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Electromagnetic pollution: A primer

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Abstract
Recently, there is a significant growth in the scientific research (by measurement and computation) on the nature and side effects of electromagnetic pollution and its impact on living organisms. The opinions of researchers about the influence of electromagnetic pollution on living organisms are divided. International and national regulations fix limits to human exposure to electromagnetic radiation. This paper reviews results related to the environmental effects of electromagnetic fields from RF to EMF.

Keywords: electromagnetic pollution, electromagnetic radiation, human health

1. Introduction

The modern life has been greatly impacted by two omnipresent forces: gravity and electromagnetism. Electromagnetic (EM) fields are present everywhere in our environment. Although EM fields are invisible, they create or induce voltages and currents within the human body. We are now living in a "soup" of electromagnetic pollution. Perhaps the major biological effect of radiofrequency (RF) electromagnetic fields is global warming [1]. Both radio frequency and microwave field radiations have been increasing.

Current technologies have become a source of electromagnetic pollution from generated electromagnetic radiation. All electrical/electronic devices produce electromagnetic pollution, which depends on the amount of voltage and current they use. Electromagnetic pollution is the sum total of all the man- made electromagnetic fields and are harmful to human beings. All living creatures are somewhat influenced by EM pollution. The main strong sources (both natural and man-made) of EM pollution include wireless communication, power transmission lines, and common electronic devices (such as smartphones, tablets), radars, transformers, antennas, and portable computers. The pollution can also be generated by working household appliances such as washing machines, refrigerators, microwave ovens, radios, television sets, smart meters, smart appliances, smart homes, electric stoves, heaters, boilers, freezers, extension cords, house wiring, video display systems, lamps, toasters, coffee pots, and hair dryers. Common sources of radiation is illustrated in Figure 1 [2]. The biological harm caused by this EM pollution is still open to question since there is no clear evidence of its negative influence on humans [3, 4].

Concept of em pollution

Electromagnetic pollution is an important environmental variable in any smart city. It has become more significant for human health especially in the city centers where base stations are used densely, or cellular systems are densely used. EM exposure levels in any area can be simply measured with an electromagnetic field meter. The main variable that measures the EM radiations is "power density," measured in W/m^2 [5].

Radio frequency (RF) electromagnetic radiation is caused by wireless communications, radar, security scanners, smart meters, and medical equipment. Electromagnetic radiation can be classified into two types: ionizing radiation and non-ionizing radiation. Non-ionizing radiation, in contrast to ionizing X-rays, does not have enough energy to break chemical bonds. Ionizing EM radiation includes mid- to high-frequency radiation which can lead to cellular or DNA damage with prolonged exposure. As shown in Figure 2, ionizing radiation occurs at frequencies above 2900 THz. Electromagnetic radiation at frequencies below the UV band are classified as "non-ionizing radiation" because they lack the energy to liberate electrons, i.e. ionize or effect changes in atomic structure [6]. Sources of EM radiation characterized by frequencies below 300 GHz can be associated with the nonionizing radiation. There has been a dramatic increase in the number of devices emitting non-ionizing radiation.

Effects of EM pollution

Electromagnetic radiation is a form of environmental pollution which may hurt humans and animals. Prolonged exposure to time-varying electromagnetic radiation (3 kHz to 300 GHz) has serious biological and health effects. It may cause sunburn within hours of exposure, and the burn severity increases with the duration of exposure. RF energy at power density levels of 1-10 mW/cm^2 or higher can result in heating of tissues. Microwave radiation at frequencies from 300 MHz to 300 GHz can cause thermal effects, increasing the temperature of exposed organisms. Microwaves have the capacity to excite water molecules and other components in food, elevating their temperature. An increased risk of an accident occurring through the use of a cellular phone while driving has consistently been shown. It has been observed that the mortality rate from cardiovascular diseases and cancer was higher among those workers who worked close to electric fields in comparison to the administration personnel in the same companies.

The main problem is the determination of the direct EM field source, to which the subjects under investigation are exposed. The distance between a person and the source of radiation is a crucial factor in EM radiation exposure. For example, consider the radiation pattern of a cell tower antenna shown in Figure 3. People living within 500m radius are prone to ill-effects of EM radiation [7]. Establishing the levels of EM radiation is at great importance for human health especially for people in urban areas. There are international standards and limits on the effects of EM radiation on human health. Each nation has its own prescribed limits [8].

EM pollution reduction

Unprecedented human exposure to electromagnetic radiation from conception until death has been occurring. But how do we reduce or eliminate electromagnetic pollution? The IEEE, World Health Organization, and FCC have established safety limits for exposure to various frequencies of electromagnetic energy. Some government health authorities have taken steps to reduce public exposure to EM radiation by regulating use of wireless devices by children and recommending proper use of wired communication devices. In the US, government regulation for safety purposes has led in legislations such as the Radiation Control for Health and Safety Act of 1968 and the Occupational Safety and Health Act of 1970 [9].

To reduce the negative effects of EM exposure may require taking the following technical measures: the reduction in radiated field intensity, replacing overhead transmission lines with underground power lines in inhabited areas, and protection of persons by adequate shielding [10]. Microwave absorption materials have been known to reduce or eliminate microwave pollution. Rows of trees can be used as an instrument of health improvement. They serve as vegetation barriers to minimize electromagnetic pollution in sensitive areas such as hospitals and kindergartens [11]. Facilities such as schools, hospitals, offices, and settlements should be established in areas well away from energy transmission lines and base stations. Taking these precautions will avoid serious disorders in human beings [12].

