Parameters of electromagnetic pollution from different sources and their hazard impact

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Abstract. During this recent year and a coring development of technology and electronic and software, unexpected kind of pollution among this type of technology appear in our life, this is electromagnetic radiation (EMR), which expose to people, which has Surprisingly risen. For the people who is connected with technology or not, it is important that they have sufficient information about EMF emitting from the equipment that related to field they are in. Therefore, EMR is not only described, but the effects of EMR sources have also been studied in this paper. EMR is basically divided into two parts which are ionizing radiation and non-ionizing radiation. In the other way the techniques we use most often in every life are exposed to radio wave electromagnetic radiation, as the telecommunication systems and microwave oven. but, EMR emitted from these systems it almost has largely ignored due to their low energy level, where it has greatly hazard with the passage time and increased of exposure to this type of radiation. However, EMR ionizing as x-ray, and medical equipment, hence, this type almost related by special way just to people inside this fields and it has personally exposure, more importance they must know about its impact hazard informed about, then they should be having protective to avoid this dangerous type of radiation. on other side all must be caution for their health. The definition of EMR and sources of radiation are very importance for all people must know about the radiation emitted from each device and by details, in order to be obtain their protection to avoid the exposure for radiation in direct way.

1. Introduction

Electromagnetic field (EMF) and electromagnetic radiation (EMR), especially those emitted in the radio wave and microwave range, are a significant contributor to environmental pollution (EMP). As a result this contribution is increased by technological applications of the devices - sources of the EMF and EMR such as TV, computer monitors, cell phones, electric blankets, camera machines, microwave ovens and some others. It is demonstrated by some practical experiences in this area. In this paper the EMR intensity in different frequency bands is reviewed and possible hazard for humans and animals is discussed.

2. Electromagnetic field

Electromagnetic fields, emitted from man-made sources as well as electric fields and natural magnetism, cover the entire environment in daily life. The source of the electromagnetic field can be located very closely to a user. Therefore, it can result in dangerous impact depending on the EMR intensity, duration
and frequency. The highest frequency and the shortest wavelength correspond to higher field energy emitted. Different EMR sources are reviewed below.

1.1. Electromagnetic radiation

The EM radiation is mainly divided into two components, such as ionizing and non-ionizing radiation. The ionizing radiation is a high-frequency EM wave with frequency higher than $10^{15}$ Hz, it has an ability to ionize atomic bonds in cell molecules. For example, X-rays, gamma rays, and some ultraviolet (UV) sources belong to this category. Excessive exposure to this effect can result in dangerous conditions such as damage to living cells as well to the DNA chain [2]. The non-ionizing radiation has not enough energy for dividing atomic bonds, e.g. visible light, infrared, RF (radio frequency), microwave. They are distributed in the band range from 1 Hz to 300GHz. However, these waves produce thermal effects depending on some parameters such as distance, frequency and time. Other effects are discussed in some researches.

1.2. Electromagnetic spectrum

At present time, the use and importance of electric energy is growing up because of industrialization and technology development. A lot of electrical devices emits the electromagnetic field in different frequency bands: TV, computer monitors, cell phones, electric blankets, camera machines, microwave ovens and some others. The GSM usage and other electrical equipment reached the top level, by which our life becomes more simple. However its contributing in to the radiation of the electromagnetic field increases too [2]. Therefore, many researches should be focused on measurements of its performances.

1.3. Radio wave and health effects

1.3.1. Effect from mobile devices

The current literature focuses on changes in the activity of the human brain and differences in cognitive work or other neuro-behavioural endpoints associated with exposure of the radio wave EMF. The brain is positioned very close to the mobile phone antenna. Therefore the RF and EMF source runs through the brain to some extent, and the effects of this radiation on the brain are of a certain scientific value. There is another problem, that there is a possible link between the effects of EMF RF mobile phones, and the health and risk of brain cancer.

However, given that mobile technology has been available to the public for more than a decade, its excessive use was expanded in recent years. Therefore there is relatively long waiting times for manifestation of life-threatening diseases. Symptoms reported are self-inflicted, hypersensitivity, sleeping problems and headaches. In general terms on medical complaints they occur due to RF exposure [3].

