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ELECTROMAGNETIC POLLUTION ITS IMPACT AND CONTROL

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Abstract-Current advances have turned into a wellspring of inescapable electromagnetic pollution from created electromagnetic fields and coming about electromagnetic radiation. By and large, this pollution is significantly more grounded than any common wellsprings of electromagnetic fields or radiation. The mischief caused by this contamination is as yet open to address since there is no evident and conclusive proof of its negative effect on people. This is regardless of the way that greatly low-frequency electromagnetic fields were named possibly cancer-causing. Therefore, in late decades a critical development can be seen in logical research keeping in mind the end goal to comprehend the impact of electromagnetic radiation on living creatures. Electromagnetic contamination is getting increasingly extreme these days. In this paper, the characters and impacts of electromagnetic radiation on creatures are examined. Thermal effects and non-thermal effects of electromagnetic radiation on live things are additionally displayed. Then a series of suggestions to diminish electromagnetic pollution are put forward. With the fast improvement of electronic innovation, electromagnetic pollution is getting increasingly genuine with each passing day. So it has been focused on numerous nations and has entered the rundown of open perils, which should be wiped out on the United Nations Human Environment Conference. Particularly microwave radiation is the fundamental cause of electromagnetic pollution which irritates the ecological balance but also threatens human beings. Consequently, it has a wide centrality to examine how to dispose of electromagnetic pollution.

Keywords-High Frequency Radiation, Microwave Radiation, Thermal effect, Non-thermal effect

I. INTRODUCTION

EMFs are energy waves with frequencies beneath 300 Hertz. They are imperceptible to the exposed eye; travel through empty space, through the air and different substances. We are presented to a virtual cluster of destructive EMFs known as

electromagnetic pollution. Visible light, microwaves, radio waves and x-rays are examples of electromagnetic waves, however with various wavelengths. The development of electrically charged particles makes electromagnetic waves, otherwise called "electromagnetic radiation" since they transmit from the electrically charged particles. Electromagnetic pollution happens every time electricity is generated. We are encompassed by it whether from mobile communication towers, satellite GPS system, wireless systems (Wi-Fi, Wi-MAX), radar, electrical cables, cell tower transmitters, PC screens and hard drives, wireless web, microwave ovens, TVs, fluorescent lights, electric meters and sub boards, dimmer switches, mobile phones, line and cordless phones, house wiring, home appliances and the rundown goes on.

Table 1: Sources of electromagnetic fields and radiation influencing living organisms [1].

Type	Frequency	Source
Static	-	Natural, video screens, magnetic resonance imaging, and other diagnostic/scientific equipment, electrolysis, and welding devices
ELF	Below 300Hz	Power transmission lines, home wiring, car electric engines, electric trains and trams, and welding devices
IM	300Hz -100 kHz	Video screens, antitheft devices used in cars, homes, and shops, card readers, metal detectors, magnetic resonance imaging, and welding devices
RF	100 kHz - 300GHz	Radio, television, smartphones, tablets, microwave ovens, radar and radio transmitters, and magnetic resonance imaging



Electromagnetic fields as well as electromagnetic radiation, as electromagnetic pollution, influence different components of the environment. Among the components of that condition, every single living life form ought to be put at the main position. In this way, it turns out to be critical to fittingly decide the nature and related symptoms of electromagnetic pollution and its effect on living beings. Consistently living life forms are exposed to various sorts of electromagnetic pollution. In any case, every one of them can be all around described by their physical parameters, for example, sort (electric, magnetic, electromagnetic), frequency, and intensity/power. Electronic gadgets, for example, cell phones, tablets, microwave ovens, radio, and TVs transmit low-intensity electromagnetic radiation at frequencies from 300MHz to 300GHz that can be related with microwaves. Then again, power transmission lines and electric devices are main source of electromagnetic fields (basically electric for power transmission lines, principally magnetic for Transformers, or electromagnetic for reception antennas) and radiation of much lower frequencies yet considerably higher intensities. An intensity larger than 3 mG could be damaging. Accordingly, the safe total EMF daily exposure level should be of 1 mG. There has been developing concern about conceivable unfavourable well-being impacts because of Electromagnetic field (EMF) Radiation from mobile towers and handsets. In the course of recent years, various health activists what's more, resident associations have begun restricting the erection of telecom towers on housetops and in populated ranges, guaranteeing that radiation from such establishments causes serious health dangers. It ought to be understood that diverse sorts of electromagnetic fields or electromagnetic radiation are responsible of various sorts of phenomena that can be seen because of radiation exposure. For illustration, high energy microwave radiation at frequencies from 300MHz to 300GHz can be carcinogenic and cause thermal impacts, expanding the temperature of exposed creatures. Then again, a similar kind of microwave radiation at bring down frequencies from 100 kHz to 300MHz has no such impact. It is essential to take note of that the source of electromagnetic radiation described by field frequencies below 300GHz can be related to the nonionizing sort of radiation [2]. On the other hand low frequency, electromagnetic fields are the source of another kind of electromagnetic radiation as on account of power transmission lines or transformers (by the action of the processes and

