \right] \tag{20}$$

or

$$\overline{u}(z,t) = \frac{1}{\sqrt{4\pi Dt}} \exp\left[-\frac{(z-vt)^2}{4Dt} - \alpha t \right] \tag{21}$$

The function $\overline{u}(z,t)$ fulfils the following dependence

$$\int_{-\infty}^{+\infty} \overline{u}(z,t)dz = \exp(-\alpha t) \tag{22}$$

It is possible for practical applications, assuming the constant value of the diffusion coefficients Di= const, to present the solution of the partial differential equation

$$\frac{\partial \mathrm{C_i}}{\partial \mathrm{t}} = \mathrm{D_i}\frac{\partial^2 C_i}{\partial z^2} - \frac{\partial \mathrm{vC_i}}{\partial \mathrm{z}} - \mu_\mathrm{i} \cdot \mathrm{C_i} \tag{23}$$

in the following form:

$$C_i(z,t) = \frac{C_{io} S}{\sqrt{4 \cdot \pi \cdot D_i \cdot t}} \exp\left\{ -\left[\frac{(z - v \cdot t)^2}{4 \cdot D_i \cdot t} + \mu_i \cdot t \right] \right\} \tag{24}$$

Parameters of the above equation may be determined using the regression model [9].

Description of the soil filter method

In order to verify results obtained from theoretical models the soil filter with dry matrix were constructed. This column-shaped filter with the inside diameter of 135 mm and the height of 2000 mm was made of polypropylene and is a segmented

Description of the soil filter method

In order to verify results obtained from theoretical models the soil filter with dry matrix were constructed. This column-shaped filter with the inside diameter of 135 mm and the height of 2000 mm was made of polypropylene and is a segmented structure consisting of 18 cylindrical test cells, each of the height of 100 mm and the outside diameter of 137 mm. The gravel layer, of the height of 200 mm, located at the bottom of the soil filter holds up all the cylindrical test cells. The scheme of this filter is shown in Fig.1. The sand deposit was used as a model to simulate the penetration of petroleum contaminants from the soil surface towards underground waters.

The function of hydrocarbon concentration Ci (z, t) described by eqn. (24), may be determined by measuring of the hydrocarbon concentration in each of the 18 segments of the column soil filter in relation to the assumed migration time. Distribution of the selected hydrocarbon concentrations in the soil filter was experimentally determined after 24, 48, 96, 192 and 384 hours (it means after 1, 2, 4, 8 and 16 days). For example, distribution of isooctane and n-hexadecane concentrations obtained using the soil filter method is respectively shown in Figs 2 and 3.

Comparison of the results calculated from eqn.(24) with those obtained from the soil filter method will make possible not only to determine unknown diffusion coefficients Di but also to choose the most useful for calculation transport model as well.

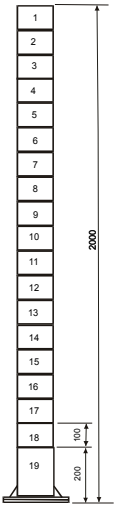

Fig. 1. Illustration of the soil filter method

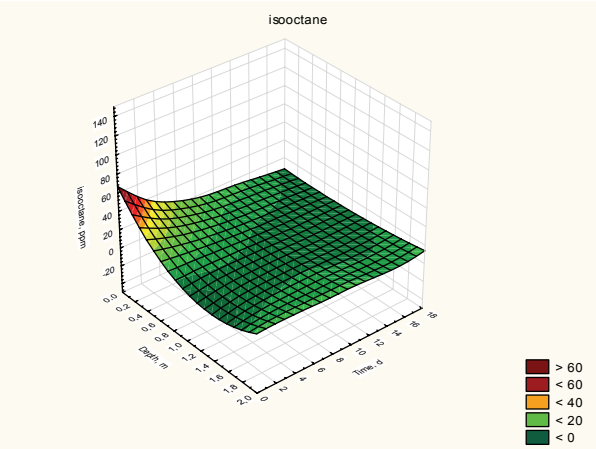

Fig. 2. Distribution of isooctane concentrations obtained in the soil filter.

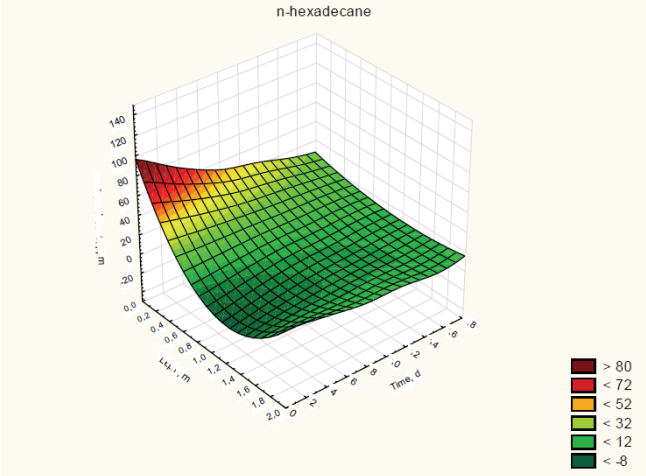

Fig. 3. Distribution of n-hexadecane concentrations obtained in the soil filter.

Conclusions

The function Ci (z, t), described by eqn. (24), being the solution of the mass balance equation (23), has to be determined in order to estimate the real threat of hydrocarbons being migrated through the ground especially in the perpendicular direction. Due to this function the time of hydrocarbons migration from the surface of the ground to the surface of the underground waters may be evaluated. Taking into account the convection term in eqn. (23) explains increase in velocity of hydrocarbons migration into orthogonal direction to the free surface of effluents.

Moreover, the last term of the right-hand side of eqn. (23) allows to consider the effect of microorganisms upon changes of hydrocarbons concentration in the soil. As hydrocarbons concentration in the system where their migration takes place is usually higher from that of bigenic elements (N,P) it may be assumed that the decomposition reactions of migrating hydrocarbons are of the first order [10]. The discrete function Ci (z, t) may be experimentally determined by measuring the values of hydrocarbons concentrations in the soil filter in relation to the assumed migration time. Notation

μi	hydrocarbons' biodegradation coefficient, [s-1]
Ci	concentration of key component "i" in the matrix [kg.m-3]
Cio	initial concentration of key component „i" in the matrix, [kg.m-3]
Di	equivalent diffusion coefficient of key component "i" [m2.s-1]
i	a symbol standing for the first letter of the tested hydrocarbon (i =b, t, x, h, o)
S	the maximum depth of hydrocarbon penetration through the ground, [m]
t	migration time, [s]
z	direction of hydrocarbons' migration, [m]

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N. Chernobaeva (National Aviation University, Ukraine, Kyiv)
N. Shutko, Dr.Sci. (National Aviation University, Ukraine, Kyiv)

DETERMINATION OF FACTORS THAT INFLUENCE ON AMOUNT OF LOSSES OF LIGHT GASOLINE HYDROCARBNONS FROM EVAPORATION IN HST

Horizontal steel tanks (HST) are considered as the source of emission of light hydrocarbons. Identified groups of factors and factors that influences the magnitude of losses of light hydrocarbons by evaporation from the HST.

Today losses of oil product at objects of fuel supply are determined as ratio between delivered oil product and actual stored residue. Such calculation is done every quarter of the year. Difference between these values, taking into account oil products issue is considered as natural losses. Additional processing of exploitation data will allow developing of new methodology for estimation of oil products losses from evaporation. From the above mentioned we can make a conclusion that determination of the most valuable factors influencing evaporation of light hydrocarbons and their interconnections is an important scientific-practical task. Object of research is evaporation of gasolines during fulfilling of technological operations. Subject of research is factors that influence on the intensity of gasolines evaporation at HST. Literature analysis has shown that chemical composition and temperature regime of tanks are the most important factors. Aim of the research is determination of factors and group of factors that act during the process of light hydrocarbons evaporation from gasolines during technological operations. Nowadays it is an important scientific-practical task, because there are no works describing complex impact of factors on gasolines losses from evaporation.

Well known methodologies developed by Konstantinov M.M., Korshak A.A., Gizzatov M.A., Prohorov A.D., Ashkinazi M.I., Budarov I.P., Boichenko S.V. are applicable for one-time calculation of losses and do not allow estimating impact of certain factors. Today tanks are equipped with temperature, pressure, density detectors, automatic level controllers, etc. It allows constantly monitor the parameters of petroleum products. But these means of automatization are used for registration of parameters of oil product discharging and reception operations. Modern parameters control systems can be used for both registration of oil product parameters and obtaining data about equipment state. Data about oil product state that are collected via these detectors can be accumulated by the system and can be used for volume of losses forecasting. It will make possible determination of the most valuable factors and interconnections between them as well. Application of available data will simplify task fulfillment.

Technological regimes of horizontal steel tanks (HST) use HST of volume from 3 to 200 m3 are used for state accounting operation with oil, oil products, their storage and payments between supplier and consumer. Excessive pressure foreseen for most of these tanks is not more than 0,07 MPa. These tanks may be either ground or underground. Main technological operations with HST are discharging, reception,

storage and pumping. During pumping gasoline changes it's temperature and density. It happens because temperature and density of gasoline in tank and pumped one may differ. During discharging level of gasoline, temperature, pressure of saturated vapors in gaseous medium (GM) of tank decrease. During gasoline pumping out from the tank suction of air and addition evaporation of light hydrocarbnons take place. It is accompanied by pressure rise up to the adjusted value of breathing valve (BV). If the pressure in GM exceeds adjustment of the BV than the «backward breathing» will take place. Gasoline storage is accompanied with changes of temperature, density, level and pressure in GM. Gasoline level changes during storage due to evaporation of light hydrocarbons, variation of density and temperature. Density changes in a result of light hydrocarbons evaporation and daily temperature variations. Gasoline temperature changes because of daily temperature variations as well. When pressure in GM reaches the adjusted level in BV, the emission of light hydrocarbons take place. It is known as "small breath". During acceptance gasoline's temperature changes (pumped gasoline mixes with the residue in tank). Amount of emitted vapor-air mixture (VAM) in this case and concentration of light hydrocarbons in it will be determined by closed or open kind of stream of the filling process. In case of open-stream filling the higher turbulization of surface is observed. Process of evaporation is intensified and concentration of emitted light hydrocarbons in VAM increases. During closed-stream filing only internal medium of liquid are subjected to turbulization. Evaporation from surface is less intensive in this case.

Factors that influence on volume of light hydrocarbons evaporation during technological processes

According to we can determine four groups of factors that influecne significantly on hydrocarbons evaporation:

- Economic;
- Ecological;
- Technic;
- Technological.
- Economical factors include the following:
- Expenses for implementation of systems or means of environmental protection from volatile hydrocarbons evaporation and thus increasing of gasoline prices;
- Economical effect from implementation of environmental protection systems;
- Increase of incomes that be stipulated by optimization of technological processes and use of modern effective equipment;
- Amortization costs;
- Costs of technological processes;
- Prices for oil products

Considering these factors we can decide that today conclusion about rationality and efficiency of application of means for losses prevention, means of losses forecasting, their monitoring will be made basing on results of these factors analysis. In case of negative economical effect there is small probability that

decision about use of means of losses minimization will be taken. So, one of the main aspects to be considered is effectiveness and initial price. For example, even if systems for volatile fraction adsorption are of high efficiency they will not be popular because of the high price.

Technical factors that influence on volumes of losses from evaporation include characteristics of additional equipment (technical characteristics of pumps) and parameters of tank. The most valuable among them are geometrical size of tank, quantity and type elements stop valves, heat isolation. Data, allows considering that net volume of losses during "big breathing" increases with decrease of tank content. Net average losses in middle climatic zone are 1,42 kg/m^3. This data can vary depending on the grade of investigated gasoline, conditions of storage and climatic zone, where researches were done. Great role is also played by the technical state of equipment. Technological factors include those, influencing on tank operation or those considered as characteristics of oil proguct (gasoline in our case). Special attention must be paid to factors that influence on volume of losses from evaporation: atmospheric pressure, Pa; temperature of environment TEnv; adjustment of breathing valve for excessive pressure or vacuum; coefficient of tank use; coefficient of tank negotiability; temperature regime of tank; presence or absence of means for losses prevention; quantity of holes and their mutual disposition.

Atmospheric air influences mainly on losses of volatile hydrocarbons during storage. Impact of environment temperature is revealed greatly in regions with increased temperature background. Adjustment of breathing valves of the tank may depend on technical conditions of use and may vary in a range 1800 - 2000 Pa. When the coefficient of tank use increases (level of tank filling) the volume of GM decreases. It will stipulate decreasing of vapor-air mixture emissions into atmosphere. The most valuable factor in this group is temperature regime of tank. It is influenced by geographical position, tank painting and temperature isolation. Decreasing of temperature variation gradient will contribute to reduction of emissions.

That is why building of underground reservoirs is seemed to be the most rational for providing optimal temperature regime. At the same time building of ground reservoir with heat insulation may be in 10 times more expensive (spending on the type of oil product). Technological parameters that determine such property of gasolines as evaporation include: fractional composition of gasoline; hidden heat of evaporation; gasoline liability to formation of vapor locks; coefficient of vapors diffusion; surface tension; chemical composition of gasolines; density. Modern raw material base for gasoline production is characterized by increased content of products of catalytic oil processing.

It leads to high content of components with low boiling temperature and decreasing of initial boiling temperature. Components with low boiling temperature (hydrocarbons C1-C6) make the most part (up to 98-99%) of evaporating components. These components are contained usually in gasolines (Budarov, 1961). It should be mentioned that vaporability of gasolines is in almost 1000 times higher than of dark oil products. Results of light fractions evaporation are the following:

heavier fractional composition, density and viscosity increase, decrease of saturated vapors pressure.

It may be also determined a group of technological factors that will be defined by interaction between tank itself gasoline and parameters of technological process:

- Temperature of VAM in GM of tank, ТПППС;
- Mass of VAM in GM of tank, kg;
- Oil product density in GM of tank, g/cm3;
- VAM density in GM of tank, g/cm3;
- Level of gasoline in tank, H;
- Volume of gasoline in tank, Vg;
- Volume of GM in tank, VGM;
- Expenditure of oil product, pumped into tank, Q;
- Expenses of oil product, pumped out of tank, QEx;
- Excessive pressure in VAM of GM, P;
- Concentration of light hydrocarbons vapors in GM of tank C;
- Quantity of VAM emitted into environment, kg;
- Quantity of air coming into tank during pumping out operations, kg.

Ecological factors that have impact on quantity of losses from evaporation are limit acceptable concentration of light hydrocarbnons in area of tank placement. Today there are no norms for pollutants emissions into atmosphere at objects of oil products supply. That is why harmful impact of these losses is not considered properly. Peculiarity of this kind of pollution is that emissions are concentrated at the height of 2-3 m above the ground. It is a working zone, other words it has direct negative impact on personnel health at oil depots. Situation becomes worse due to the escalates increasing number of objects thair distribute gasoline. Today there are more than 7000 filling stations in our country and this number is growing constantly. The situation becomes more complicated in a result of old, out of date equipment. At the same time filling stations are not equipped with any means for losses decreasing. It should be also mentioned that except individual impact of each factor it is necessary to take into account interaction of group of factors. This will determine the final result. Choice of optimal decision (for example method of losses decreasing or environmental protection technology) will depend on general analysis of all factors.

Conclusion

Exploitation information collected by means of automatization may be a basis for solving this question. This is the most appropriate variant because fulfillment of planned experiment in conditions of oil depot or filling station is impossible due to peculiarities of its functioning. Practical realization of these researches will give possibility to create new measures for estimation industrial and ecological safety of horizontal tanks, consider them as a source of environment pollution. In it's turn it will give possibility to develop and implement in our country norms for emissions of volatile hydrocarbons into atmosphere. Later it will stimulate modernization of existing equipment and introduction of means for losses decreasing.

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A. Nikitin, PhD (National Aviation University, Ukraine, Kyiv),
G. Nikitin, dip. Ing.
(National Aviation University, Ukraine, Kyiv)

PROSPECTS FOR MODERNIZATION OF AIRCRAFT'S TRIBOSYSTEMS IN ACCORDANCE WITH THE DIRECTIVE ICAO DOC 9977

Presents an analysis of the ICAO Doc 9977. This directive is a tool allowing increasing safety. However, if it is ignored, then not only will not be able to influence, to increase reliability, but will serve as an effective mechanism for removal from the market of aircraft design bureaus, which will not begin work on its implementation.

In 2013, the ICAO Doc 9977 «Manual on Civil Aviation Jet Fuel Supply» Doc 9977 AN/489 Directive entered into force on [1]. What impact wills the introduction of this directive aircraft's tribosystems?

At first glance, as the name implies, this directive only applies to issues of fuel. However, a detailed study suggests that the field of the Directive is much wider. In particular, it introduces significant changes in the design of aircraft. How should change the design of aircraft and their systems with the introduction of this directive?

In addition, it should be noted that as a consequence of the introduction of the Directive ICAO Dok. 9977 - on the market of the aviation industry, a new effective tool for competition for markets and markets air aircraft.

Than justified the introduction of the directive Dok. 9977?

As always - an analysis of the statistics of causes of failures and disasters lethal devices. For more information on this subject can be found on the author's website www.fuel-contaminstion.com [7].

Airlines today are paying great attention to the quality assurance of fuels and lubricants refueled aircraft. We are interested in the question - if the fuel when refueling clean and has a concentration of contaminants in the range of 1-2 mg / liter, why ICAO imposed such stringent requirements for aircraft?

Our studies of actual contamination consumable aircraft fuel tanks showed that the concentration of contaminants in them several times higher than the permissible level. A sample taken from the tanks- consumable caissons aircraft Boeing 737-400 there is a large number of particles of size 50 ÷ 100 microns. Fiber chips larger than 800 microns are present. The overall level of contamination of samples characterized 11 ÷ 17 purity classes according to GOST 17216.

What accounts for such a high level of contamination of jet fuel in airborne systems LA? First of all, because of operational services, and hence developers aircraft escaped major source of pollution.

Result of the defects of modern on-board cleaning processes occurring in the dynamics of pollution fuel - caissons aircraft. The main source of contamination of the tanks, caissons in our opinion this is not it ironic - «clean" fuel.

Studies conducted by PhD V.I. Terekhin's group revealed that the average level of contamination of fuels fed to the wing is in the range of 2 ÷ 3, 2 grams / ton [4, 5]. At the same time, it was found that in the process of settling in the ground level of contamination of fuel tanks is reduced by an average of 70%. In other words 70% of the contaminants precipitate and accumulate at the bottom of tanks. Buck caisson is actually almost perfect sump.

There are processes of sediment contamination and sedimentation of particles similar to those that go to ground tanks. With an average duration of two hours, for the year class plane Boing 767 carries for the year about one thousand six hundred flights.

During this time the aircraft accumulates in the tank about a hundred pounds of dirt. Thus, after one year, filling the tank with clean fuel, we find when mixed with impurities that are already there, the concentration of contaminants over 3,000 grams / ton. This is 5.2 times greater than the concentration characteristic for the 17 - grade purity GOST 17216, respectively, and one thousand six hundred times greater than is permissible to feed the engine.

Pollution accumulating in the tanks - caissons is a time bomb. Unlike ground tanks that are on the ground motionless, tank - caisson during the flight all the time varies with the wing and the aircraft as a whole. According to V.L. Rudakoff of the wing aircraft in flight are 6.4 to congestion at 1 ÷ 3 s-1[6]. The consequence of this is the possibility of active shaken (mixing) of sediment pollution and fuel. The difficulty is that it is unknown when the turbulence reaches its critical value and will takeoff contamination from the tanks bottom.

Thus, it is obvious that the problem of fluid contamination today is mainly a problem onboard aircraft system.

In accordance with the directive of ICAO Doc 9977/AN 489 flight crew should receive fuel in the process, independently perform its input control and ensure the maintenance of the level of cleanliness until delivery to the engine. Earlier the crew controlled only issues related to the availability of necessary aviation fuels and lubricants on board, the availability of documentation confirming the quality of fuel and for fuel systems - questions centering aircraft during refueling.

In discussing the directive ICAO Doc 9977/AN 489 of the International Round Table «Modern requirements of aviation fuel. The requirements of ICAO 9977/AN 489 "Guide for the supply of aviation fuel for civil aviation " to the rules of supply of aviation fuel to airlines and its quality control standards ," it was noted that [2]:

• No one fuel, oil tank and hydraulic oil tank at modern aircraft has no system of protection against penetration and accumulation in the inner cavity of mechanical particles and water pollution through the drainage system;

• No one fuel, oil tank and hydraulic oil tank aircraft has no system of monitoring the content of mechanical impurities and moisture in the liquid;

• No one fuel, oil tank and hydraulic oil tank of the aircraft is not adapted for the leaching of internal cavities;

Actual aircraft fuel systems require the addition of the block diagram of components capable of solving the above mentioned problem.

Firstly, the fuel system in accordance with the requirements of ICAO Doc 9977 should include pollution control systems.

These systems must be monitored content as well as mechanical impurities and water. Moreover, the control must be arranged in the filling process and during operation (during parking, and the flight).

As of today, no pollution control sensors or control devices for water on board of any aircraft is simply not [3].

Secondly, the fuel system must be equipped with an efficient cleaning system. System ensures the cleanliness of fuel on board the aircraft in its current form is also not suitable for use. If it had been able to provide cleaning, probably, and was not themes for this article, and the relevance of appearance ICAO Doc 9977.

To summarize , we note again that the 9977 directive in the case will be ignored , not only will not be able to influence , to increase reliability , but will serve as an effective mechanism for removal from the aircrafts and helicopters market of the design engineering bureau, which will not begin work on its implementation . Of course, immediately implement all the tasks that confront developers Directive 9977 impossible. It will take time and the emergence of new and effective design solutions. However, they have. Note about that with some practical solutions can be found on our website [7].

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T. Marynych, postgraduate
(National Aviation University, Ukraine, Kyiv)

STABILIZATION OF SERVICE PROPERTIES OF TURBINE OILS WITH ELECTROSTATIC FIELD AND IMPULSES OF ELECTROMAGNETIC NATURE

Author reviewed the question of recovery of service properties of turbine oils by electrostatic field and impulses of electromagnetic nature. The article describes results of tests of physical and chemical characteristics. Effect of electrostatic field and impulses of electromagnetic nature on service properties of turbine oils also was covered in the article.

Thermal power stations (TPS) and heat electric generation plants (HEGP) are the main consumers of turbine oils. They use a wide range of turbine oils as a lubrication material, to maintain operation of turbine regulating system, to cool turbine friction joints, turbine generators, compressors and other turbine units. Ensuring operational capability turbine oils intensively affected of different factors, namely mechanical impurities, water contamination, high temperature combined with active action of aerial oxygen and catalytic action of metal. All above mentioned factors cause intense oil oxidation, formation of insoluble compounds like sludge. As a result physical, chemical and thermal stability of oil decreases, the process of oil ageing, gradual destruction and degradation of chemical elements of turbine oil is activated.

Therefore, the question of recovery service properties of turbine oils is of the most immediate interest.

Taking into account importance of immediate solution of above mentioned questions the necessity of experiments and tests of turbine oil was appeared. The purpose of experiments is to stabilize service properties of turbine oil by electrostatic field and impulses of electromagnetic nature.

To realize tests 3 samples of turbine oil type TP-22S were taken, namely: sample № 1 – fresh oil, sample № 2 – oil with 7205 service hours, sample № 3 – used oil (drained from lubrication system of HEGP). Parameters used to control the results of tests were the following: presence of mechanical impurities (as factor, defined oil purity), acid number and thermal oxidative stability (as factors, defined the presence of oxidative processes in oil).

Treatment turbine oils by impulses of electromagnetic nature allowed to decrease concentration of mechanical impurities in sample № 2 after two hours of treatment. Concentration of mechanical impurities in fresh oil was 0,0046 % (absence of mechanical impurities according to GOST 6370-83), oil with 7205 service hours – 0,0166 %. Two-hours treatment by impulses of electromagnetic nature of oil with 7205 service hours allowed to decrease concentration of mechanical impurities up to 0,0071 % and after four hours – up to 0,0063%. The results of practical tests are presented in figure 1.

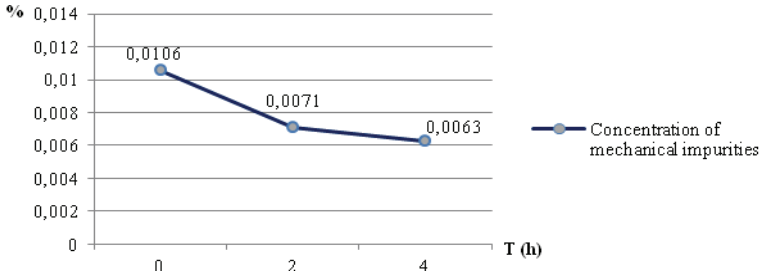
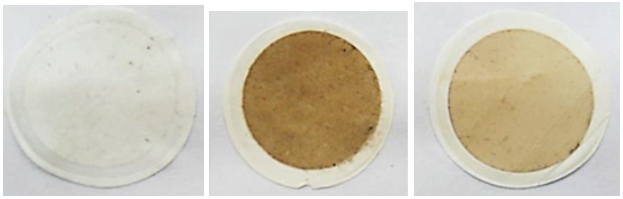


Fig.1. Dependence of concentration of mechanical impurities on time of treatment oil by impulses of electromagnetic nature

Figure 2 presents photos which describes change of concentration of mechanical impurities in turbine oils after treatment by impulses of electromagnetic nature.



a) b) c)

Fig. 2. Photo of samples of turbine oil after treatment by impulses of electromagnetic nature: a) sample of fresh oil, b) oil with 7205 service hours, c) oil with 7205 service hours after treatment

At the same time, the acid number of turbine oil after treatment by impulses of electromagnetic nature increased, which may indicate the negative impact of the above mentioned treatment (acid number of fresh oil was 0,016 mg KOH/g). The results of practical tests are presented in figure 3.

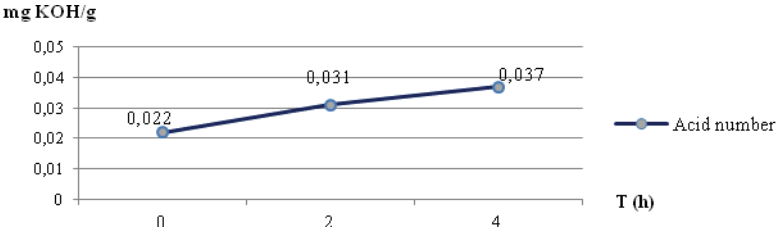


Fig. 3. Dependence of acid number on time of treatment oil by impulses of electromagnetic nature

The other type of treatment of turbine oil was treatment by electrostatic field. It was decided that one of the main parameter which defined the presence of oxidative processes in oil is acid number. And the main task of method of stabilizing service properties of oils which can define its serviceability is removal of oxidative products and recovery of properties. Therefore initially the acid number was defined.

However, treatment of used oil by electrostatic field didn't allow improve service properties. It can be assumed that oil included terminate (maximum) content of oxidative products and also inefficiency of electrostatic field to remove oxidative products and recover properties. Experimental results are shown in figure 4.

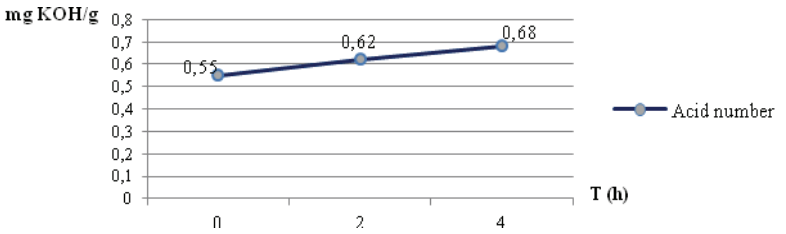


Fig. 4. Dependence of acid number on time of treatment used oil by electrostatic field

Compared with insignificant increase of acid number in used oil after treatment by the electrostatic field acid number of fresh oil (fig. 5) is growing rapidly, that demonstrates the negative impact of field on the oil structure.

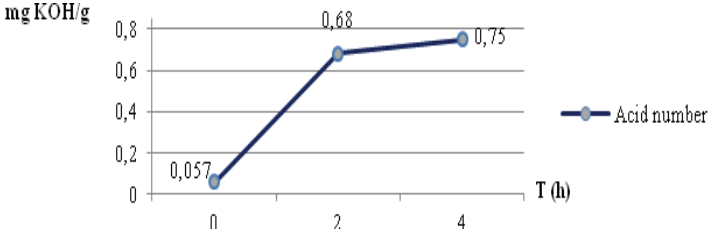


Fig. 5. Dependence of acid number on time of treatment fresh oil by electrostatic field

Thermal oxidative stability was defined according to GOST 23175-78 instead of GOST 981-75 to optimize time of test. Thermal oxidative stability of fresh turbine oil before and after treatment by electrostatic field was well above the value of thermal oxidative stability of used oil before and after treatment. The results presented in table 1.

According to table 1 thermal oxidative stability of samples fresh turbine oil before and after treatment by electrostatic field didn't change, but for samples used turbine oil (for example, oil include oxidated particles, oil black) thermal oxidative stability decreased after treatment.

Table 1

Value of thermal oxidative stability of turbine oil

Sample of turbine oil	Thermal oxidative stability (T), min	ND for test
Sample № 1 (fresh oil)	17,2	GOST 23175-78
Sample № 1 (fresh oil after treatment by electrostatic field	17,0	
Sample № 3 (used oil)	14,0	
Sample № 3 (used oil after treatment by electrostatic field)	12,0	

Decrease of thermal oxidative stability after treatment indicates that the charge of the particles occurs during processing electrostatic field which promotes rapid oxidation especially for used oils (with oil black) and further formation of big quantity of varnish (fig. 6 shows heavy increase of varnish, whereas fig. 7 describes a moderate curve behavior that characterizes varnish content).

Therefore it can be assumed that treatment of used oil by electrostatic field doesn't have positive effect in recovery service properties, but lead to deterioration of oxidative stability of oil.

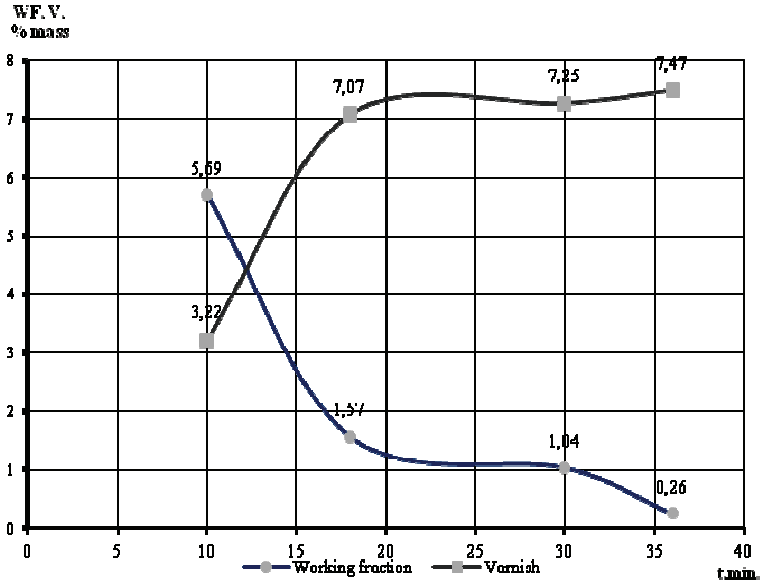


Fig. 6. Dependence of working fraction and varnish on time (sample of used oil after treatment by electrostatic field)

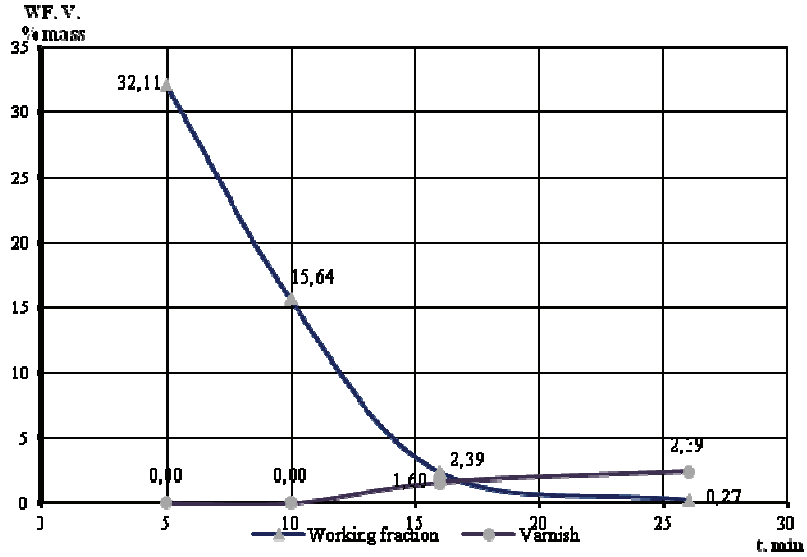


Fig. 7. Dependence of working fraction and varnish on time (sample of fresh oil after treatment by electrostatic field)

Conclusions

Treatment of turbine oils by impulses of electromagnetic nature allowed to decrease the concentration of mechanical impurities as described experimental results. However, method of stabilizing anti oxidative properties of turbine oils affecting impulses of electromagnetic nature showed negative results as well as affecting electrostatic field. Negative effect proved by acid number tests and thermal oxidative stability tests.

