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INTERACTION OF ELECTROMAGNETIC RADIATION FROM CRT MONITOR WITH HUMAN BODY

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The electromagnetic field intensity and specific absorption rate (SAR) are calculated for different distances of user form source of Electromagnetic Radiation (CRT Monitor). The induced electric field and SAR inside human body tissues; specially in human skin due to EMR of extremely low frequency (60 Hz) are evaluated. The calculated values of SAR are compared with standard limits given by various international authorities like Federal Communication Commission (FCC), International Radiation Protection Association (IRPA/INIRC), International Commission on Non-Ionizing radiation Protection (ICNIRP) etc.

Keywords: Electromagnetic Radiation (EMR), Specific Absorption Rate (SAR), Cathode Ray Tube (CRT), Monitor etc.

1. Introduction

The EMR are invisible line of force i.e. occurs whenever electricity is being conducted. These line of forces occurs from both natural sources as well as man made or artificial sources of EMR .The natural sources are as sun, atmosphere and solar disturbances , thunderstorm activity of cloud & earth magnetic field etc. . The man made sources of electromagnetic radiation are T.V, microwave oven, high voltage electric lines, FM, mobile phones and their towers, computers (CRT monitor) and electric lighting etc. The computers and other electronic devices are an integral part of our work and personal lives. As a result, we are exposed to EMR continuously emitted by such devices i.e. computers, oven, T.V., F.M mobile phones and their towers etc. The young generation today is expected to experience a longer period of exposure with radio frequency field generated by the computer mobiles phones and other electronic devices. The children normally started using these wireless devices at early age and this makes them more exposed then to adults. The human body always exposing to electromagnetic radiation of varying intensity which is depending upon the location. The human body is complex function of electrical conductivity, density and its complex permittivity (Foster and Schwan 1996). The EMR is characterized by its frequency, intensity of electric and magnetic fields, their direction and polarization characteristics in free space. The fields inside the tissues of human body can interact with them and therefore it is necessary to determine these fields for general quantification of biological data obtained theoretically. When an electromagnetic field falls upon the human body, then it partially penetrates into human body and it is attenuated by human body tissues and its parts absorbed by the body tissues (Pathak etal. 2003). The absorption of EMR is expected to raise the body temperature (McIntosh etal 2005). The variation of induced electric field inside human body tissues at two commonly used frequencies of mobile phones has been calculated by Kumar & Pathak (2006). Here we use theoretically calculated internal fields to evaluate SAR at different distance of user or human from the CRT Monitor (EMR sources).

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2. Materials and Methods

2.1. Electric Field s Surrounding the EMR Source

The mobile phone transmission towers are transmitting electromagnetic fields in the microwave frequency range. The intensity of these fields is maximum near the transmission towers and reduces as inversely proportional to the square of distances. The value of electric field E_0 at a distance r from vertical transmitting antenna of power P is given by Polk (1996)

$$P/4\pi r^2 = E_0^2 \varepsilon_0 c/2$$
$$E_0 = (P/2\pi r^2 \varepsilon_0 c)^{1/2}$$
$$E_0 = 7.746\sqrt{P}/r$$

where p is emitted power by CRT monitor (15) and ε_0 is permittivity of free space & c is speed of light.

2.2. Penetration of Electric Field Inside Human Body

When the radiated field falls on a human body, the penetration of the field depends on the frequency of radiation. Thus the field at a depth z due to incident electric field E0 on the surface is given by Polk (1996)

$$E_z = E_0 \exp|-z/\delta|$$

Where _ is the skin depth, whose value depends upon the frequency of radiation for biological body and is given by

$$\delta = 1/q\,\omega$$
$$q = [\mu\varepsilon\,\{(1 + p^2)^{1/2} - 1\}/2]^{1/2}$$
$$p = \sigma/\omega\varepsilon$$

Where _ is Radian frequency of radiations, _, is the permittivity of tissue material, μ be its permeability and _ its conductivity (Gabriel, 1996).