devices present in the Power System [3]). Such electromagnetic fields that are portrayed by field frequencies of 50Hz or 60Hz are semi stationary and their two field component (electric and magnetic) can be considered as particular [2].

Disturbing reports of possibly destructive impacts of electromagnetic contamination drew the consideration of the World Health Organization (WHO), which in 2007 introduced a synopsis report of a worldwide research program titled Electromagnetic Fields [4]. In the report area committed to the impacts of low- frequency magnetic fields of 50Hz and 60Hz, it was expressed that there are no firm grounds to take care of as far as possible for long haul presentation to these fields; nonetheless, an alert is prompted [4]. In May 2011, in Lyon, France, the International Agency for Research on Cancer (IARC) and WHO qualified the electromagnetic fields of radio frequencies as perhaps expanding the danger of building up a threatening cerebrum growth, glioma, which is chiefly connected with the utilization of cell phones [5]. The issues portrayed above still stay unanswered today and result in an awesome increment of enthusiasm for all parts of electromagnetic contamination and particularly its effect on living life forms.

II. EM RADIATION SOURCE

Aside from the utilization in communication, some other critical employments of electromagnetic radiation as appeared in figure 1 underneath, in our everyday life is as per the following:

- a. Conversion of electromagnetic radiation from Sun (solar energy) to chemical energy (food) by plants through the process of photosynthesis.
- b. X-ray utilized for bone structure imaging at hospitals.
- c. X-ray utilized as a part of Security Scanner at Airports and shopping centres
- d. Microwave utilized as a part of microwave broilers and radars.
- e. Radio waves utilized as a part of radio and television broadcasts.
- f. Visible light utilized for normal vision.
- g. Infra-red waves utilized as a part of night vision goggles and in TV remote controls.

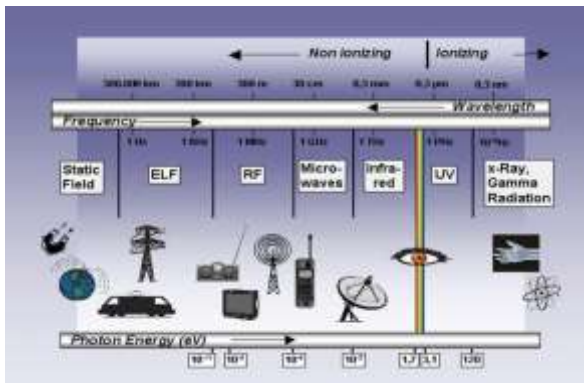


Figure 1: Complete EM Spectrum

Table 2: EMF Source

EMF Source	Operating Frequency	Transmission Power
AM/FM Tower	540 KHz-108 MHz	1 KW – 30 KW
TV Tower	48 MHz – 814 MHz	10 – 500 Watt
Cell Towers	800, 900, 1800, 2100, 2300 MHz	20 W
Mobile Phones	GSM-1800/CDMA GSM-900	1 W 2 W
Wi-Fi	2.4 – 2.5 GHz	10 – 100 mW

As per the information paper “Effects of Electromagnetic Field Radiation from Mobile Towers and Handsets” given by TRAI (Telecom Regulatory Authority of India) in 2014 the number of above EMF sources are approximately 380,1201, 51ac and 900 plus [respectively which are contributing in EM radiation.

