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Radio Pollution

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Abstract:

Electromagnetic energy represented by electromagnetic fields. The world is saturated with presence of EM waves due to advancement of technology wireless communication. The other EM devices like radars are also responsible for such EM waves around us. These EM waves are generated intentionally or unintentionally. These waves are generated to meet certain objectives namely fast communication, detection of objects anywhere in the globe. However these waves are creating lot of pollution on living human being. In this paper the effects of such unconventional pollutions are described.

Key words: *Pollution, progression, development*

1. Introduction

Pollution is the result of progression and development that is occurring on a regular basis. With the growth of technology more and more development is taking place in order to improve the quality of human life. This series is certainly giving high level of comfort and a rich lifestyle to all humans but is sadly diminishing the worth of human health; the need to have a good and healthy environment is ignored. Many new inventions and introductions are causing a danger to human life as they are done artificially. Environmental pollution is any discharge of material or energy into water, land, or air that causes or may cause acute (short-term) or chronic (long-term) detriment to the Earth's ecological balance or that lowers the quality of life.

2. Radiation Pollution

Radiation is a form of energy on the move. Radiation is electromagnetic in nature. We live in a radiation

world and are exposed to both natural and man-made radiation.

3. Types of electromagnetic radiation:

_ *Ionizing radiation*

It contains enough energy to cause ionization. Ionization is a process by which electrons are stripped from atoms and molecules. Its interaction with matter can change chemical reactions in the body that leads to damage in biological tissues including effects on DNA (deoxyribonucleic acid) – the genetic material. Gamma rays and x-rays are two forms of ionizing radiation.

_ *Non-ionizing radiation (NIR)*

It does not have sufficient energy to cause ionization in living matter. It causes some heating effect, but usually not enough to cause any kind of long-term damage to tissues. Radiofrequency energy[2], visible light and microwave radiation are considered non-ionizing.

Figure: 1.

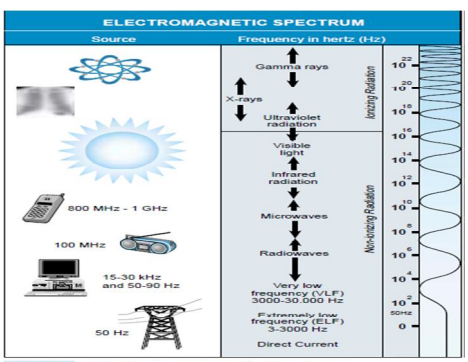


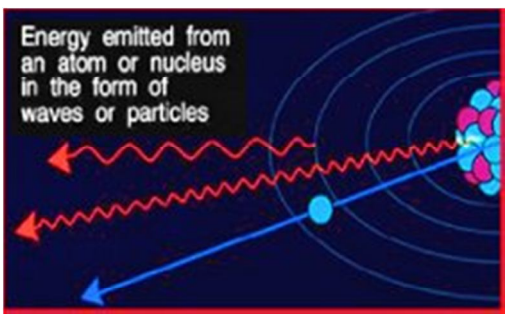
Fig. 1 The Electromagnetic Spectrum

There are various forms of electromagnetic radiation. These differ only in frequency and wave length.

- Heat waves
- Radio waves
- Infrared light
- Visible light
- Ultraviolet light
- X rays
- Gamma rays

Most of the more familiar types of electromagnetic radiation (e.g. visible light, radio waves) exhibit "wave-like" behavior in their interaction with matter (e.g. diffraction patterns, transmission and detection of radio signals).

Figure: 2. Particulate



4. Specific forms of ionizing radiation:

Particulate[2] radiation consisting of atomic or subatomic particles (electrons, protons, etc.) carries energy in the form of kinetic energy or mass in motion.

Electromagnetic radiation in which energy is carried by oscillating electrical and magnetic fields travel through space at the speed of light.

Alpha particles and beta particles are considered directly ionizing because they carry a charge and can, therefore, interact directly with atomic electrons through coulombic forces (i.e. like charges repel each other; opposite charges attract each other).

The neutron is an indirectly ionizing particle. It is indirectly ionizing because it does not carry an electrical charge. Ionization is caused by charged particles, which are produced during collisions with atomic nuclei. The third type of ionizing radiation includes gamma and X rays, which are electromagnetic, indirectly ionizing radiation. These are indirectly ionizing because they are electrically neutral (as are all electromagnetic radiations) and do not interact with atomic electrons through coulombic forces.

5. Dose

- Only the amount of energy of any type of ionizing radiation that imparted to (or absorbed by) the human body can cause harm to health.
- To look at biological effects, we must know (estimate) how much energy is deposited per unit mass of the part (or whole)

of our body with which the radiation is interacting.