Therefore, it was concluded not to consider electrostatic field and impulses of electromagnetic nature as a method of stabilizing service properties of turbine oils.

UDC 665.76

N. Krasilnikova, postgraduate student (State owned Enterprise S&R Institute of Crude Oil Refining and Petrochemical Industry "MASMA", Ukraine, Kiev)
I. Lyubinin, PhD (State owned Enterprise S&R Institute of Crude Oil Refining and Petrochemical Industry "MASMA", Ukraine, Kiev)
K. Pashynska (National Aviation University, Ukraine, Kiev)
Ye. Rudnytska (National Aviation University, Ukraine, Kiev)
O. Yevdokymenko (National Aviation University, Ukraine, Kiev)

ESTIMATION OF TRIBOLOGICAL AND OPERATING CHARACTERISTICS OF HYDRAULIC FLUIDS

Tribological and operating estimation methods of hydraulic fluids are considered. It is concluded that tribological estimation methods used are insufficiently informative. A novel determination method of lubricant tribological characteristics is proposed. In P, V and T coordinates, such a method allows to define areas of normal mechano-chemical wear and damageability for a test lubricant.

Requirements for operating characteristics of hydraulic fluids become more and more strict. It is explained by higher pressures, higher temperatures and smaller system volumes, that increase circulation ratio and consequently increase loads on a hydraulic medium. Because of it, a role of an estimation of tribological and operating characteristics of hydraulic fluids in the development stage as well as in the stage of selection for particular equipment is increased.

In modern practice for the estimation of tribological characteristics one can use:

- four-ball machine for the estimation of extreme pressure and wear preventive properties according to different standards [1-3];
- FZG gear test rig for the estimation of extreme pressure properties [4].

Test results on a friction test machine rather relatively can be used for operating conditions, therefore a quality of hydraulic fluids is estimated when operated in pumps of different constructions.

During testing on a hydraulic pump according to [5] (100 hours at 2000 pounds per square inch), a total wear is estimated (US Steel 126 and 127 specifications). According to the method of Vickers, tests are carried out in a rotary vane pump at given pressures and temperatures (14 MPa, 250 hours). Then stator and blade wear is estimated according to [6].

Over the last years the FE-8 roller bearing test rig [7-9] for the estimation of tribological properties and the Parker Hannifin (Denison Hydraulics) hybrid pump test for the estimation of operating properties are proposed to use. This hybrid pump is a combination of a piston pump with a vane pump. The Parker (Denison) specification defines three approval classes: HF-0, HF-1 and HF-2. A fluid is HF-0 approved under positive test result in both a vane pump and a piston pump, otherwise approval is HF-1 or HF-2 in one pump respectively.

It is obvious, that these methods of tribological estimation do not meet the requirements of developers and consumers of hydraulic fluids and systems, and operating estimation methods are long-term and expensive. An estimation method of tribological properties of lubricants by pressure (P), velocity (V) and temperature (T) criteria is proposed.

Under a steady temperature state a relation between a load, a sliding velocity, a friction coefficient (f) and a mean bulk temperature of a friction assembly is expressed by I.V. Kragelsky formula:

$$T = \frac{A \cdot V \cdot P \cdot f}{S \cdot K}, \qquad (1)$$

where A – thermal equivalent of work; S – heat transfer surface area; K – heat transfer coefficient.

Considering, that $P/S = P_{unit}$ (unit pressure) and substituting it in (1):

$$T = \frac{A \cdot V \cdot P_{unit} \cdot f}{K}, \qquad (2)$$

From the analysis of the formula (2) follows, that ratio A/K depends only on the friction assembly construction and test conditions, while T and f are registered parameters. Selecting particular V values and registering T and f parameters (corresponding to the moment prior to a scuffing), an acceptable unit load, i.e. critical load, can be calculated:

$$P_K = \frac{T}{V \cdot f} \cdot \frac{K}{A} \qquad (3)$$

From the formula (3), according to obtained values of P_K parameter at different sliding velocities, a transition boundary from a normal friction to damageability in the form of $P_K = f(V)$ can be defined. In logarithmical coordinates P/V, this transition boundary is represented in the form of a straight line (Fig. 1) with an angle and a height depending on a quality of a test lubricant.

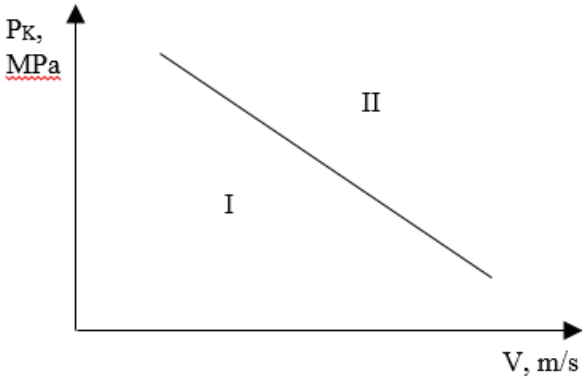


Fig. 1. Sliding velocity *V* dependence of a load P_K in logarithmical coordinates (*I*, *II* – normal friction and damageability areas respectively)

In sum, knowing operating conditions of the friction assembly and using test results, usage applicability of a lubricant of one kind or another in the given friction assembly can be preliminary predicted by a proposed method.

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UDC 665

Emrah Kinav, S.Z. Baykara (Yildiz Technical University, Turkey)

A NEW MODEL FOR CHARGING EVS WITH CURRENT FUEL INFRASTRUCTURE – SELF CHARGING ELECTRIC VEHICLE CONFIGURATION FED BY STATIONARY OUTBOARD FUEL

Recently, huge incentives have been allocated for the accommodation of electric vehicles. But despite the incentives, desired volumes of electric vehicle production and sales are still far from being reached. Although there are more than one reason for this situation , the most important one is the lack of well established electric vehicle charging stations widely spread in sufficient quantities, that are ready for use wherever and whenever customers need them.

Options are far less especially for customers who need to use fast charging stations instead of slow charging ones at home or office garages taking 6-8 hours. Logically, the basic reason for insufficient charging infrastructure is unwillingness to invest in such expensive technology, as the number of electric vehicles on the roads are still very low for a viable business option. On the other hand, the number of electric cars is not likely to increase unless charging infrastructure is sufficient. This chicken and egg dilemma is rather inhibiting for fast charging stations that are more expensive.

Current situation seriously slows down the electrification of transportation system while proceeding from infancy period to mass production stage. For starting a viable EV system, a model that can use the currently available fuel infrastructure is needed during the transition period.

The purpose of the present work is to create a new pure electric vehicle configuration which does not necessarily need an EV charging station and which can be charged at any currently available fuel station. To enable an electric vehicle charge itself by an onboard internal combustion engine-generator while being refueled from an outboard fuel source (for exemple at a dispenser in a CNG – LPG - gasoline station). Once the number of electric vehicles on the road reaches a sufficient level so as to make the charging stations a viable business by themselves, investors will need much less government incentives.

Keywords; Electric vehicles (EVs), charging infrastructure, fuel infrastructure

It is a fact that besides all the advantages and ease the use of energy brings to our lives, it is also damaging the natural environment. Global warming and greenhouse gas effect are the main reasons for this damage. Emissions of CO_2 are assumed to constitute 50% of the greenhouse gas effect. According to many scientists, there is a relation between rise of CO_2 amount in the atmosphere and global warming and next century will face 2-4°C temperature rise.(IPCC, 2001)

At the end of 1980s, as environmental issues became more clear, emission regulations have become available for land vehicles [1]. In 2009, transportation accounted for approximately 20% of global primary energy use and one quarter of all energy-related carbon dioxide (CO2) emissions [2].

Electric Vehicle Initiative (EVI), a multi-government policy forum dedicated to accelerating the introduction and adoption of electric vehicles worldwide, aims to reach the target of 20 million EVs on the road by 2020 [3]. International Energy Agency's Improvement scenario also contains the same figures from EVI which takes current 200.000 EVs worldwide as a base and improves CO2 emissions by 10 gigatons (Gts) by 2050 [4] [5].

Despite the government incentives, desired volumes of electric vehicle production and sales are still far from being reached as of today. But would investors be willing to commercialize EV charging infrastructure and invest without waiting for any government subsidies if 20% of the current annual 60 million car production was electric vehicles today? Assumed answer for this, especially for DC fast charging systems was, definitely yes. Question that we had in mind in order to make this a reality was "how can we let the customers freely charge their EVs today, without major charging infrastructure installed throughout the country". Answer to this question was the driver for starting our present work, to enable the current fuel infrastructure that is already established for conventional fueled vehicles.

Main aim of the present work is to find a viable solution for inadequate charging infrastructure for electric vehicles and enabling them to be charged at any fuel station while vehicle is running on the road and battery is about to be depleted. By doing so, range anxiety issue will be overcome and one of the biggest problems prohibiting the sales of battery electric vehicles (BEV) will be solved. This way, electric vehicle users can access to readily available charging infrastructure spread all over the world. It is at highest importance not to make huge infrastructure investments during the infancy period of BEVs and accelerate the transition in to mass production stage.

Creating a new electric vehicle configuration which can charge itself by an onboard generator, is the solution present work brings for the lack of charging infrastructure. This new configuration can be placed in between pure electric and hybrid electric vehicle (range extender) configurations in many ways.

Pure electric vehicles or battery electric vehicles as seen on Fig.1, have a battery pack for storing the required energy and an electric motor for traction of the vehicle. When the battery is depleted and there is no energy for traction, it has to be charged in an electric vehicle charging station. This station can be a charging point established in a house – office garage, as well as a public charging station. Usually, slow charging systems are used where electric vehicle can be parked for long durations, such as house – office garages. Use of slow charging stations are much cheaper then the fast charging stations and give opportunity for BEV users not to loose time for charging during a busy day by charging overnight while they are sleeping. Those BEV users who have the possibility to charge at house – office, although scarce, can also use the publicly availbale fast charging stations for charging their vehicles in 15 – 30 minutes in between a trip.

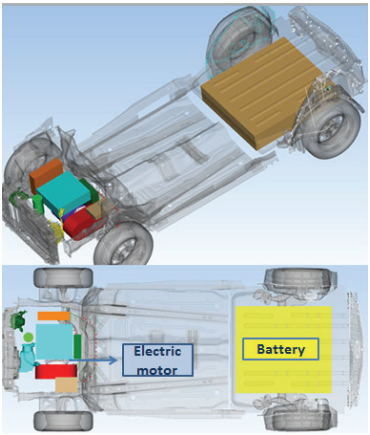

Fig. 1. Battery Electric Vehicle component layout.

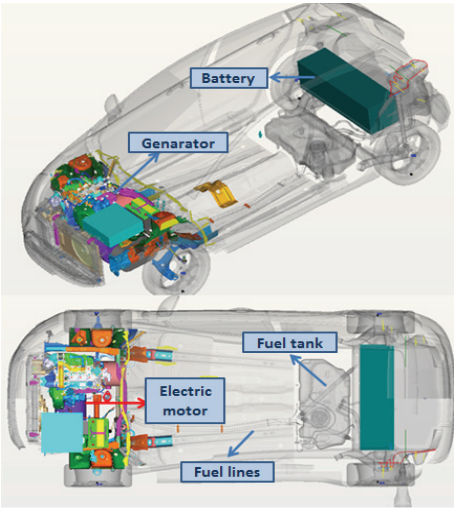

Fig. 2. Hybrid Electric Vehicle component layout.

Studies show that the foremost reasons BEVs are still not able to reach the desired sales volumes are lack of charging infrastructure and range anxiety caused by the fact that users can not charge their vehicles anywhere they want to drive. This requires planned journeys rather than unplanned as people are used to today. At the same time increased battery capacity due to lack of frequent charging opportunity adds significant cost on the vehicle initial cost. As BEVs are already not

able to benefit the many cost reduction items associated with mass production, any add-ons to initial cost determines one of the most important decision factors for customers during vehicle selection.

Hybrid electric vehicle (HEV) configuration contains, in addition to electric motor and battery, an ICE and a fuel system is required to keep charging the battery on the road without vehicle having to stop (Fig.2). When the battery is depleted in serial hybrid vehicles, vehicle does not have to stop for charging and ICE can operate at a designed operation point to produce electricity for charging the battery. This way, unlike BEVs, lack of charging infrastructure and range anxiety are no longer a big problem for customers while deciding about buying a HEV, or currently named as range extended vehicles (REV).

Vehicle in Fig.2 is the subject of the present work, which can be named as outboard fueled electric vehicle. It is categorized between pure EV and hybrid EV by combining both of their advantages.

Difference from any pure electric vehicle configuration is that not only can the battery be charged from the grid but also the ICE-generator can fast charge the battery while fuel being fed from an outboard source. Engine operates at its single most efficient design point and is enabled to be more efficient then an ICE vehicle using the same ICE for traction purpose (especially in city cycles, where EVs are mostly driven). Because there is no energy source (fuel) stored onboard the vehicle, it is a pure electric vehicle, not a hybrid electric vehicle. This specification makes it a new electric vehicle configuration in between battery electric vehicles and hybrid electric vehicles.

In this new configuration, fuel is fed to the ICE-generator from an external source through a fuel regulator system and there is no fuel tank on the vehicle that will store fuel while the vehicle is running on the road. External fuel source can be a fuel dispenser in a gas station, a fuel tank, a fuel truck, etc. Fuel regulator regulates the fuel pressure and flow, to enable the ICE-generator to operate efficiently. This configuration provides electric vehicle users the advantage of a hybrid vehicle by not being dependent on charging infrastructure while away from home / office charging facility but also combines together with the advantages of pure electric vehicles. Due to the fact that there is no fuel storage inside the vehicle, lack of fuel, fuel tank, fuel lines, chassis parts that are designed and assembled to provide safety gives possibility to manufacture more simple, lighter weight and eventually cheaper vehicle then a hybrid electric vehicle. It also enables to delete safety tests and counter measures for fuel safety issue, further reducing the design and product development initial costs.

It can be used just like an EV and can be charged from city electricity at home or office. As the vehicle is driven, each kilometre brings the charge to depletion. Eventhough EV users try plan their journeys according to the charge status and range, there are always risks to travel more then planned or use more energy per distance traveled because of weather conditions, road conditions, driving habits, confort and entertainment accessories of the vehicle, etc. These are usually the main drivers of range anxiety as well. As there are insufficient charging opportunities available everywhere and anytime, EV users do not have the luxury of using the infrastructure they have with their current ICE vehicle. Unlike other EV

users, new configuration EV users will not have any range anxiety because there are many already established fuel stations all around the city and highways which can be used to power the ICE-generator on the vehicle, just like any ICE vehicle on the road today. LPG, CNG or any other fuel can be utilized to generate electricity in the vehicle and charge the vehicle during the short time at the fuel station.

As in hybrid electric vehicles, fuel is to be used to charge the depleted batteries but unlike them, there is no fuel stored on the vehicle. Since there is no fuel and fuel systems on the vehicle, not only that vehicle is enabled to be lighter weight (around 50 kg. due) and more energy efficient but also there is no need for any fuel related safety precautions and associated safety tests. Moreover, since the vehicle is not a hybrid electric vehicle requiring complex control systems, medium scale companies can be able to commercialize such vehicles as well. This may even speed up the transition phase because medium scale companies are usually faster to act.

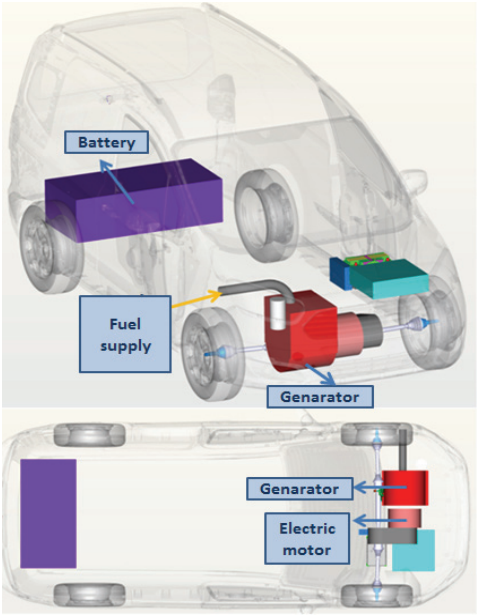

Figure 3. Outboard fuel fed electric vehicle component layout

When we are driving our vehicles today, for most of the time, we are driving in urban areas. There are congestions, traffic lights, pedestrians, etc. that we have to pay attention and keep pushing gas and brake. As a result of this, we do not have the luxury to drive at a single speed, unlike in highways. Since the internal combustion engine of the vehicle operates at many different operation points which are mostly out of the most efficient design area, we can not achieve the best mileage. In the current work, since ICE-generator is used at its most efficient design area, it

operates around 25-30% more fuel efficient. Result of this is around 4-5% higher mileage of the vehicle in urban area against any comparable conventional vehicle with same ICE and fuel.

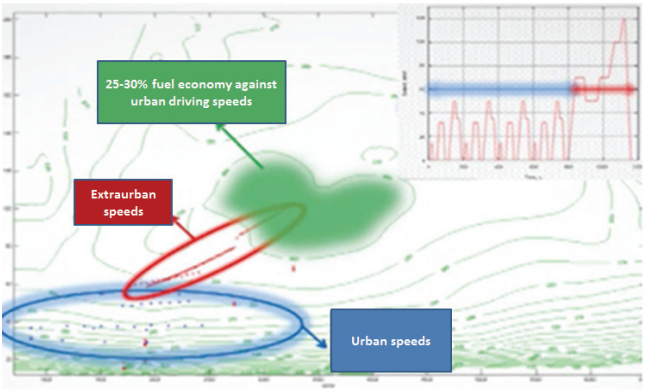

Figure 4. Exemple of an ICE operating at different operation points with different specific fuel consumption (g/kW) (BSFC – Brake Specific Fuel Consumption)

Advantages over pure electric vehicles:

- No range anxiety
- Ability to charge at any fuel station during emergency
- As there will be no range anxiety and users will be able to charge at fuel stations, battery sizes can be kept at minimum by considering the daily journey ranges in each part of the world.
- Since 40 – 50% of the vehicle cost is battery itself, reducing the size of the battery will greatly influence the total price of the vehicle.
- To be used anywhere around the world with established fuel infrastructure (8500 LPG and 12500 gasoline stations already established in Turkey)

Disadvantages over pure electric vehicles:

- Add on weight of the ICE-generator causes lower energy efficiency (~5km less range against a similar BEV)

Advantages over hybrid electric vehicles:

- Higher energy efficient design due to deleted weight of the fuel, fuel systems and chassis parts used for fuel related safety of the vehicle.
- Shorter design duration and no design limitations arising from fuel systems.
- No product development tests related with fuel systems
- In real world designs, hybrid vehicles are usually not benefitting from use of clean fuels such as LPG, CNG, hydrogen due to the fact that their storage tanks are larger then gasoline tanks in comparison. But since new design concept EV does not store the fuel on the vehicle, there are many

options to use whichever fuel user wants without compromising vehicle volume.

- Empty area left from fuel tank, fuel lines and chasis parts to accomodate-secure them can be used for more useful reasons for marketting advantage.
- Complex hybrid electric vehicle control systems are not needed and medium scale companies can also commercialize such vehicles.
- ICE-generator operating at one single design point optimized for energy efficiency and fuel consumption enabling the same vehicle and ICE to be more fuel efficient then its ICE version (~30% less fuel consumption without even changing any engine components). Engine components can also be optimized for a better efficiency at single operation point.

Disadvantages over hybrid electric vehicles:

- Vehicle can not be driven without stopping on single charge as charging takes place inside a fuel station by use of an outboard fed fuel.

Conclusions

In the present work, we are proposing a system to ease and speed up the transition period for EVs. The growing number of land vehicles in the world and the fact that they are polluting the environment and harming people is the reason for drawing attention to them. Currently 97% of the fuels being used on land vehicles are petroleum based [5]. The proposed technique is to facilitate the transition to electric vehicle utilization in daily life. Even though the EV technology is currently available, and there is need to reach a higher share in the market for being able to observe the advantages it will contribute. The proposed technique is strongly believed to be worthwhile since there are not enough fast charging stations available wherever and whenever users need them on the roads.

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UDC 665

K. Suyarkov (hansaconsult Ingenieurgesellschaft mbH REINBEK, Germany)

FUEL FILLING COMPLEX LOW COST

International Air Transport Association (IATA) says that "Fuel supply reliability has a major impact on financial and operational viability of flights. Airport fuel infrastructure forms a vital part of the fuel supply chain. While at most airports the fuel facility appears to be adequate, some airports are perceived to have insufficient or excessive facilities. The knock-on effect of non-availability of jet fuel or even restrictions in availability is huge: consequential damages may arise from cancelled flights, diversions, payload limitations, tankering, and techstops for refuelling.". That's beyond all question that jet fuel supply operations shall be organised on a highest level of quality and reliability. In following sections of this report a number of solutions how it can be realised were highlighted. This approach will be discussed based on operation strategy of single low cost tank farm.

Transformation process model. There are two categories of inputs in any operation's processes; transformed and transforming resources. Tank farm' transformed resources are jet fuel itself, special additives on one hand and capital/finance on another hand. That "things" will be changed as a result of operation: fuel and additives will be received, tested, cleaned and dried, stored, tested again, cleaned and dried ones more and delivered to the fuelling tank car. Another transformed resource is money witch should be invested in transforming resources: fix equipment and personnel.

Tank farm business model is designed to enable the operation to transform the inputs into outputs. Key outputs to satisfy customers are: aircraft fuelling operations as such and paperwork to be able to provide at all times a clear picture of all fuel transformations and quality control reports.

Market analysis

Aviation is a dynamic industry that continuously adapts to various market forces. Key market forces that impact it are fuel prices, economic growth and development, environmental regulations, infrastructure, market liberalization, airplane capabilities, other modes of transport, business models, and emerging markets. Each of these forces can have both positive and negative impacts on the industry.

World regions development

Worldwide economic activity is the most powerful driver of commercial air transport growth and the resulting demand for airplanes. The global gross domestic product (GDP) is projected to grow 3.2 % per year for the next 20 years, driving both air passenger traffic and air cargo traffic to average 5.0 % annual growth worldwide over the same period.

Low cost jet fuel tank farm business model has been developed for small airports and can supply relatively small fuelling operations. Major customer groups for such tank farm are airlines how operates a number of regional and single aisle jets.

Aircraft fleet by world region can be evaluated from the chart below:

Region	Regional jets				Single aisle jets			
	2012	Share of fleet	2032	Share of fleet	2012	Share of fleet	2032	Share of fleet
Asia Pacific	130	2%	420	3%	3.470	68%	10.350	69%
North America	1.710	21%	1.070	15%	3.760	51%	6.140	69%
Europe	350	8%	200	3%	3.160	72%	5.930	75%
Latin America	90	7%	210	6%	1.050	80%	3.150	84%
Middle East	60	5%	30	1%	500	45%	1.420	47%
CIS	200	21%	120	9%	680	57%	1.100	73%
Africa	120	20%	130	7%	420	60%	1.040	68%

Source: own research

This chart demonstrate that everywhere in the world a common fleet share of regional and single aisle aircrafts was 50% to 87% in 2012 and expected to be 48% to 90% in 2032.

Global jet fuel demand

In 1992, more than 70 % of all traffic was carried by airlines in Europe or North America. By 2032, that proportion will shrink to 39 %. Asia Pacific and Middle East airlines are becoming prominent in global aviation.

Following chart demonstrates a total jet fuel demand for passenger traffic by world regions.

Region	Revenue passenger-kilometres, bn		Jet fuel consumption, m Ton	
	Mean growth rate per year	2032	Mean growth rate per year	2032
Asia Pacific	7,9%	1.014,8	5%	156,7
North America	3,2%	524,9	0,2%	91,7
Europe	4,4%	451,1	1,2%	65,8
Latin America	5,2%	95,3	1,4%	23,5
Middle East	5,4%	80,9	2,1%	12,9
CIS	5,5%	34,0	1,7%	14,1
Africa	7,2%	53,2	3,9%	19,9

Source: own research

Low-cost carriers drive the strong demand for new, efficient single-aisle airplanes. Their share of the market is expected to grow from 14% to 20% by 2032.

All above mentioned figures demonstrate that the biggest sales opportunities and market growth rates can be expected on Asia Pacific markets, especially in China and South Asia.

Jet fuel supply chain

Fuel is now the largest component of an airline's cost structure. Fuel costs have risen dramatically between 2004 and 2011 from 17% to 30% of operating costs. The cost structure of jet fuel today shows how dominant upstream costs are. Some 75% of in-plane jet costs, excluding any taxes, consist of the cost of crude oil. Refinery costs and profits represent 13% of the jet fuel price. Transportation, storage and logistics can add a further 8-12%. Taxes and royalties vary a lot, from zero up to the 27-34% paid on domestic jet fuel in Brazil, India and Japan.

Development of the operational strategy

According to Hill (1994), the basis for developing an operation strategy is a framework, consist of 5 steps. Corporate objectives and appropriate world market overview has been analysed in the previous chapters. In order to achieve these objectives certain steps shall be undertaken:

Supply chain establishment: Due to the fact that described tank farm works as "open access" depot, all oil companies and/or traders who will be able to meet quality requirements can delivery fuel to this tank farm.

Utilise a modern and high accuracy inventory of the fuel with interface to ERP system which will ensure effective business relationships with fuel owners and airlines.

Highest product quality and operation safety standards shall be established and achieved by each tank farm in order to improve parent' company image and global market position.

Well trained and high motivated operation and management staff on one hand and state-of-the-art and properly maintained equipment on the other hand are factors that play a key role in effective and low-cost operation of the tank farm.

Tank farm is an organisation that provides customers (generally airlines) with fuel handling services such as receiving, storage and distribution with continuous quality control operations (sampling and testing).

Tank farm operation processes can be described with the Four "V"s Model tool:

Volume of services is low – tank farm with 300 m^3 fuel capacity can serve small amount of regional and single aisle aircraft movements only. Repetition of services is high – these aircrafts have a small variety of fueling / defueling procedures. Each staff member shall provide a high grade of operative multitasking because of very low staff utilisation. Operation procedures shall be well defined and proper recorded. Unit costs are high: fuel is about 30% of overall costs for airlines.

Variety of services is low – it is only one jet fuel grade with or without additive can be delivered to customers. Product is very well defined, any variations of the specification are not allowed. Fueling procedures are relatively complex and standardised: there are a number of limits and parameters that shall be fulfilled.

Aircrafts will be fuelled on the regular basis according to the flight schedule.

A little variation within flight schedule is possible but, generally, fuel demand is pretty much predictable. Fuelling capacities can be extended after certain period of time because modular design of the technological modules. Each fuel farm shall be designed for the estimated performance peaks. For unexpected fuel consumption peaks an additional amount of fueling tracks can cover an additional fuel demand.

Visibility of fueling operations is high, aircraft captains are involved in the fuelling process and responsible for fuel quality delivered to their jets. Fuelling operations shall be finished exact during permitted time frames. Normally fuel is not stored at airport' tank farm for a long time, only a settling time is critical and shall not be accelerated. Each airline is satisficed as long as it can get clean and dry fuel on specification fuel on time.

Maintenance strategy

Proper maintenance of the tank farm equipment has a significant impact on its operating costs particularly because unexpected breakdowns can be eliminated. Some of the common maintenance strategies are:

Strategy	Approach	Strong points	Weak points
FBM	Fix it when broke	- maximised equipment uptime; - short-term costs reducing effect; - no unnecessary repair costs	- Unplanned tank farm shutdown losses; - fuelling by reduced flow rates; - spare parts procure-ment at highest price; - reduced equipment life;
TBM	Scheduled maintenance	- maintenance can be done during lowest capacity utilisation; - spare part costs are predictable and can be optimised by on-time ordering; - high availability of tank farm is ensured	- can be expensive by replacement of well-working equipment; - repair work must be done by authorised personnel only; - necessary replacements can be postponed until scheduled routine interval will expire
CBM	Based on monitoring of critical working parameters	- costs optimisation by prediction of wear out failures; - replace "seal units" against latest models can provide filling operations with additional performance	- spare parts for critical and expensive equipment can be not available at time when replacement shall be done; - authorised personnel may be not available on a short notice

Maintenance strategy for the fuel tank farm should be based on:

- Investigation of the critical equipment;
- Risks evaluation for critical equipment;
- Planning and scheduling of maintenance procedures;
- Identifying "normal" wear parts and emergency spares
- Records and maintenance quality check completion.

Planned Maintenance of Critical Equipment

Planned (scheduled) maintenance of the critical equipment shall be undertaken in accordance with the maintenance schedule, to the required frequency by the operations manager or maintenance contractor in accordance with the manufacturer's instructions.

The critical equipment demands particular care and attention and should be observed before and during its operation by routine visual inspection to ensure its general condition is sound with no visible damage to the body or components, to check the seal is in good condition and ensure no leakage occurs. If wear leakage or other defects are found the operations manager or maintenance contractor shall be advised to undertake immediate repairs or replacement in accordance with the manufacturer's instructions.

After the service and/or repairs have been completed the operations manager or maintenance contractor shall complete and sign off the appropriate document to provide a record that the required work has been undertaken and the unit is fit for purpose. Records about planned and proceeded maintenance procedures shall be kept based on check lists approved by equipment' manufacturers.

Future operation improvement

An improvement of the future operation performance can be achieved by further costs optimisation. A significant cost savings will be reached using an adapted mix of maintenance strategies that should be revised on the different stages of the tank farm live cycle. A monitoring of shutdowns, its causers and costs connected with can provide management with useful information for taking strategic decisions. Permanent costs monitoring by using ERP tools allows management observe trends and predict negative impact of market and operation changes.

Periodical process hazard & risk analysis can deliver to management an overview of strength and weaknesses of critical operations within a tank farm so that operation staff can be instructed how hidden hazards shall be minimised.

The environmental issues shall be also considered with a great care because any fuel spillages or fire accidences can cause huge losses or even destroy fuelling business at all. Installing and proper maintenance of high safety integrity level equipment is the best investment tank farm management could provide for improve process safety.

Automation and SCADA systems with an interface to inventory, logistic and contract management IT modules as well as to flight information services database can help operation staff to avoid operations which can damage an equipment or environment. As many monitoring tasks are performed manually, the risk of operator' errors increases, as does the time to realise that something has gone wrong; both can have a major impact on safety and the environment as well as quality performance. Using and regular upgrade of such systems should contribute tank farm operations to be more effective and to minimise time' and product' waste.

Automated processes are better able to monitor what's going on in the field to help improve the management of all activities. This includes having more visible and accurate information on the tank farm status, which can be done through instruments that send data back to the control room. Proper displaying of information about the status of the tank farm on the operator' panels avoids a situation where tank farm is "flying blind."

Finally, in addition to improving workflow and optimizing processes, automating tank farm and terminal operations management increases the accuracy of shift logs to help management ensure procedures are being properly followed and reported.

Strategic operational challenges

Thinking about the best solution for the operational improvement it is recommended to follow both philosophies – Total Quality Management (TQM) and just-in-time (lean) production. In the following section TQM and Lean are compared with an intension to find the best ideas and principles from each approach and implement it into Low Cost Jet Fuel Tank Farm operation concept.

The discussion is done with following criteria:

Quality of the products/services

It is therefore of fundamental importance that every responsible organization involved in aviation fuel manufacture, supply, storage, transport, testing and aircraft fuelling has such a system in place for managing quality, in order to maintain the aviation fuel specification and quality while in its custody and/or its control. These systems should ensure that:

a) aviation fuel is manufactured to the latest issue of the relevant specification;

b) facilities and equipment are maintained in good condition for the safe delivery of on-specification, clean and uncontaminated aviation fuel from refinery to aircraft;

c) an auditable and documented record exists, confirming correct handling and testing of aviation fuel throughout the supply chain from refinery to aircraft;

d) traceability is maintained to ensure that products are on-specification and fit-for-purpose on delivery to aircraft.

