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Human Health and Electromagnetic Radiations

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Abstract*— The man of 21st century is a man of comfort. Today's man totally depends upon the technology; he cannot spend a second without technology. There are various equipments such as wireless phones, various electrical equipments etc. Which has become an integral part of his life? Life cannot be imagined without these equipments. Large numbers of devices among these generate electromagnetic radiations. These electromagnetic devices have various uses in domestic, industries and medicine. MRI and CT SCAN are used to find out the abnormal conditions in human body, hyperthermia technique is used to treat cancer and tumours and Induction heating is used in industries. In spite of all important applications the electromagnetic fields imposes great danger to the human body. Electromagnetic pollution (or EMF pollution) is a term given to all the man-made electromagnetic fields (EMFs) of various frequencies which fills homes, workplaces and public spaces. When something in the environment is called a pollutant, it implies that it is somehow harmful to nature and to human beings. In this paper the various sources of electromagnetic radiations and the effect of these radiations on the life of human beings has been taken into account. In short this paper throws light on the other side of the emerging technology.

***Keywords*— Electromagnetic Field (EMF), Electromagnetic Radiation (EMR), Electromagnetic Pollution (EMP), Specific Absorption Rate (SAR) For Cellular Phones.**

I. INTRODUCTION

Electromagnetic radiations can be classified into two types ionizing radiation, non-ionizing radiation. They are called so based on whether they are capable of ionizing atoms and breaking covalent bonds or not. Ultra violet and higher frequency radiations, such as X-rays or gamma rays are ionizing. These pose their own special effects on the life of human beings. Non-ionizing radiation is associated with two major potential hazards that are electrical and biological. Moreover, induced electric current caused by radiation can generate sparks and create a fire or explosive hazard. The electromagnetic spectrum includes several different classes of radiation: low frequency, radio waves, microwaves, infrared waves, visible light, ultraviolet light, x-rays and gamma rays. Wave frequency differentiates one class of radiation from another [1]. Figure 1 is a graphical representation of the spectrum of electromagnetic energy or radiation in ascending frequency (decreasing wavelength). Electromagnetic pollution is due to frequencies which are oscillating slower than visible light waves. But x-rays and gamma rays (which oscillate faster than visible light) are highly dangerous but they are rarely present at our dwelling places and workspaces. Electromagnetic pollution is everywhere. This paper discusses the effect of the electromagnetic pollution on the human body and also the various sources responsible for electromagnetic pollution.

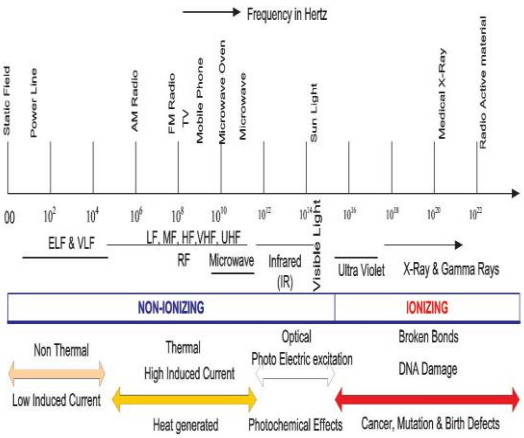

Fig 1. Electromagnetic Spectrum

II. SOURCES OF ELECTROMAGNETIC RADIATIONS

The various devices which are responsible for electromagnetic pollution are as follows:

- computers and related equipment
- Cellular (mobile) phones
- information networks
- electrical appliances
- electronic equipments
- cell phone masts
- microwave ovens
- house-wiring
- high and low voltage power lines and many others

In reality every new invention leads to the electromagnetic pollution. The rate of increase is rising exponentially. This paper discusses the adverse effects of the electromagnetic fields on the human body.