2.3. Specific Absorption Rate (SAR)

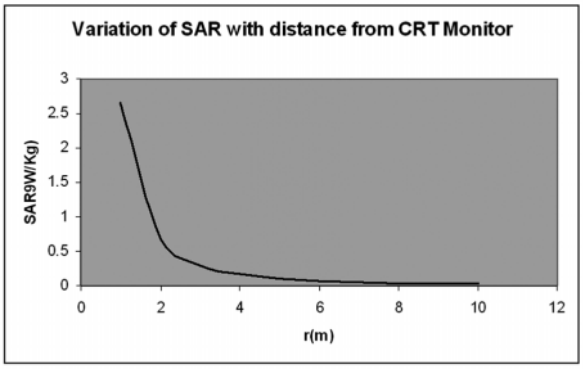
The SAR is defined as the time derivative of the incremental energy (dw) absorbed by or dissipated in an incremental mass (dm) contained in a volume element (dV) of a given density (p). It is given by Adiar (2002)

$$SAR = d/dt\,(dw/dm)$$
$$= d/dt\,(dw/\,pdV)$$
$$SAR = \sigma E_i^2/p$$

Where Ei is the induced electric field inside the materials. This relation represents the rate at which the electro-magnetic energy is converted in to heat through well established interaction mechanism. It provides a valid quantitative measurement of all interaction mechanisms that are dependent on the intensity of the internal electric field (Guy 1979). The effects of radio waves modulated in amplitude at extremely low frequency (ELF) are dependent on the electric field intensity (Adey, 1981). Specific interactions mechanism are better understood, they would be expressed in term of SAR and modulation characteristics even though the interaction mechanism may not necessarily be thermal. The value of SAR in human body tissues due to home appliances at various frequencies is calculated by Kumar et al. (2008).

Table 1
Calculated Values of SAR Inside Human Skin at Different Depth

S.No	Distance of user from CRTMonitor r(m)	Incident Electric Field Eo (V/m)	SAR(W/kg) inside human skin at different depth						
			1mm	1mm	1mm	1mm	1mm	1mm	1mm
1	0.1	1224.7	2.66	2.66	2.66	2.66	2.66	2.66	2.66
2	0.2	612.35	0.665	0.665	0.665	0.665	0.665	0.665	0.665
3	0.3	408.23	0.295	0.295	0.295	0.295	0.295	0.295	0.295
4	0.4	306.17	0.166	0.166	0.166	0.166	0.166	0.166	0.166
5	0.5	244.94	0.106	0.106	0.106	0.106	0.106	0.106	0.106
6	0.6	204.11	0.0739	0.0739	0.0739	0.0739	0.0739	0.0739	0.0739
7	0.7	174.95	0.0593	0.0593	0.0593	0.0593	0.0593	0.0593	0.0593
8	0.8	153.08	0.0415	0.0415	0.0415	0.0415	0.0415	0.0415	0.0415
9	0.9	136.07	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328	0.0328
10	1.0	122.47	0.026	0.026	0.026	0.026	0.026	0.026	0.026



3. RESULT AND DISCUSSION

Calculated value of SAR inside human skin for different distances of user from CRT Monitor is given in Table .For skin the harmful values of SAR are found up to 50 cm from the CRT monitor and these values are shown in italic bold digits in Table. The variation of SAR with distances of user from CRT monitor is shown in figure. & it shows the value of SAR decreased with increasing distance of user form CRT monitor. Finally it may be suggest that the user must sit beyond 50 cm. form CRT monitor for the safe exposure. There are standards by international bodies on exposure to the occupational & general public. The guidelines and regulation governing the safe use of RF/microwave radiation are given by international authorities: The International Commission on Non-ionizing Radiation Protection (ICNIRP 1998), Institute of Electrical and Electronics Engineers (IEEE 2001), National Council on Radiation Protection and Measurement (NCRP 1986), The Australian Radiation Protection and Nuclear Safety Agency Standard

(ARPANSA, 2002). All these agencies have set up the safe limits of whole body SAR (0.08 W/kg).

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