

Exposure to Hazardous Effect of EM Radiation

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Abstract

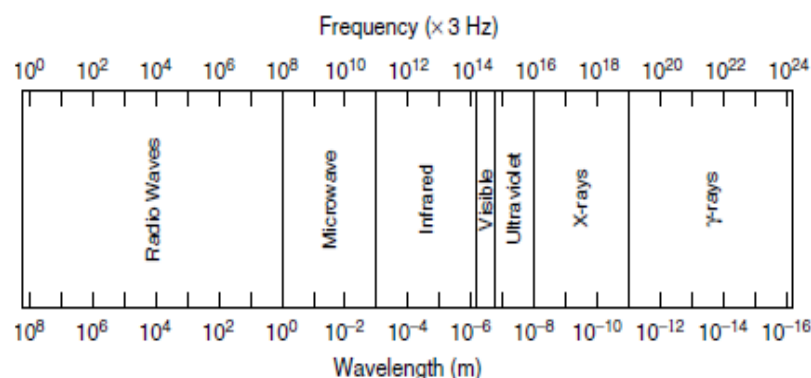
An Electromagnetic Wave consists of two waves perpendicular to each other, one represent Electric field & other one is Magnetic field . The EM spectrum is traditionally divided into the seven regions. This spectrum is split up into 81 octaves. Radiation energy lies between 10 KHz – 300 GHz in the electromagnetic spectrum. This article is to identify and to recognize the effect of radiation on biological aspect and neurological effect of EM radiation.

Keywords- Biological effect, Thermal effect, neurological effect, safe microwave radiation.

INTRODUCTION

Light has been a trusted probe of a variety of aspects of the universe since the beginning of scientific inquiry. Light, an electromagnetic (EM) field, is an intimate

coupling between time dependent electric and magnetic fields. The EM spectrum is traditionally divided into the seven regions is shown in fig. No.1



The most familiar region of the spectrum, the visible region, consists of wavelengths that range from about 0.40 μm at the blue end to 0.78 μm at the red end. Breaking the spectrum into six rather than seven or eight bands is of little consequence

typically, because most objects emit a range of colors.

This range of colors having approximate wavelength, frequency and energy is shown in fig. No. 2.

Color	Wavelengths (nm)	Frequencies ($\times 10^{14}$ Hz)	Energies (eV)
Red	780–625	3.8–4.8	1.6–2.0
Orange	625–590	4.8–5.1	2.0–2.1
Yellow	590–565	5.1–5.3	2.1–2.2
Green	565–500	5.3–6.0	2.2–2.4
Blue	500–435	6.0–6.9	2.4–2.8
Violet	435–380	6.9–7.9	2.8–3.6

Ionizing radiation (IR) causes damage at various hierarchical levels of organization in biological systems. Damage to biological systems by ionizing radiation is caused primarily by the macromolecular lesions due to direct interaction of radiation with macromolecules. The human body begins to significantly absorb electromagnetic radiation when the frequency exceeds about 15 MHz. This absorption varies for different parts of the body.

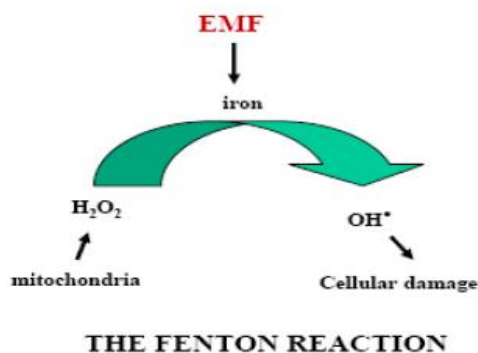
broadcast towers, cell towers, etc. emit RF/microwave/EM radiation continuously. A cell phone that is ON but not in use is also radiating. Cell phones operate within the frequency band of 800 MHz, 900 MHz and 1800 MHz and the latest 3G technology works between 1900 -2200 MHz. A Swedish Professor Jhon Herdell conclude that most of the risk for brain tumors increasing largely in those people who use the mobiles more intensely.

EXPOSURE TO BIOLOGICAL ASPECT

1. The transmitting towers, such as AM and FM broadcast section, TV

2. EM radiation damage the DNA, radiation at some cell phone levels damages DNA and the damage could

not always be repaired by the injured cell. DNA-damaging effects of mobile phone irradiation, indicate the cause to be a non-thermal effect of electromagnetic radiation. The reaction which takes place in our body is called Fenton reaction. Damage to DNA is a central mechanism for developing tumors and cancer. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer. This Fenton reaction shown in fig. No. 3.



3. Effect of TV and FM Towers :- In Australia it was found that children living near TV and FM broadcast towers (similar to cell towers) had more than twice the rate of leukemia as children living more than seven miles away from these towers.
4. In another study, TV signal exposed workers were observed to have

increased IgG and IgA and decreased lymphocytes and T8 cells, resulting in a decrease in immune response.