III. ELECTROMAGNETIC RADIATIONS (EMRs)

A) Low Frequency EMRs

Strong electromagnetic fields (EMFs) of low frequency about 50 to 60 cycles per second (hertz, or Hz) are very harmful. It is possible to shield a house from electric field generated by nearby power lines but is difficult to provide shielding from magnetic field generated by them. The magnetic field can be shielded by using the underground transmission system but the cost much higher than the overhead transmission line system. The long-term exposure of low frequency EMFs may give rise to various health problems especially lack or fatigue, irritability, aggression, hyperactivity, sleep disorders and emotional instability. Large numbers of individuals are becoming hypersensitive to EMR. EMR exists around power lines,

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power tools, boilers, electric stoves, heaters, freezers and television sets when in use using an electric iron or an electric keyboard or working with handheld power tools can quickly drain our energies. Stray currents and radiating fields can be present around us even if appliances are switched off. AC electric fields do not disappears when an appliance is switched off, only AC magnetic fields disappears.

Table 1. Operating frequency and average power radiated by Cellular Phones, Cordless Phones and Walkie-talkie.

Type of mobile radio	Frequency (MHz)	Average radiated power
Cellular PCS	824-849 1850-1990	A few hundred milliwatts
Two way, hand held	30,50,150,450 and 800	Between 2 and 5 watts
Cordless Telephone	49,915,2450	Tens of milliwatts

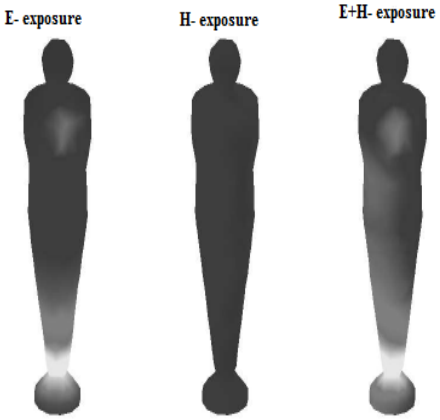

Fig 2 Shows The Effect Of The Electric Field, Magnetic Field And The Electromagnetic Field On The Human Beings.

When human body is exposed to electric field and magnetic field alone then no significant effect is observed on human body. But adverse effect is observed on the human body when it is exposed to both electric and magnetic fields, i.e. electromagnetic radiations.

B) High Frequency EMRs

High frequency electromagnetic field is mainly generated by the cellular phones, microwaves and antennas. High frequency EMFs is due to radio frequency energy in the frequency range of low, medium, high, very high, ultrahigh frequencies or microwaves and is often referred to as radio energy. The term radio frequency energy is used for all the frequencies between 30 kHz and 300GHz. Biological effects of radio frequency (RF) energy are:

- The RF energy heats up the tissues in a similar manner a microwave oven heats the food and it can be dangerous in case of prolong exposure.
- Tissues can get damaged if exposed to RF energy because they are not capable of dissipating large amount of heat generated. This can lead to skin burns, deep burns and heat strokes.
- Eyes are most affected by the RF energy because the lack of blood flow to cool the cornea can lead to cataract.

IV. RADIO FREQUENCY RADIATIONS

A) Cellular Phones EMRs

Cellular phones work by emitting radio frequency radiations that are transmitted through the antenna in the phone. While using the cellular phone, the device and thus its antenna end up right next to the head and the radiation from it easily affect the brain.

B) Cordless Phones EMRs

Swedish scientists have found that cordless phones give rise to the risk of cancer. Researchers studied malignant brain tumor patients on the basis of their usage of cell phones and cordless phones and they found that cancer risk was increased for those who used cordless phones and the user which use both have even higher risk.

V. HAZARDS OF ELECTROMAGNETIC POLLUTION

Electromagnetic pollution has various hazards like electrical hazards, fire hazards, biological hazards and DNA fragmentation.