The ICNIRP provides limits and recommendations to the general public for exposure. in which the mobile base stations should be limited to 2 W/kg in 10 g for head and body and 4 W/kg for 10 g for the limbs and 0.08 W/kg for the whole body. It is for average duration 6 minutes [6]. Some studies suggest that exposure to a specific 400-gram SAR can cause damage to human blood vessels, which can cause death within 48 hours. As in most cases of exposure to a maximum of 10 - 40 g SAR, where damage is less in the blood vessels, knowing that it may lead to loss of fluid and imbalance in some cells [6], [13]. As we know some countries have their own protocols to limit an exposure for human being of order not to exceed limitation level exposure which is 0.45mW/cm², which recognized by ICNIRP for mobile phone. Other countries like USA and Canada allow exposure to 0.57mW/cm² [7].

| Table 1. ICNIRP limit levels for general public exposure to time varying electric fields |
|-----------------------------------------------|
| Frequency range, f | Electric field strength (V/m) |
| Up to 1Hz | - |
1.3.2. Effect from Wi-Fi
There were investigated effects on mice of the radiofrequency radiation emitted from indoor Wi-Fi Internet by access devices using 802.11.g wireless standards wireless gateways communicating at 2.437 GHz that were used as radiofrequency wave sources. The study indicated that their DNA was damaged due to exposure (P < 0.05). Low levels of lactose and low levels of catalase and glutathione peroxidase activity in the experimental group were also confirmed, which may be due to radio frequency effects on enzyme activity (P < 0.05) [9].

1.3.3. Effect from laptops
The laptops (LPTS) have magnetic field and complex polarization waveform. An evaluation of their basic internal quantities should comprise the following steps:
* Represent the spatial homogeneity of the magnetic field of the admirer.
* Represent the time of the dependence on the components of the domain.
* Evaluate compliance with ICNIRPs core constraint value, taking into account their frequency dependence [10].

Due to electromagnetic exposure a set of scientists are focused on hypersensitivity of EMR systems from common exposure, such as electronic appliances, smart gadgets, computer systems, wireless systems and some electrical devices in the home or office. On another side, the World Health Organization (WHO) recognized that the symptoms of hypersensitivity include electromagnetic symptoms of skin and nerve debility [1]. Some symptoms of hypersensitivity are: decrease vision, shortness of breath, heartbeat unbalanced, problems of attention and memory, headaches, fatigue and nausea, pain of limbs, muscle stiffness, burning sensation, etc. [4, 5, 11].

In accordance to safety law in SMEMSP [6], the safety limit rate of magnetic exposure to EMF (up to 800 Hz) is 2/f, where f is the EMF frequency. Hence this safety rate limit can be known as the critical level of radiation at which an environment situation is unsafe for humans. The level of safety limit determined in range 0.2 and 0.4 μT [2, 7-9]. Thus, the Protection of SMEMSP has brought the Non Ionizing Radiation Protection Act [10], which sets out the risk conditions and protection measures in critical situations. It should be noted, that ICNIRP has put the value of EMF safe for people and the employee. Depend to that, we have safety limit is for persons is 5/f and for the employee 25/f. [11].

1.3.4. Effect from microwave oven

2. Specific absorption rate
Specific absorption rate (SAR) is the value of importance dose measurement, it is defined as the average mass rate of energy absorption in a tissue. It depends on the intensity and power density of the field and some other tissue characteristics as geometry, size, the direction of the object to which it is exposed, the field frequency and the exposure time. The principle of modern dosimetry in the frequency range from about 100kHz to 10GHz have recently been revised. It can be calculated by an equation

\[
\text{SAR} = \frac{\partial W}{\partial t}
\]

In other way physical and electrical parameters of the SAR can be calculated by an equation

\[
\text{SAR} = \sigma |E|^2/2\rho.
\]
where \( w \) the energy absorbed in (Joule), \( E \) the electric field strength in (V/m), \( \sigma \) the tissue conductivity in (S/m), \( \rho \) is the mass density of tissue in (kg/m\(^3\)), \( m \) is tissue mass in (kg).

Table 2. ICNIRP basic restrictions on exposure to electric and magnetic fields in the frequency range 10MHz to 10GHz for occupational and general public exposure [1]

| Exposure quantity                          | Occupational (W/kg) | General public (W/kg) |
|-------------------------------------------|---------------------|----------------------|
| SAR averaged over the body and over minutes 6 period | 0.40                | 0.08                 |
| SAR averaged over any 10g in the head and trunk and over any 6 minutes period | 10                  | 2                    |
| SAR averaged over any 10g in the climbs and over any 6 minutes period | 20                  | 4                    |

Table 3. measure EMFs near some household/office Appliance/electronic device [4]

| Appliance | Near the appliance | 1 m from appliance |
|-----------|--------------------|--------------------|
|           | Magnetic field (mT) | Electric field (V/m) | Magnetic field (mT) | Electric field (V/m) |
| Computer  | 1                  | 1500               | 0.1                | 300               |
| Laptop charger | 6              | 800                 | 0.4                | 50                 |
| Laptop    | 0.08               | 1500               | -                  | 80                 |

3. Conclusion
Different sources of electromagnetic pollution are discussed. Intensity of components of their electromagnetic emission in different frequency bands are presented. Their potential danger for human tissue is evaluated.

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