Fig 1: Common sources of radiation [2].

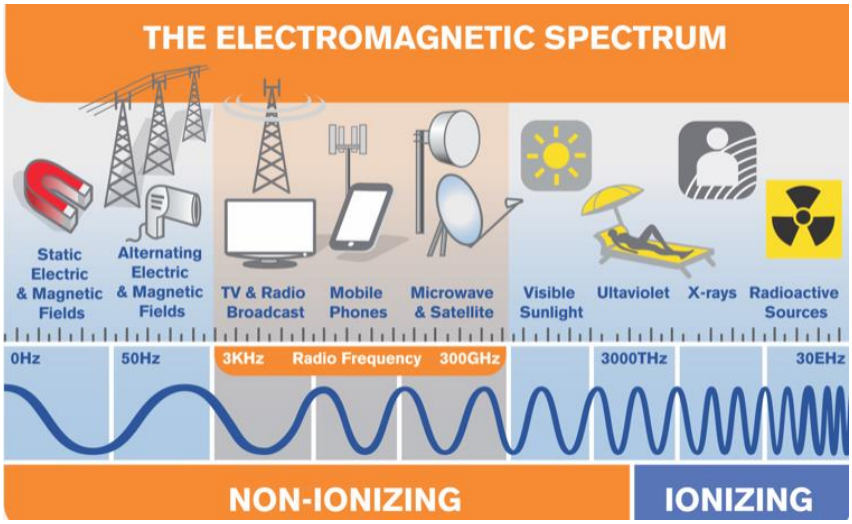

Fig 2: Ionizing and non-ionizing radiation [6].

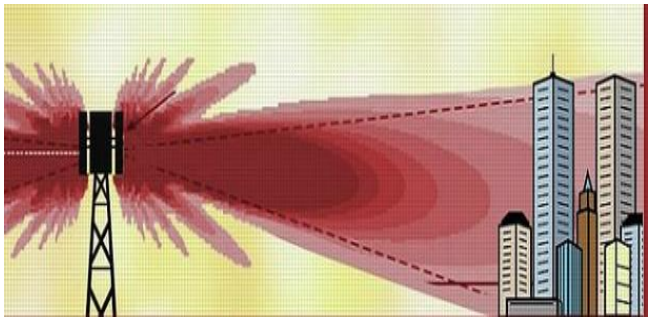

Fig 3: Radiation pattern of a cell tower antenna [7].

Conclusion

As a result of industrialization, urbanization, and modern technology, the environment has been subjected to electromagnetic pollution. The sources of electromagnetic pollution of the environment are increasingly diversified and intense, causing an alarm for the future of mankind. The exposure of human beings to high levels of radiation can lead to serious health problems and even death.

The research problem related to the effect of EM pollution on living organisms is increasingly popular among scientists worldwide. However, there are no definitive answers yet to the question of whether electromagnetic pollution has a negative influence on living organisms. There are gaps in the understanding of the biological effects of EM pollution, requiring more research. More information about electromagnetic pollution can be found in books in [13-15].

References

1. Velentza O. Electromagnetic pollution-pathological effects of electromagnetic fields in man," AASCIT Journal of Health. 2015; 2(6):74-79.
2. Health hazardous effects of electromagnetic pollution," http://sfgt.ae/index.php/health-hazardous-effects-of-electromagnetic-pollution/
3. Redlarski G, et al. The influence of electromagnetic pollution on living organisms: Historical trends and forecasting changes, BioMed Research International, vol. 2015, 2015.
4. Posudin Y. Electromagnetic pollution," https://doi.org/10.1002/9781118914236.ch34
5. Balmori A. The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle? Toxicological & Environmental Chemistry. 2006; 88(2):287-299.
6. Radiation pattern of a cell tower antenna," https://me.me/i/radiation-pattern-of-a-cell-tower-antenna-baso-station-mast-14388044
7. Prabhudesai A. "Mobile towers banned near schools & hospitals!, 2018,https://trak.in/tags/business/2012/11/14/mobile-towers-banned-schools-hospitals/
8. Kurnaz1 C, Engiz BK. Monitoring and assessment of electromagnetic pollution in Samsun (Turkey)," Proceedings of 39th International Conference on Telecommunications and Signal Processing, 2016.
9. Electromagnetic radiation and health, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/Electromagnetic_radiation_and_health
10. Lingva D, Borș AG, Borș AM. Electromagnetic pollution and its effects on living matter", Electrotehnica, Electronica, Automatica. 2008; 66(2):5-11.
11. Cuinas I, Alejos AV, Sanchez MG. Vegetal barriers for minimizing electromagnetic pollution at cellular phone bands," Electronics Letters. 2005; 41:6.
12. Saim K, Zerrin KS, Selçuk S. Electromagnetic pollution in buildings and its effects on human health," Proceedings of the 7th ICEENG Conference, 2010.
13. Swartwout G. Electromagnetic Pollution Solutions (Accelerated Self Healing). Createspace Independent Pub., 3rd edition, 2012.
14. Newerla B. Protect Yourself From Electromagnetic Pollution By Using Crystals. Inner Traditions/Bear, 2010.
15. McLean L. The Force: Living Safely in a World of Electromagnetic Pollution. Scribe Publications, 2011.