A) Fire Hazard

Extremely high power electromagnetic radiation can cause sparks (electrical arcs). When an induced voltage exceeds the breakdown voltage of the surrounding medium (*e.g.* air). These sparks can then ignite flammable materials or gases, possibly leading to an explosion. This can be a particular hazard in the vicinity of explosives or pyrotechnics, since an electrical overload might ignite them. This risk is commonly referred to as Hazards of Electromagnetic Radiation to Ordnance (HERO). On the other hand, the risk related to fuelling is known as Hazards of Electromagnetic Radiation to Fuel (HERF).

B) Biological Hazard

The most understood and discussed biological effect of electromagnetic fields is dielectric heating. For example, touching or standing around an antenna while a high-power transmitter is in operation can cause severe burns. These are exactly the kind of burns that would be caused inside a microwave oven. This heating effect varies with the power and the frequency of the electromagnetic energy. A measure of the heating effect is the specific absorption rate (SAR), which has units of watts per kilogram (W/kg). The IEEE [4] and many national governments have established safety limits for exposure to various frequencies of electromagnetic energy based on SAR, mainly based on the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines [5].

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C) Electrical Hazard

Strong radiation can induce current capable of delivering an electric shock to persons or animals. It can also overload and destroy electrical equipment. The induction of currents by oscillating magnetic fields is also the way in which solar storms disrupt the operation of electrical and electronic systems, causing damage to and even the explosion of power distribution transformers,[2] blackouts (as in 1989), and interference with electromagnetic signals (*e.g.* radio, TV, and telephone signals).[3]

D) DNA Fragmentation

In 2009 the study at the University of Basel in Switzerland found that intermittent (but not continuous) exposure of human cells to a 50 Hz electromagnetic field at a flux density of 1mT induced a slight but significant increase of DNA fragmentation in the Comet assay.[6] However this level of exposure is already above current established safety exposure limits.

VI. SAFETY GUIDELINES

From the above discussion we come to know that there are two sources of electromagnetic pollution and their effects are different on human body so different protection measures are required for both low frequency and high frequency electromagnetic pollution.

A) Low Frequency EMP

It must be tried to minimise electromagnetic pollution, especially while sleeping when the pineal gland is most susceptible. Also one should sleep in the dark or at least eyes must be covered to produce the immune-stimulating hormone melatonin. Preferably all power points in the bedroom should be switched off and all electric leads with 2-prong plugs should be unplugged before going to sleep. If the head faces a wall with power-points or other electric wiring inside the wall close to the bed then bed should be moved towards the middle of the room. While using electric blankets, the bed should be warmed beforehand and the plug should be removed before going to bed[7]. It should be tried not to habitually remain within a few metres of a working electric appliance. Fluorescent lighting, watching television, using video games, computers and even electric typewriters and hand-held electric tools should be avoided. Television sets also emit harmful X-rays so television watching should preferably be as far away as conveniently possible. The field is strongest directly in front and at the back of the television. Computer monitors apparently have stronger radiations to the sides than to the front [8].

B) High Frequency EMP

Human beings should spend less time on the cellular phones. Cellular phones with a lower specific absorption rate (SAR) should be used. Use of cell phones should be limited in case if children below 10 years [9] .It should be avoided to make calls with a low signal and low battery as the cell phone will generate more radiation in an effort to compensate for it.

VII. CONCLUSION

After this study it can be concluded that electromagnetic fields are harmful and can have adverse effect on human body depending upon the intensity and frequency of electromagnetic field. It is always a good idea to avoid the unnecessary exposure to electromagnetic fields whenever possible. Though technology makes our life very comfortable but at the expense of our health, it is our first duty to save our life. Thus we should use technology wisely so that we can save ourself as well as mother earth.

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Author's Profile

Ankur Mahajan Was Born On April 1988 In Jammu Region Of Jammu & Kashmir India, After Getting B.E. Degree In Electrical Engineering From Jammu University In 2010; In 2011 He Joined Nitttr Chandigarh As A M.E. Student. The Author Has 2 Papers In International Conferences, Out Of Which 1 Is In IEEE Conference Held At China. The Author Is Also Writing A Book On Microcontrollers And Plc With Mandeep Singh.

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