Going back to the lean - the main aspect of it is a just-in-time production. It is assumed that total costs shall be decreased due to the elimination of buffer time periods so that internal organisation problems can be highlighted and solved with minimum impact on the business. In case of aviation fuel tank farm there are practically no time buffer integrated into the process of receiving, storage and distribution of the jet fuel. Only an option of of too long storage time of certain fuel batches could be minimised in order to save costs for recertification of these batches.

A significant part of TQM is a waste minimisation or, ideally, elimination. Due to the quality control standard procedures, defined in the Aviation Fuel Quality Control and Operating Standards (JIG, last issue) a fuel which has been used for quality control during receipt, storage and fueller loading procedures, shall be delivered to the recovery tank(s). After settling and quality check this product can be returned to the storage tanks.

Quality Management

For the jet fuel tank farm it is preferred to apply for independent ISO ***** certification. However, a company certified according to ISO standards, cannot guarantee a high quality jet fuel and fuelling service automatically. But it is ensured that internal quality-relevant procedures are established and formalised.

From TQM perspective, a senior management shall be responsible for implementation of necessary structures and tools that will support the staff in ensuring fuelling services of high quality. Lean philosophy speaks about minimisation of the human factor influence on the process. Both ideas can be integrated in the jet fuel tank farm operation: a state-of-the-art equipment as well as integrated automation system will allow the staff to follow quality procedures defined in the Quality Manual as a central internal quality management document.

Staff qualification improvement

The majority of accidents can be attributed to lack of attention to, or failure to carry out, or deviations from prescribed procedures. The training and indoctrination of all personnel at all levels in all of the operational tasks they are normally required to undertake, and the tasks they would be expected to perform in an emergency, is of prime importance in seeking to achieve "accident-free" operations.

New jet fuel tank farm staff must be thoroughly trained in all operations and procedures, which they will be called upon to perform in the course of their duties and in all actions to be taken in the event of an emergency. Existing personnel called upon to undertake new tasks must be similarly trained before undertaking the new task without supervision.

An employee training record must be maintained for every employee which indicates:

a) for which tasks training has been given and the date of such training;

b) the signature of the trainer;

c) a "yes/no" assessment of whether the trainee demonstrated satisfactory understanding of the training;

d) the signature of the trainee.

Follow-up job observation (with refresher training if it is found to be necessary) is to be undertaken by supervisory or training staff at a frequency determined by the Senior Manager based on his assessment of on-going operator performance. The dates and results of these follow-up observations are to be recorded on the operator's training record.

The learning aspects such us stimulating creativity and individual improvement (emphasized in TQM), and, on the other hand, a certain amount on routine standardized procedures which should be learned in teams (lean arguments) can be combined in order to improve operations at jet fuel tank farm.

Customer requirements

The delivery of aviation fuel into customer’s aircraft tanks is the last link in the chain of storage and handling. Customer’s interests in this chain are clear defined and can be formulated as “reliable delivery of clean, dry, on-specification jet fuel for reasonable price”. Customer focus is one of the characteristics of TQM. The lean concept does not really care about customer’s needs so that it would recommend to follow TQM approach and to invest in the customers care improvement. The most important areas were product quality control, automation of handling procedures and equipment maintenance.

Supplier requirements

The risk to the integrity of the fuel in relation to its inherent properties and from contaminants (water, particulate and microbiological material) can occur at any point in the supply chain from the point of manufacture to the final delivery to aircraft. An ability to provide at all times a complete history of all fuel movements and quality control reports from a refinery to the tank farm is an essential responsibility of suppliers.

The suppliers play a significant role in both TQM and lean philosophies. An establishment of long term mutual partnership with the supplier could improve the reliability and quality of the fuel delivered to the tank farm.

Performance measurement / benchmarking

Jet fuel tank farm performance can be measured using internal and/or external bench marks. Comparison of levels of performance achieved within certain period between peer group organisations can be done based on numerical data (e.g. financial ratios) or non-numerical (e.g. awarding of certificates).

However, a purpose of performance measurement could be differ depended on the methods used by TQM and lean management. TQM measurements could help to identify problems or to confirm certain susses, where lean approach could be used for set-up operation targets.

There are some areas where operation improvement could bring a competitive advantage for the jet fuel tank farm:

Business globalisation: building of reliable and cost-effective global supply networks and sharing of high qualified staff experts cap play an important role for the parent organisation;

Environment responsibility: high energy efficiency and waste minimisation could bring a significant cost saving effect;

Technological innovation: only state-of-the-art and completely automated jet fuel tank farm is unique so that it can compete successfully with other existing small and medium tank farm on the market.

People management: top skilled, loyal and motivated staff with full acceptance of the highest level of product quality philosophy working more efficient and error free.

Conclusions

Low cost operations reducing costs and driving more value from the operation. In particular, inventory, process and condition monitoring of the jet fuel tank farm – implemented to comply with the HSE recommendations – are leading to significant cost savings and added value. These include a greater return on investment, an increased level of overall compliancy, real-time visibility of plant operations, and empowered personnel to drive ongoing performance improvements.

All the solutions and recommendations presented in this paper have their own characteristics suitable for fuel farm with low cost operations structure. Generally they could be applied in any regions for small civil domestic and international airports.

A consequent follow of fuel quality management standards, risk management guidelines and safety and environment recommendations is join mission of tank farm management and operating staff. This prevents crisis situations and also provides opportunities for more effective operations.

Last but not least, intensive communication with all stakeholders during the operation improvement process is strongly encouraged.

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María del Mar de la Rica, César Velarde
(Observatory of Sustainability in Aviation (OBSA). SENASA. Madrid, Spain)

INCLUSION OF BIOFUELS AND SUSTAINABILITY CRITERIA ON THE EU REGULATION: EU FUEL QUALITY AND RENEWABLE ENERGY DIRECTIVES. APPLICATION ON AVIATION

The EU Fuel Quality (FQD) and Renewable Energy (RED) Directives define the EU strategy for the implementation and development of biofuels in the region. The expected development in the production of feedstocks and use of agricultural land for this purpose has resulted in the need to define a series of sustainability criteria to avoid the possible negative environmental effects and incentivize the production of those biofuels that have higher greenhouse gas emissions savings.

The legislation requires operators to demonstrate the compliance with these requirements by the provision of specific data or the use of a sustainability voluntary scheme. In addition to the sustainability criteria, further sustainability issues are still under discussion and it is foreseen that the Fuel Quality and Renewable Energy Directives are amended in the near future. The RED applies to biofuels used in aviation when sold in a Member State, although does not establish consumption targets. Thus, biofuels used in aviation can account towards meeting the Directive targets and qualify for incentives by the Member States (such as the EU Emissions Trading Schemes) but only if they comply with the sustainability criteria.

Background to the Renewable Energy Directive

The history of European policy for sustainable transport biofuels goes way back before the approval of the Renewable Energy Directive (RED) in 2009. In 2003, Directive 2003/30/EC called the Biofuels Directive aimed to promote the use of biofuels or other renewable fuels for transport purposes. It was the first time that non-binding targets where introduced, requiring Member States to set an indicative target for 2005 of 2% of biofuels, and a longer term expected target for 2010 of 5,75 % of all petrol and diesel for transport placed on the market.

However, no individual objectives for Member States were set. It did contain specific regulations on the Member States' reporting obligations meaning that they were to submit annual biofuel progress reports to the Commission. In addition, the Member States should submit evaluation reports to the Commission every two years. However, the 2 % of biofuels use objective by 2005 was not fulfilled.

As a consequence the Commission published in 2006, a detailed *EU Strategy for Biofuels*[1] , which included measures to promote the production and use of biofuels. A binding target was first proposed in 2007 in the *Renewable Energy Road Map*[2] which was followed by the communication from the Commission of an

1 COM (2006) 34 final, An EU Strategy for Biofuels, Communication from the Commission

2 COM (2006) 848 final, Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future, Communication from the Commission.

Energy Policy for Europe[3] dealing with energy and sustainability issues and underlining the need for a coordinated promotion of biofuels throughout the EU. The energy policy was the first step for the elaboration of the RED Directive and the Fuel Quality Directive (FQD) on a later stage.

EU Policy Framework:

The policy for renewable fuels in Europe has been developed through the Renewable Energy Directive (2009/28/EC) that establishes a common framework for the promotion of energy from renewable sources and the EU Fuel Quality Directive (2009/30/EC).

The Renewable Energy Directive sets out, for each Member State, the share of energy to be achieved from renewable resources up to 2020. To fulfill this policy, it is expected that demand for biofuels will increase substantially in the coming years, resulting in more land being allocated and more people working for their production. In order to avoid the potential detrimental effects of EU biofuels policy on climate change, the EU Fuel Quality and Renewable Energy Directives set environmental sustainability criteria, including GHG emissions savings to be attained as well as criteria intended to protect against the conversion of land with high biodiversity or carbon stock. Additionally, the regulation sets mandatory national targets of how much each Member State will have to contribute to a 10% target of use of renewable sources for the transport sector.

This 10% objective must be largely covered by biofuels and bioliquids and therefore the Directive sets certain sustainability criteria referring to the protection of land with high ecological value, greenhouse gas emission savings, and the socio-economic impact. Those Environmental Sustainability criteria will have to be met if a certain biofuel or bioliquid is to count for the Member State's mandatory targets, for any renewable energy obligation to be imposed or for any subsidy payment.

In addition to this, both Directives establish a requirement for the Comission to submit a report to the European Parliament and the Council from 2012 and every two years after that.

Sustainability Criteria:

In order to be able to account towards the national targets, biofuels must comply with specific sustainability criteria. The list of the sustainability criteria from the Renewable Energy Directive is similar to the one in the Fuel Quality Directive, although enforcement and implementation is further developed in the first one.

One of the requirements makes it compulsory to achieve a minimum greenhouse gas emission saving from the use of biofuels of 35% for the short period. From 2017 on, it must be 50%, and from 2018 it must be 60% for new installations. In addition, land on which the crops are grown must not have had a high biodiversity value in January 2008 (e.g. designated areas for nature protection, virgin forest, species-rich grassland) nor crops should be grown on land with high carbon stock in January 2008 (e.g. wetlands, continuously forested areas).

There are no direct requirements for social and economic sustainability. However, the Commission shall report every two years on the impact on social

[3] COM (2007) 1 final, An Energy Policy for Europe, Communication from the Commission.

sustainability in the Community and in third countries of increased demand for biofuel, and on the impact of EU biofuel policy on the availability of food at affordable prices, in particular for people living in developing countries, and wider development issues. Reports shall also address the respect of land use rights.

The sustainability criteria are applicable both to biofuels produced in the EU and imported biofuels. As a result, those imported biofuels that have not proven to meet the sustainability criteria will have to comply with the Renewable Energy Directive requirements to count towards the achievement of the EU or national renewable energy obligations. Biofuels produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues, need only fulfill the the requirements for GHG emission savings.

Greenhouse Gas Reduction Calculation

Greenhouse gas emissions reductions have to be proven in accordance with specific calculation requirements contained in both Directives. Member states must assure that the biofuels comply with these requirements and in order to do so, operators have to use a mass balance system which allows consignments of raw material or biofuel with differing sustainability characteristics to be mixed. Sustainability criteria compliance must also be proven by operators. In order to do so, operators have three alternatives:

1) By providing the national authority with data, in compliance with requirements that the Member State has laid down (Member States must provide a national system)

2) Using a voluntary scheme recognized by the Commission for this purpose.

3) In accordance with the terms of a bilateral or multilateral agreement concluded by the Union and which the Commission has recognized for the purpose (the Commission shall seek to make bilateral agreements for third countries that guarantee that sustainability criteria are similar to those under EU law)

For the calculation of the greenhouse gas impact of biofuels the RED gives default values of 22 biofuel production pathways that may be used. For other production pathways operators have to do their own calculations according to a given methodology described in the RED. Disaggregated default values may be used for some factors (e.g. for the transportation of biofuels). Total GHG emissions are the sum of emissions from cultivation, processing and transportation of biofuels.

Voluntary Schemes:

Since 19 July 2011, the EC has recognized 14 voluntary schemes that apply directly in 27 EU Member States. To achieve this recognition, the Commission assesses each scheme that to evaluate if its rules cover the requirements. When using a voluntary scheme, operators must arrange an independent auditing process for the information to be provided to the national authority.

Current ILUC concerns

After the approval of the RED and the FQD, one of the concerns that were still being discussed was the lack of consideration of Land Use Change (ILUC) in the European regulation. ILUC refers to the displacement of food crops produced when feedstock used for biofuels is produced on existing cropland previously used

for food crops. But when agricultural production is displaced, the price of the displaced products is likely to increase. A price increase then creates an incentive to expand cropland for agricultural production. This expansion of cropland for production of displaced agriculture products has been described as the indirect land-use change effect.

Whilst the previously Directives included sustainability criteria, the greenhouse gas emissions associated with changes in the carbon stock of land resulting from indirect changes in land use are not subject to the reporting requirements. In October 2012, the Commission proposed an amendment to the renewable energy and the fuel quality directives[4]. In this proposal, the Commission acknowledged that ILUC can affect the amount of greenhouse gases associated to biofuels but also identified a number of uncertainties and limitations associated with the available numerical models used to quantify indirect land-use change (Council, (2014)). For this reason, it was recommended that the issue should be addressed under a precautionary approach.

The proposal included the introduction of iLUC factors using generic values according to the type of crop (cereals and other starch rich crops, sugars or oil rich crops). The Commission's approach gave oil rich crops an ILUC factor 4-5 times higher than cereal and sugar based crops. The introduction of these factors would have implied a big impact on the implementation and use of certain feedstocks in Europe since they would have been greatly penalized.

However, due to the possible impact on the industry, the introduction of ILUC factors has been postponed to 2016 due to lack of agreement on the factors.

Application to Aviation Biofuels

The RED applies to biofuels used in aviation when sold in a Member State, although does not establish consumption targets. Thanks to that, biofuels used in aviation can account towards meeting the Directive targets, although has to be specified in the National regulation. Up to now, only the Netherlands has included bio kerosene to account for the obligation, which establish an incentive to its use as it allows trading them in the form of "bioticket".

RED also qualifies Bio Jet Fuel for incentives by the Member States but only if they comply with the sustainability criteria. An example of this is that the use of aviation biofuels account with a zero emissions factor in the EU Emissions Trading Scheme, so its related emissions have not a cost for the airlines as fossil jet ones do.

Conclusions

While including the sustainability criteria in the RED and in the FQD has been a big step in the approach of the Commission to alternative fuels, there are still some issues in which it has to continue to work on in order to further understand not only direct but also indirect effects. ILUC should be considered but further

[4] COM(2012) 595 final, Proposal for a Directive of the European Parliament and of the Council Amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources

understanding is required before it is included in the European Legislation in order to avoid undesired effects on the still developing biofuels industry.

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S. Puzik, Associate Professor, V. Manzii, Associate Professor,
A. Hvozdetskyi, postgraduate
(National Aviation University, Ukraine)

METHODS OF CALCULATING THE GEOMETRIC DIMENSIONS OF THE GRAVITATIONAL INERTIAL CLEANER TYPE (GICT)

The calculation of geometrical dimensions GICT and the main forces acting on it for cleaning jet fuel

The problem defined. There are different types of power cleaners. Centrifugal cleaning – a branch of particle contaminants from fluid cleared in the field of centrifugal forces. Since they present drawbacks such as complexity konstuktsiyi, heavy weight, the presence of moving parts, large energy consumption, the use of centrifugal cleaning in civil aviation (CA) is limited.

Theoretical studies of the purification process payments in a magnetic field does not exist, so practice using experimental data. It is known that the magnetic cleaning provides high filtration fineness that life continues to work fine filter, requires no power consumption, but provides only removing ferromagnetic particles, which limits its use in CA. One of the unexplored power cleaner is GICT (Fig. 1).

Research results. This is the cleaner fluid, which combines elements of the cyclone and gravity cleaner. Structurally, it is a coil spring in a helical tension formed by a pipe with an external diameter $d_з$, $d_в$ inner diameter and height, where n – number of turns of the coil.

Averaged radius R (bending radius) is determined according to the normal, depending on the diameter and wall thickness $d_з$ tube and the thickness of the pipe wall $\frac{d_з - d_в}{2}$.

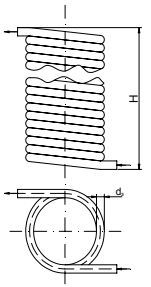

Fig. 1 General view GICT

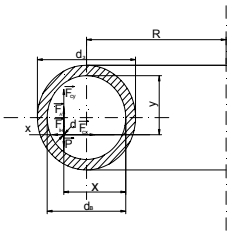

Fig. 2 Scheme of forces acting on particle contamination

Polluted aviation fuel supplied to the bottom of the coil, and hence (peeled) above. Thus particle pollution are uneasy motion: figurative with fluid and relative (relative to the fluid flow).

In Fig. 2 shows the forces acting on the particle pollution:

P – gravity;

F_A – buoyancy force;

F_{cx} – horizontal component stoksivskoho resistance;

F_{cy} – vertical component stoksivskoho resistance;

$F_{\text{ін}} = m V_{\text{сер}}^2 / R$ – inertia, which $V_{\text{сер}}$ – average flow rate of the liquid.

To investigate the relative motion of particle contamination using differential equations of relative motion:

A: Projected on the axis "x"

$$m\ddot{x} = F_{\text{і}} - F_{cx} \tag{1}$$

or after substitution and abbreviations:

$$\ddot{x} = \frac{V_{\text{сер}}^2}{R} - \frac{18 V_{\text{р}} \text{c}_{\text{р}}}{d^2 \text{c}_{\text{ч}}} \dot{x} \tag{2}$$

where $V_{\text{сер}} = 4Q / d_{\text{в}}^2$

This equation can be solved by double integration by introducing for convenience steel $a = \frac{V_{\text{сер}}^2}{R}$, $b = \frac{18 V_{\text{р}} \text{c}_{\text{р}}}{\text{c}_{\text{ч}}}$, is presenting in the form:

$$\ddot{x} = a - \frac{b}{d^2} \dot{x}; \tag{3}$$

$$\dot{x} = \frac{ad^2}{b}\left(1 - e^{-\frac{b}{d^2}t}\right), \text{ або } \dot{x} \approx \frac{ad^2}{b};$$

$$x \approx \frac{ad^2}{b}(t-1). \tag{4}$$

B: Draw up a differential equation of relative motion projected on the axis "y":

$$m\ddot{y} = P - F_A - F_{cy},$$

or after substitution and abbreviations:

$$\ddot{y} = g\left(1 - \frac{\text{c}_{\text{р}}}{\text{c}_{\text{ч}}}\right) - \frac{18 V_{\text{р}} \text{c}_{\text{р}}}{d^2 \text{c}_{\text{ч}}} \dot{y}. \tag{5}$$

For ease of integration is denoted by $c = g(1 - \rho_{\text{р}} / \rho_{\text{ч}})$, ie:

$$\ddot{y} = c - b / d^2 \dot{y}.$$

After integration we obtain:

$$\dot{y} = \frac{cd^2}{b}\left(1 - e^{-\frac{b}{d^2}t}\right);$$

$$\dot{y} \approx \frac{cd^2}{b}\left(t - \frac{d^2}{b}\left(1 - e^{-\frac{b}{d^2}t}\right)\right) \text{ або } y \approx \frac{cd^2}{b}(t-1).$$

Members $e^{-b/dt}$ neglected.

Example take the coil with an internal diameter of pipe $d_в$ – 5,3 cm; outside diameter $d_з$ = 6 cm; average radius R = 2,6 cm. Flow rate per unit time Q=86,6 (cm^3/s).

Substituting the values consistently x_i, can find time t_x– particle pollution deposition of each vertical layer, and similarly, substituting in the value $y \approx \frac{cd^2}{b}(t-1)$ of y_i, we can find the time tyosadzhennya particle pollution from each horizontal layer. Thus:

$$t_x = 1 - \frac{bx}{ad^2} = 1 + \frac{0{,}066x}{8{,}5d^2},\ t_y = 1 - \frac{by}{ad^2} = 1 + \frac{0{,}066x}{726d^2} \qquad (6)$$

Rezultatyrozrahunkiv given in Table. 1., 2.

Table 1

The deposition of particles on each horizontal layer

x, cm	t_x, s				
	D, cm				
	0,001	0,002	0,005	0,01	0,02
5,035	39073	9768	1563	390,7	*97,68*
4,505	34960	8740	1399	349,6	87,4
3,975	30847	7737	1234	308,47	77,37
3,445	26734	6684	1070	267,34	66,84
2,915	22621	5655	905	226,21	56,55
2,385	18508	4628	741	185,08	46,28
1,825	14163	3541	567	141,63	35,41
1,325	10283	2571	412	102,83	25,71
0,795	6170	1543	247	61,7	15,43
0,265	2055	514	83	20.55	5,14

Table 2

The deposition of particles on each vertical layer

y, cm	t_y,s				
	d, cm				
	0,001	0,002	0,005	0,01	0,02
5,035	458	115,25	19,28	4,58	1.15
4,505	411	103,5	17,4	4,11	1,035
3,975	363	91,5	15,48	3.63	0,915
3,445	314	79,25	13,12	3,14	0,7925
2,915	266	67,25	11,6	2,66	0,67
2,385	218	55,25	9,68	2,18	0,55
1,825	170	43,25	7,76	1,7	0,43
1,325	121	31	9,8	1,21	0,31
0,795	73	19	3,88	0,73	0,19
0,265	25	7	1,96	0.25	0,07

As known, the velocity distribution in the pipe cross-section is given by:

$$V_x = 2V_{\text{cep}}\left(1-\frac{4(x')^2}{d^2}\right) \text{ та } V_y = 2V_{\text{cep}}\left(1-\frac{4(y')^2}{d^2}\right). \quad (7)$$

For analytical studies take inertial cleaner with the following parameters: $d_в$ =5,3 cm; $d_з$ =6 cm (GOST 8734-58).

$R \geq 5d_з \geq 30$ cm (take R=36 cm). As for fluid consumption Q by unit time, then Q=86,6($\frac{\text{cm}^3}{s}$).

Now $V_{\text{cep}} = 3.93(\frac{m}{s})$. Successively substituting the expression for the velocity value V_{cep} and $x'_I = y'_I$, we obtain the flow velocity in each layer. The results in Table collected by. 3.

Table 3

The flow rate of fuel in different layers GICT

x'_I–y'_i	2,385	1,85	1,32	0,79	0,26
V, ($\frac{\text{cm}^3}{s}$)	1,49	4,01	5,89	7,15	7,78

Thus, the results presented in Table. 3, indicate that the relative horizontal displacement can be ignored for the time horizontal movement many times more, while the vertical, ie almost a vertical position relative motion.

Since the path $s = V_{\text{cep}} \cdot t_y$, then, taking the data from the table. 2 are at $t_{\max}$=458 (s) i $V_{\text{cep}} = 3,93(\frac{m}{s})$, $S_y \approx 458 \times 3,93 = 1800(\text{cm})$.

Since the length of one loop is $2\text{p}R = 163\,(\text{cm})$, then the required number of turns $n_y = \frac{1800}{163} = 11,01$ (rounds to n=11turns).

Height GICT with the number of turns in $d_з$ =6(cm):

$$H_y \approx 11 \cdot d_з = 11 \cdot 6 = 66\,(\text{cm}).$$

Conclusion. The main driving forces in GICT is the gravitational force, so it's actually kind of gravitational cleaners.

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O.F. Aksenov, Doctor of Technical Science,
S.V. Boichenko, Doctor of Technical Science,
A.O. Azarenkova (National Aviation University, Kyiv, Ukraine)

INVESTIGATION OF THE PERFORMANCE AND ENVIRONMENTAL CHARACTERISTICS OF MOTOR GASOLINES WITH DIFFERENT CONTENT OF ETHANOL

This paper considers the prospects for the use of ethanol as an alternative motor fuel additives for alternative used in unmanned aircraft. Also, the paper presents the experimental investigation of physical, chemical, environmental and performance properties of alternative fuel motor with different content of ethanol.

The use of ethanol-based fuel, which covered a large part of the world energy market, every year becoming more important, as experts predict the near future increase in its production worldwide.

In Ukraine, the use of bioethanol fuel is taken to reduce dependence on imported fuel and in the fight against environmental pollution. Ukraine also has a competitive advantage among other countries in the production of fuel ethanol: rich soil, favorable agricultural infrastructure and tradition of growing grain.

The use of bioethanol can reduce exhaust emissions by increasing the oxygen content, promoting a more complete combustion of fuel.

Investigation of operational and environmental performance of motor fuels with varying ethanol content for unmanned aircraft conducted at the National Aviation University testing laboratory products "AviaTEST" together with research and production center of unmanned aircraft "Virage".

The object of the study was car gasoline A-92 with different content Bioethanol additives (5 to 85% vol.).

Research carried out by the unmanned aircraft BVS M-7D "Heaven patrol", whose main function is the mapping and aerial surveillance in real-time patrols linear objects. Engine type - 2T, PD, petrol.

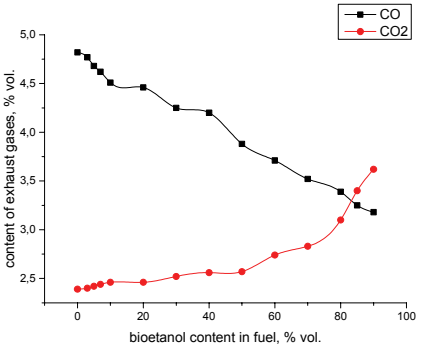
Unmanned aerial vehicle BVS M-7D "Heaven patrol"

Figure №1

Environmental properties measured by indicators of volume of emissions of carbon monoxide CO, carbon dioxide CO_2 and hydrocarbon gas analyzer device to INFRAKAR M. The research results are presented in *charts* 1, 2.

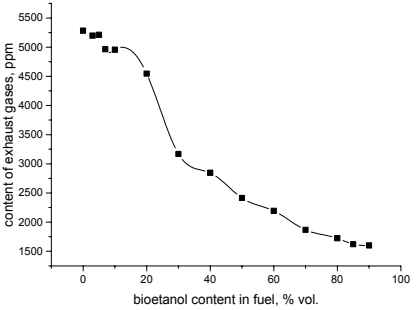
The dependence of the emission of carbon monoxide CO and carbon dioxide CO_2 content of ethanol in fuel

Chart №1



The dependence of the emission of hydrocarbons C_XH_Y of ethanol content in fuel

Chart №2



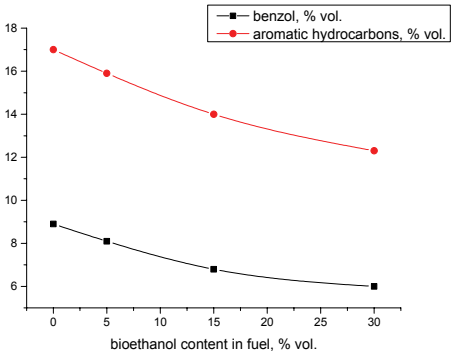
Thus, with increasing ethanol content in the fuel mixture there is a significant reduction of exhaust gases such as CO, hydrocarbons and CO_2 emissions increase, indicating a more complete combustion of exhaust gases due to the fact that bioethanol is oxygen, ie more burning emissions and cleaner exhaust observed.

Also as environmental indicators studied aromatic hydrocarbons and benzene. Since they are toxic and hazardous substances to the environment and human health environmental standards of the European Union and Ukraine and permanently reduce their content in the fuel. Requirements for aromatic hydrocarbons by ISO 4839-2007 "High quality motor fuels. Specifications "that meets Euro 4 decreased from the requirements of ISO 4063-2001" Petrol.

Specifications ", which complies with Euro 3ta was canceled at the end of 2013, from 42 to 35% (vol.). Dependence of changes in the content of aromatic hydrocarbons and benzene content of ethanol in the fuel are shown in chart 3.

Dependence of change of aromatics and benzene content of ethanol in fuel

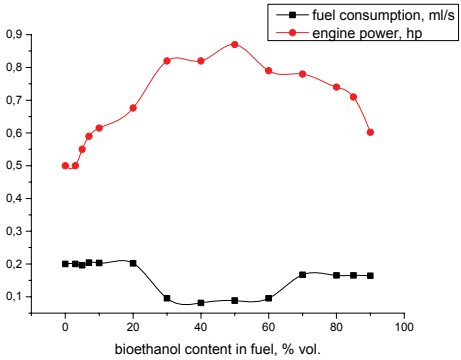
Chart №3



Operating properties measured at static thrust performance, the time of the engine at constant volume unit of the fuel mixture and engine power.

Dependence of static thrust and power output of ethanol content in fuel

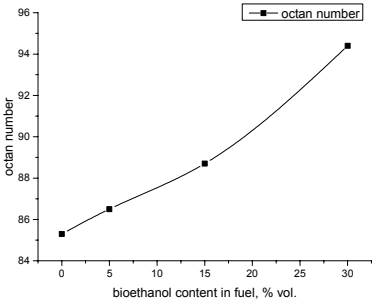
Chart №4



One of the main characteristics of bioethanol fuel is the detonation resistance. The octane number of bioethanol higher octane gasoline, thus increasing the compression, and as a result, provides new opportunities to increase engine power. Below are the experimental data, depending on the content Joints Bioethanol fuel additives chart 5.

Dependence of the octane number of ethanol content in fuel

Chart №5



Thus, the results of experimental data on the properties of the impact of ethanol motor fuel, it can be argued that ethanol is a promising alternative replacement fuel of petroleum origin and has a number of advantages. These are:

• cleaner exhaust (30% less emissions, due to the fact that ethanol is oxygen, ie dozhyhayutsya emissions) and to eliminate the risk of cancer by 30%;

• bioethanol production in many countries, allowing them to reduce their energy dependence on suppliers of oil and gas resources.

• octane ethanol higher octane gasoline, thus increasing the compression, and as a result, provides new opportunities to increase engine power;

• using bioethanol as a gasoline additive in an amount up to 15% of engine not subject to structural changes.

Conclusions:

The results of experimental researches of additives to motor fuel ethanol showed that the use of ethanol can increase energy efficiency in operation vehicles, reduce fuel base gasoline and significantly reduce emissions of products of incomplete combustion (carbon monoxide and hydrocarbons) from the exhaust gases, allowing expected to reduce the total hazardous emissions.

The introduction of ethanol as an alternative fuel additive will improve the level of energy security; proper functioning of the domestic market motor fuels to reduce dependence on imported energy state; development and stability as the country's agriculture and domestic oil market.

Based on the results and further research will be developed and investigated the optimal concentration of ethanol in motor fuel for unmanned avaitsiyi that does not lead to structural changes in the engine and do not impair the physical and chemical properties of the fuel.

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O.V. Sosnin
Doctor of political science, professor,
(National Aviation University, Ukraine, Kyiv)

ESTABLISHING PUBLIC ADMINISTRATION OF EDUCATION – THE WAY TO BUILD IN UKRAINE INTO THE KNOWLEDGE SOCIETY

The questions of public administration education, which was important for the adoption of the Law of Ukraine "On Higher Education". The analysis also experience information to provide scientific, technical and manufacturing processes at leading educational research centers in the world.

In the context of the new Law of Ukraine “On Education”, which integrates a lot of issues concerning the development of a national system of training highly qualified personnel, with increasing efficiency we have to focus on the problems of training for extremely complex high-tech industries, which are particularly and the design and manufacture of aerospace engineering. Its foundations were laid at the base of our university and thinking about demands of the new century, Ukraine accession to the global innovation process, a new stage of self-development of person, society and state we have to pay attention to the problem of public administration of education process.

In the world the active discussion of these issues has yet begun in the late twentieth century, when under the influence of competition for possessing of nuclear, aero and space-rocket technology it became visible falsity of extensive consumption of natural resources that caused a deep crisis in political development. It should be understood that there is correct understanding of the ancient Greek word “crisis” (κρίσις), which means “court” it could be added and other similar content notion, in other words today we need to assess the conditions where the existing means achieving the goal are out of date, and as result this become the occasion to understand the situation, feel keenly personal responsibility and decide on the future life.

Overcoming the crisis in 70-s years of the XX century advanced countries of the world and, first of all, USA started global on its extant of applying new knowledge and technology system process of information accumulation and educated people creating information resource for needs to make changes in building in and administration of industries. As result they formed bases of new, so-called, innovative economy. Its main development recourse even fundamental characteristic was information and highly educated people: knowledge and skills of which to continuing education on standards of the global educational centers, skills to intellectual labor and “machine” thinking in acquisition of information and communications technologies (ICT) stipulated even appearance of the preconditions for development of society on new principles – informational society.