Electromagnetic radiation sources can be characterized into two types. One sort of radiation is called ionizing radiation from X-ray, T - ray and so on. It can empower the radiated material to deliver free electrons, with the goal that the particles end up plainly charged particles. The other sort of radiation is called non-ionizing radiation from radio recurrence and microwave. It can cause electron energy level change when the emanated material retains energy.

EMF radiations are divided into two classifications, ionizing and non-ionizing, contingent upon frequency and the power level. Ionizing radiation is electromagnetic radiation whose waves contain energy adequate to beat the coupling energy of electrons in atoms or particles, in this way making particles. e.g. UV rays, X-beams , gamma beams as appeared in figure 2 underneath.

Non-ionizing radiation alludes to an electromagnetic radiation that does not convey enough energy per quantum to ionize particles or

atoms. e.g. low frequency radiations like radio waves, microwaves, also, infrared radiations as appeared in figure 2 underneath.

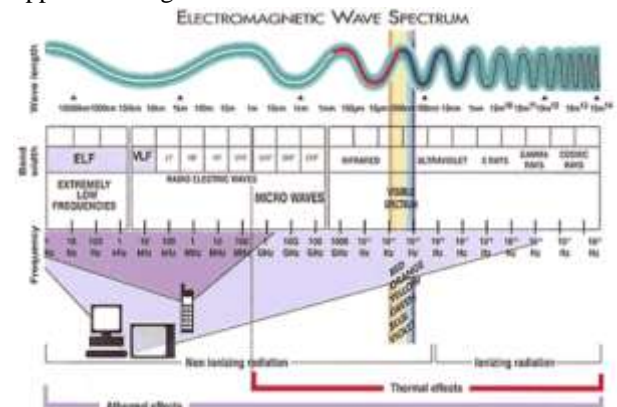


Figure 2:Type of EM radiation

Impacts of EMF radiation can be contemplated in two ways i.e. bio-effect and health effect .Electromagnetic contamination is the impacts which prompt environmental aggravation.

- A. Bio-impacts are quantifiable reactions to a boost or to an adjustment in the air and are not really destructive to our health. Biological impacts can be two sorts:
 - a. Non-Thermal impacts caused attractive field, electrostatic field, and low frequency field and microwave radiation. Non-thermal impacts are ascribed to the instigated electromagnetic effect inside the organic cells of the body which is perhaps more destructive.
 - b. Thermal effect refers to the heat generated due to absorption of EMF radiation. It caused by molecular friction amid radio frequency and microwave radiation. While utilizing a wireless or cell phone, the greater part of the thermal effect happens at the surface of the head, making its temperature increment by a small amount of a degree. Prolonged thermal effect may prompt increment in body temperature.
- B. Health effect are the progressions which might be short or long term. These impacts stress the system and might be destructive to human health.

III. CHARACTERS OF ELECTROMAGNETIC RADIATION

A. High-frequency Radiation(100KHz-30MHz)

In the scope of high frequency, the operators are normally presented to the close field zone. Along



these lines, the spatial field force is high. In the meantime, the electric force is not straightforwardly corresponding to magnetic intensity. Subsequently, they follow up on life form separately. What's more, since human body has certain height, width, and thickness, it can be impacted by electromagnetic field through three measurements and high power transmitter, its transmitting energy spreads abroad in the type of wave and results in electromagnetic pollution.

B. Microwave Radiation (>300MHz)

At the point when microwave energy follows up on living things, some portion of the energy is reflected and part is assimilated and after that changed into thermal energy. The measure of energy consumed by life form fluctuates if the dielectric constant, electric conductivity, thickness of living being or, on the other hand, microwave frequency is extraordinary. The dielectric constant is identified with the segment of extensive atoms in living being and microwave length. The shorter of microwave length, the shallower of microwave radiation.. At the point when the frequency is not as much as 1000 MHz, almost 40% of microwave energy going into the tissue is changed into heat. At the point when the frequency is in the vicinity of 1000 and ~1000 MHz, the two life forms' inside organs and surface tissues can retain the energy at certain proportion. At the point when the frequency is bigger than 3000MHz, a large portion of the microwave energy is reflected by a living being and under 40% is retained. After consumed energy is changed into heat, the surface tissues are warmed up. Tepidity and causalgia will be felt. In any case, if the earth temperature is high, the air velocity is low, the air is sodden and the garments are thick and dull, the heat loss rate will diminish so that person is able to get harmed by microwave radiation effectively and genuinely.