- The international (SI) unit of measure for absorbed dose is the gray (Gy), which is defined as 1 joule of energy deposited in 1 kilogram of mass. The old unit of measure for this is the rad, which stands for "radiation absorbed dose." - 1 Gy = 100 rad.
- Equivalent dose – the biological effect depends not only on the amount of the absorbed dose but also on the intensity of ionisation in living cells caused by different type of radiations.
- Neutron, proton and alpha radiation can cause 5-20 times more harm then the same amount of the absorbed dose of beta or gamma radiation.
- The unit of equivalent dose is the sievert (Sv). The old unit of measure is the rem. - 1 Sv = 100 rem.

6. Sources of Radiation Exposure

- Radiation is permanently present throughout the environment, in the air, water, food, soil and in all living organisms.
- Large proportion of the average annual radiation dose received by people results from natural environmental sources.
- Each member of the world population is exposed, on average, to 2.4 mSv/yr of ionizing radiation from natural sources.
- In some areas (in different countries of the world) the natural radiation dose may be 5 to 10-times higher to large number of people.

Electromagnetic energy is a term used to describe all the different kinds of energies released into space by stars such as the Sun. These kinds of energies include some that you will recognize and some that will sound strange. They include:

- Radio Waves
- TV waves
- Radar waves
- Heat (infrared radiation)

- Light
- Ultraviolet Light (This is what causes Sunburns)
- X-rays (Just like the kind you get at the doctor's office)
- Short waves
- Microwaves, like in a microwave oven
- Gamma Rays

7. Electromagnetic fields and public health: mobile phones

Mobile or cellular phones are now an integral part of modern telecommunications. In many countries, over half the population use mobile phones and the market is growing rapidly. At the end of 2009, there were an estimated 4.6 billion subscriptions globally. Mobile phones communicate by transmitting radio waves through a network of fixed antennas called base stations. Radiofrequency[4] waves are electromagnetic fields, and unlike ionizing radiation such as X-rays or gamma rays, can neither break chemical bonds nor cause ionization in the human body. A large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use.

8. Short-term effects

Tissue heating is the principal mechanism of interaction between radiofrequency energy and the human body. At the frequencies used by mobile phones, most of the energy is absorbed by the skin and other superficial tissues, resulting in negligible temperature rise in the brain or any other organs of the body. A number of studies have investigated the effects of radiofrequency fields on brain electrical activity, cognitive function, sleep, heart rate and blood pressure in volunteers. To date, research does not suggest any consistent evidence of adverse health effects from exposure to radiofrequency fields at levels below those that cause tissue heating. Further, research has not been able to provide support for a causal relationship between

exposure to electromagnetic fields and self-reported symptoms, or "electromagnetic hypersensitivity".

9. Long-term effects

Epidemiological research examining potential long-term risks from radiofrequency exposure has mostly looked for an association between brain tumors and mobile phone use. However, because many cancers are not detectable until many years after the interactions that led to the tumor, and since mobile phones were not widely used until the early 1990s, epidemiological studies at present can only assess those cancers that become evident within shorter time periods. However, results of animal studies consistently show no increased cancer risk for long-term exposure to radiofrequency fields.

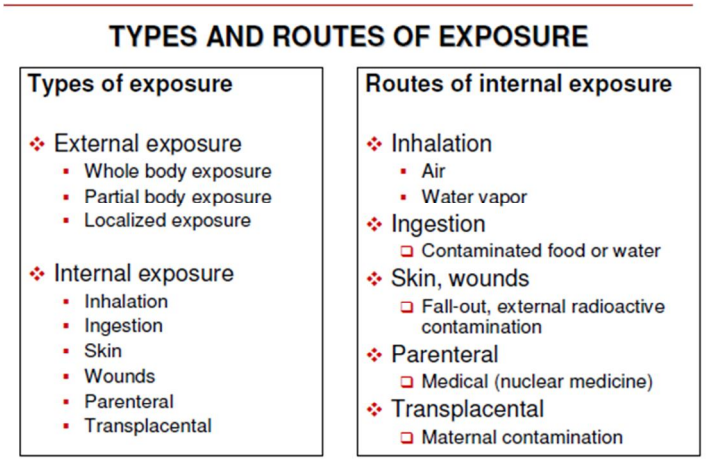
While an increased risk of brain tumors is not established, the increasing use of mobile phones and the lack of data for mobile phone use over time periods longer than 15 years warrant further research of mobile phone use and brain cancer risk. In particular, with the recent popularity of mobile phone use among younger people, and therefore a potentially longer lifetime of exposure, WHO has promoted further research on this group. Several studies investigating potential health effects in children and adolescents are underway.