The advent of a computer and global ICT than became a key element in transforming the life condition of a man-creator, society and world order. As result, we all began to move to virtual environment of the computer world. Virtual, not

because it is “unreal” or “fictitious” world, but because there were minimal barriers to the dissemination of information in the artificially constructed cyberspace. All this resulted in promising applications intangibles assets of the society - accumulated scientific and technical information, patents on inventions, creative ideas, unique scientific and technological solutions in production technologies of complex equipment, so-called “know-how” models of production processes and so on. They began rapidly conditioned competitive advantage of countries and virtually “dragged” everyone into the sphere of influence of the international information exchange. Unfortunately, it so happened then that our human ingenuity went nowhere because the national system of education, scientific and technical activities had still been building on the principle of “nothing should be changed”. It has not been changed during the years of independence and we are almost feudal country and that is why today our youth focused on work and study in Western civilization, now perhaps in China, always being in a complex and contradictory situation of choice, that in itself requires from them considerable knowledge and sustainable value systems.

The changes, have occurred in the organization of educational R&D activity in the developed countries of the world during the reforms it became such that have a general tendency to publicity. Under influence of information the science and technology policy became more complex and open - special public sphere in the general social communication society “deliberative” (from deliberate - to discuss, debate) meaning “such that discusses” problems of human conscious attitude to education, information and knowledge as an essential resource of the development, requiring changes in administration of an individual in the educational activity.

There it should be noted and realized and talk about the problems of scientific and technological development, that is extremely complicated. It is only in the popular media investors instinctively sought to turn to the garage where young people like Jobs and Wozniak, Gates, Brin or Zuckerberg create innovation. In fact, as it turns out, they are pre-planned and funded even watched over the structures of intelligence, the Pentagon and their contractors. Climing to a new stage of the development poses before our high school new quality requirements of openness in the system of science and education. The goal, of course, is a highly educated man preparing for a future professional activity, however, not simply due to the systematic accumulation of organized knowledge, but also ensuring equal starting conditions for obtaining education that, firstly, creates identity, and secondly, directs the youth to further generation of new knowledge and professional skills.

Note, all of this will occur against the backdrop of the collapse of existing in Ukraine political and legal system, shifting coordinate measuring bias for our understanding of international relations, that have already largely destabilized the operation of conventional circuits unifying most influential scientific and educational centers of the world.

Today humanity is moving to a postindustrial phase of the development in the aerospace industry, i. e. it begins the domination of Robotics, new materials with extremely complex science-intensive technology of their production.

Conclusion

This does not only put pressure over the human mind, but always requires from high school teachers to think creatively and exclusively responsibly treat to their own education and, of course, behavior. This in itself that new technological improvement creates in the industry a new socio-political climate and a new system of basic values - through them the global information and communication space is being formed and the fifth dimension or virtual reality for the individual, with fundamentally new features and a huge number of information combinations for decision making. That is why in our university we have exclusively carefully and more responsibly to treat teaching humanities at the new stage of the development of engineering education. On the background of the existing systems of international information exchange for that very reason today they are putting way to the society in which knowledge become a man capital, form his require to the society, that is effect of an objective need in new manufacturing and all other social relations in the world globalizing under pressure of information.

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N.F. Rzhevska,
Candidate of political science, Associate professor
(National Aviation University, Ukraine, Kyiv)

STRATEGIC PROGNOSTICATION OF THE USA FOREIGN POLICY

This article is highlighting the special use of the strategic prediction process. This problem is analyzed in the theoretical and practical aspects. There is a brief analysis of the systematic approach usage in the prediction of the USA foreign policy.

The research of strategical prognostication, in particular the USA, where was its main theoretical and applied formation grounded, is very important, first of all, because of the political theory development and its adoption in the modern world of political practice. Nowadays, when political systems are making the huge turn to the democratical values, humanitarian priorities, culture of piece and mutual cooperation on the international arena, without the detail professional analysis and making out prognostications, avaliable and historically based possibilities for democratical transformations, making out of which is a pretty risky deal, sometimes an impossible one.

The main role in the providing USA foreign policy strategy belongs to the main American "think tanks" (under the term "think tanks" one means a group, institute or centre, organized for the intensive investigation and conceptual providing of the political and secutiry strategies of the USA) that make out the American behaviour scenary in the world, as well as, basic grounds for the international strategy political assessment, give the recomendations for the most problems according to the foreign and domestic policy in general [3, p.2].

Prognostication, the basis of which grounds in the person's cognitive activity is getting an important kind of social prognostication. First of all, it is connected to the one's experience, modern phenomenons and processes knowledge. It is based on the scientific data, dynamic and statistic rules. Social process prognostication is an independent prognostication branch that, first of all, is combining the primary data of history, sociology, political science, statistics, demography etc. Moreover, every single prognostication has the veritable character.

The most difficult kind of prognostication is a political one because it deales with the processes and events on the political arena. Politics touches the million's interests and theirs ways of life, and politicians, specially, political elite members have to prognose the results of their actions.

Startegical prognostication is based on the situation modelling knowlegde, development tendency analyse abilities, and according to this data one gets the abilities to find out the changes necessity, work out the changes strategy, use the save methods and it needs from the subject some abilities to embody the strategy into life. Strategical prognostication gives an opportunity to determine the real state of things, as well as, total possibilities, showed by means of this analysis, dynamics and perspectives of single objects and as well as totality of objects development that are making out the system and factors or grounds that speed up or slow down the movement to the aim. According to the knowledge one can make out some variations of decisions for the situations development influence in the certain direction.

The principles of strategical prognostication are made out due to the concerete scientifical prognostictional methods of research. Nowadays there is a great amount of general as well as particular social prognostication methods. Austrian futurist Erich Yatch thinks that there are more than 200 of them and it is not the end.

Political analysis is, first of all, the concentrate effort aimed at the research and finding out the key properties, the very alternative versions of the political course.

Political and social purpose analitical centres in the West began to appear starting the beginning of the last century. From the very beginning they represented themselves as university structures which were involved to the govermental programms making. They were intellectual cooporations that tried to combine the scientific innovative offers with the political science, grounding social humanitarian modelling.

Specialists are determining the think tanks in a different way. Anaway, they can be determined in general as: 1) institutes, cooporations or groups organized for the interdisciplinary researches; 2) consultative experts committees that provide the researches and give some special tips to the government; 3) independent intellectual structures that embody the players in the political process. Besides this term is used as a general title for the military laboratories, cooporations, academies, organizations that are supporting multidisciplinary theoretics and intellectuals that are orientated towards the analytical or political recommendations working out.

For the systematization and charactiristic step by step development of think tank scientists is using the following criteria as the time of forming; oraganizing mission (determinant tasks they are solving); the way of acting and its structural organization way; specific way of cooporation with the government [1].

Nowadays a lot of transnational non govermental organizations that are based in the USA are aimed towards the researchment of the different ways of the world politics. It is better to determine four basic types of the USA NGO: specific ones with the determinate professional specialization; cosmopolitan based on spiritual development of the person; transnational, they include the transnational cooporation; as well as, analytic cooporations or think trusts. The last ones play a key role in the foreign policy of the USA.

Analytical cooporations can be determinated as the basic points of the USA global force. They are taking part in the solving problems of the political reality correction by means of the full cycle of analitical production: from the problem analysis to the decisions implementation in terms of mamagenent system. The part of of them is oriented towards the cooperation with the global insitutions, first of all, UN, part is a link of state mechanizm. Formally, independent intellectual institutions are organized on the model of business cooporations, they have often branches. As, for example, Cernegie foundation has the branch in Russia, RAND – in GB and in Holland [2, p. 2].

“Think tanks” are thought as high-principled base of the international political power of the USA. Here the idea of generating process is combinined with the applied pecularity within the simultaneous realization of aim strategy that means the concrete social economic and political results. The last one positon differs them from the exclusively academic structures. Very often analytics are dealing with the high-principled providing of the political cultural expansion of the USA. Such a

mission has Carnegie Endowment for the International Peace and Brookings Institution. The leading think tanks are under the influence of state interests, first of all, political economical and security interests. According to the high level of the American society economization level such interests are the same level of importance for transnational cooporations as well. The activity of the think tanks is mostly determined by the influence of the cooporation that provides the research financing, political leaders activity support, periodical and special literature publishment. Analytical structures are the special link of the American political system governance that combines in a functional way cooporation activity with the foreign activity of the state. American analytic cooporation functioning is truly supported the big business, so it is more than just a simple reflection of the social structure society pecularities.

The objective ground for the strategic prognostication according the American analytic centres is a systematic building of the political phenomenon or process that is researched. The point is that, orientation to the systematic principle makes up the one from many main pecularities of the modern scientific style of thinking that appeared in the second half of the 20 century in the USA. It was taking the leading places during the long period of time in the world science. At the same time, during this period of time there are a lot discussions because of the aims and tasks of the "general system theory", system principle content, especially in political researches.

Prognostication of the social political processes needs a historical experience from one side and the traditions of the certain society. From another side, logics of the system method application is combined with the civilization experience that means that modernization encloses all the society spheres. Modern theoreticians determin political as well as social, economical, spiritual and other types of modernization. Political modernization with its specificity is a synthesizing according to the given above types because of its main characteristics are providing structural and qualitative changes not only in politics, but in social, economical, cultural and other spheres, creating the terms for stability and consolidation of society.

"The main point of system analisys and prognostication social and political prosecces demands are next: the research of certain social system in the modern conditions is impossible if it is not crossing its borders. Such an approach can change not only the way of thinking but also practical actions in process of social organizm reformation. Neglecting the principle of the old system borders crossing, unwillingless to refuse stereotype ideas, as a rule, instead of society modernization cause its visibility".

System approach of the state analytic structures creates a clever alternative during the making out of strategical decisions. Special councils and associations within the think tanks are organizing different researches of the actual problems in foreign affairs. Their advantage in taking of foreign policy decisions is a possibility to use its own structure for the research activity results in the certain political programs. The institute of advicers itself gives a chance to carry out the task of foreign policy management by means of more flexible mechanizm. As a rule, the most important influence belonbs to the advicers that are closer to the leaders. Disputation in the collegiate circle can be strict but they don't ruin the general line of the USA behaviour on the international arena. Moreover, the potential of the

analysts conformism in team is carried out not in a complete way in favour of security forces. However group or corporative logics of the top-managers about the foreign policy management is mostly based on the general system ideology.

The principle of prognostication systematic is combination of all the prognosed indexes of the object, its environment and important factors.

System approach is a methodology of the object's analysis in terms of nature and society as well, as a system, and the prognostication objects can be considered as systems, so it can be applied to problems of prognostication. Such a principle is the main one of the USA analytic centers.

The relationship between the elements in the system has some certain properties that are characterizing connection, interaction or orderliness of the given elements, so they are the certain display of the central principle about integrity of the system. There are two main functions of the system approach: a) formulation of the problems for getting new knowledge and solving new tasks; b) methodological analysis of the certain knowledge is carried out on basis of integrity principle, according to this principle the interconnection and cooperation of the elements are producing new system properties of the object that are not typical for its single elements and for the number of other principles.

In such a way, prognostication of the state or behavior of the system cannot be considered as formal prognostication of the state or the of system elements action, there should be taken into account their interconnection and appearance of the new properties due to the new state and behavior of the components.

Conclusion

Systematic in prognostication means that policy is a united object, but from the other hand, it is a complex of the independent blocks of prognostication. Such a principle gives a chance to get a visible model of the researched object in the system of its direct and reverse, hierarchical and coordination relations, determine its main system features – basic structure, content, functioning, ways of realization.

So, the matter of system prognostication in the American school of political analysis needs the usage of cooperation within the system, as well as, the connection ways between the object of prognostication and prognostication background, in other words, evironment. System analysis demands such a prognosis construction that is based on the models and means system.

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O.Yu. Kondratenko
Candidate of historical sciences, Associate professor
(National Aviation University, Ukraine, Kyiv)

INFORMATIONAL COMPONENT OF RUSSIAN AGGRESSION AGAINST UKRAINE

This aggression is called hybrid war because its implementation combines a variety of means, including information warfare, trolling, active military exercises near the Ukrainian border, support for separatism and the dominance of saboteurs. With all the information predominant factor was the Russian-Ukrainian geopolitical crisis as evidenced by the Russian media content, filled with anti-Ukrainian propaganda.

Emphasize that Ukraine has become a victim of information mostly aggression by Russia, as it is in the south and east of our country for many years created original habitat Russian media, the activity of which was accompanied by a manipulative techniques in relation to the local population. The strategy of the Kremlin has long existed a plan to strengthen the pro-Russian sentiment southeast of Ukraine and the transformation of the region by creating pseudo state ship. As you know, this plan received a result code name "Russian Spring". A special activation Russian media in Ukraine took place during the election campaign when the issue was highlighted Russian language in terms of giving it the second state. Extremely noisy and manipulative actions against Ukrainian State Kremlin began after the events known as the "Orange Revolution." It is necessary to think of what was already the new Ukrainian leadership was seen by Moscow to as nationalist and even fascist. Another motive for informational aggression of Russia against Ukraine became territorial claims regarding the controversial situation of affiliation Ukraine Crimea. All the time in the press and media intensified question "ill-treatment" of the Ukrainian leadership of the Russian population in Crimea. Besides regular "guests" in Sevastopol as "the city of Russian glory" were so odious policy O. Luzhkov and K. Zatulin constantly with words incited hatred of all Ukrainian. In a word, the Russian press holds true anti-Ukrainian propaganda over the past twenty-three years [5].

That's Russian assigned the role of "primary unifying factor" because that is what explains the furious battle for Ukraine bilingualism actually since it gained independence. Another addition to this may be the accusations that the Ukrainian authorities on the part of on "excessive Ukrainianization" south-eastern regions of Ukraine and attempts to ban Russian. In this regard, even cited "examples" of removal from discharging their obligations of Russian officials of various ranks. Another way to keep Ukraine within Russia's geopolitical field is defending Eastern Slavic Orthodox canon, which is regarded as only the beginning Holy Trinity - Russia consisting of Russia, Ukraine and Belarus. However, due to Russian and Russian-language media in Ukraine over the last two decades actualization question "protect Russian citizens abroad by all available means no matter where citizens are faring." Therefore, in addition to the formation of the Eurasian Economic associations equally fundamental challenge for Putin is to collect together all the

Russians and Russian-speakers within the so-called. "N the world." To achieve this, the State Duma of the Russian Federation at the time was passed two laws that provide the legal basis for the protection of citizens abroad even to the use of Russian troops outside the Russian Federation. Obviously, the Russian Federation, as well as at the time the Soviet Union, to strengthen its geopolitical position uses in the practice of so-called foreign policy. theory of war. Russian politicians aware of the limitations of resource potential for the implementation of such measures more and forcing the event to the depletion of the armed forces of Ukraine, realizing the danger of a collision with a full-scale sanctions from the West. Such aggressive behavior by the Kremlin seeks to strengthen and expand its geopolitical influence including at the expense of territories of other states demonstrated for the first time since the Cold War, and the last recovery carries risks, at least in a narrow scale [3]. It is possible that the latest change periodically Cold War military confrontation regional scale and regulated by major geopolitical players. Worsening conflict between the centers of power intensifies for Ukraine to divide them, as in the Cold War this problem or have experienced and continue to experience: Korea, Germany, Vietnam, and to a lesser extent China, that countries that are more likely to become a geopolitical ideological battle field. Russia relies primarily on sluggish reaction force of the EU bureaucracy in its structures and energy dependence of "Gazprom". With all the adventurousness of the Russian Soviet recovery plan in the form of the Eurasian Economic Union by, and now the power of incorporation is more than evident as the lack of adequate resources in the Russian Federation to conduct long-term resistance multiplied by the lack of powerful geopolitical allies, which at one time secured Soviet Union brings Russia plans to virtually zero. Therefore, we do not exclude that the current Russian actions can be viewed as the last battle for the post-Soviet Ukraine, and in particular to restore the Eurasian transcontinental empire. It is well known that complete a full-fledged Eurasian integration structures Moscow Ukraine without fail [1].

Given the variety of methods used in hybrid RF war leading tool for achieving the goals of Russian in Ukraine is still informative. Aggressive information campaign of much more active with the deteriorating events in Kiev November 2013 This aggression by Russia can be regarded only as a campaign aimed at undermining the legitimacy of the first actions of the opposition, and soon the new Ukrainian authorities. Discrimination latter occurs through massing in the media a number of epithets like "Bandera", "junta", "click", "fascists", "neo-Nazis" who have become a kind of cliché used at the time Goebbels propaganda. At the same time, Russia is trying to keep the information war against Ukraine globally through channels such as «Russia today», a number of European media and Internet network. For example, the recent European information space flooded manipulative materials content, better known as pro trolls. Latest actively posted as comments on local media sites, such as The Gardian, and the appearance of related items in social networks. It is believed that organizational resources such propaganda in the West are Russian finances for which rents Kremlin lobbyists, experts and PR-company objectives. Conversion of these materials is carried out to undermine the image and discrimination Ukraine, whose members allegedly received the authority as a result

of armed revolution. Equally important is the representation of the Ukrainian army operations in the Donbass as punitive operations [2].

Annexing Crimea and increasing the pressure on Ukraine for the purpose of denying its European aspirations of the Russian Federation has challenged the entire Euro-Atlantic civilization. However, Russia's chances of winning at least a minimal look that parties are fundamentally different models of war. If the West is banking on economic and evaluative tool in this confrontation, Russia prefers a rigid force as a means of losing the significance of the current geopolitical struggle. It becomes quite obvious absurdity strategy to support terrorism on the territory of Ukraine, as this phenomenon for many years fighting Russia itself. Even the means of information warfare Kremlin look too primitive for today, and accusations of fascism and neo-Nazism Ukraine are designed primarily to Russian audiences. However, we note that the Russian government still managed to win over their own populations, nearly half of which after careful processing media of Kiselev are ready to fight with mythical Bandera in Ukraine, which means more to the brotherly people.

Conclusion

Region and the whole south-east Ukraine could become a kind of geopolitical hook for as in information and international legal terms. With the annexation of the latter will only increase international economic and political isolation. Moreover, already in the short term cannot be ruled out a sharp drop in the economy of the Russian Federation for the sharp strengthening of economic sanctions and restrictions on access to the latest technologies, which remain the prerogative of the West. A growing number of Russian and foreign analysts agree that Russia does not have enough resources to keep within its geopolitical field Ukraine, let alone play the Eurasian empire in economic or political format. In the end, all efforts to restore Russia to Europe new dividing lines will encounter on the determination of the United States on preventing the emergence of a new "Berlin Wall" in Ukraine as a symbol of the Second Cold War.

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V.I. Mazur, Associate Professor
(National Aviation University, Ukraine, Kyiv)
O.Yu. Mazur, Leading Engineer
(Ukrainian National Airlines, Ukraine, Kyiv)

SOME ASPECTS OF BIOMETRIC PASSPORTS INTRODUCTION IN UKRAINE IN COMPLIANCE TO ICAO AND EU SPECIFICATIONS

This article contains analysis of current issues and prospects of biometric passports introduction in Ukraine.

In today's world, it has become increasingly important that documents required to travel – passports and identity cards – are secure.

Biometric passport, also known as an e-passport or a digital passport, is a combined paper and electronic passport that contains biometric information that can be used to authenticate the identity of travelers. These passports and identity cards have a computer chip which stores the holder's personal data and photograph. At a border checkpoint, a snapshot of the passport holder can be instantly compared to the photo on the chip. The aim is to ensure that the person using the passport and the person in the passport photo are one and the same.

Passports issued nowadays have an embedded RFID chip that carries digitally signed biometric information. When placed under a reader, radio waves "read" the tags which then broadcast back the information they contain. Access to this chip is wireless, which introduces a security risk. While there are measures in place to prevent unauthorised access to the data in the passport, tests show that it is easy to remotely detect the presence of a passport and determine its nationality. Although all passports implement the same international standard, characteristics of each implementation provide a fingerprint that is unique to passports of a particular country.

To prevent wireless reading of the passport content without the owner’s consent, passports can use a mechanism called Basic Access Control (BAC): to access the smartcard one must visually read some information printed in the passport. Communication between the passport and reader is encrypted, with an encryption key that is written on one of the passport pages. The idea is that the communication is only after opening the passport and (optically) reading this key, which presumably indicates consent by the passport holder. The key is written in the so-called Machine Readable Zone (MRZ) at the bottom of one of the passport pages; machine readable here means is can be read by OCR (Optical Character Recognition). A passport with such an OCR-readable MRZ is officially called a Machine Readable Travel Document (MRTD).

Characteristics of document and chip, which are used with this contactless smart card technology, embedded in the passport, are defined in the International Civil Aviation Organization's (ICAO) Doc 9303.The passport's critical information is both printed on the data page of the passport and stored in the chip. Public Key Infrastructure (PKI) is used to authenticate the data stored electronically in the passport chip making it expensive and difficult to forge when all security

mechanisms are fully and correctly implemented.

After adoption in Ukraine of the law on demographic registry and documents, and on the way of transition to electronic (biometric) documents, Ukrainians are increasingly concerned about the problem of observance by Ukraine of international standards in the sphere of biometrics and personal data protection. Ukraine's Cabinet of Ministers promised to start issuing biometric passports to Ukrainian citizens in January 2015. Still, due to lack of many standards and mechanisms, our country can consider only gradual production and issuance of biometric passports relevant to International Civil Aviation Organization standards.

The currently standardized biometrics used for this type of identification system are facial recognition, fingerprint recognition, and iris recognition. The decree of the Ukrainian government number 185 of March 13, 2013 refers to the use of electronic documents in two formats of biometric data - facial image and fingerprints. This corresponds to the requirements of the ICAO (Doc 9303) and the ISO / IEC standards 19794-5:2005, ISO / IEC 19794-4:2005.

ICAO defines the biometric file formats and communication protocols to be used in passports. Only the digital image (usually in JPEG format) of each biometric feature is actually stored in the chip. The comparison of biometric features is performed outside the passport chip by electronic border control systems (e-borders). ICAO standards intend interoperability between different countries and different manufacturers of passport books. They define biometric file formats and communication protocols to be used in passports, including the consulates of Ukraine abroad, and the gradual withdrawal of passports that do not comply with the standards.

Ukraine currently does have infrastructure for printing those passports, but does not have one for collecting biometric data. In fact, Ukraine officially at a very high international level in its scientific, technological and production capacity for manufacture of biometric identity document, but printing of biometric passports requires the development of infrastructure for collecting the information that will be put on the passports, as information is not collected by the enterprise that will print the biometric passports. The producer only prints pages in which data will be wired in. The data has to be collected at the place where people submit documents to receive passports. Ukraine has to create a network for collecting biometric data, for example, in the Foreigner Regional Registration Offices and passport departments. For sure, these institutions are to have equipment for collecting the data which will be wired in the biometric page, for example, for finger prints, eye retina scanning, etc. People should not have to go to another region to receive passports with a biometric page. Information collection points should be at least in each regional center and large district centers. Data received in the information collection points are processed and go to the central database and then they will go to the production facilities where the biometric passport will be printed.

Many experts in the field say that Ukrainian government needs to focus not just on migration management but, primarily, make improvements in document security. As we all know, personal data protection is a very sensitive issue in Ukraine. There is voiced concern over the government's idea to create a central database containing personal data of individuals. Such a database raises a number of

privacy concerns, including risks of data leakage and usage of data for other purposes than it was originally intended. In a number of European countries, such as France, Germany or Netherlands, biometric data is stored only on a card retained by the individual rather than recorded in a central database.

Biometric passports also should be easy to scan, for example, at a border checkpoint, bank or any other institution where the passport could be required. It is important that the equipment can scan not only biometric passports of Ukrainian citizens, but also citizens of other countries.

Ukrainians are currently the second most frequent recipients of Schengen visas, after Russians. In 2012, more than 1.3m C-category (short-stay) visas were issued to Ukrainians. Ukraine was the first Eastern partnership country to launch a visa liberalisation dialogue with the EU, in 2008. Years later, the country has made substantial progress, but European Commission says that some key conditions have yet to be fulfilled, including the introduction of biometric passports. Since Ukraine has become an associate member of EU (and as primary goal of digital passports introduction is possibility of visa-free entry to EU countries), it is reasonable to draw on their experience and implement similar standards and technologies.

All EU passports implement BAC. Since June 28, 2009 all passports issued by European Union member are biometric and contain at least two fingerprints. The prints are stored in a micro chip in the passport. While the ICAO specifications define authentication mechanisms and Basic Access Control (BAC) to protect the privacy of embedded data, Extended Access Control (EAC), intended to protect sensitive biometric data, is undefined. As a result, it is left to individual States or regions to produce their own specification for an implementation of EAC. European Union has developed a set of protocols to implement EAC which extend the underlying inter-operable Public Key Infrastructure (PKI) that participating States must employ. The EU specification may be adopted by some non-EU States, including our country.

Conclusion

As summary, we can come to the conclusion that there is still many issues in place that must be resolved before introduction of biometric passports in Ukraine. Main thing for the realization of the project is high-quality and quick collection of information and retaining confidentiality. Information should be processed and transferred quickly and safely. It is obvious that the state should determine who will keep the information, and a state agency should be involved in this.

To reduce the risks of data protection violations, instead of a central nationwide database, a local database could be created. As an alternative, specific databases linked to certain authorities – the State Migration Service or State Automobile Inspection – could be used.

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O.O. Kozhushko, Assistant
(National Aviation University, Ukraine, Kyiv)

INTERNATIONAL INFORMATION TRANSPARENCY

Access to information is crucial in the effort to increase accountability and transparency, improve governance, and give people a meaningful voice. If information isn't public, people can't enjoy many of their rights, such as participating fully in political life. Ensuring disclosure of and access to information can empower people and institutions to prevent and fight negative effects.

Access to information is a fundamental human right and a multi-dimensional tool serving both governments and citizens. Enshrined in Article 19 of the Universal Declaration of Human Rights, the right of access to information improves governance and lives as it assists public administration to become more transparent and accountable and enables citizens to engage more meaningfully in public life, understand policies, help determine public priorities, and use the information to ensure the exercise of their other human rights, including the rights to clean water, a safe environment, and education [2].

Transparency and accountability need each other and can be mutually reinforcing. Together they enable citizens to have a say about issues that matter to them, to have the means, resources and opportunities to influence decision-making, hold those making decisions to account and affect development outcomes. public officials, civil servants, managers and directors of companies and organisations and board trustees have a duty to act visibly, predictably and understandably to promote participation and accountability. Simply making information available is not sufficient to achieve transparency. Large amounts of raw information in the public domain may breed opacity rather than transparency. Information should be managed and published so that it is:

•relevant and accessible: information should be presented in plain and readily comprehensible language and formats appropriate for different users. It should retain the detail and disaggregation necessary for analysis, evaluation and participation. Information should be made available in ways appropriate to different audiences;

•timely and accurate: information should be made available in sufficient time to permit analysis, evaluation and engagement. This means that information needs to be provided while planning as well as during and after the implementation of policies and programmes. Information should be managed so that it is up-to-date, accurate, and complete [8].

Transparency is a characteristic of governments, companies, organisations and individuals that are open in the clear disclosure of information, rules, plans, processes and actions [7].

The main argument in favor of transparency is accountability. A positive case for transparency is that public deliberation as an essential element of legitimate democratic decision making. The main argument against transparency is that it might lead decision makers to take extreme positions in order to please their

interests or interested individuals or to make strategic use of information in order to appear competent [5].

Regime transparency depends upon both the demand for information and the supply of information. Specifically, regimes can seek «effectiveness-oriented» information to assess whether regime members are collectively achieving regime goals or «compliance-oriented» information to assess whether particular actors are individually fulfilling regime commitments. The incentives and capacities that relevant actors, whether governments, nongovernmental organizations, or corporate actors, have to provide such information depend on whether the regime's information system is structured around self-reporting, other-reporting, or problem-reporting. Although many of these factors are determined by characteristics of the actors involved or the structure of the problem, regimes can increase transparency by enhancing the incentives and capacity actors have to contribute to a particular regime's transparency [4].

Transparency exposes the close relationship between provider and recipient, thus reducing opportunities for political favouritism, corruption or misappropriation. While some governments may not find this a desirable effect of transparency, those wishing to reduce corruption or improve their image as a destination for foreign investment or donor funding will welcome the opportunity to have an incentive to expose corrupt practices. When a government is unwilling to share information on this relationship, the parliament, civil society, media and public can demand greater openness. At the international level, transparency can improve the quality and outcomes of international discussions. An accurate and shared understanding of the status quo provides the foundation for negotiations. Typically, the wealthiest countries have access to greater information about their own and others' policies (by having the resources to research the policies of their competitors),meaning that they are better placed to promote their own aims and objectives within such negotiations. Transparency reduces asymmetries in knowledge among negotiating partners, thereby improving outcomes as parties are less likely to be defensive if they are not «negotiating in the dark». Openness and transparency allow for sharing of best-practice policies. It allows countries to review the policies of their peers. Countries appreciate the opportunity to compare their performance and learn from similar countries, particularly those in their region or fellow members of multilateral organizations. Peer review can result in pressure to reform unsound policies, when neighboring countries or the global community are negatively affected, or because countries can compare their performance with other countries. There is a large gap between providing information and acting on that information. There are clearly major differences in the amount and quality of information among countries [6].

The government transparency polices have evolved over three generations.The first generation encompassed a variety of right-to-know policies, which were designed to prevent arbitrary government action. The second generation provided more targeted transparency policies which mandate baseline levels of information disclosure by the government. Targeted transparency policies are purely one-way. Collaborative transparency policies build on right-to-know and targeted transparency policies by leveraging computer technology and the Internet to serve as a medium via which government may interact with stakeholders. This approach is

two way and user-centered, with government playing a facilitating role to communicate information in real-time and in scalable formats [3].

Transparency describes the availability of information about potential adversaries'actions, capabilities, and intentions. There are four types of transparency, each corresponding to one of the four general ways states obtain information about their potential adversaries: cooperative, ambient, coerced, and unilateral. Cooperative transparency is caused by states' institutionalized and cooperative efforts to increase transparency. Various cooperative mechanisms can be used to increase transparency, including sharing of information, meetings, discussion forums, buffer zones, verification provisions in treaties, and shared intelligence. These institutional mechanisms vary according to their formality, the extent of the regime's rules, bureaucracy, procedures, and functions. Cooperative transparency is divided into informal (exchanges of information where the nature of information offered or exchanges is not specified formally or in advance)and formal (treaties and agreements specify the nature of information gathered and exchanged). Ambient transparency is caused by factors including the extent of global media coverage, relative ease of travel, and amount of trade and telecommunications, as well as information generated by non-governmental organizations, think tanks, and universities. Although these factors are hard for policy makers to manipulate, an increase in any of them generally increases transparency. Coerced transparency occurs when states are forced to open up. Unilateral transparency has three forms. The first is intelligence transparency which is a state's independent and directed efforts to collect information. These efforts include satellites, spies, and other such methods to gather and assess information. The second is confrontational transparency which is caused when states communicate in order to coerce or deter (information revealed to coerce or deter during a confrontation, standoffs, or competitions). The third is proffered transparency which is when states unilaterally reveal information in an effort to despiral conflicts and reassure others [1].

The international trend of passing access to information statutes continues, with more than 90 countries claiming a statutory right to information. Many of these countries are failing to fully and effectively implement their laws, and at present there are few objective means of analyzing and addressing this critical problem. More than 5 billion people around the globe are afforded some legal rights to information, however, in many countries this right has not been made meaningful or transformative for its citizens [2].

Conclusion

Information is fundamental to make informed decisions. Transparency is essential for monitoring and shaping compliance with obligations, such as commitments made under international agreements. Openness and transparency of government are key pillars of democracy. Data produced and collected by the government are the basic ingredients for governments to provide services, make policy, and be held accountable for their performance. Efficiently managing this information is essential to effective governance, especially since most citizen interactions with government generate information. Transparency remains an important component of open government. Governments must proactively release

information about what they do. People must utilise this information to make full use of their rights.

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I. Yu. Shcherbyna, V. N. Kubalskiy,
Candidate of law, Associate professor
(National Aviation University, Ukraine, Kyiv)

UKRAINE'S ROLE IN THE WORLD IN COUNTERING HUMAN TRAFFICKING

This article is dedicated to the issue of combating trafficking in human beings in the world and in Ukraine in particular. The authors pay attention on further developing of regional and international agreements between Ukraine and the countries of Eastern and Central Europe.