5. The RF Exposure can adversely affect the heart of a patient using Pace Maker, Implantable Cardiovascular Defibrillators (ICDs). These radiations may stop Pace Maker from delivering pulses in a regular way or may generate some kind of external controlling pulse putting the patient to death.
6. A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiations continuously react with the developing embryo, increasing cells, because of thermal heat also. Electromagnetic radiation damages the placental barrier; the membrane which prevents the passage of some materials between the maternal and fetal blood, protecting the foetus, implying that no pregnant woman should ever be using a cell phone.[1]

THERMAL EFFECT

1. When EM radiation is absorbed, it is converted into heat. A readily understandable mechanism of effect of radiation is tissue heating (thermal

effect). Biological systems alter their functions as a result of change in temperature. When electromagnetic radiation is incident on matter, it causes the charged particles to oscillate and gain energy. The ultimate fate of this energy depends on the situation. It could be immediately re-radiated and appear as scattered, reflected, or transmitted radiation. It may also get dissipated into other microscopic motions within the matter, coming to thermal equilibrium and manifesting itself as thermal energy in the material.

2. Intense radio waves can thermally burn living tissue and can cook food. In addition to infrared lasers, sufficiently intense visible and ultraviolet lasers can also easily set paper afire. Ionizing electromagnetic radiation can create high-speed electrons in a material and break chemical bonds, but after these electrons collide many times with other atoms in the material eventually most of the energy gets downgraded to thermal energy, this whole process happening in a tiny fraction of a second.
3. The inverse or time-reversed process of absorption is responsible for thermal radiation. The resulting radiation may

subsequently be absorbed by another piece of matter, with the deposited energy heating the material. Radiation is an important mechanism of heat transfer.[2]

GENETIC EFFECTS OF RADIATION

1. The genetic effect of radiation is an important part of the biological effect of ionizing radiation studied by radiation genetics. The mutagenic effect is produced by all types of ionizing radiation, as well as by ultraviolet rays, if the hereditary structures of any organisms—from viruses and bacteria to highly organized animals, including man—are subjected to them.
2. Radiation may produce all types of mutations (gene, chromosomal, genomic, and cytoplasmic). Within a particular range of dosages the frequency of mutation increases proportionally to the radiation dosage. When the dosage is increased beyond a certain value the linearity of the curves describing mutation frequency as a function of dosage is destroyed. The newly induced mutations are usually recessive and harmful. An increase in the radioactive background leads to the accumulation of latent harmful

mutations in populations of organisms, including those of man.

3. An important practical application of the genetic effects of radiation is radiation selection, that is, the selection of economically valuable mutations obtained from cultivated plants and industrial microorganisms that have been exposed to radiation. New varieties of oats, barley, peas, peanuts, fruits, and ornamental plants developed by this method are already being cultivated on a large scale. Many highly productive industrial strains of microorganisms—producers of antibiotics, vitamins, and amino acids—have also been obtained by means of radiation mutagenesis.[3]

NEUROLOGICAL EFFECT

When the nervous system or the brain is disturbed, by EMR, morphological, electrophysiological, and chemical changes can occur. A significant change in these functions will inevitably lead to a change in behavior. Indeed, neurological effects of EMR reported in the literature include changes in blood-brain-barrier, morphology, electro-physiology, neurotransmitter functions, cellular

metabolism, calcium efflux, responses to drugs that affect the nervous system.[4,5]

SAFE MICROWAVE RADIATION

The rate at which radiation is absorbed by the human body is measured by **specific absorption rate (SAR)**, measured in units of watts per kg (W/kg) of tissue. If the heat generated is small, the body's thermoregulatory mechanism can dissipate it without causing adverse effects. If the temperature exceeds this capacity, about 1 to 2 degree Celsius, tissue damage may occur. Every mobile phone comes with a SAR rating (although some manufacturers try to hide it). Regulating agencies has set its maximum levels for handsets. Radiations depend on its design, antenna, how it is held and used. Institute of Electrical and Electronics Engineers (IEEE) Committee on Man and Radiation, national and international organizations have established safety guidelines for exposure to RF energy. Testing has shown a wide range in radiation exposure to the user of various brands and models of cellular phones.

The SAR values of a few cell-phone models are tabulated below:

Manufacturer	Model	SAR Output (W/Kg)
Motorola	V195s	1.6
Nokia	E710x	1.53
LG	Rumor 2	1.51
Sony Ericsson	W350a	1.48
Samsung	Instinct	1.46
Samsung	Soul	0.24
Nokia	9300	0.21
Output is expressed in Watts per Kilogram Current UK Standard = 1.0W/Kg Current US Standard = 1.6W/Kg		

Increase in thermal effects occurs when whole-body energy absorption exceeds a SAR of 4 W/kg. Taking this value as threshold for harmful effects, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) applies a safety factor of 50 to derive safe limits for exposure to general public.

CONCLUSION

With ever increasing use of the spectrum due to modern communication equipments and also use of latest digital processing techniques for most of the devices there is a need for laying down the guidelines for Emission standards. Scientific studies have failed to provide support for a relation between EM exposure, lower than the reference values in the present ICNIRP guidelines and self-reported symptoms

(sometimes referred to as electromagnetic hypersensitivity). Available studies suggest that self-reported symptoms are not correlated to an acute exposure to EM fields, but the limited number of studies does not allow any firm conclusion.

ACKNOWLEDGEMENT

The author would like to acknowledge and extend heartfelt gratitude to Dr. B.K.Panigrahi, Principal, Prof. R.V.Bura, Dean(Aced.), Prof. K.C.Mohapatra, H.O.D, E.T.E and Er. P.K.Nandy, Secretary, Padmanava College Of Engineering, Rourkela for their full co-operation during the preparation of this paper . Most especially to my family and friends . And to God , who made all things possible.

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