10. Exposure limit guidelines

Radiofrequency exposure limits for mobile phone users are given in terms of Specific Absorption Rate (SAR) – the rate of radiofrequency energy absorption per unit mass of the body. Currently, two international bodies have developed exposure guidelines for workers and for the general public, except patients undergoing medical diagnosis or treatment. These guidelines are based on a detailed assessment of the available scientific evidence.

11. Effects of electromagnetic radiation on children[1]:

Figure 3. Children can be exposed to radiation by a variety of routes.



The biological effects of ionizing radiation are the combined result of *direct* absorption of energy at molecular level and the *indirect* oxidative damage produced by the reactive oxygen species ("free radicals") produced through a process called water radiolysis. (i.e. direct and indirect effects). Direct and indirect effects may lead to recognizable damage particularly when they affect molecules of biological importance. Biological effects also depend on the radio-sensitivity of the tissue exposed. Two kinds of effects of radiation on tissues are observed.

-*Deterministic effects* (or "tissue reactions") occur when a large number of cells have been damaged and as a result of that, the tissue structure or function is affected. These effects occur at doses above a certain threshold, with the frequency and the severity of effects increasing sharply above this threshold.

To the extent that the organism is able to compensate for the loss of cells, the harm may be temporary. Examples of deterministic effects are nausea, diarrhoea, skin damage and sterility.

-*Stochastic effects*[3] occur when cells are not killed, but are modified.

Some of the changes may persist in daughter cells. Examples of stochastic effects are cancer in the individuals who have been exposed to radiation if the transformation occurred in a somatic cell, and hereditary diseases in descendants of individuals exposed, if the transformation occurred in a germ cell (i.e. oocytes or sperm cells).

Table 1. Effects of whole body exposure to IR

Whole body dose(G_y)	Symptoms	Survival time
20	Damage to cardiovascular and central nervous system	Hours to a few days
8-20	Damage to gut	About two weeks
3.5	Bone marrow damage	LD50/60(50% will die within months if not treated
0.5-3	Bone marrow damage causing transient reduction in the blood cells	All survive, but possible later damage or death(moderate high probability of stochastic effects)
<0.5	Stochastic effects may occur later in life	All survive, but possible later damage or death(low probability of stochastic effects)

These values are presented as an example, but they have been estimated for an average population and dose would probably be lower for children.

12. Radiation associated with cancers:

Epidemiological studies have shown that moderate and high dose exposure to ionizing radiation leads to an increased risk of cancer. Exposure in childhood, in particular, increases risk of leukemia, breast and thyroid cancer. Age dependence for these cancers, which are among the diseases most readily induced by radiation, is complex, and generally tracks changes in background rates, i.e. increase in the risk due to radiation is proportional to the

overall increase in cancer risk due to aging.

Leukaemia: Studies of survivors of atomic bomb explosions (Life Span Study / LSS) showed an increased risk in both incidence of leukaemia and associated mortality. Furthermore, the risk of leukaemia from radiation is higher than for other risk factors and occurs earlier than for solid cancers. Leukaemia risk is best described by non-linear fit; risk is higher for exposures that occur in childhood, but tends to begin to decrease 10–15 years after exposure.

Breast cancer: Breast cancer risk was associated with radiation exposure in the LSS cohort and among several medically exposed groups. The risk increases with dose linearly and is particularly high for those exposed at young ages. The risk of breast cancer was increased in women who were under 10 years of age at the time of the atomic bomb explosion – a time when girls have little or no breast tissue.

Thyroid cancer: Thyroid gland tissue is highly susceptible to radiation during childhood. In the LSS cohort, a significant association was found between radiation dose and risk of thyroid cancer for those exposed before 19 years of age. Irradiation in childhood for benign conditions, as well as therapeutic exposure, can increase the risk of thyroid cancer. Risk is highest for children and decreases with increased age at exposure.

Brain cancer Ionizing radiation is related to brain tumours, although the relationship is weaker than for the cancers described above. Most brain tumours associated with ionizing radiation are benign. Japanese data show no association with brain cancers, but an increase in malignant brain tumours has been observed in patients who received radiotherapy. The evidence is strongest for those exposed before 20 years of age.

13. Safety measures for men

- Shields, special clothing, goggles must be used by the personnel working in a potentially hazardous areas. In addition

awareness training must be given.

- High power installations must be located atleast 150miles away from the fueling operations.
- All areas in which the energy levels exceed the safety limits should be considered hazardous. Accordingly admittance to areas where the exposure levels exceed the above limits should be restricted and warning signs posted.

14. Protective methods for devices

- Physical isolation which reduces the strength of the EMR energy. It consists of separating the source and receiver so that the EMR effects are reduced.
- Filtering which reduces the effects of conducted EM energy at particular frequencies.
- Bonding or grounding which reduces the possibility of equipment acting as an antenna.
- Shielding which absorbs or reflects unwanted radiation fields.

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