According to the statistical data, human trafficking has become the third largest criminal industry in the world, after the weapon and drug trade in the last years. Such conditions cause bad impact on carrying out rights, freedom and interests of the citizens. It threatens the well-managed national and international economic process and legal relations. Approximately 2.4 million people are trafficked across international borders annually, with women and children constituting the largest proportion being trafficked [1, p. 5]. The lack of opportunities in the home countries (poverty, social exclusion, unemployment, discrimination) and insufficient public awareness were among the main causes of people's vulnerability to trafficking.

On the international level Ukraine actively cooperates with other countries in the sphere of combating trafficking in human beings combining the strategy of combating trafficking in human beings, illegal migration and transnational crime at the national and international levels.

The international cooperation of Ukraine in the fighting against human trafficking is carried out on three main levels:

1) the participation of Ukraine in the various international organizations;

2) the fulfillment of its obligations under the universal multilateral treaties on human rights, the provisions of which are related to the issue of combating trafficking in persons;

3) in the framework of bilateral and multilateral local and regional agreements in combating international crime.

It's important to emphasize that such multilateral cooperation within the various international organizations and States fulfillment of their obligations under universal multilateral treaties on human rights include [2, p. 68]:

1) the direct cooperation aimed at achieving the purposes of the treaties;

2) the regular exchange of information on effective techniques and strategies of human rights protection (and fighting against human trafficking,) used by the States.

Needless to say that nowadays the conclusion of bilateral agreements in combating trafficking in human beings gives the place to regional and international ones. The countries that should be involved in the process of signing such agreements with the most vulnerable states in Eastern and Central Europe (meaning

the countries of origin, transit and destination of trafficked victims) such as Russia, Turkey, Poland, Czech Republic, Italy and United Arab Emirates.

On the national level in its attempts in combating trafficking in human beings Ukraine joined the Convention against Transnational Organized Crime in 2000 and ratified it in 2004. In 2001. Ukraine also signed the Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children, Supplementing the United Nations Convntion against Organised Crime. In 2004 the Verkhovna Rada of Ukraine adopted the Law of Ukraine "On Ratification of the United Nations Convention against Transnational Organized Crime and its Protocols that supplement it."

Moreover, realising the necessity of further regulation of trafficking in human beings issue the Government of Ukraine signed and ratified the numerous acts of international legislation in this area and adopted the Law of Ukraine on Countering Human Trafficking in September 2011 addressing all aspects of human trafficking including identification, provision of assistance and support as well as cooperation mechanisms. Followed by the adoption of the State Programme on Combating Trafficking in Human Beings until 2015 and related bylaws regulating the cooperation of national and local state authorities, local governments and non-governmental organisations in countering human trafficking and providing assistance to victims of trafficking [3].

The programme concentrates on two possible ways of solving the problem of trafficking in human beings and providing assistance and protection to victims of trafficking [3, p. 1].

The first option consists of solving the problem of trafficking in human beings through carrying out systematic measures by state authorities for budget funds. The disadvantage of this option is that its implementation requires a considerable amount of budget funds.

The second, best option foresees the set-up of cooperation between state authorities and non-governmental organisations, in particular the implementation of an effective referral mechanism in the sphere of combating trafficking in human beings in the following areas:

- organisation of awareness-raising activities among the population, aimed at preventing people from getting into trafficking-related situations;
- increasing the professional level of specialists who provide assistance to victims of trafficking and implement their rehabilitation and social integration;
- carrying out continuous monitoring of the implementation efficiency of activities aimed at combating trafficking in human beings;
- increasing the quality of services provided to victims of trafficking, in particular by implementing standards in social service provision to such persons.

Conclusion

Analysing the legislative and executive measures taken to prevent further possibilities of being trafficked we came up with the solutions that can improve the current situation. First of all, we need to create a joint convention introducing a

common set of laws between Ukraine and the main countries of destination in order to eradicate human trafficking and protect the victims and to further develop municipal law aimed at combating trafficking in human beings.

Realising the necessity of development of a national referral system with clear referral structures in each oblast we require the strengthening of the cross-border policy and the creating of a single system of counter-trafficking monitoring in the whole country by the establishment of multidisciplinary teams to evaluate the effectiveness of activities carried out on national and regional level, and to conduct a research on Ukraine as a destination country for trafficking in human beings. That will allow to obtain a clear picture on the dimension and trends of this phenomenon and therefore to develop the appropriate responses.

Furthermore, the cooperation between governmental and non-governmental stakeholders should be based on a clear differentiation of responsibilities, roles and capacities, as well as transparency that can be achieved through the creation of co-operation agreements with the formalised mechanisms and procedures. And to consolidate the anti-trafficking efforts of governmental bodies at central and local levels, as well as of NGOs and IOs that will enable a regular exchange of information and experiences on an individual basis.

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R.V. Fedynets, Postgraduate
(National Aviation University, Ukraine, Kyiv)

INTERNATIONAL LAW AND GEO-ECONOMIC CAUSES OF TERRORISM ESCALATION AND OCCURRENCE

Actuality of the question is caused by the urgent need to improve and find new ways of bringing peace to the "hot spots" as well as the need of society to stop the illegal activities of terrorist organizations and terrorists.

International law always has been the essential tool of regulating international relations. Even taking into account the imperfection of international legal norms and principles, they were and still are the only set of rules that are recognized by the international community and are designed to assist international community in addressing the most pressing international problems in the process of cooperation between the countries.

But to be able to perform tasks what international law confers upon international norms it is necessary to increase their effectiveness. Because solving most global problems - the problems of peace and stability in international relations, equality of states at the international arena - is depending on the effectiveness of international economic law - the instrument of which are the standards that are set out in international instruments.

Over the past decade, number of international legal instruments to combat terrorism was adopted. In particular, within the United Nations system universal agreements were adopted - Convention on Offences and Certain Other Acts Committed on Board Aircraft, 1963 ("Tokyo Convention") concerning aviation safety; Convention for the Suppression of Unlawful Seizure of Aircraft 1970 ("Hague Convention"), concerning the seizure of aircraft; Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation of 1971 ("Montreal Convention"), which applies to acts of aviation sabotage such as bombings aboard aircraft is in flight; International Convention for the Suppression of the Financing of Terrorism, 1999 and others are among them.

In 2006, guidelines of the global counter-terrorism strategy were prepared by Kofi Annan - "Unity in fighting against terrorism", which became part of the UN global counter-terrorism strategy adopted 5 years after the terrorist attack of September 11. The strategy was adopted by the Member States on September 8 in the form of resolutions and Action Plan. Assumed that it is able to strengthen national, regional and international efforts to combat terrorism.

However, the number of committed terrorist acts is increasing regularly. It is evident, therefore, that international legal efforts that world community is making are ineffective. Therefore, the acute problem is the efficiency of international legal impact on the terrorism emergence and escalation.

When examining a map of outbreaks of terrorism and putting it on the world map, one would see that a halo origin of the most part of terrorist organizations, as well as so-called "hot spots" are mostly poor regions where conflicts are permanent.

Most conflicts toda are asymmetric (exmp France - Mali, U.S.A. - Iraq), where terrorism is often is an act of resistance.

This asymmetry in international relations was caused inter alia by the ineffectiveness of international economic law, which had led to the emergence of geo-economic factors and the escalation of international conflicts in general and terrorism in particular. In particular, they (factors) are of uneven development of countries, accompanied by a rapid deepening of differences in terms of social and economic development, the transition of leverage of poer to the multinationals companies and intensification of the struggle for natural resources and more.

Despite dozens of international legal instruments that regulate global trade and international economic relations (United Nations Charter, especially the sections such as "international economic and social cooperation 'and' Economic and Social Council", Geneva "Principles of international trade relations and trade policy "1965, Marrakech agreement 1994, package of agreements establishing WTO, IMF, ICAO, the Treaty of Rome 1957, the Maastricht Treaty of 1993, the North American agreement on free Trade Association - NAFTA, and many others), the activities of international organizations (UN, WTO, ILO), declaring the need for preferences to developing countries, uniform development of all countries, customs border and debt relief – nowadays we observe the problems of poverty, lack of food, pollution, food production. All of the abovementioned problems, are causing the conflict potential in certain regions of the world, ie, constant war, fighting - including terrorism.

Consequently, international economic law in the form in which it exists today - is ineffective and does not perform its tasks, and does not meet properly the subject of his control - international economic relations. This leads to uneven development and other problems that ultimately provoke armed conflict - including terrorist acts. System and the mechanism of international economic law requires, therefore, a thorough research on finding ways to improve them.

Today classical international law that is reflected in the United Nations Organization system and being established after the Second World War, doesn't correspond to modern reality and modern international economic relations and the settlement of such issues as - selective adherence to international law, the failure of the international legal obligations by the activities of transnational corporations in international economic relations outside the legal field. This discrepancy leads to the ineffectiveness of international economic law - as the only one legal instrument regulating the world economy. Gaps and shortcomings of international law described above, have negative impact on general state of international relations around the world, resulting in a worsening of the socio-economic problems in many parts of the world. These problems are not improving during last decades, and often are the basis of the emergence of armed conflict and outbursts of aggression.

Thus, termination of such conflicts is precisely to solve pressing social and economic problems by legal means, and this why it is necessary to reform the global context of international economic law - which is outdated and static so that does not meet its tasks.

The main ways of improving the efficiency of international economic law and its rules, of course, are closely related to the progressive development in regard

to a new level of international relations. The main features of these relationships have become an absolute respect for all members of the international relations of existing rules and principles that govern a particular area of international relations, the specification of the general principles to more specific and a review of the concept of "advisory nature" in order to transfer some of the principles from the recommendations – that are not binding - to the level of international legal obligations.

Also development of a control mechanism - as a legal instrument of international economic law - seen to be necessary, taking into account the fact that in the absence of the latter, in the face of one-sided obligations of multinational corporations, without the possibility of sanctions, such commitments in their action are coming under the scope of the aforementioned "Global Compact", or existing corporate codes of conduct which are not of binding force. The possibility of filing lawsuits against the parent company can be an effective way of implementing the envisaged international legal standards and norms of international economic law and must be taken into account by states and international economic law.

Only by reforming the system of international economic law and the development of new international instruments is the opportunity to solve the most pressing social and economic problems and relieve tension in the entire regions, and consequently - to eliminate the causes of ongoing and new armed conflicts, including - acts of terrorism.

Conclusion

Improving the effectiveness of international economic law is objectively necessary because the realities of our days require strict compliance with the existing international legal principles and norms, as well as their (principles and rules) transformation in accordance with the dynamic development of international relations. Fundamental meaning in this respect has, inter alia, conscientious fulfilment of international agreements - not only to establish a new more effective law enforcement, but also to reach a higher level of trust and cooperation in international affairs, and improving international legal norms and bring them into conformity with the requirements of the current state of international economic relations.

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I.S. Iatsukhnenko, Postgraduate
(National Aviation University, Ukraine, Kyiv)

INTERNATIONAL LAW MECHANISMS FOR WORLD FOREST ECOSYSTEM PROTECTION

The article is dedicated to the research of international law mechanisms for world ecosystem protection The appropriate international law sources and the researches of the native and foreign scientists are analyzed. The Author pays accent to the necessity of further international law mobilization for the ensuring of natural forests ecosystem protection. Key words: international law mechanisms, forest ecosystems protection, Forest principles, international convention.

The world forest ecosystems are very important for the environment and for the human. They influence the climate of the Earth, make it milder, regulate the cloud building and the atmosphere precipitation level. Thus, they minimize the possibility of flood, drought and severe storm formation. The latest investigations show, that the deforestation and the forest degradation produce the desertification and soil degradation, making the live of human beings on these territories almost impossible. The world forest ecosystems are a home for a lot of species. Thus, they help to save the biodiversity. At the same time, a lot of indigenous people cannot exist without the forest ecosystems. Their political, social-economical, cultural and religious institutions depend on the forest ecosystem protection [6, p. 80-90].

At the same time, forest has been for a long time a source of wood and non-wood products. The forest degradation is a source of the quick enrichment. The country that protects its forests may lose its competitiveness at the world market. Only the collaboration of all countries and of all engaged in the forest-related activities countries may change the situation in such a way, that forest protection will be understood as a more efficient way of forest harvesting by all the countries and by all the major companies. Such collaboration must be based on the international law mechanisms that should be understood as a complex of international law principles and legal provisions that have with its aim to protect the world forest ecosystems from the hazards derived from the anthropogenic activity [1, p. 248-252].

Forest management and forest protection have been an important part of international legal process since the Earth Summit in Rio in 1992. At that summit the document, known as Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests was adopted. The preamble of the document states, that “The subject of forests is related to the entire range of environmental and development issues and opportunities, including the right to socio-economic development on a sustainable basis” and that “These principles reflect a first global consensus on forests. In committing themselves to the prompt implementation of these principles, countries also decide to keep them under assessment for their adequacy with regard to further international cooperation on forest issues”. Principle

1 states that “States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies and have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction” [2, p. 850-851]. Chapter 11 of Agenda 21: Combating Deforestation, also adopted in Rio, also has a great influence on the international legal mechanisms of Forest protection, representing a holistic approach [3, p. 310; 2, p. 255]. Since the Rio meeting some progress has been made. The Intergovernmental Panel on Forests (IPF), from 1995 - 1997, and the Intergovernmental Forum on Forests (IFF) from 1997 - 2000, both conducted under the auspices of the United Nations Commission on Sustainable Development, were the main intergovernmental discussion level for development of this mechanisms. They adopted the non legally-binding document, known as IPF/IFF Proposals for Action [4, p. 118-120]. The next international panel for forest law discussion is presented by United Nations Forest Forum (UNFF) that was established by ECOSOC Resolution/2000/35 as part of a new international arrangement on forests. The UNFF has adopted a lot of important documents on forests (UNFF Plan of Action, UNFF2 Ministerial Declaration to the World Summit on Sustainable Development. On the basis of UNFF6 ECOSOC resolution 2006/49 was adopted. The most important document, adopted as an outcome of UNFF activities, was the Non-Legally Binding Instrument on All types of Forests, adopted on 28 April 2007 [4, p. 121-122].

All the above mentioned documents are non-legally binding. International community fails to adopt a legally-binding document, because it is very difficult, to accommodate the interests of all the engaged parties. The international legal process is determinated by the neoliberal concept. It is understood, that the market should resolve all the problems on itself. But in reality the big international companies use all the above mentioned documents to spread their influence and to gain more in shorter period of time. Some International conventions are related to forest ecosystem protection, but they cannot take into the account all the aspects of this problem. In addition, all of them were adopted before GATT 1994 that makes the prohibition of wood trading illegal, because the legal principle states that “Lex posterior derogat priori”. That’s why the International community fails to combat the deforestation, and the nature forest lost, that leads to an extraordinary dangerous threat for the humanity, continues [5, p. 270-280].

Conclusion

In order to ensure the world ecosystem protection, the efficient legally-binding agreement is required. This agreement must ensure the bigger control by the state and international organizations, reducing the role of private companies, integrating the resources from all the sources and ensuring the public control. Its adoption will be possible only through the wide-spread public information about the disastrous results of forest degradation on all the levels and through the understanding of the role of forests by people, engaged in the decision-making progress.

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O.M. Ryzhko, Ph.D. in Philology
(National Aviation University, Ukraine, Kyiv)

UKRAINIAN MEDIA IN THE CONTEXT OF AXIOLOGY

Mass media materials devoted to retransmission of European values paradigm by Ukrainian media in connection with political reasons, in particular with the European choice of the way of state development are analyzed. It helps to determine peculiarities of providing the process of European values occurrence in Ukrainian social space.

For one thing, it is difficult to talk about values, when the economic crisis has turned into crisis of state. In the conditions of permanent escalation of the conflict in all its forms and manifestations – and well-crafted and skillfully executed provocation and emotionally aggressive response to provocation – it is difficult to determine dominance. What is prevalent? Basic, national, civil, personal or ecological values? «*Freedom* of unique personality and *co-involvement* of the whole» [3, 429] are defined by philosophers as the most fundamental values of human existence that «infest all other core values» [3, 429]. Purposeful restrictions on freedom and will of expression and contempt for human rights in Ukraine initially led to the opposition and mass protests, and after that – to crash. As a result, a radical value orientation: «I love my country but I hate the state» was assured. On the other hand, right now we can see axiological shift. A society that aspires *to be and to grow*, needs a guiding light. Therefore hierarchy of values takes on special significance. It is too presented through media channels. Since the mass media, due to their undeniable, pervasive, irreversible and often destructive influence on society, able to stabilize or destabilize the global community, depending on their role in the crisis of social processes, accompanied by a reassessment of values, hybridization of them, changing value orientations, displaying transformed values in the new codes.

For example, until the transformation of the economic crisis to political crisis we could talk about the frequent manifestations of the destructive influence of media on society, particularly through the «escalation of gloom» (biased agenda setting when only negative news are chosen – disaster and scandals are easier to sell – leads not only to distortion of reality reflection, but also makes the depressive mood in society), information noise, distraction on pseudo-events etc. Here we need to consider that «the systematic formulation the meager agenda exhaust the mobilization and intellectual potential of the state and reduces the threshold of emotional and moral worldview» that «leads to total apathy, discrediting action itself, freezes innovative searches» [2, 9], ie to reduce social development in the present and impossibility of it in the future. In contrast, in conditions of political protest of the end of 2013 – the beginning of 2014 exactly mass-media has become a platform where values and values paradigms generated, transformed, re-formatted and replicated in doing a strong influence on revival of the vital forces of the people.

Therefore axiology of mass media becomes one of the priority research areas that require thorough developing.

Consider, as an example, particularities of presentation of European values in Ukrainian mass media. At the beginning of November 2013 I have analyzed a number of mass media materials on the retransmission of paradigm of European values in Ukrainian media in connection with political reasons, in particular with the European choice of the way of state development, for determining the particularities of the occurrence of European values in the Ukrainian social space.

Common human values represent European axiological paradigm. Among them absolute (freedom, good, goodness favor, spirituality, wisdom) and socio-political (human rights, rule of law, good neighborhood, environment protection, social solidarity etc.) are dominant. The domestic mass media have made efforts to promote the clarification and promoting these values. But the state itself, despite the declared intentions, did not contribute to institutional change, deliberately conducted manipulative policies aimed at archaism Ukrainian consciousness and behavior. As a consequence, human rights as the highest value of the European community (according to a survey of Europeans «Eurobarometer», conducted several years ago to order of the European Commission: «Human rights (37 %) were in the first place among the ideals of surveyed in 27 EU countries, then in the list – the peace (35%), democracy (34%), the rule of law (22%), respect for other cultures (17%), solidarity (15%), respect for human life (14%), equality (13 %), personal freedom (11%), tolerance (10%), self-expression (4%), and in last place in the list of values – religion, which proved important for 3% of surveyed» [4]). Human rights for Ukrainian were at 13th place, and democracy, respectively, on the 3rd and the 7th, according to a national report «Sustainable Human Development: Ensuring Justice»: 1) order, 2) fairness 3) freedom 4) self-government, 5) stability, 6) patriotism, 7) democracy, 8) consent, 9) work 10) nation, 11) abundance, 12) state 13) human rights, 14) business, 15) church, religion, 16) success [2, c. 250]. Moreover, the dominance of the values of «stability», «justice», «order» and «abundance» showed a traditionalist matrix of behavior of Ukrainian society. On the one hand, it hampered the potential initiatives of strategic institutional policy changes, and on the other hand, such values hierarchy gave «an excellent opportunity to political actors to manipulate mass consciousness, playing on the threat of social instability and civil unrest» [2, c. 249].

In justifying the need to integrate Ukraine into a modern cultural life of Europe, Oksana Pachlowska resorts to bright and eloquent metaphor «Melancholic retreat for hedgehogs and foxes», which, on the one hand, clearly defines the differences of axiological orientations of «Europeans two parts of Europe», «mind – and sense, rationalism – and element, skepticism – and mystic highs – that the two wings of European consciousness, the combination of which is building a unique phenomenon of European culture» [1, c. 134], and, on the other hand, she named the platform at which it is possible to correct value orientations of modern Ukrainian, at a time when «in resolving issues of moral norms society has to focus on simple and practical model of success» [2, c. 242], losing faith in fairness: «Culture. Culture. Culture. The only thing that saves you from forgetting and alienation. The only thing that erases distance – geographical, temporal and spiritual. Now only depends on us whether WE return honor, dignity,

freedom, free breathing and epic calm presence of the future to our culture» [1, c. 135].

Clearly, to overcome many phobias (such as fear of dissolve, lose identity in which it is often forgotten that the confession of human values does not negate national), hard-crustedness thinking, develop critical perception of a united Europe not only as a supranational political entity, but as a spiritual phenomenon as opposed to blind imitation, you need to implement a systematic educational activities. And this is one of the important functions of the mass media. Here it should be noted that the issue of clarifying and promoting of European values (which is not limited to increased welfare, it is primarily the basis for finding ways of understanding between these various European nations) modern Ukrainian media play still mostly constructive role as in consistent implementation of mentioned educational function for correction value orientations of modern Ukrainian as a system of universally material and spiritual wealth, which determines the thoughts, actions and relationships of people; that motivate changes in outlook and cause the volition to change lifestyle.

These themed blocks were allocated based on semantic analysis from among of mass media materials related to European values: 1) *interpretive and explanatory* materials (preferred); 2) *meditative* (reflections on the problem); 3) *modal* (revealing the attitudes of different political and cultural forces to the problem – understanding / misunderstanding, acceptance / rejection, tolerance / aggression, etc.).

In the context of rebellion of Euromaydan, logically, the term «European values» has become one of the dominant. Media content of this period can be divided into the following components: 1) *manifest* (version of *modal*) where (consists mostly of the interview, for example, J. M. Barroso, Z. Brzezinski, G. Westerwelle and information notes) emphasis on the very presence of these values as paramount sign of Ukrainian society; 2) *meditative* (for example, the interview of Mr. Gritsak «Ukraine As an Aircraft That Is Captured by Terrorists» for «Zhytya. Ukrainska Pravda» [5]); 3) *analytical*, such as material of the sociologist A. Shestakovskiy «Radical Europeans: Euromaydan Values Compared to European Ones. Infographics» for «Ukrainska Pravda» [6]; this report, incidentally, contains data by which universalism, benevolence, independence and security are the highest priority values for participants or protests (11.8% of the population of Ukraine); they are supported by half of the adult population (50.3%), so we can assume that these values are relevant to them. Since the values do not change so quickly, we note that European values are naturally inherent in Ukrainian and G. Westerwelle remarks during a visit to Maydan in Kiev: «I'm here - European among Europeans» is quite justified.

Conclusions. In general, the features of presentation of European values by Ukrainian media can be considered: 1) development of the theme in blocks with domination of interpretation and explanatory materials; 2) attraction to balance the presentation of information and ensuring reflection plurality of views on the issue; 3) attempts to perform educational functions; 4) poly-genre (analytical articles, interviews, expanded information notes, etc.), to ensure the diversity of coverage.

Comprehensive study of the axiological features of modern Ukrainian mass media requires a separate research, designed to solve a *scientific problem*, which involves finding answers to the following questions: for what, nevertheless, are modern Ukrainian mass media calling? What pyramid of values are they building? What values are regulating contemporary journalism? What are the rules ensure the implementation of these values? What is the role of QMS in the processes of finance that «proved to be negative socio-humanitarian process of implantation of financial motives, financial values, that transforming basic values (fundamentally freedom, co-ownership, boon, gain, good, truth, creativity, beauty, holy, wisdom, harmony are the basic or core values) of personality» and as a result, it was the aftermath of the formation of the institute «life is not for the money but for credit"» [2, 75] (ie the expansion of «consumer society»)? What features of the QMS are leading to stabilization or destabilization of the global community?

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V.M. Vasyl’chenko, Ph.D. in Philology
(National Aviation University, Ukraine, Kyiv)

THE PHRASEOLOGISMS MOTIVATED BY THE RITE OF OATH IN THE MEDIA

The article deals with the functioning of the phraseologisms motivated by the rite of oath in the media, given their typology, nature of the relationship with the rite, defined the peculiarities of structural organization of these units, their stylistic potential are characterized.

Ceremonial Ukrainian field showsclear links with phraseology. Phraseologisms reflecting the ethnic element of spiritual culture forms the «sacred popular phraseology» (M.Tolstoy) [2, p. 70]. In the phraseological system of Ukrainian language there are fragments of verbal ritual oath. Oath is well-known in all over the world as a ritual aimed at certification and acknowledgment of allegiance, obedience or loyalty to any obligation [9, p. 260]. It allows also assuring the veracity of the uttered words, of fidelity in love and so on. It is often reinforced by the mention of something precious, sacred to someone who promises. Oath is known from archaic times of the spell itself, during which a man in a solemn ceremony with witnesses brings misfortune on himself, if not to fulfill the promise. The «objects» of oath were *life, mother, God, all holy things, blood, health, children, honor, good name* [7, p. 483]. Historically, the oath is based on the fear of «unseen force, destructive effect of which can be heaped up on the person who swore, in violation of the oath of allegiance» [15, p. 18]. Etymologically, the word of the oath (psl. *prisęga) derived from the verb *prisęgti (*to swore*), meaning «to touch the subject, by which people has swore» [5, p. 579]. Thus, initially the essence of the oath was to touch (the movement was a sign of intimacy, involvement, loyalty) to a particular object (symbol of the rite), endowed in the semiotic system of society by sacred importance (land, a sacred stone or image sacrificial fire, weapons, etc. [8].

Synonymous with the word «oath» is the word «*swear*». Those who violate the oath, are called «perjurer». In etymological terms, the word «oath» is related to the word «swear», «curse», «damn» 6, p. 470]. The following etymology refers to the idea of curse as punishment for perjury. It connects the rite of oath with the rite of utterance of a curse.

There is also a kind of oath as swear the name of God and other deities for the purpose of strengthening of the truth of his words; it is less solemn ritual performance compared with an oath. It invokes of evil over as the punishment if spoken words would be false [7, p. 47]. It was the most common way to trial. There are of types: verbal oath, oath using the cross, removal and kissing the icons [3, p. 165].

The rite of the oath, according to researchers, reaches primitive times. Y. Pisarenko one of oath (so-called «oath of grass on his head») generally offers

qualified as «universal model rite of transition», which at the same time, according to the researcher, perfectly translates the meaning of the term «tradition». Russian peasant to prove the belonging of controversial land of hay, put on his head a piece of turf and swear (sometimes at the same time avoiding the border), when the area around which argue, it does not belong to him, he will bepunished by the«Mother damp land». Originally probably the oath is the vow in general, the process of which it was shown the belonging of those who vows to 'sort-earth «by the temporary burial (and respectively - death) under the sod. The script reproduces the returning to the bosom of mother earth and re-birth [10, p. 79].

The rite in the judicial discourse launched in pagan times and in the Middle Ages it reached its climax. In the second half of the XVI – XVIII each member of the trial was sworn in, swearing in the name of God in the presence of people in front of holy orders Holy Cross and the Gospel [4].

The rite of oath included: a) the swearing parties; b) witnesses (people, gods by that people had swore); c) a sacred object (the cross, the Gospel); d) the procedure of holding the rite and d) text (verbal formula) [3, p. 166]. It had been holding in the holy place (the ancestral graves, church, etc.). Swearing in church people kissed the cross and the Gospel solemnly calls upon God as a witness. Many peoples by the act of kissing the cross (such as shrines) argued the swear, the oath [1, p. 57]. This ceremony was called kissing the cross. «It was considered so holy act that no one dared to break it by any unrighteous action» [11, p. 262-263].

There is a group of phraseology that is in the motivational relations with the ritual oath. These links are fixed at the level of both form and content level. Some of these items describe the ritual, its different variants (components): *давати / дати слово честі* [13, p. 211], *давати / дати обітницю* [13, p. 209], *давати хреста* [13, p. 215], *положити зарік* [12, p. 538]. The form of some items shows that swear was occured with body parts: *давати / дати голову* (*руку*) *[на відруб* (*відсік* і т. ін.) [12, p. 177-178], *ручатися (ручитися) головою* [12, p. 626], *присягаю на божі вії* [14, p. 52].

It was found a group of units, whose shape reflects the fact of the involvement in the rite of God's name. Here God is the force by which people swear and call Him to be their witnesses: *присягаю перед Богом святим* [14, p. 28], *їй же Богу (бо…) [святому!]* [14, p. 26], *їй же богу*, *їй же богу моєму, їй же ти богу* [13, p. 42], *Богом [живим] божуся!* [14, p. 23-24], *Бог мені свідок* [13, p. 38].

A number of idioms, which include component GOD, is a curse (sinister wishes) in their structure. Usually, this verbal magic formula was aimed at the person who swears (carried out the spell itself). Evil wishes to yourself were voiced, if the spoken word -was not true. The expression of these units contains a description of what happens in the case of the blood oath: *хай (нехай) мене Бог (Господь) поб'є (уб'є, покарає)* [13, p. 40], *убий (побий) мене Бог* – [13, p. 909]. There are many oath by which people conjured himself among all available material. They have diverse topics. In particular, these are wishes:

1) death (*щоб я вмер!* [14, p. 484]), but more often – a variety of diseases. And the names of diseases are mentioned infrequently: *щоб мені трясця* [13, p. 902], *хай трясця мене б'є!* [14, p. 471]. Often such phraseological

unit contains information about obtaining injury: *щоб мені язик відсох (усох)* [13, p. 976], *щоб мене скрутило* [13, p. 821], *щоб мені печінку роздуло* [13, p. 749], *щоб очі повилазили* [12, p. 479];

2) disasters against evil forces: *враг візьми мою душу!* [14, p. 59], *нехай мене враг візьме!* [14, p. 59], *враг мене (мою душу) візьми* [13, p. 150];
3) absence of goodness or deprivation of salvation*: бодай (щоб) мені добра не було!* [13, p. 63], *бодай я довіку щастя не мав* [14, p. 531];
4) be damned: *щоб я був проклятий (проклят)* [13, p. 974];
5) to be in the next world: *щоб мені [крізь землю] провалитися* [13, p. 704], *щоб [крізь землю] провалитися* [13, p. 572];
6) generalized distress: *бодай (хай) мені те та се* [14, p. 533];
7) failure: *щоб я (ти) [так] з носом був* [13, p. 974], *щоб я так жив!* [14, p. 461], *щоб я [так] жив (на світі був)* [13, p. 974];
8) disaster from the sky and celestial elements: *хай мене скарає небо* [14, p. 266], *грім би мене вдарив (побив)* [13, p. 197], *хай мене грім поб'є* **(***уб'є, вдарить, приб'є* і т. ін.**)** [12, p. 170; 13, p. 198];
9) disaster from the cross as a magical power: *хай (нехай) мене [святий] хрест поб'є* [13, p. 935], *побий мене [святий] хрест*, [13, p. 935].

Using this type of phraseologisms is a main element of artistic styles: – *От **щоб я проклятий був! Щоб я проклятий**... – Брешеш, гаде! – закричали партизани й почали його бити. – **Клянуся святою рідною нашою землею! От щоб я подавився нею**, гляньте! – він почав їсти землю, обливаючись сльозами* (http://www.ukrcenter.com); *Еге, кропиву! Добра кропива! Хіба ти не бачиш, скільки наросло тих чортів, **бий їх сила божа**! Ось я вас, проклятих, усіх викошу!* (http://bookz.ru/authors/ne4ui-levic_kii-i/kaidashe/page-9-kaidashe.html). However, the available material demonstrates uses of such units in the texts of media. Getting here phraseologisms of the oath bring to that texts elements of archaic: *Але при чому тут Ірина Фаріон? **Даю руку на відруб**, що вона під жоден із цих критеріїв не підпадає* (http://blogs.pravda.com.ua/authors/tiahnybok/528c69493363a/page_10/).

However, the relationship with the rite of oath nevertheless remains. It represents a form of both phraseological and its semantics, as analyzed units show analogical type of secondary semiosyz when phraseologisation of free expression, which is part of the verbal code rite, occurs in semantically close direction: ***Даю вам слово честі**, Порошенко про це навіть не знав* (http://www.telekritika.ua/media-corp/lyudi/2010-10-26/56915).

By using these idioms in the text, the author, on the one hand, makes some phraseological semantics, and the other - he updates reference to ritual oath in the mind of the recipient. As a result, an appropriate connotation background of the statement is formed: *Лавринович б'є себе в груди: **Їй Богу**, жоден червоний прапор не розгортався* (http://www.gart.org.ua/?page=news&element_id=32770).

