AVIATION IN THE XXI-ST CENTURY

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Wireless communication safety analysis

The features of electromagnetic pollution generated by means of wireless communication have been studied. It has been established that under the conditions of partial screening at premises, poor passing radio waves causes significant increase in radiation intensity. For the purpose of electromagnetic fields attenuation the use of composite metal and polymeric electromagnetic screens with minimal reflectance properties has been proved to be efficient.

Radio signals are part of everyday life that are created by both natural and artificial sources, such as base stations of mobile communication, radar installations, remote controls, medical, electrical and electronic equipment. The level of electromagnetic radiation from the source grows exponentially, popularity of wireless technology and Wi-Fi are also increasing. In Ukraine the impact on public health associated with the effect of electromagnetic radiation (EMR) of ultra high and higher frequency is growing as well.

Despite the considerable attention paid to applied research and development of protecting means from the effects of high radiation for people under the production and living conditions, problems related to this issue are far from the final solution. Ukraine has risen the maximum permissible levels of radiation frequency for base stations by four times (10 $\mu W/cm^2$, corresponding to general European standards) , which will partially reduce the severity of the problem, but will also put forward new tasks associated with redistribution of radiation in space. Most studies on protection of people from the exposure to electromagnetic fields of ultra high and higher frequency (mobile, wireless computer networks, microwave technology for various purposes, radio facilities of civil aviation, etc.) are limited to testing certain areas, buildings, premises and ascertain the specific fact of exceeded or acceptable levels of radiation [1, 2]. Considerable number of work is devoted to the experimental study of the levels of radiation, development of actual distribution diagrams and definition of sanitary protecting zones, zones of building restrictions, etc. [3, 4]. In recent years, a series of experimental and theoretical researches on reducing radiation exposure of workers to ultra high and extremely ultra high frequency by the means of shielding with protective materials of various compositions and configurations has been made [5].

The most common and widely applied methods of protecting workers are reduction of equipment radiating capacity, increase of the distance between the source and employees and reduction of working time in the area of radiation. In modern terms, these methods are of limited use or not efficient at all. Approaches to protect workers from exposure to certain radiation sources (sources group) are significantly different.

Capacity of some power sources can be reduced. This includes UHF equipment that is used in the production and spurious emissions of many electronic

devices. This method is used to reduce the impact on personnel operating radio equipment in civil aviation. But virtually all wireless devices (both indoor and mobile base stations) must operate at nominal capacity. This capacity reduction and increase equally result in unstable operation. The limitation of time of exposure to radiation is problematic given that person is exposed during the working day at the workplace, and in many cases further under domestic environment, making recovery time insufficient.

The most acceptable method of reducing the impact of high radiation on workers is their shielding. But there is a problem of losing connection used for industrial purposes or its insufficient quality.

It was established that under the conditions of partial screening areas poor passing radio waves causes significant increase in radiation intensity due to reflection of waves from the internal sources (Table. 1).

Table 1

The levels of energy flux density in different rooms with the same generation of ultra-high frequency radiation

Number	Energy flux density W, $\mu W/cm^2$	
	Background radiation level of external radiation source	Radiation level at switched source
1	0,20	2,3
2	0,19	2,5
3	0,20	4,3
4	0,25	2,8
5	0,22	3,6
6	0,20	7,8
7	0,24	12,5
8	0,20	16,7

Thus, the cell phone radiation significantly increases the lower the level of base station signal.

Our experimental studies have shown that the intensity of radiation of mobile communication devices increases dramatically when the signal from the base stations to reduces to 0,2-0,1 $\mu W/cm^2$. But the real radiators of ultrahigh and superhigh frequencies are very sensitive to mechanical and other influences (even humidity and pollution of surface antenna affect them) that leads to origination of side radiation (spurious emissions).

The importance of taking into account the spurious radiation is conditioned by the fact that current regulations allow the installation of antennas of base stations on the roofs of buildings. In general, it is safe because the building itself is in radiation shadow ("dead zone") relative to the main lobe. But side emission can significantly exceed the electromagnetic fields in the building. The most effective means of reducing their impact is shielding. But there is a

problem with the focusing of the reflected radiation in unwanted directions. This imposes certain requirements for protective surfaces: they must ensure overall screening rates, leaving the level of radiation sufficient for industrial needs and have minimal reflection indices. Metal and polymer composite electromagnetic screens with adjustable protective properties are proved to meet the mentioned requirements. Thus, the most efficient method of reducing electromagnetic fields of ultrahigh and superhigh frequencies is shielding external radiation with simultaneous reducing emissions of internal sources. Reduced levels of external radiation of mobile communication cannot exceed 0.2 $\mu W/cm^2$, that will ensure reliable mobile communications without excess radiation levels from cell phones themselves. The metal and polymer composite electromagnetic screens with minimal reflectance properties are efficient for the reduction of electromagnetic background.

References

1. Думанський Ю.Д. Гігієнічна характеристика електромагнітного випромінювання радіотелефонів базових станцій рухомого зв'язку / Ю.Д. Думанський, В.М. Павлик, С.С. Галак // Гігієна населених місць. – 2009. – Вип. 53. – С. 223 – 227.

2. Електромагнітне випромінювання, що створюється обладнанням стільникового зв'язку в умовах радіоекранованих приміщень / [Думанський В. Ю., Біткін С.В., Галак С.С., Прусов Д.Е.] // – К.: Гігієна населених місць. – 2010. – Вип. 55. – С. 188–191.

3. Думанський Ю.Д. Методика розрахунку гігієнічно безпечної зони покриття базової станції систем рухомого зв'язку / Ю.Д. Думанський, В.М. Павлик // Гігієна населених місць. – 2007. – Вип.49. – С.226 – 230.

4. Мордачев В.И. Необходимый и достаточный уровень мощности электромагнитного излучения базовых станций сети GSM / В.И. Мордачев, А.С. Свистунов // Доклады белорусского государственного университета информатики и радиоэлектроники. – 2013. – № 7. – С. 44-50.

5. Демский Д.В. Метод расчета эффективности экранирования для неоднородных электромагнитных экранов: дис. … канд. техн. наук: 05.12.14 / Демский Дмитрий Викторович. – М., 2014. – 114 с.