IV. BIOLOGICAL EFFECTS OF ELECTROMAGNETIC RADIATION

A. Effects of Electromagnetic Radiation on Organism

Thermal Effect:

Organism can be regarded as complicated combination of electric resistance and electric capacities. Under the alternating electric field, the polar distribution will be rearranged. The electric power can be changed into heat by molecular friction. Besides, there is a dielectric arrangement in the organism, the particles of which will move with the variety of the electric field .At the point when the frequency is very high, the particles and

particles in living being vibrate at the equilibrium and heat will be delivered. So they can cause local induction turbulence. In the meantime, a few arrangements in the life form are conductors, (for example, body liquids) and have the comparable properties as closed loop circuit. So they can cause induction turbulence. Along these lines, radiation energy changes into heat. Since each tissue has its unique conductivity, the heat impacts of EM energy on variant tissue are extraordinary.

Non-Thermal Effect:

Electromagnetic radiation can bring about pan asthenia and the disorder of a cardiovascular system, which demonstrates that non-thermal impact may have an influence amid electromagnetic radiation. As indicated by the reports of recent years, low power microwave radiation can prompt electro activity of cochlea and hypothalamus. What's more, there shows up abnormality in brain.[7].

Thermal impacts and non-thermal impacts influence life form simultaneously. Non-thermal impacts are relative to electric intensity while thermal impacts are to the square of electric intensity. Thermal impacts assume the fundamental part when the radiation control is high. On the difference, non-thermal impacts are more noticeable when the radiation control is low yet radiation period is long. Everything has two sides. Electromagnetic radiation can profit human body if the electric intensity is appropriately controlled. Once the esteem surpasses the wellbeing edge, it will be extremely destructive.

B. Propagation of EM waves in Organism

At the point when electromagnetic energy proliferates in various natural showers in type of wave, there will dependably have reflection, refraction, diffraction, scattering and polarization at surfaces in light of the variation properties of natural showers. Accordingly, when the electromagnetic wave propagates through free space to a life form, it goes into variant dielectric of various properties. So reflection, refraction, and diffraction will dependably happen when electromagnetic wave spreads between self-assertive dielectric. Therefore, an outrageous complex energy circulation diagram will show up among the tissues in the creature.

V. CONTROL

Keeping in mind the end goal to dispense with electromagnetic pollution, the first and most imperative is to diminish radiation sources and point of confinement radiation amount in the safe margin. In the meantime, defensive moves must be



made to guarantee the security of people in general populace. Here are a few proposals as follows:

- A. **Develop Plants and Flowers around Severe Polluted Areas:** Analyses demonstrate that plants can retain electromagnetic radiation adequately. So in the extraordinary emanated zone (for instance the spots around the tower) plants and blooms ought to be raised.
- B. **Be Careful to Arrange Microwave Station and Microwave Antenna:** Microwave station ought to be avoided abiding ranges to keep away from coordinate radiation. In the short scope of microwave transmitting way, no skyscraper abiding house ought to be developed and the existed living arrangement ought to be appropriately protected. Near microwave station, no open place of diversion ought to be as high as conceivable to build the vertical separation between person and microwave reception apparatus.
- C. **Take Protective Measures for Professional Man:** The professional should wear protection shoes and gloves when entering the 50MHz field. In the event that the frequency is higher than 50MHz, they should wear encased security apparel and have consistent physical examinations.
- D. **Execute the Electromagnetic Radiation Safety Standards:** The finished tasks must be tested and those that don't comply with benchmarks must be revised.
- E. **Consider the Electromagnetic Shielding Distance between Buildings:** Presently we ought not just consider the supply of water, power, and warmth as before when we pick the job area, yet in addition incorporate EM pollution. The electromagnetic protecting separation of abiding houses must be discovered. Those inquiries, for example, how far the house ought to be from the transmitting station to stay away from the radiation danger must be replied. In addition, individuals there will probably be harmed by electromagnetic pollution.
- F. **Shield and Connect Ground the Electronic Equipment:** Experiments demonstrate that it

is very powerful to diminish the radiation and spillage if the hardware is appropriately protected and associated with the ground.

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