Conclusions

Thus, the analyzed units certify the fact of motivational links between ritual reality and phraseological system of Ukrainian language. The idiom of this type as

the expression and content plan transmit the methods of implementation of appropriate rituals and their general semantics - the assurance of the veracity of what was said. These units are often used in spoken texts and artistic styles. However, there is a place for them in a journalistic style, which means they are the creation of appropriate connotation background.

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T. M. Andreeva, Ph.D. in Philology
(Taras Shevchenko National University of Kyiv, Ukraine, Kyiv)

UKRAINIAN TAUTOLOGICAL PHRASEOLOGY IN THE TEXTS OF MEDIA

The article analyzes the Ukrainian tautological phraseological units, defined their nature, based on repetition, method of formation, found imagery, semantic kernel (tautological pair) selected functional groups, characterized using of them in the texts of media.

Phraseologisms are characterized by having specific nomination. Arising as a result of re-naming, they are deeply integrated into popular culture. Imaginative basis of such units «reflects the characteristic features of people’s worldview included as part of the concept of «mentalit». On this basis, in linguistics (as in cultural studies and philosophy) was formed and became generally accepted view of the structure of language phrasebook as the most transparent language subsystem for implementing concepts lingual means «language» ethnic culture» [2, p. 35].

A separate group of phraseological system of Ukrainian language are the tautological phraseological units (hereinafter – TF). They are characterized by formal features such as tautological repetition. It implies the existence of another phraseological unit within two (rarely - three times) used the same common root of idiomatic component. As you know, repeat – is the simplest stylistic figure which «is used in the folk art, primarily in folk songs and poetry, and is due to compositional semantic factors» [5, p. 555]. As an important figure style, it serves an artistic means of aesthetic and emotional understanding of reality, which resorted speaking [6, p. 219]. Repeat is directed at achieving the «expressive-figurative or expressive effect» [8, p. 459]. This figure of speech enables the author to draw the attention of the reader (listener) at a point in the text, or draw attention again. Repeating fragment strongly imprinted in memory and reliably stored there [3, p. 5]. Repetition of words with a similar meaning, said I. Uluhanov, «again and again returns the reader to the main subject of broadcasting to the common notion, which was the basis of the values of all repeated words. In this way the complexity of multidimensional concept is demonstrated, its importance, elationare affirmed»[10, p. 47]. The repetition of the same words as part of TF expressing quantitative amplification intensity value that has such a phraseological unit. A. Vasilyev offers call using TF «idiomatic hyperbole» [1, p. 32].

TF are the result of the integration of phrases under which researchers understand «one of the processes of phraseology on the basis of a single word, in which all elements are integrated and actively participate in the creation of value phraseological unit, or, more precisely, to create the image that the value motivates: *кисла Оришка; Михайло незгадайло; лелека, що літа далеко; попарити сухим віником*” [4, с. 190]: *морочити памороки*, *марнота марнот*. The reception of «deliberate tautology», that underlies of the TF, mainly provides distinct

expressiveness of analyzed phraseologisms ad as a result it becomes widely used means of image: *Та й дачниці, мовляв, як видко з листа, обридли вже тобі* ***гірш за гірку редьку*** (А. Головко); *Робота в мене – тихішої не знайдеш: бакенщиком* ***вік звікував*** (О. Донченко).

Analyzed TF are characterized by the so-called «intensified voltage» semantics, which indicate the presence of sema like «very, extremely, completely, totally» [9, p. 197]. The high expressivity of TF is achieved through a specific organization and persistence of the structural model, which shows regular increasing. These units have the ability to wide modeling [1 p. 32].

Figuratively semantic kernel of TF forming tautological pair (hereinafter – TP) – the unity of the two components of a full-blown (tautological components): *коліно в коліно*, *плоть від плоті*. Of course TF equal to TP, but TP may include up to multi-units: щоб тебе (його, її *і т. ін*.) *писачка писала* / *списала*, *міряти* однією *міркою* (*на* одну *мірку*). But this type has low productivity.

The nature of the TA provides grounds for separation of TF into two groups: 1) TF expressive and 2) TF meaningful purpose. The first group includes units forming which aims to create an appropriate expressive effect: *падь пала*, *з далекого далека*, *вік вікувати / звікувати*, *кат катом; кат з катів*, *святая святих*, *пропадати пропадом*. The second – the phraseological that convey information more logical and created largely without guidance on expressiveness: *з вуст у вуста* з сл. ”передаватися, передавати, переходити“, *від (з) уст до уст*, *від дзвінка до дзвінка*, *час від часу; від (із) часу до часу*, *від букви до букви*, *раз за разом*.. The expression units of the first group demonstrated a higher level semantic «dissolution» ofcomponents (*пришити пришву (пришви)* – ”Доповнити сказане кимсь, втрутитися в чужу розмову“, *розводити / розвести розводи* – ”Бути надто несміливим, не виявляти належної рішучості, наполегливості в чому-небудь“. Component units of the second group more distinct: *хвилина в хвилину*, *так за так*, *суди та пересуди*. For the most part, their semantics is motivated by the value of the components: *від дошки до дошки* – “Від початку до кінця“, *з години на годину* – ”У найближчий час“, *як рівний з рівним* – ”Рівноправний, рівноцінний з ким-небудь“.

In stylistic terms TF often function as a neutral one, but as a part of the subsystem available: a) the bookish **(***святая (свята, святе) святих*); b) humorous (*бодай рак урачив*; *не в лоб, так по лобі*); c) abusive (*нехай (хай) лизень злиже*; *сто сот крот болячок*);d) disparaging (*один одному на голову лізе*); e) vulgar (*дубом одубитися*); f) obsolete (*дзвонити (видзвонювати) в усі дзвони*); g) ironic **(***один від одного недалеко відбіг*) and ironically familiar (*мішок мішком*).

The media that serve native element for the creation and operation of phrases TF often used in headlines. This enables you to create powerful imagery effect: *Сирія оточена військовою технікою:* ***з години на годину*** *може початися ледь не третя світова війна* (http://tsn.ua/svit/siriyu-otochena-viyskovoyu-tehnikoyu-z-godini-na-godinu-mozhe-pochatisya-led-ne-tretya-svitova-viyna-308792. html). TF can be used alone (***Від дзвінка до дзвінка*** (http://uanews.crimea.ua/politics/2014/04/28/26426. html), or as part of spreading structures (***«Від дзвінка до дзвінка»*** *чи «вільні хліби»* (http://archive.wz.lviv.ua/articles/87336), *Читаю* ***від букви до букви…***

(http://www.mv-visti.org.ua/?p=2702). Headlines of TF in the structure may be a composite structure in which no part of phraseological provides situational «sticking», leading the reader from the overall image to its particular embodiment: ***"Плоть від плоті"***. *Журналісти і політики зрослись у безпринципності* (http://ipress.ua/ljlive/plot_vid_ploti_zhurnalisty_i_polityky_zroslys_u_bezpryntsypnosti_12550.html); ***Жарти – жартами***, *але що з тролейбусами?* (http://pplus.in.ua/novyny/1128-zharti-zhartami-ale-scho-z-troleybusami.html).

Stylistic marking of the TF provides the headline of appropriate tone, makes a variety of expressive colors: *Янукович показав студентам* ***"святая святих"*** *на Банковій* (http://www.pravda.com.ua/news/2012 /11/15/6977516/); *Ну добре, Юлія Володимирівна у тюрмі – це плюс. Але і мінус – а не дай Бог з нею щось станеться, Бог його знає, того ВВП, – що встругне, не знаєш. Тоді з нею на шиї прийдеться* ***вік вікувати***. *Не всім, звичайно, а Віктору Федоровичу* (http://maidanua.org/2013/11/taras-voznyak-kudy-ne-kynsya-vsyudy-klyn-hocha/).

The TF are also used as titles printed publications: *Альманах* ***«Кінець кінцем»****: розвідка сучасного мистецтва* (http://news.if.ua/news/1222.html).

The TF is expressive carriers of connotations in the body text: *Маг і чародій з Міжгірщини Михайло Юрик* ***дивним дивом***, *використовуючи свої екстрасенсорні можливості, зміг познайомитися в недовірливому Ужгороді з доцентом кафедри німецької філології…* (http://goloskarpat.info/publ/22249-yak-vdpochiti-v-koshce-za-11-vro.html); *Стосовно образу німця – не можна усіх* ***міряти однією міркою***. *Коли людина потрапляє в екстремальні умови, саме тоді проявляється її справжнє "я"* (http://ogo.ua/articles/view/2004-01-29/5759.html).

The TF with typologically other phraseological units are included in the series aims phraseology used to saturate the text by emotional components: ***Хоч криком кричи***, ***хоч лягай і помирай***, *але в кращому випадку так звана «влада» обмежиться відписками, але жодне питання вирішено так і не буде* (http://politikym.net/vlast/osobennosti_genocida_po_odesski.htm).

Along with headlines and body text TF are also used in direct language that allows illustrating the emotional state of the character of the material: *Раптом почали у двері* ***валом валити*** *ці так звані «тітушки»* (http://9-channel.com/zhurnalist-natalya-bilovitska-potrapila-v-otochennya-titushkiv-onovlyuyetsya-00058133.html).

Also it was found using of phrases of semantic destination: *Як правило, інформація про них передається* ***з вуст у вуста*** *лише «своїм» або ж продається за гроші, переконані досвідчені грибники* (http://mistovechirne.in.ua/podii-i-faktu/2570--l-------r); *Молоді батьки вже можуть розмовляти зі своїми батьком-матір'ю,* ***як рівний з рівним*** (http://provinciyka.rv.ua/6948-z-babuseju-krz-zhittja.-jak-virshiti.html). Being paid to transfer logical information, such units are nevertheless making expressive component.

The conclusions

Thus, features of imaginative understanding of reality, on the one hand, and the need to focus on some important concepts that served multifaceted, on the other, led to the emergence of such phenomena as TF. These units are reflected certain fragments of the national outlook, specific ethnic communication, especially the formation of conceptual and linguistic pictures of the world Ukrainian ethnos. The nature of these units is based on repetition; they are formed as a result of integration phrasemes around figurative meaning core – the tautological pair. Because of its distinct expressiveness the TF are both in the headlines and in the body texts in the media publications.

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I.V. Kevlyuk, PhD student
(National Aviation University, Kyiv, Ukraine)

TRANSFORMATION OF THE JOURANALISM AND PHENOMENON COGNITIVE LINGUISTICS IN THE MODERN SCIENTIFIC KNOWLEDGE

In the article examines the history of the formation of cognitive linguistics, the basic concepts of cognitive linguistics. There was a brief overview of the methodological works of major schools of cognitive linguistics, outlined the prospects of future developments in Ukraine.

Cognitive linguistics began to develop in the second half of the XX century. Its formation is associated with the names of G. Lakoff, G. Lanhaker, G. Steinthal, R. Brendom, M. Dammett, I. Baudouin de Courtenay and other scholars who were interested to establish the relationship of language and mind, to explain linguistic patterns using calls to the structural character of the language. Research areas were chosen approach of the language structures and phenomena of the outside language: cognitive principles and mechanisms not only the language but also the principles of human categorization, pragmatism and functioning of language in general, such as brevity. The most influential linguists who worked on this line and focusing their attention on cognitive principles were U. Chief, Ch. Fillmore, G. Lakoff, R. Lanhaker and L. Telmi. Each of these linguists began to develop its own approach to language description and linguistic theory that focuses on a specific set of phenomena and problems.

In the USSR, the first stirrings of cognitive linguistics emerged initially in the form of analytical reviews and translations of English-language primary sources of these problems. In published “Short Dictionary of the cognitive terms” edited by A. Kubryakova [9], which defined the perspectives of cognitive research in the post-Soviet countries. Not all linguists those countries perceived cognitive linguistics as a science. P. Parshin considered the application of cognitive linguistics as an inversion of the traditional psycholinguistics, as an explanation of the linguistic reality of psychological hypotheses [14]. In Ukraine the cognitive linguistics began to develop in the light of the onomasiolohia and linguakonseptology.

Cognitive linguistics as a branch of linguistics based on the theoretical works of cognitive science, which originated in the United States after the Second World War. The emergence of cognitive science in this period was due to the urgent need for the creation of powerful computers.

Cognitive science has set itself the task of research knowledge (cognition) and the associated processes and structures, although this problem to some extent already implemented such branches of science as philosophy, logic, psychology. New Trends in cognitive linguistics based on the basis of the above research predecessors and many modern linguists Y. Apresian, N. Arutyunova, A. Akhmanova, R. Budagov, A. Vezhbytska, S. Vorkachov, W. Gak, V. Dem'yankov, C. Jabotinska, V. Zvehintsev, S. Katsnel'son, M. Komlev,

V. Kasevych, M. Kocherhan, A. Kubryakova, A. Leontiev, L. Lysychenko, B. Maslov, L. Novikov, M. Parshin, V. Pisarenko, A. Selivanov, B. Serebrenykov, I. Sternin, J. Stepanov, A. Schaff, D. Shmeliov, R. Frumkin et al. The analyzing recent years with the publication on cognitive science, seeing the lack of consensus views of scientists on the subject and basic provisions of this trend linguistics, terminology, etc. instability.

Cognitive Linguistics (from Eng. Cognition "knowledge, cognition", "cognitive ability") – linguistic direction that functioning of language regards as a kind of cognitive, as cognitive, and cognitive mechanisms and the structure of human consciousness through analyzes linguistic phenomena.

For example, Maslov said that when it comes to the formation of cognitive linguistics as an independent scientific discipline, it is necessary to form its categorial-conceptual apparatus for making description language – primary and essential task of science. It should be noted that the terminology of cognitive linguistics system is characterized not so much by new terms, as clarified and unified concepts already existing in linguistics or borrowed from other sciences. The key terms of the cognitive linguistics are: a mind, the knowledge, a conceptualization, a conceptual system, a cognition, the language view of the world, a cognitive framework, a mental representation, the cognitive models, a categorization, a verbalization, the mental constants culture, a concept, a world view, conceptual, the national cultural space and other. All these concepts are related to cognitive human activity, that activity as a result of which a person comes to a particular decision or knowledge. The cognitive activity refers to the processes that accompany the processing of information lies in the creation of special structures of consciousness. Then the language (speech) activities – one of the cognitive activity [13, p.13-14].

The review of methodological works of major schools of cognitive linguistics that exist in the U.S. and Western Europe are evidence of a systematic and thorough development of cognitive linguistics. This framing semantics and structural grammar [Ch. Fillmore, P. Kay, A. Goldberg, W. Croft], the cognitive grammar [R. Leneker], the theory of conceptual metaphor [J. Lakoff, M. Johnson, N. Turner, J. Grady, R. Gibbs, S. Kevechesh, R. Nunews] and conceptual integration theory [J. Fokonyu and M. Turner], the prospect theory [R. McLori] and prototype theory [E. Roche, A. Vezhbytska, G. Lakoff], the theory of semantic primitives [A. Vezhbytska], the ikonizmus theory [J. Hyman et al.]. S. Jabotinska considered a positive feature of the American cognitive linguistics, which determines its specificity as a scientific field, methodological "adaptability" desire in some way related to language structure information, identify algorithms for the use of such structures. The disadvantage of the American cognitive linguistics is an attraction to "ethnocentrism" isolation on their own theories and lack of knowledge of European linguistic traditions, especially in linguistic semantics. The cognitive linguistics in Ukraine is present to study three types: 1) work, in which the authentic and refined cognitive methods proposed for the analysis of the language system (center – Cherkasy National University name of Bohdan Khmelnytsky), literary text (center - KNLU, Kherson State University) and discourse (KhNU name of Karazin); such studies are scarce; 2) work with multiple conceptology (successful and

unsuccessful), which is similar to work of this kind in Russia do not have a clearly defined methodological grounds; 3) many works by authors who wrongly call their cognitive research; in these studies did not solve the problem of cognitive linguistics not apply its methodological apparatus or existing analysis techniques applied very illiterate and sometimes ironic that on the one hand, leads to the discrediting of these methods, on the other – is grumbling critics cognitive linguistics, which, however, they know not what they do not criticize cognitive linguistics and its simulacrum [5].

Recent research also indicates that a kohnityvizm together several scientific areas: cognitive psychology, cultural anthropology, design of artificial intelligence, philosophy, neuroscience, linguistics, etc. In this regard, V. Maslova said "interdisciplinary nature of cognitive science" [13] and V. Demiankov not accidentally called this science "the federation subjects" with many schools and movements [3].

The processes associated with the knowledge and information are called cognitive. They are also synonymous with the word "intellectual", "mental", "reasonable". The according of the kohnityvizm, a person must be studied as a system of information processing, and human behavior – described and explained in terms of its internal states. These states manifest physically observed and interpreted as obtaining, processing, storage, mobilization and information for the efficient solving of the problem. Since the solution of these problems is directly related to the use of language, it is natural that it was in the spotlight of the kohnityvists [3, p. 17-33].

Since cognitive linguistics sees language as built-in the general cognitive abilities, it is of particular interest to her are: 1) the structural characteristics of the natural language categorization (a prototypity, an ambiguity, the cognitive models, a mental imagery and a metaphor); 2) the functional principles of linguistic organization (conciseness and naturalness); 3) the conceptual interface between syntax and semantics (the study of cognitive grammar); 4) experience and pragmatic language use; 5) the relationship between language and thought, including the question of relativism and conceptual universals.

Every new trend in linguistics associated with the new methods of language. As to the method of the cognitive linguistics definite the general opinion. Howling pain of uncertain method of investigation was the cause denial of cognitive linguistics as a distinct paradigm in linguistics. Some researchers (eg, V. Kasevych) [7, s.199-200], reflecting the contribution of cognitive linguistics in modern linguistics, concludes that the developed approaches and results, while enriching linguistics, do not create any new object (more precisely, the subject) studies, or even the new method as "rightly assume that cognitive linguistics exists - simply because there is no nekohnityvnoyi linguistics". The researcher V. Pisarenko expresses the opinion that "cognitive linguistics, of course, there is (as noncognitive exists – for example, structural), and within it is formed and a special understanding of the term, which is significant and has the meaning". [15] A. Kubryakova believes that cognitive linguistics worked out his method, which provides for "permanent correlation of speech data from other experienced sensorimotor data ... on a broad cultural, sociological, biological tech and – especially – the psychological background "and that" the method of cognitive science is primarily in an attempt to combine data from different sciences to harmonize the data and find meaning in

their correlations and relationships" [10, p. 5-6].

Model of any ethnic group displayed his tongue – shaped language world. Rightly notes this S. Yermolenko, stating aksiomatycly speaking in the language of various forms of human knowledge, their existence through language that informs us about the world. From the moment when a particular ethnic group becomes fact his awareness of his isolation, his "otherness", "it is already online". Ethnicity shows records of his being (existence) in the language. Bringing people into ethnic groups, a common language at the same time acts as a basis for the occurrence of each individual "special sense of belonging to the same genealogical roots, one culture" [4, p. 7]. Entering the arena of modern linguistic studies of cognitive linguistics has given scientists an opportunity to make new conclusions about the relationship between language and the objective world. In contrast to the idea of mapping each linguasystem objective world one of the postulates of modern cognitive linguistics argues that the language "in their own interprets it" [8, p. 12].

Conclusions

Thus, the central problem of cognitive linguistics – to construct a model of linguistic communication as the basis for knowledge sharing. Even von Humboldt believed that language – the main activity of the human spirit, which permeates all spheres of human life and cognition. Finally, it is in cognitive linguistics scholars focus switches to determine the role of language as an instrument of cognition and conditions [13]. In domestic linguistics cognitive linguistics has a clear direction for its development. If a foreign linguistics cognitive direction arose in connection with the study of various types of daily semantics in our country cognitive ideas expressed in connection with research in the field of nominations. In this theory, the relationship was considered a form of speech and language content on semasiological and onomasiological levels.

Thus, the current approach to the study of language is so complex that may qualify as an interdisciplinary cognitive science that combines the efforts of linguists, philosophers, psychologists, neuroscientists, culture, experts in the field of artificial intelligence.

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T. Martynova, Ph.D. in Philosophy
(National Aviation University, Kyiv, Ukraine)

EFFECT OF MEDIA ON THE FORMATION OF UKRAINIAN NATIONAL POLITICAL CONSCIOUSNESS IN THE CONTEXT OF GLOBALIZATION

In the article questions of influence of mass media on political consciousness of Ukrainian in the context of the growing role of information and mass communication in terms of globalization are analyzed.

Keywords: globalization, political consciousness, national consciousness, informational influence, mass media.

Problem statement. Globalization processes include economic, political, social and spiritual spheres of society. Its influence on society in general and the level of political consciousness of people in particular is more and more pronounced and intensive. It creates new conditions and dimensions of political reality, which we should comprehend and adapt to it. This leads to appearance of new methods of influence the political consciousness of the public and correlation of the methods, that has been repeatedly tested. After all, the development of the state and its democratic modernization and legitimacy of political processes and the fate of the country as an independent subject of international relations depend on the level of development of the political consciousness (especially in countries where there are transformation processes), awareness of political realities and needs by community. Thus, the research of methods to influence the political consciousness is updated.

In modern conditions the influence of mass media to the spiritual processes in society significantly increases, because of their social importance, and the mass availability. Mass media involve citizens in the information relationships and form a value-semantic model for mastering by society. Thus change the axiological pattern of society and guide the traditional system of intellectual production in some way.

Especially important is the influence of the media on the formation of national consciousness, as they are the important means of creating historical and cultural information space of the state, which, in essence, is the spiritual and ideological glue that cementing people into the political nation. Known expert in mass communications V. Lyzanchuk said: "... networks of information communications create the human communities, required public-political, socio-economic, ideological, historical, ethnic and other information pass through it. National network of mass media is one of the "three pillars", in which public consciousness, along with the national intellectuals and the national political elite are based on"[6, p. 15].

However, the media can not only consolidate the society, but also play a destructive role, undermine its social and psychological stability through the creation and promotion in public consciousness negative value images, ideals and values that are strange for domestic culture. Therefore, the society and the state must constantly take care of neutralization of regressive trends in information and

axiological field and mobilize the resource potential of the media to create such a value system that could provide the spiritual unity of society [10].

On the way of profound social and economic transformation, today Ukraine is facing the task of overcoming totalitarianism as a way of thinking in all areas of life and consolidation of multiethnic Ukrainian society into a unified political nation with a high level of national consciousness. Since the information activities of mass media will continue to grow and intensify consistently, the problem is that these activities meet Ukrainian national interests, contributed to the approval of the independent Ukrainian state.

Globalization in political area leads to an increase in the size of the community of people engaged in the same political activities; significantly increased social heterogeneity of communities involved in mass political processes; considerable complication of all social relations and relations of all political actors, expanding their interpersonal and intergroup relations; further equalization of characteristics of participants of various types of mass politics. Therefore, in current conditions it is appropriate to talk about the emergence of mass political consciousness. [7]

The main functional properties of mass political consciousness manifested as an influence on political processes, the formation of political values and ideals influence on the political activity of the subject, the ability to predict and simulate the political process. [9]

Socio-economic and political factors primarily influence on its formation, but the influence of ideological means is also powerful, given the dynamism and capacity for rapid change of mass political consciousness. This feature serves as a basis for the manipulation of it, which is quite common in politics.

Information influence is the easiest and most effective among the various means of influence on mass political consciousness. "We must recognize the fact that we learn about the world mostly indirectly; mainly refers to the world informed through information channels. What one knows today, up to 20% based on its own experience, and 80% passed through the press, radio and television" [5, p. 87].

Quite common is the idea that political consciousness and behavior strongly depends on the information field, which mass media creates. For example, E. Dennis emphasizes that "mass media" form "our thinking," affect "our thoughts and guidance," pushing "us to certain kinds of behavior" [2, p. 139]. Media by creating a public opinion influence the behavior of citizens.

Given the high level of trust in the media by the public, new technologies mass media can significantly affect the social consciousness. Citizens of Ukraine actively perceive propaganda clichés, stereotypes imposed by the media, especially in the periods of increased political participation (election campaigns, political crises, referendums, etc.). [5, p. 205].

Information space also becomes the main scene of collisions and fighting of varied national interests in the conditions of deepening of global integration and strengthening of tough international competition. Level of modern information technology allows states to implement their own interests without the use of military force and to weak or cause significant harm to the security of the competitor state that does not have an effective system of protection against negative information

effects [4]. A striking example is the information policy of the Russian Federation concerning Ukraine, whose strong state is contrary to Russia's national interests, and cultural marginality of a significant percentage of Ukrainians, shifting in our values, lack of stable national ideals are fertile ground for the application of manipulative technologies used by Russian mass media. Information war waged by Russia against Ukraine today demonstrates the power of using by mass media manipulation technologies for demoralization, ideological and political disorientation of the people.

Different interpretation of Ukrainian national idea in the media reinforces the opposite (depending on region) views on forming a model of the future Ukrainian society, which creates favorable conditions for strengthening the confrontation of regional dimension. Today it manifested in a distorted perception residents of the Western Ukraine as "Bandera" by Ukrainian of the eastern regions, which envying their values, culture and ideals.

The lack of a common information space in Ukraine is one of the reasons for this. Regions and center live their lives about which they write, respectively, in regional and in central (Kyiv) mass media. In the capital, they are not interested in regional periodicals and regional TV channels, while in the regions is almost impossible to buy a Kiev press, although television and radio broadcasts from Kyiv available in Ukrainian provinces (however, this does not mean that someone is interested in them!) [9].

Basic parameters and development trends of mass media that formed in Ukraine generally are not adequate to the needs of society in the formation of modern Ukrainian identity, preservation of cultural and historical identity, the development and articulation of the general public values, socialization, providing information and psychological security of citizens. [3].

Information and cultural space of our country largely shaped by powerful information flows of foreign countries, filled with cultural patterns of not the best quality, other people's ideals and values and, in fact, is not national in content. In such conditions the media, unfortunately, does not contribute to the formation and strengthening of national identity, and is a powerful and permanent factor in the lack of spirituality and denationalization of Ukrainian.

Ukraine has not produced effective mechanisms to protect personal information and cultural space from the external expansion, does not make a strong and effective legal mechanisms for regulation of mass media activities considering of the important role the media for the development of spirituality and formation in society spiritual values.

Conclusions. Mass media in the processes of formation of national political consciousness are a powerful tool of returning the society to its core values of identical and adequate ideas, customs, traditions, mentality, centuries-old cultural and historical experiences of the people.

Today the system of Ukrainian national mass media objectively does not focus on the formation of a developed national consciousness and state and political identity, preservation of cultural and historical identity of the Ukrainian society.

Ukraine has not produced effective mechanisms for the protection of its own information and cultural space from the external expansion.

Implementation of a balanced state information policy that would create the necessary conditions for a functioning national mass media in society as an important factor in the formation and strengthening of the national consciousness of the citizens of Ukraine, establishing an independent of state should be an important condition for the formation a holistic national information and cultural space in Ukraine.

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V.A. Emets, Postgraduate
(National Aviation University, Ukraine, Kyiv)

INFORMATION COMPONENT OF TERRORISM IN THE GLOBALIZATION

Modern information environment is characterized by strengthening of tendencies to manipulate the mass consciousness globally. Various kinds of terrorist organizations are very actively exploring the information space and try to take advantage of the means of mass communication as levers of influence on public opinion.

At present time globalization processes terrorism has become one of the most important problems facing the world community. Note that the term "terrorism", most of scientists assume as the social activities, which is a conscious purposeful use of violence by the hostage-taking, arson, murder, intimidation and public authorities in order to achieve criminal intent.

Terrorism because of its specificity, as available, often is the effective form of violence tends to increasingly wide spread pared. Violence in various forms (in particular for terrorist) largely is determining the look of the modern world, pointing to the imperfection of human society, and also the weakness of the opposing him the organizational and legal system. [1]

In this connection there are legitimate concerns that terrorism is directly connected with the peculiarities of the modern society development, which are caused by the influence of globalization, which are characterized, as it is known, with interdependence of countries in various fields: economics, politics, social sphere, culture, ecology, information technologies, trade, etc. [2].

As a result of the socio-political and scientific-expert discourse - challenges of globalization, terrorism and the clashes of civilizations has closely intertwined [3]. Namely globalization has led to the fact that terrorism has become to be a natural, impersonal and unpredictable phenomenon in social and political life of the XXI century citizens.

An important element in the study of any problem is the analysis of the problem's picture in minds of humanity. Globalization has created a new social field. And this field serves the global information space of. It is important to be aware of the fact that modern society is a society of information. Indeed, in modern society the mass media means in the formation of public opinion, not only play a crucial role, but are its translator and advocate, and its spokesman.

Media - is a powerful psychological weapon.

Over the past hundred years, information has become one of the leading factors in the society development. With its help man comprehends the world and its structure, public institutions and laws of their operation, the role of information in policy decisions and choosing the direction of social change is increasing.

Time has changed is not so much the essence of information as the intensity of its effect on people and society as a whole. According to G.G. Pocheptsov, Doctor of Philology, Professor, and Honored Journalist of Ukraine: "Information

begins to carry in itself both creative and destructive power, but in a much greater degree than it was previously, "[4] and it is impossible not to agree.

Integrity and viability of the modern world is largely achieved through intensive information exchange between the constituents of its components. Block only some information flows even for a short time can lead to serious crises and disasters. Anyway, information and telecommunication facilities have now become factors, which determine the ability to provide strategic stability and development of society and the State as a whole. Academician S. Kovalevsky offers to consider the information as the crucial system's element of survival, and the information's security - as one of the most important components of our country national security.

Paul Virilio, the French philosopher, in his work "From Terror to Apocalypse" indicates that terror is always guided to media and that territory, which will be the scene where will be played all more less presentable events, are televisions' screens and computer's display. Information space and the processes that take place in it, objectively becomes the subject of the close attention from both sides, like from terrorists' side, so from the side of those forces which are confronting the afire mentioned. In this space, the media is the driving force, the main element of information warfare, able to influence the situation directly. [5]

The problem of modern terrorism informational component is becoming almost a key to understanding the associated threats. To conquer the information space is the first task which present day's terrorist organizations are trying to resolve. As a form of violence, terrorism manifests itself publicly, terrorists want to be heard/ seen, their instruments designed for a mass audience emotions. And media is promoting them to utilize their goals, unwittingly contributing to the activities of terrorists, because they serve as a guide/translator and mouthpiece of terrorism.

The correct choice of object to create communicative resonance, constant stimulation the problem's discussion, a multi-channel impact on the audience, etc., demonstrate the good preparation for terrorists to conduct large-scale multi-level psychological operations in other countries information space.

The Institute of Sociology of Humboldt University (Germany) Professor Herfried Münkler believes that "modern terrorism, as calculated for a long time the political and military strategy, which has no more than thirty years history. Terrorism used to deal with the same weaponry that was used by his anarchist precursors, namely a short gun and a bomb; but present-day kind of terrorism is fundamentally different from others by combining the use of weapons with the media activities. This combination is crucial innovation of the modern terrorist use of force". Terrorist strategies cannot to be functioning not to have the public opinion resonance. Their intensity is amplified in the media revolution cause, that of local, regional, at best, creates a unified world public opinion which the Media will serve in real time - decisive factor here is the emergence of mass printing, distributing of radio, nascence and development of television, the use of relay satellites [6].

Info Space problem is that its channels are to be used both for and against, and that is what that is often used by terrorist organizations.

Illuminating the terrorist attacks, the Media are converting into the channel of between the terrorists and the public. Terrorists use the resources and information space infrastructure as an implement in the fight for the audience

attention. The phenomenon of terrorism is manifested in the mass-broadcast of the survive of catastrophic events directly to the recipient; and at this moment it does not matter how far away from the actual scene it is.

Terrorists are actively exploring the information space and, with different kinds of political technologies and Media, achieve their objectives. Execution of terrorist's acts, which are accompanied by the terrorists interview appearance, those that are done to world's leading TV channels, information about threats of new terrorist attacks, regularly are leaking to the press, determine the increased public interest in the terrorist organizations, that motivates Media to cover this problem broadly.

The terrorist organizations' activities information component at the present day globalized world is the Media goal - so called "information message". The terrorist act becomes to be known to a large audience through the Media. Thus, we can see the constructing of the strategic chain: the terrorist's attack - the Media message about the terrorist's attack and, as a result, the society response to the event.

Through the use of the "information message", terrorists reach a psychological effect, when through the mass broadcast of fear and terror, they achieve their aim.

Having a powerful information potential, terrorism strives to reach the maximizing the witnesses audience of their actions, and with this goal they use the global Media potential.

The conclusions

Availability of information resources in the modern world, unhindered exchange of information creates a great opportunity for of manipulating information and use of the information space as a testing field for experiments on mass consciousness.

Mass media are the one of the components in the terrorists' strategic chain. Media play the role of public opinion formation with the possibility of influence on Public Authorities. And because terrorism does not come from nowhere, and has some basis: religious claims, property, territorial, that is why in a globalizing society Media reveal the essence of terrorism, explain their motives and thus attract citizens to solve the world's social problems.

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G.I. Nazarenko, Candidate of Philological Science,
(Department of Journalism IIR NAU, Ukraine)

INTERNET TROLLING: THE LATEST EFFICIENT MANIPULATIVE TECHNIQUE FOR THE FORMATION OF PUBLIC OPINION IN UKRAINIAN MEDIA LANDSCAPE

This article focuses on the Internet trolling analysis as the present-day efficient manipulative practice for forming public opinion. In particular, the article studies application of trolling techniques as a tool for competing with political opponents during the recent presidential election in Ukraine in May 2014, that is, creation of freelancer troll groups, trolling strategy development by spin doctors, etc.

For the last two decades, Ukraine like all civilized countries worldwide has been experiencing an accelerated growth in network communication, particularly, social networks, information and analytical portals, various forums, blogs and chats that became an integral component of public life and a significant element of personal interaction with the community. Today, they connect millions of people regardless their age, social group, and political and other views. An important feature of virtual interactions is that every user may decide whether to communicate as a real person revealing a specific set of personal details, or anonymously (under a nickname that gives no way for identifying an author.) Anonymity (or pseudo-anonymity) of speaking up ideas to an unlimited audience was a key driver for the emergence of an unusual network communication phenomena named trolling. Researches fail to give an unambiguous definition for trolling. However every expert involved in its studying underline its libeling nature. Trolling can be individual or collective, spontaneous or organized, and unexpected or well-planned. Trolling is a form of fomenting conflict, humiliation and offence by a participant of online communication (a troll), and since it's a deliberate violation in network ethics, it is often performed anonymously.

The term *trolling* dates back to late 1980s. It entered the modern language of media users from a computer slang spoken by some online community members. Most experts believe that the term is an abbreviated phrase "trolling for suckers" denoting a sport fishing technique, and "trolling" here is a distorted form for "trawling". But obviously, the term went viral due to another meaning that originated from a Scandinavian folklore. In German and Scandinavian myth-making, trolls are evil horrible creatures hiding in mountains and wild forests, and come out to do people harm. According to some legends, trolls were in war with people and gods, and they were impudent, cruel and obstinate. However, the Scandinavian folk literature sometimes displays the trolls as good-tempered masters of the Northern nature who can make themselves somewhat useful. This meaning exactly represents the phenomena occurring in social network, discussion and thematic forums, portals, etc., for the past two decades and involving so called "trolls", that is anonyms who appear in the virtual space and extensively post rude, inflammatory, sarcastic and abusing comments and messages.

In recent times, trolling is becoming an increasingly broad tactical move in informational wars breaking out in the Ukrainian media landscape. In the beginning of the 21st century, trolling was perceived as a successful strategy for efficient conflict escalation that is applied in a political, international, economic and other spheres of modern life. There started to appear online communities for sharing the related experience. Most sources consider Judith Donath, an American media expert and a fellow at Harvard University, to be the first researcher of trolling in academic literature. She studied and investigated into Internet-trolling in her paper *Identity and Deception in the Virtual Community* published in 1996. Judith Donath asserts that trolling is a game about identity deception and simulation, but one that is played without the consent of other players who are not cognizant of trolls. Other media researchers define trolling as an online sabotage, deliberate provocation, virtual war, ultimate Internet fighting, etc.

Trolling technologies applied in informational wars breaking out in the Ukrainian media landscape are expanding and modifying. However, they are not sufficiently used during advertising, election, outreach, information countering and other strategies. Particularly, trolling as a practice for combating rivals was heavily involved in the last Ukrainian presidential election in May 2014, as evidenced by Ukrainian media. *Visti* journalist Taras Kozub wrote an analytical review *Internet trolls go to the polls* that read the following: "One week before the election day, the bots' performance (paid online commentators) reached its high point. Key candidates' headquarters organized real verbal battles on news websites and social networks. . . In international practice, especially in Kyiv/Moscow info war, trolling is one of key weapons. In recent years, any economic, gas or trade war between Ukraine and Russia was based on a simultaneously running information war with a purpose of organizing some offline campaigns." That fact is also underlined by Prof. G. G. Pocheptsov, a prominent Ukrainian media communication expert who states: "Information wars boost greatly the efficiency of real ones."

Journalists cleared up that HQs of key candidates for presidency were keeping in secret their cooperation with paid news commentators, while real verbal battles broke out between them. In most cases, online trolling activities are arranged in the following way: a great quantity of freelancer trolls are paid depending on the number of comments posted by them (one troll generates up to 50–70 comments daily). These are often unique comments, however the text should comply with guidelines that envisage a set of must-be points, messages and terms. The dynamically updated guidelines also include a list of websites and even links to specific news that should be commented to create the appearance of public support or popular resentment. Freelancer troll teams are coordinated by a supervisor who sends them updated guides once a day or two days, and receives daily report from them including comment texts and direct links. Such campaigns are carried out by engaged PR companies which enlist the services of trolls. The whole operation is headed by a spin doctor who develops a so called trolling strategy.

Developing for the past two decades as an up-to-date efficient manipulative practice for forming public opinion through network communication, trolling evolved into a significant social and psychological phenomena that shows a destructive effect on some individuals affected by manipulative techniques, and on communicative mutual interaction in online communities as a whole, which cannot be ignored. Besides, a modern trolling became one of the most powerful tools for large-scale public

brainwashing and nearly unpunished ruining activity towards whatever event, attitude or strategy. The matter is that a provocative act or scandal around an event, brand or well-known figure organized by trolls is not covered by any law or regulation and is referred to as a virtual miscommunication, though economical, political, image-related and other negative results of trolling can be more severe than a serious crime.

The situation is complicated by the fact it's almost impossible to differentiate deceptive comments, articles and opinions from real posts. Trolling identification is very complex and arbitrary, thus any conclusions, observations and attempts to oppose the aggression are very week. Ukraine's political online trolling is as widely spread as paid and well-disciplined protesters on streets and squares. Spin doctors say that troll commentators leave their messages on social network pages of Ukrainian journalists, experts and politicians. Troll news appear every day on various websites, and news agencies unintentionally distribute them not having an opportunity to verify sources. Thus, trolling is becoming an increasingly grave problem for national and international political journalism. Researcher R.A. Vnebrachnykh wrote in his article *Trolling as a Form of Social Aggression in Virtual Communities* two years ago: "With due regard for recent scenarios of *computer* or *Facebook* revolutions, trolling may convert to a popular occupation for a host of professions, for example, journalism, international politics, international economics, and etc." Analysis of current media landscape in Ukraine shows that the specified pessimistic forecast has turned into reality, and that trolling technologies during online wars and ultimate fighting are extensively applied for organizing information provocations grounded on scenarios of impact on targeted audience in social networks, forums, information portals, blogs, online media, etc. Trolling has evolved to a really popular journalism trend and an up-to-date efficient manipulative practice for forming public opinion in Ukrainian media landscape.

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K.V. Antonenko – PhD in Economy, O.I.Kotlyarova – magistr
(Institute of International Relations NAU, Kiev)

PROSPECTS OF INTERNATIONAL GRAIN MARKET IN THE SEASON 2014-2015 YEARS

Modern society is impossible to imagine without the needs of people who are paid in goods and posluhamy.Znachennya international trade in the international economy due to the fact that her background is an important factor and feasibility of international exchange of goods and services.

In 2013, the grain market has shown a significant increase of production volumes. Prospects for grain yield in 2014 as a whole remains favorable, despite the expectation of reducing their global production.

According to the forecast of the Food Agriculture Organization of the United Nations, published in May 2014, world cereal production in 2014/2015 marketing year versus second year from 2013 will remain at record levels, although slightly decreased - by 2.4%, or 60.6 million . tons, and will be 2 458,2 million tons Forecasts of world wheat production in 2014 and revised in the direction of a small reduction - up to 701.7 million tons, or only 1.9% from last year's record level. These projections due to the reduction of crops in Canada, the expectation reducing harvests in Australia, Syria, the United States and in Russia and Ukraine, which hosts more political tension. However, expected good harvests of wheat in Argentina, Brazil, India, Mexico and Pakistan. However, the situation regarding the supply and demand for wheat is generally balanced, given a sufficient level of world stocks of wheat. According to the forecast of the Food Agriculture Organization of the United Nations, published in May 2014, world cereal production in 2014/2015 marketing year versus second year from 2013 will remain at record levels, although slightly decreased - by 2.4%, or 60.6 million . tons, and will be 2 458,2 million tons This level of world cereal production is mainly due to the volumes already planted cereals, sowing plans for the second half of 2014 and expectations for normal weather conditions. However, the decline in grain production expected sometime in feed grain and wheat [1, c.54].

Forecasts of world wheat production in 2014 and revised in the direction of a small reduction - up to 701.7 million tons, or only 1.9% from last year's record level. These projections due to the reduction of crops in Canada, the expectation reducing harvests in Australia, Syria, the United States and in Russia and Ukraine, which hosts more political tension. However, expected good harvests of wheat in Argentina, Brazil, India, Mexico and Pakistan. However, the situation regarding the supply and demand for wheat is generally balanced, given a sufficient level of world stocks of wheat.

In 2014, the expected moderate reduction of feed grains - up to 1 255.4 million tonnes, or 3.9%, mainly due to the reduction of its production in the U.S. against the background of revision downward crops in the EU, Canada and Ukraine.

However it is expected that global stocks of feed grains will be reduced somewhat conditional on the growing demand for feed grains.

It is expected that the global demand for grain in the 2014/2015 marketing year will exceed last year's figure by 1.9% to reach 465.7 million tons 2 This moderate growth is conditioned by a decrease in industrial and feed consumption of coarse grains. In particular, the consumption of coarse grains is estimated to increase by only 1.8% - to 1 264.2 million tonnes mainly due to a possible increase in prices. However, it is expected that the use of feed grains from China will grow by 8.0% compared with last season. Wheat consumption will increase by only 1.7% - to 699.2 million tons The main factors that led to restrained growth in wheat consumption include current competitive cost advantage of feed grain price increases for wheat since the beginning of February 2014, reducing exports from Canada Argentina and Ukraine, as well as severe weather conditions. At the same time the volume of world rice consumption expected to increase by 2.4% - to 502.3 million tons, including the largest importer may be China. Increase in food grain consumption is estimated to increase by 1.5% - to 1 108.0 million tons this level indicator will provide grain population level 153.4 kg per year per capita, compared with 152.7 kg last year. It is expected that by 2014 compared with the previous year the share of wheat, coarse grains and rice cereal consumption remain intact and constitute 28.4%, 51.3 and 20.4%, respectively [5, c.35].

According to the forecast of global rice production in 2014 may again reach record levels and correspondingly increase to 501.1 million tonnes, or 0.8%, mainly due to falling world prices for rice and severe weather conditions in the area of cultivation. It is expected that the global demand for grain in the 2014/2015 marketing year will exceed last year's figure by 1.9% to reach 465.7 million tons 2 This moderate growth is conditioned by a decrease in industrial and feed consumption of coarse grains. In particular, the consumption of coarse grains is estimated to increase by only 1.8% - to 1 264.2 million tonnes mainly due to a possible increase in prices.

According to the forecast of world cereal stocks by the end of 2015 growing season compared to the record level of the previous season will be reduced by only 8.0 million tons, or 1.4% - to 565.8 million tons of slowdown in growth of world grain stocks in 2014/2015 marketing year in mainly conditioned by the reduction of feed grain stocks by 4.3% - to 206.3 million tonnes, including maize in China and the U.S., and for the first time in 8 years insignificant decrease in stocks of rice by 0.4% - to 180.1 million tonnes against a background of moderate build-up of stocks of wheat at 1.1 % - to 179.5 million tons, including China, Canada, the EU, India. Waiting for a slight drop in world grain stocks slightly affect the world average ratio of grain stocks to their level of consumption in 2014/2015 marketing year is estimated at 22.7%, up 0.6 percentage points less than last season, but more than the historical minimum - 18.4 % in season 2007 - 2008 years.

According to the forecast volume of world trade in cereals in 2014/2015 marketing year is estimated at 330.8 million tons, up 1.5%, or almost 5.0 million tonnes less than the previous season. A slight reduction in the volume of world trade in cereals in the season 2014 - 2015 years (July / June) primarily driven by a decrease in the proportion of coarse grains by 2.7% - to 142.0 million tons,

including corn and barley and wheat by only 0.6% - to 149.5 mt at the same time the volume of world trade in rice in the season 2014-2015 years (January / December) remain almost unchanged compared to last season, slightly decreased by 0.1% to 39.2 million tons and will stay at historic highs mainly due to increased demand from China and Nigeria [2, c.488].

Currently the largest exporters, which determine the state of the world wheat market are Argentina, Australia, Canada, the EU, Kazakhstan, Russia, Ukraine and the United States (Figure 1):

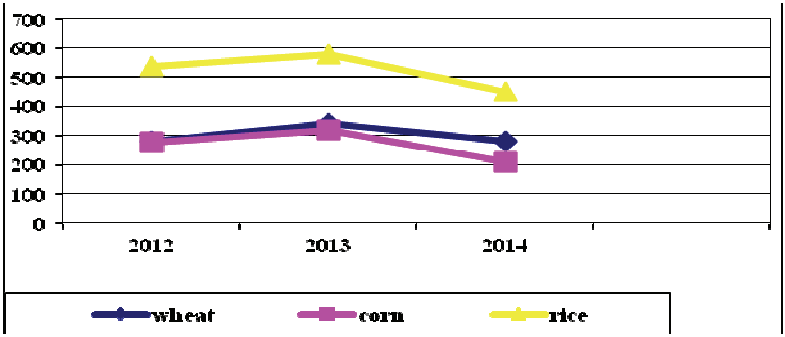

Figure 1. Dynamics grain prices (U.S. dollars).
Source: Note. Powered by author IMF to data.

It is expected that the main consumers of wheat will be Turkey, where its production fell to its lowest level in 20 years, the EU and Ukraine that provided preferential quotas on imports of wheat, Bangladesh, Egypt, Indonesia, Libya, Nigeria, Syria and Vietnam.

According to the Food Agriculture Organization of the United Nations, there are countries where food insecurity status is at extremely low levels, including: Syria, Yemen, South Sudan. Overall, 33 countries, including 26 African countries require foreign food aid.

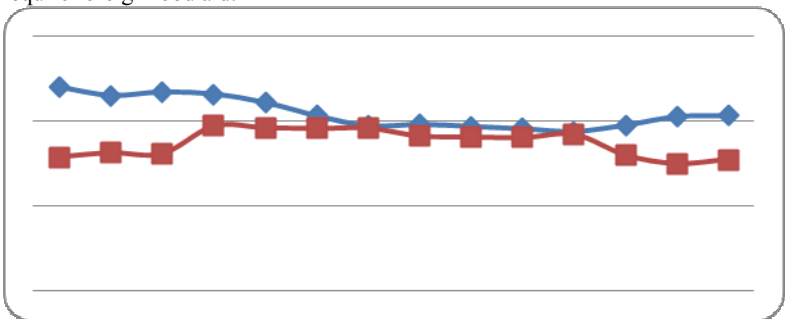

Figure 2. The dynamics of price indices for cereals.
Source: Food Agriculture Organization of the United Nations.

Rising prices for corn, which was observed from the beginning of February 2014, due mostly severe weather conditions in the U.S. and Brazil, as well as aggravation of geopolitical situation in the Black Sea region. At the same time the average price of corn during the first four months of 2014 remained lower than the price level in the same period last year. Index grain prices in April was 206.9 (the highest value since August 2013), which is 15.4 percentage points higher than at the beginning of the year, but less by 23.8 percentage points compared with the corresponding month of 2013 (Fig. 2). Weather conditions, geopolitical crises and fluctuations in the U.S. dollar will remain important factors in the formation of price trends for grains [3, c.334].

The above data indicate that the world market of cereals in 2014/2015 marketing year as a whole will be quite favorable for exporting countries.

Conclusions

Thus, global trade growth in 2013 was 2.1%. The slowdown in growth was the result of a number of adverse global economic conditions, including the debt crisis in some euro area countries.

The current stage of development of world trade is characterized by three main factors of international protection, as increased international competition, strengthening of existing integration and the emergence of new groups, industrialization of most developing countries, the problem of the debt of these countries as well as post-socialist (emerging market) economies and others. By the results of 2013/2014 marketing year, world production of cereals reached historic high. In particular, compared to last year world wheat production increased to 715.1 million tonnes, or 8.4%, coarse grains - up to 1 306.7 million tons, or increased by 13.0%, and rice - to 496.9 million tons, or increased by 1.2 %.

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M.P. Vysotska – PhD in Economy,
(Institute of International Relations NAU, Kiev)
V.O. Ilenko– bahalour

IMPACT OF GLOBALIZATION ON LABOR MIGRATION

Under the influence of globalization the world is becoming more common international migration. The main problem of migration is supposed the migration of workforce of the country. In Ukraine migration is extremely common. Therefore, the outflow of personnel for Ukraine is an actual problem. The problem of migration requires careful research to identify key factors and motivations developing measures for the control and regulation of migration processes in Ukraine.

According to research of the International Organization of Migration (IOM) every second young Ukrainian in age from 20 to 35 years wishes to emigrate from Ukraine . [5] The total population of Ukraine on January 1, 2013 is 45.4 million people. Among them migrants is more than 6.5 million people, or 14.3 % of Ukraine's population . [6]

According to the State Statistics Service of Ukraine among the countries , which often Ukrainians migrate are: Russia (43.2%),Poland (14.3%) , Italy (13.2 %) and Czech Republic (12.9 %). Among other countries Ukrainians also migrate to Spain (4.5 %), Germany (2.4%) , Hungary (1.9%), Portugal and Belarus (by 1.8%) . [6]

According to the World Bank's data in the beginning of 2013 the structure of emigration flows of Ukrainian is following: Russia (56%), Poland (5%), the USA (5%), Kazakhstan (4%), Israel (4%) Germany (3%), Moldova (3%), Italy (3%) and other countries. [7].

So the most portion of the Ukrainian emigration is directed to Russia. It is associated with the opening of borders and the lack of a language barrier.

According to the International Organization of Migration (IOM), the gender distribution of Ukrainian labor migrants in 2012 was as follows: men was 65.7%, women was 34.3%. Men often migrate to Russia, Portugal, Czech Republic, and women migrate to Italy, Turkey and Greece . [5]

The age structure of Ukrainian migrants in five age groups is: employees aged 15-19 years - 3%, 20-24 years - 15% 25-34 - 34 %, 35 -44 years - 31 %, 45 years and older - 17%.

Besides the determining of the age structure of migrants, it is also necessary to determine their level of education to define further characteristics of employment areas.

The distribution of migrants by level of education in Ukraine are: workers with primary education (2%) with incomplete secondary education (8%), with complete secondary and secondary special education (48%), with basic higher education (24%) and with higher education (18%).

The largest number of Ukrainian migrants are people with complete secondary and secondary special education (48%), they graduated from secondary

schools, gymnasiums, lyceums, colleges, technical schools, people with basic higher education (24%) in other words graduated from institutions and got the qualification of “Bachelor” and people with higher education (18%) they graduated from institutions and got qualification of "specialist" and "master". After determining the level of education of migrants we can provide characteristics of the field of their employment.

Among the main areas of employment Ukrainian migrants are: construction (54%), home care (17%), wholesale and retail trade (9%), agricultural sector (9%), industry (6 %) and other activities (5%).

The main factors that promote to increase migration processes in Ukraine include:

• Low wages
• Instability of the Ukrainian economy,
• Lack of jobs for people (mostly in small towns and villages)
• A good social support in countries where Ukrainians migrate,
• Political instability in the country,
• Loss of hope for a better life in Ukraine for themselves and their children,
• Lack of conditions for self-fulfillment (it causes the brain drain potential). [5]

The majority of migrants - people from 25 to 45 years who have completed secondary or special education and people with higher education, people, who are good prepared and are highly qualified staff.

The average cost of education is: in the United States from $ 13,000 to $ 40,000 per year, in the UK from £ 7,500 to £ 15,000 per year, in France from € 5000 to € 10 000. A low-cost education can be graduated in Spain ($ 700 - $ 1000 - public and $ 10 000 - private universities), Italy (€ 500 - € 3000), the Netherlands (€ 4000 - € 12 000), Canada ($ 8000 - $ 15,000), China ($ 2000 - $ 7500) and Japan ($ 6500 - $ 10,000). [8]

Instead, the average cost of education at the best universities in Ukraine range from 11 to 20 thousand UAH. It is from $ 1,400 to $ 2,500 or € 930 to € 1700 per year at NBU [9,10].

The most preferred professions in Ukraine include: engineers, specialists in service, IT professionals, doctors, ecologists, chemists, psychologists and personal advisers, marketers, public relations specialists, specialists in nanotechnology. [11]

The most desirable jobs abroad include: doctors and pharmacists, specialists in forestry and agriculture, experts in the field of fine arts, engineers , specialists in business, lawyers, IT professionals , teachers and experts in the field of natural sciences, journalists , social workers, researchers. [12]

According to the State Employment Service in 2012 among the professions, for which the number of unemployed registered with employment centers, the largest are: utility workers, boiler operators, vendors of food and non-food products, motor vehicle drivers, guards, cooks, workers in low-skilled jobs agriculture. However, the decrease in employment was recorded in agriculture and construction. [13]

In addition to negative effects of labor migration it also has a number of advantages that can be used to improve the situation (Table 1.).

Table 1

Advantages and disadvantages of migration

Advantages	Disadvantages
1). An opportunity to get new experience	1). The lossess of the highly skilled workers
2). increasing the number of transfer payments from abroad	2).Increasing the proportion of elderly per one young man
3) The professional development of workers (if worker will come back in Ukraine)	3) Inhibition of STP in the country (due to active migration of scientists)
4). increasing of knowledge of foreign language	4). The decreasing of retire and other social benefits.
5). state savings for unemployment benefits	5). increasing the retirement age.
6). Decreasing unemployment through workplaces abroad (for those people who for a long time could not find a job in Ukraine)	6). decreasing of patriotism in the country.

Investigating migration processes in Ukraine we can notice both positive and negative effects. However, labor migration on a large scale can significantly damage the development of Ukraine's economy, so it is necessary to reduce migration through a range of measures:

- creating a favourable conditions in the country for business opportunities;
- development of internal migration to meet labor market needs in Ukraine as an alternative to going abroad ,
- stimulation the return of emigrants ;
- protection of the rights of employees through trade unions
- regulation of migration by stimulating the arrival of more educated and skilled migrants.

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S.Gryniuk, Ph.D
(National Aviation University, Kiev, Ukraine)

INTERNATIONAL COOPERATION OF UKRAINE IN AEROSPACE INDUSTRY

The article presents the analysis of scientific and technical cooperation of Ukraine in the field of exploration and use of outer space in the international context; the main principles of the policy of Ukraine in the sphere of space activities in different countries; the international commercial space projects with the participation of Ukrainian enterprises.

Rocket and space industry of Ukraine, as one of the leading and science-intensive sectors of the domestic industry during the existence of the USSR, today, is unfortunately, experiencing not the best of times. Considering the current situation and the actual course of development of the country as a whole, the Ukrainian government carries out considerable work on improving the efficiency of space capabilities for solving actual problems of socio-economic, ecological, scientific and educational development.

Today Ukraine is an egalitarian subject of the international space law, joining the fundamental acts in the field of research and use of outer space, adopted within the UN.

Ukraine's cooperation in the field of exploration and use of outer space for peaceful purposes with foreign lands is based on the current legislation of Ukraine and international treaties concluded with foreign states in the field of space.

Ukraine is a member of international organizations, coordinating space activities, including: the UN Committee on the peaceful uses of outer space (COPUOS), the world Committee on space research (COSPAR), the interagency Committee on space debris (IADS), the world organization of satellite research of the Earth (CEOS), the International Astronautical Federation (IAF).

Ukraine has signed bilateral treaties on cooperation with space agencies and departments of the Russian Federation, Kazakhstan, the USA, Brazil, Argentina, India, China, Israel, Turkey and the countries of the European Union.

Ukrainian space industry enterprises have established partner relations with the leading world aerospace companies: «Sea Launch», «Boeing» «Lockheed Martin», EADS, «Daza», «Fiatavio», RSC «Energy»; signed multilateral agreements and cooperation agreements with international organizations and telecommunication companies «Intelsat», «Intersputnik», «Eutelsat», «Inmarsat», «Eumetsat».

The policy of Ukraine in the sphere of international cooperation with other countries is determined by the following principles: compliance the international obligations of Ukraine in the space sector; accordance to the priorities and objectives of Ukrainian foreign policy; strengthening the positions of the Ukrainian enterprises on the world market for space technology and services; the concentration of efforts on priority areas of space activity.

During the past five years the international activity of Ukraine was aimed at developing and deepening international cooperation in the space sector with the countries of the European Union, the Commonwealth of Independent States, America, the Middle East and Africa, the Asia-Pacific region.

It was organized and conducted the following activities to develop the Ukrainian-European cooperation:

• international seminar «Prospects of participation of Ukrainian scientists in the Seventh EU framework program (FP-7) research and technological development»;

• international conference on the 7-th framework Program of the EU in Hungary;

• Third international conference on space exploration in Italy;

• seminar on the actual needs of Ukraine in the services provided by the European satellite navigation system EGNOS;

• meeting with representatives of the General Directorate «Enterprise and industry» of the European Commission, aimed at deepening cooperation between Ukraine and EU in the sphere of outer space in accordance with section «Space» project of the Association Agreement between Ukraine and the EU;

• the formation of the joint working group «Ukraine-EU» to develop cooperation in the space sector and approval of the regulations for its functioning.

With the aim to develop the cooperation with the Russian Federation it was signed a Road map of deepening bilateral cooperation in the space industry, a meeting was held between representatives of GCAU and the ACF on the preparation of the program of cooperation for 2012-2016, was organized a meeting during which the sides discussed topical issues of Russian-Ukrainian cooperation in the space sphere.

The cooperation of Ukraine with other countries in this context is not less fruitful too.

The meetings of the heads of space agencies of Ukraine and Kazakhstan in the framework of the official visits were held to discuss the actual flow and the prospects of cooperation.

The visit in DCAU of the delegation of the Ministry of defense of the USA took place, during which they discussed a range of issues regarding the continuation of cooperation within the framework of the «Agreement between Ukraine and the United States to provide aid to Ukraine in the elimination of strategic nuclear arms and preventing proliferation of weapons of mass destruction» dated by the 25th of October 1993.

It also continues the execution of obligations of the international agreement between Ukraine and Brazil «On long term cooperation in the use of a carrier rocket «Cyclone-4» on the launch center «Alcantara».

It was hosted the Ukrainian-Canadian aerospace business seminar in Kyiv in 2011 by the initiative of the Embassy of Canada in Ukraine with the aim of finding new ways of bilateral business cooperation.

It was signed the Framework Agreement between the Government of Ukraine and the Government of Peru concerning cooperation in the area of space activities.

To establish the Ukrainian-Mexican cooperation in the space sector it was held a meeting, during which the Mexican side submitted a draft Agreement on cooperation in the field of the exploration and use of the outer space for peaceful purposes.

With the purpose to intensify the cooperation of Ukraine with the countries of the Middle East and Africa official meetings and negotiations were held:

• the Chairman of DCAU Alekseev with the Minister of science and technology of Israel M Greenbloom and the Space Agency of Israel during the International aviation and space salon «Le Bourget»;

• the Chairman of DCAU with the Ambassador of Egypt in Ukraine;

• with the delegation of the Republic of Sudan;

• with the General Director and the Chairman of the Algerian space Agency.

There were organized and held the activities on issues of development of the bilateral cooperation with the countries of the Asia-Pacific region:

• the visit of a delegation of GCAU in the Republic of India;

• the first meeting of the Ukrainian-Chinese Subcommittee on cooperation in the space sector created in the framework of the intergovernmental Commission on cooperation between Ukraine and China, during which the sides discussed the state of implementation of the Program of Ukrainian-Chinese cooperation in the exploration and use of outer space for peaceful purposes in 2011-2015;

• the first meeting of the Ukrainian-Chinese Sub-Commission in Beijing on issues of trade and economic cooperation, in which the First Deputy Chairman of GCAU Baulin took part;

• the visit of the delegation of the Republic of Korea in Ukraine;

• was signed in Seoul the Agreement between GCAU and the Ministry of education, science and technologies of the Republic of Korea on the establishment of Joint Committee on cooperation in space sphere;

• the visit of the delegation of the National Institute of Aeronautics and space of the Republic of Indonesia (LAPAN) to Ukraine.

In this context it should also be emphasized that during the years of Ukraine's independence there were ensured favorable international legal conditions for the enterprises and institutions of the space industry to the world market, expanding the participation of Ukrainian enterprises in international commercial space projects. The most significant of them are the «Sea Launch», «Land Launch», «Dnepr», «Cyclone-4».

Conclusions

As a conclusion it should be said that aviation and space industry, as no other, was and will remain an important national asset, providing high-technology civil production sector. For their further development it is needed the precise eye and the support of the state policy; the strategic course of the personnel policy, taking into account innovative development sectors; and, in connection with the intricacy of the penetration to the American and the European markets, focus on affordable and promising markets of Russia, Asia, Africa and Latin America.

With the prudent management and the correct marketing policy the aviation and space industries of Ukraine have all possibilities for their further development and prosperity.

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I. Derev'yanko,
PhD of Historical Sciences
(National Aviation University, Kyiv, Ukraine)

ECONOMIC DIPLOMACY AS IMPORTANT COMPONENT FOREIGN POLICY

The article reveals the essence of the role of economic diplomacy. The attention is focused on the fact that economic diplomacy is designed to provide protection and promotion of international economic relations in the economic interests of the countries.

Economic diplomacy is becoming an increasingly important part of international relations. This evaluation refers to economic diplomacy as the use of government relationships and government influence to promote the commercial interests of (a group of) companies in a foreign country. A wider interpretation of economic diplomacy also encompasses the use of economic instruments for political purposes (for example security, alliances). Consequently, economic diplomacy forms part of a collection of bilateral and multilateral (for example cultural, historical, political) relations between countries. [1]

Economic diplomacy is concerned with economic policy issues, e.g. work of delegations at standard setting organizations such as World Trade Organization (WTO). Economic diplomats also monitor and report on economic policies in foreign countries and give the home government advice on how to best influence them. Economic diplomacy employs economic resources, either as rewards or sanctions, in pursuit of a particular foreign policy objective. This is sometimes called "economic statecraft". [3]

Economic diplomacy not only promotes the state's prosperity but also, as occasion demands and opportunity permits, manipulates its foreign commercial and financial relations in support of its foreign policy. Accordingly, economic diplomacy is a major theme of the external relations of virtually all countries. At home, economic ministries, trade and investment promotion bodies, chambers of commerce, and of course foreign ministries, are all participants in economic work. [2] Current trends include increasing collaboration between state and non-official agencies, and increased importance given to WTO issues, the negotiation of free trade and preferential trade agreements, and accords covering investments, double taxation avoidance, financial services and the like. Abroad, embassies, consulates, and trade offices handle economic diplomacy. The main focus is on promotion, to attract foreign business, investments, technology and tourists. Economic diplomacy connects closely with political, public and other segments of diplomatic work. [4]

Economic diplomacy is traditionally defined as the decision-making, policy-making and advocating of the sending state-business interests. Economic diplomacy requires application of technical expertise that analyze the effects of a country's (Receiving State) economic situation on its political climate and on the sending State's economic interests. The Sending State and Receiving State, foreign business leaders as well as government decision-makers work together on some of the most

cutting-edge issues in foreign policy, such as technology, the environment, as well as in the more traditional areas of trade and finance. Versatility, flexibility, sound judgment and strong business skills are all needed in the execution of Economic Diplomacy. [5]

As all government agencies that have economic mandates operate internationally and are players in economic diplomacy though they do not describe them as such. Further, non-state actors such as NGOs that are engaged in economic activities internationally are also players in economic diplomacy (Bayne and Woolcock (eds) 2007). Businesses and investors are also actors in the process of economic diplomacy, especially when contacts between them and governments are initiated or facilitated by diplomats. [8]

Berridge and James state that "economic diplomacy is concerned with economic policy questions, including the work of delegations to conferences sponsored by bodies such as the WTO" and include "diplomacy which employs economic resources, either as rewards or sanctions, in pursuit of a particular foreign policy objective" also as a part of the definition. [6]

Rana defines economic diplomacy as "the process through which countries tackle the outside world, to maximize their national gain in all the fields of activity including trade, investment and other forms of economically beneficial exchanges, where they enjoy comparative advantage.; it has bilateral, regional and multilateral dimensions, each of which is important". [7]

The broad scope of this latter definition is especially applicable to the practice of economic diplomacy as it is unfolding in emerging economies. This new approach involves an analysis of a nation's economy, taking into account not only its officially reported figures but also its gray, or unreported, economic factors. An example might be the new Republic of Kosovo; in that emerging nation, widely regarded as a candidate for "poorest nation in Europe", an enormous amount of economic activity appears to be unreported or undocumented by a weak and generally ineffectual central government. [12] When all economic factors are considered, the so-called "poorest" nations are demonstrably healthier and thus more attractive to investment than the raw statistics might otherwise show. [5]

Economic diplomacy might be seen as a distinct component in diplomacy in general and how the approach to decision-making and negotiation on mainstream economic topics may diverge from more overtly political diplomacy. economic diplomacy has become more important with increased international economic interdependence or globalization and the greater need to find negotiated solutions to challenges, such as stable financial systems, open trade and investment, or climate change, in order to achieve domestic policy objectives. states remain the main actors in economic diplomacy, despite the relative increase in the importance of non-state actors and the fact that markets must be treated as endogenous to the policy process.

Diplomacy that promotes national economic interest and business in other countries is defined as economic diplomacy. It is associated with trade, business, market and investment promoted through political diplomacy. Economic diplomacy depicts how states conduct their economic relations with other countries by using

political influence and promoting trade and investment to find a market for its products and services. [4]

The emergence of democracy and globalization has transformed the role of political diplomacy toward economic diplomacy. There is a growing realization that economic relationships have a strong impact on political diplomacy. The end of the Cold War, emerging democracy and development are the products of economic diplomacy. For instance, many Eastern European states joined the European Union in the 1990 s to fulfill a larger economic interest among European nations. [7]

Economic diplomacy is functional at three levels: Bilateral, regional and multilateral. Bilateral economic diplomacy plays a major role in economic relations. It includes bilateral trade and treaty; agreements on investment; employment or avoidance of double taxation; and range of formal and informal economic issues between two countries. Bilateral Free Trade Agreements have been the order of the day, and is being implemented by many countries around the world. [8]

Regional cooperation is of growing importance in economic diplomacy. National interest and economic liberalization is easily accepted when it is confound to a particular region. Opening of borders and markets become easier within a regional framework.

Multilateral economic diplomacy takes place within the framework of World Trade Organization (WTO), World Bank, International Monetary Fund (IMF), UN agencies et al. With the establishment of WTO, there has been a policy shift in global trading system to promote economic activities. However, there is a challenge in sustaining competitiveness in multilateral and bilateral trade agreements. Nepal, so far, has not been influential on issues of aid, trade and FDI in multilateral development forums such as the World Bank, IMF, WTO and UN agencies. [6]

The success of political diplomacy is a reflection of economic dimension. The objective of diplomacy in today's changing scenario is not to increase political clout but to achieve economic understanding. The days when diplomats fought battles behind closed doors for geo-political gains, for their respective nations, is over. Today "Geo-Eco" has taken precedence over "Geo-Pol". Nations are in the race to become economic power houses as they know that it is the key to becoming a global leader. Economic soundness ensures stability and ability to exercise influence in world affairs.

Countries are now signing free trade agreements and Memorandum of Understanding (MOUs) to further their national interests. The European countries have their own union and even their own Constitution. Most of the member states have adopted the new currency called 'euro'. Owing to this, It has become a regional hub for economic cooperation and wields political clout over important world affairs. Its economic stability has made it a power to reckon with along with US and China. The EU after America is India's second largest trade partner. A few former Soviet colonies too are clamoring to be a part of the ever expanding EU. What better example of economy driven domination than the US which on one hand has close economic ties with China, an authoritarian state, and on the other is trying to bring about democracy in states like Iran & Iraq? [8]

Economic diplomacy can be conceived as the application of a nation's favourable economic conditions, by conferring rewards or penalties, toward

particular foreign policy objectives. As an area of study, it explores the multiplicity of tensions between politics and economics, between international and domestic pressures, and between governments, business and civil society.3 Existing literature largely focuses on how economic diplomacy is practiced in trade-related negotiations; however, emerging economies are increasingly employing it in wider policy arenas. In recent years, economic diplomacy has been used by both state officials and corporate leaders in rising powers to leverage foreign investment and integration in global supply chains into diplomatic power on political issues.

Conclusion

Economic diplomacy is a form of diplomacy. Economic diplomacy is the use of the full spectrum economic tools of the state to achieve its national interest. Economic diplomacy includes all the economic activities, including but not limited to export, import, investment, lending, aid, free trade agreements etc.

Economic diplomacy was present from its origin in foreign policy. It is the predominant mechanism of fruitful achievement of the trade and economic relations based on the bilateral and multilateral levels. It is an instrument for development of effective cooperation between the countries and regions at the global level.

The priority of economic interests is a result of cooperation between the countries in spite of the differences existing between them, caused by various ways of economic development, effectively overcome and promote development of stronger social, economic and political mutual relations in the world. The role of economical diplomacy is irreplaceable in this process.

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I. Nabok, Ph.D. in Economics
(National Aviation University, Ukraine Kyiv)

FEATURES OF THE CREATION AND OPERATION OF INTERNATIONAL STRATEGIC ALLIANCES IN THE AVIATION

Essence and features of global alliances, the main reasons for the creation of international strategic alliances in aviationare writtenin this theses.Argued for a competitive advantage in the work that the company receives from participation in strategic international alliances.

Globalization heightens the interdependency and inter-linkage of economies, foreign ownership of national enterprises and cross-border business collaboration is becoming the norm.

Alliances between airlines have become a dominant feature in air transport, and a new global phenomenon unfolding relatively quickly through multiple collaborative business arrangements. Alliance agreements took different forms and included various elements of code-sharing, marketing and pricing cooperation, schedules coordination, and offices and airport facilities sharing.

Introduction to business strategic alliance carries some risks and threats, as though through partnerships should be full of mutual trust, the companies important to identify and secure in the written contract is not only an alliance mission, goals and timetables for their achievement, but also to define the limits of partnership depth information that can be provided, the contribution of each party in terms of technology, know-how, property rights, mutual responsibility, guarantees and risk sharing in order to avoid problems in joint activities. In a dynamic business environment there is a need for modification of goals that causes a periodic review of the parameters of the agreement. At the same time it allows to determine the feasibility of further cooperation

More than other forms of internationalization, international strategic alliances provide firms with strategic flexibility, enabling them to respond to changing market conditions and the emergence of new competitors. They are prompted by a range of motives, including economizing on production and research costs, strengthening market presence, and accessing intangible assets such as managerial skills and knowledge of markets.

In service sectors such as airlines, alliances are aimed at sharing a partner's sales and distribution outlets.

One of the most famous partnerships in Ukraine began in 2007 created a strategic alliance "Ukrainian Aviation Group," which combined company "Aerosvit" and "Donbasaero". The goal of this alliance is to increase the competitiveness of Ukrainian air carriers for the growth of competition from international companies as well as to enhance their attractiveness.

Later, the company formed a strategic partnership "UIA" (Ukraine International Airlines) and "DniproAvia". Forming partnerships national companies enables them to

withstand tough competition with large foreign associations that took place in the field of air transport.

In all cases, international strategic alliances are being driven by the economic demands of global markets, the costs of keeping up with fast-changing technologies, and the opportunities provided by government deregulation and liberalization initiatives.

Joining a winning network or alliance at the global level is becoming crucial to firm survival in more sectors. Government regulations can also affect alliance formation. For example, in international aviation where foreign ownership is highly restricted, cross-border mergers or acquisitions are rare but alliances are the favored mode of market entry.

An important aspect of the analysis of the formation and development of strategic alliances is to study the interaction of the state with them. According to the researchers, in developed countries, where the formation of diversified companies has little evolutionary nature, the state focused on market concentration (the formation of monopolies and oligopolies). In countries "compressed development model" (for example, South Korea), where the establishment of alliances provided direct support from the state, the vast development was common and complex concentration. Thus, the state should provide clear, permanent and stable relationship with the business on the basis of harmonization of interests of various business groups, as it is the main condition of normalization of the social organization of society. More strategic alliances changing role of nation states, which gradually lose major leverage in shaping the international investment policy.

Research of Ukrainian business practices shows that in recent years, more and more domestic companies are members of strategic alliances. Enterprises of some sectors already have considerable experience in concluding alliances with other sectors alliances just there and companies are only beginning to explore the possibilities of joint activities.

As international experience shows that some areas of the company are more likely to form strategic alliances. This may be due to the specifics of their operation, a life-cycle industry, business conditions in local and global markets. The largest number of foreign companies formed alliances in automotive, aviation, pharmaceutical industry, telecommunications and information technology.

According to the results of research conducted by the Institute of Economics and Forecasting of NAS of Ukraine together with the Antimonopoly Committee, that these industries are characterized by above-average levels of competition and profitability of operations in the whole economy

In the airline industry one of the most alliances last time was the largest Ukrainian airline alliance - Airlines Company, and the third-largest Ukrainian airline Donbasaero. In February 2007, they announced the creation of a strategic alliance, called the Ukrainian Aviation Group. The purpose of this alliance was formed as improving the competitiveness of the two Ukrainian airlines in the face of rising competition from international companies as well as enhance their attractiveness. Collaboration involves combining technological, industrial, commercial and other resources, but is intended merger . Forming an alliance involves the development of the net Donbasaero as large airline based in the airport of Donetsk and one that

generates a powerful transit flows through the base airport. Airlines Company considers its participation in the alliance as an opportunity to improve the competitiveness of their partner and strengthening their market positions. Association provides Ukrainian companies to join theinternational airline alliances as separate, even the best domestic air carriers are not of interest to foreign partners. Ukrainian airlines are accepting alliance with financial support from the outside, the risk to start competing with more experienced and stronger companies.

Effective functioning of alliances Ukrainian and foreign companies promotes rational combination of the strengths of the partners. In particular, the Ukrainian business interest of Western companies such advantages as availability of funds for production with international quality standards, can experience the formation of alliances, etc. [4]. Among the advantages of local businesses that may useful for the functioning of alliances can be distinguished Ukrainian market knowledge, contacts with Ukrainian companies - suppliers and customers, etc. (fig.1).

Figure.1. Strengths Ukrainian and foreign companies that can be used in strategic alliances

The main benefits of strategic alliances for Ukrainian companies are:

1. Bridging the state of trade and investment barriers in entering the promising overseas markets.
2. Access to distribution channels and sales partner and its market position
3. Available products, technologies and intellectual property (IP) partner.
4. Stability political and economic situation of the partner.
5. Available financial resources partner.
6. Markets for new products and new products for customers.
7. Gain brand in the market through channel partners.

8. Accelerated development of new products and output them to the market.

9. Reducing cost and risk scientific and technological development and the creation of radical innovations.

10. Quickly reach critical mass and scale required.

11. Setting technology standards in the industry and production of the first products that meet these standards.

12. The utilization of by-products.

13. Available managerial skills and experience.

Operation of strategic alliances is, above all, the interaction of people working in, so you need to take into account differences in national and corporate cultures. International experience confirms that their characteristics largely determine the success of alliances. Moreover, in practice, the operation of alliances in Ukraine there are examples of cooperation of enterprises which fail due to the fact that not taken into account the specifics of corporate cultures partners and success - an effective combination of elements of culture enterprises - members of the alliance.

Conclusions

Regarding the development of strategic partnerships in the Ukrainian economy expert opinion is divided: on the one hand, strategic partnerships open up broad prospects for domestic enterprises to enter new markets, acquiring new technologies, knowledge sharing, and others with a significantly lower cost compared to self-employment, which has lead to the emergence of significant number of partnerships in the near future. On the other - participating in the partnership involves opening inside information, cooperation with a partner on a trust basis as domestic managers can be challenging.

In addition to a critical attitude to the management of such a method of interaction distribution partnerships in Ukraine is constrained by general economic, political and legal factors.

Played a role, and the financial and economic crisis has shifted the focus of managers with strategic problems the solution to the question of survival of enterprises.

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Z.S. Sokolova, PhD. (Economics)
(the Institute of International Relations of the National Aviation University, Ukraine, Kiyv)

INSTITUTIONAL BASE OF NIGERIAN AVIATION INDUTRY

In this article actual the condition of institutional base of Nigerian aviation industry is regarded. At the end of 2010's the governemental institutions in Nigeria successfully realized numerous projects, which made possible air transportation in Nigeria to become much more safe and efficient.

Nigeria is one of the leading economies in Africa. This country is classified as an emerging market, rapidly approaching middle income status. Nigeria characterized by a large area with geographically diverse regions, difficult terrain, water bodies and has enormous supply of resources. Efficient air transportation of people and goods is extremely important element for development of different directions of Nigerian economy, such as trade and tourism, and ultimately this is important for its economic growth and development.

As economic indepenedent sector Nigerian aviation industry commenced functioning in October 1958, in anticipation of independence of Nigeria (1st of October 1960) when Nigerian Airways was established as a Joint Venture between the Nigerian Government, Elder Dempster Lines and the British Overseas Airways Corporation. After several transformation, caused by bankruptcy of this government-owned nationa airlines – Nigerian Airways – in 2004, in June 2010 it was changed to Air Nigeria Development Limited, branded as Air Nigeria as a private company backed by Nigerian government [1, p. 230 – 231].

On the eve of third millennium Nigerian aviation industry after numerous changes became quite big air transport system. In spite of history of almost fifty years and significant attempts of Nigerian government to improve it at the beginning of 2000's air transportation in Nigeria suffered from poor reputation for operational efficiency and safety [1, p. 231].

There were **different factors** which over the years have **militated against Nigerian aviation industry to become efficient and safe**:

- **Absence of coherent air transport policy** within the framework of the National Transport Policy which should rely on coordination and rationality in the transport network. This caused bankruptcy of the national carrier – Nigerian Airways [1, p. 233];

- **Bad management** – in 1999 it led to a crisis in the Nigerian Civil Aviation industry following the decline of the Nigerian Airways. It had several results [1, p. 234]:

- *sharp reduction in the number of airplanes of Nigerian Airways*. For example, in 1979 this national carrier possessed 29 well maintained and functional aircrafts flying locally and internationally, but by 1999 only 2 of them were left functional;

- *major airports in the country have not been expanded and modernized* as many of them were built in the 1970's with an old architectural design. Deficiency

of airport modernization led to loose of infrastructure security at Nigerian airports. The lack of perimeter fencing allowed grazing by the runway of some airports. For example, in 2005 an Air France flight crashed on cows on the runway of Port Harcourt International Airport. Also robbery incidents occured due to loose of security along roads leading to airports, particulary at the Isolo Expressway leading to Lagos International airport;

- *facilities such as seats, airconditioning system, conveyor belt, toilet facilities, etc were decaying*. As this facilities and airport infrastructure were not upgraded, at the end of 1990's this was aggaravted by increase of flow of passengers and cargo. Decaying facilities and old infrastructure also made bad image of Nigeria to foreigners coming into the country;

- there were *often air crashes* in Nigeria. For example: 2005 in October Bellview Airlines Boeing 737 in direction to Abuja came down shortly after taking off from Lagos, killing 117 people, in December a Sosoliso Airlines DC-9 crashed in Port Harcourt, killing 103 people on board. This made passengers to be afraid of traveling by air;

- because of the avia crashes some airports were closed for reapirs. But because of bad management *airport's repairs took long time*, though tt was expected that closure will take a few months. For example: the Port Harcourt International Airport was closed for repairs for 16 months – from 18th of August 2006 to 18th of December 2007 but airport authorities promised to close it only for four months. The closure of this airport resulted in a huge financial loss for Federal Airport Authority of Nigeria (FAAN) estimated at more than 500 mln of Nigerian Naira (approx. 4 mln US dollars) of landing fees, parking fees, different levies etc.

Negative factors of Nigeria's aviation industry has had negative effect on the development of its economy [1, p. 235]:

- the decaying facilities and loose of infrastructure security made foreign investors fear to come and invest in the economy of Nigeria. It caused lost of a lot of foreign investments;

- domestic airlines have over the years disappointed passengers on both domestic and international flights. In competitive struggle this has led to the engagement of foreign airlines in some operations. This was loose of possible profit for Nigerian economy;

- economic loss because of long closure of airports also consisted in the suspension of direct flights by foreign airlines. For example: during the closure of the Port Harcourt International Airport for repairs from 18th of August 2006 to 18th of December 2007 airlines such as Air France, Luftansa and KLM suspended direct flights from Europe to Port Harcourt.

Apparently there was a need to improve the condition of the operational efficiency and safety in Nigeria on much better institutional base with higher level of responsibility, providing international operating standards.

Importance of the improvement of air transportation in Nigeria consisted not only in security of flight but also in economic effect for growth of Nigerian economy. Furthermore domestic airlines could not win business contracts involving carriage of freights and passengers such as the annual airlift of pilgrims for Hajj to Saudi Arabia. Nigerian air carriers over the years performed bad annual airlift of

pilgrims for Hajj. Because of this reason from 2008 National Hajj Commission (NAHCON) was opting for use of foreign airlines in this operation [1. p. 233-235].

For economic effect it was (and still it is) extremely important to occupy international market of air transportation. Nigerian disposition here is quite weak:

- there are 74 services per week from Western Europe to Nigeria;
- the United Kingdom is Nigeria's largest aviation market and home to a large Diaspora community;
- there are 21 flights per week from the Gulf region to Nigeria;
- Nigeria has no direct links to the growing markets of Asia. Middle Eastern carriers (such as Emirates, Qatar Airways, Middle Eastern Airlines, and Royal Jordanian) have a dominant position linking Nigeria and Asia's powerful hubs [2].

So, realizing the role of air transport in the nation's development, the Nigerian Federal Government made significant attempts to develop the country's air transport system. After the improvement of institutional structure for better management of aviation industry, the technical enhancement for safe and efficient functioning of aviation industry had to be realized.

Key duties in **Nigeria's air transport system** are held by **five Parastatals: the Nigerian Civil Aviation Authority (NCAA); the Nigerian Airspace Management Agency (NAMA); the Federal Airports Authority of Nigeria (FAAN); the Nigerian Meteorological Agency (NIMET); and the Nigerian College of Aviation Technology (NCAT)** Nigeria's **Ministry of Aviation** was created by the Nigerian Civil Aviation Act of 1964 [3, p. 11].

The **Aviation Ministry** has as part of its responsibilities the formulation of **general policy** frameworks that encourage the **growth of aviation and allied businesses** in Nigeria. **The Ministry is mandated** to ensure an enabling environment **for the safe, secure and sustainable development of air transport in Nigeria.** It updates and implements a **National Aviation Master Plan in line with International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPs)** and other national objectives. **The Ministry has five main departments: Finance and Accounts; Human Resources; Planning, Procurement, Analysis and Research; Safety and Technical Policy; and Air Transport Management** [3, p. 12].

NCAA is the regulatory body for aviation in Nigeria. It was established in 1999 to oversee all aspects of the safety and reliability of air navigation in line ICAO SARPs. The Civil Aviation Act of 2006 granted the NCAA autonomy and freedom from political interference. NCAA's goal is to make the industry not just accident-free but also investment-friendly. For ensuring a cohesive approach to all aspects of aviation safety NCAA coordinates its activity with other parastatals, notably the Federal Airports Authority of Nigeria (FAAN) and the Nigerian Airspace Management Agency (NAMA) [3, p. 15-16].

Nigeria's first success was receiving a passing grade from the ICAO Universal Safety Oversight Audit Programme (USOAP). This was achieved due to the total re-certification of the entire industry, including: airlines, airports, aircraft and human resources [3, p. 15]. Serious step for this was fixing by Nigerian government a deadline the 30th of April 2007 for all airlines operating in the country to recapitalize or to be credible in an effort to ensure better services and safety. The

airlines that satisfied the NCAA's criteria in terms of recapitalization were re-registered for operation [1, p. 233]. Also levels of skilled personnel across all the areas of aviation activity have been boosted in Nigeria through an aggressive training programme. 47% of the FAAN workforce was sent on various training programmes, either locally or abroad during 2009 – 2010 [3, p. 15 - 16].

The upgrading of Nigeria's aircraft fleet was a fairly straightforward task, due to the leasing arrangements facilitated by the Cape Town Treaty, which came into force five years after the associated 2001 conference in South Africa and has allowed brand new aircraft to become virtually standard in the State [3, p. 15].

The NCAA has been encouraging Nigerian carriers wishing to operate international routes to join International Air Transport Association (IATA), which Office was established in Nigeria in 2008. IATA's Nigeria office also covers Ghana, Sierra Leone, Gambia, Liberia and Cape Verde [3, p. 15].

One of Nigeria's most difficult aviation challenges has been achieving the Category One status from the U.S. Federal Aviation Administration (FAA). The FAA's Category One designation, part of the International Aviation Safety Assessment (IASA), permits State carriers to operate direct flights to the United States. The process normally takes five years but NCAA worked hard to achieve the required status in a shorter time. After almost four years, on 24 August 2010, Nigeria attained FAA IASA Category One status. Direct flights between Lagos and New York under this arrangement begun to perform Nigerian designated carriers Arik Air.

With new routes and carriers there is a need for better airport and airspace management. Despite the administration's commitment to upgrade State airports, there are limits to the funds available [3, p. 16]. In June 2009 in cooperation with Technical Cooperation Bureau of the ICAO a roadmap for the State's airport concession programme was provided. It was decided to make four major airports at Lagos, Abuja, Port Harcourt and Kano the pride of Africa, but to accomplish this funding was needed from the private sector and various international groups that have expressed interest in running these airports [3, p. 11].

FAAN is therefore anxious to encourage public-private partnerships that investors participate in it and benefit from the State's ongoing facility development. The intention is not to replace a government monopoly with a private monopoly, but rather encourage a competitive, free-market environment where investors can be confident in their return on investment [3, p. 18].

Today's airports are technology-driven and Nigeria is embracing new technologies in its airports as the primary means for improving efficiency. For this aim the government is seeking new partnerships. FAAN cooperated with Maevis Nigeria Limited, which has provided the State with Airport Operations Management Systems (AOMS). The Maevis AOMS encompasses various systems such as flight information display systems, Common Users Terminal Equipment (CUTE), and Baggage Reconciliatory Systems (BRCs) – all required elements for facilitating a modern and seamless travel experience. The passenger related efficiency of a given airport is determined by how smoothly travellers can check-in and depart, or conversely pick up their baggage and depart the airport [3, p. 18].

As upgrading the country's airports is a costeffective means, the federal government was pursuing Public-Private Partnerships (PPPs). PPP are the current business model of choice for developing Nigeria's infrastructure. The first example of a successful PPP initiative in the country's aviation sector was the reconstruction of the main domestic terminal at Murtala Muhammed Airport in Lagos (MMA2). The structure needed to be rebuilt after a fire destroyed the original building in 2000. Work on the new terminal was begun in 2003 after Bi-Courtney Limited was awarded a 36 year concession on a Build-Operate-Transfer (BOT) basis. MMA2 was opened four years later in 2007. The financing for the MMA2 project provided a successful test case for the viability of BOT projects in Nigeria, at a time when long-term funding was nearly non-existent. As well as pioneering a new business model for infrastructure financing, the MMA2 terminal exceeded all expectations and provided a resoundingly modern and efficient service for both passengers and cargo [3, p. 18].

NAMA was established in May 1999 as part of an ICAO Compliance Programme which advocates the separation of aviation service providers from regulators. NAMA is also very active member of the Civil Air Navigation Services Organisation (CANSO). The NAMA was given a clear mandate: to provide a safe, efficient and economically cost-effective air navigation system, with a vision to make it a world-class Air Navigation Service Provider (ANSP) with leading Communications, Navigation and Surveillance (CNS) as well as IT systems. It was also given the funds to get the job done: some 7 billion Naira (approx. 50 mln US dollars), this made available for the provision of modern air navigation services for Nigeria. The NAMA has been a huge success story in terms of both the development of Air Traffic Management (ATM) services and the achievement and maintenance of higher safety standards.

NAMA has been pushing to complete two major projects at the end of 2010's. The first is the achievement of the total VHF coverage which, upon completion, will enhance communications between pilots and controllers to the extent that aircraft crew will now be in constant contact with any of the pertinent centers within Nigerian airspace. Aircraft will now have complete access to air traffic control services enabling safer and more efficient landings all over the country. This upgrade has taken into account the shift from terrestrial to satellite-based systems, a move that will be completed over the world by 2015 [3, p. 18, 20].

The other major project underway within the NAMA is one that both defines past failures and enables future success: Total Radar Coverage of Nigeria, (TRACON). Exasperated by a five year delay on the project, Nigeria's Ministry of Aviation gave the contractor an 18 months deadline that has led to Lagos and Abuja stations being successfully completed and operational since August and September 2009, respectively. All other airports involved in the project had to be completed during summer 2010. Accurate tracking of all aircraft entering Nigeria now brings not just security benefits but also commercial advantages. An Auto Billing System (ABS) is built into the TRACON system and captures any aircraft that enters Nigerian airspace [3, p. 20].

NIMET is the designated national weather service provider in Nigeria. The Agency was established in 2003 to provide meteorological services in support

of human and environmental sustainability, policy development, and safe operation of air, land and marine transportation. The first question of any aircraft accident investigation is inevitably about the weather conditions. That is why meteorological services represent an area of aeronautical operations that is strictly regulated by ICAO in concert with the World Meteorological Organization (WMO). Every ICAO Member State is required to designate a national weather service provider, charged with the responsibility of providing aeronautical meteorological information for the safety of flight operations. NIMET is well-equipped, modern meteorological agency which makes possible to ensure aviation safety with accurate and timely weather information. NIMET's Doppler Weather Radar Project is a network of six radar facilities that will more effectively track weather systems. Another NIMET project critical to air transport safety is the Low-Level Wind Shear Alert System (LLWAS). Another important safety NIMET's implementation is thunderstorm detectors, which have been installed at eight airports across the country [3, p. 20-21].

NCAT, located in Zaria, Kaduna State, is the foremost aviation training institution in West Africa. The institution's primary responsibility is the provision of excellent training for commercial pilots, air traffic controllers, aircraft maintenance engineers, aeronautical telecommunications engineers, aviation technicians, and aeronautical meteorologists among several other aviation professions. NCAT was established in 1964 for Nigeria and other African countries in collaboration with ICAO and the UNDP. Academic activities in NCAT are carried out in five main training schools, namely: Flying School, Aircraft Maintenance Engineering (AME) School, Aeronautical Telecommunications Engineering (ATE) School, Air Traffic Services/Communications (ATS) School, Aviation Management School [3, p. 21].

Nigerian Accident Investigation Bureau (AIB). The Federal Government of Nigeria, through the Civil Aviation Act of 2006, Section 29, established the State's aircraft AIB as a corporate body and an autonomous agency reporting to the President through the Minister in charge of aviation. It commenced operations in April 2007. The autonomy granted to the AIB was to ensure its independence from government bureaucracy and political influence to ensure and enhance the credibility of its reports. The AIB's vision is to be a accident investigation body striving towards improved aviation safety, carrying out highly professional accident investigations with trained and dedicated aviation professionals using well equipped facilities. Also the Nigerian AIB implemented Accident Prevention Programme, conducts inspections to various facilities to monitor compliance with safety recommendations, and uses FDR/CVR laboratory to decode Flight Data Recorders and Cockpit Voice Recorders [3, p. 22].

Nigeria is the ICAO member and maintains a Permanent Mission at ICAO. Since becoming a member of the ICAO Council in 1962, Nigeria has continued to collaborate with ICAO making valuable contributions to the sustainable development and growth of international civil aviation – especially in Africa. In advancing aviation in Africa Nigeria has become a major partner of ICAO through various programmes, in line with the Organization's strategic objectives of enhancing air transport safety, security, sustainability. During last years Nigeria realized major ICAO's initiatives, including the Comprehensive Implementation Programme to enhance Aviation Safety in Africa, the establishment of a Regional

safety organization and various international as well as Regional conferences, seminars, symposia and workshops. Similar efforts are also being made to support the African Civil Aviation Commission (AFCAC) and the African Union in their programmes towards accelerating the growth of aviation in the continent. Nigeria's efforts in this regards include financial contributions and secondment of experts to AFCAC. Nigeria is the headquarters of the Banjul Accord Group (BAG) Safety Oversight Organization (BAGASOO) [3, p. 14].

Nigeria continues to contribute actively to the work of ICAO through the participation of its experts in the Organization's numerous Technical Panels and Working/Study Groups, such as: Safety Management Panel, Group on International Aviation Climate Change (GIACC), Aviation Security (AVSEC) Panel, Airport Economic Panel (AEP), Air Navigation Services Economic Panel (ANSEP), Air Transport Regulation Panel (ATRP), Regional Traffic Forecasting (Africa/ Indian Ocean Traffic Forecasting Group), Commission of Experts of Supervisory Authority of the International Registry (CESAIR), and many others [3, p. 14].

So, improvement of institutions of Nigrian aviation industry with specification of their obligations and responsibility gave positive results for technical enhancement of its functioning and modernization of its infrastructure that provided Nigerian civil aviation to become much more safe and efficient. This helped Nigeria to survive difficulties of global crisis. End of 2010's has been characterized by high fuel costs and tough competition, by almost 10 terror attacks and global economic down-turn. The impact of the latter was confirmed by recent IATA figures which show that overall demand in 2009 fell by 3,5%, the worst-ever decline in passenger demand, with an average load factor of 75%t [3, p. 22], but in Nigeria in this year passenger flow increased to 41% of scheduled year-on-year seat capacity growth [4, p. 18-19].

During 2002-2012 the year-on-year seat capacity growth trend in Nigeria was showing an average level of 15% in Nigeria. Only in 2007 and 2008 the trend dropped to 4% following aircraft incidents 2005, and the misgiving of the financial crisis caused several carriers to stop operations due to the decline in air travel. With a steady recovery from recession since then, the Nigerian aviation industry has seen increased passenger traffic in 2009 to 41% of scheduled capacity year-on-year growth, in 2010 – roughly 4%, in 2011 and 2012 – about 10% [4, p. 19]. In 2013 Lagos Murtala Muhammed Airport was ranked on the 5th place by seat capacity among all of airports in Africa [5, p. 2].

Now Nigeria represents an excellent example of an emerging market economy with growth trend. One of the most notable developments in Nigeria's resurgent aviation industry is the proliferation of domestic carriers. Improved access to finance has hastened operator competition within Nigeria encouraging to implement increased standards of service, reliability and choice [3, p. 22].

In future civil aviation will grow because more and more today Nigeria's inhabitant are travelling by air. The growing middle class of the State with population 150 million persons represents enormous growth potential and the flourishing tourism industry and ever-widening business opportunities represent important complimentary prospects for growth [3, p. 11]. Positive trend for this is

the performance of African air transport market – according IATA information in January 2013 intra-Africa passenger numbers increased by 9,4% year-on-year [6].

Conclusions. In spite of long history, at the beginning of 2000's air transportation in Nigeria suffered from poor reputation for operational efficiency and safety. There were different factors for this: absence of coherent air transport policy and bad management. Negative factors of Nigeria's aviation industry had negative effect on the development of its economy: loss of investements, loss of national and international market of air transport.

Apparently there was a need to improve the condition of the operational efficiency and safety in Nigeria on better institutional base with higher level of responsobility. Importance of the improvement of air transportation in Nigeria consisted not only in security of flight but also in economic effect for growth of Nigerian economy. Realizing the role of air transport in the nation's development, the Nigerian Federal Government made significant attempts to develop the country's air transport system.

During 2010's with the aim to improve effiency for all institutions, managing aviation industry, were specified obligations and responsibility. In the framework of this institutions at the endof 20210's were realized numerous projects oriented for development of safety and efficieny of aviation industry in Nigeria. This gave positive result: during 2002-2012 the year-on-year seat capacity growth trend in Nigeria was showing an average level of 15%.

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CONGRESS SECRETARIAT
National Aviation University,
1, Kosmonavta Komarova ave.,
Kyiv, 03058, Ukraine
Tel: +380 44 406-71-56
Fax: +380 44 406-79-21
e-mail: congress@nau.edu.ua
www.congress.nau.edu.ua