Effect of the Electromagnetic Radiations on Human Being

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Abstract

In this modern technological age it is difficult to imagine people without using television, computers, cell phones, microwave oven etc. Millions of people, across the world are using it every day. But increasingly the complaints of head ache, fatigue, sore eyes, hot ear and even cancer suggest that there are associated impact with use of these technological equipment and health. The paper considers elaborated methods of the calculation of the human organism radiation intensity by the aerials of the base stations of the cellular communication and the approximated calculation of the time of the safe usage of a mobile phone.

Key words*: cellular communication, mobileradiophone, influence on human health.*

1. Introduction

During recent years, the use of mobile phones has increased substantially and has been paralleled by a growing concern about the effects on health attributed to exposure to the electromagnetic fields produced by them and their base stations. Demonstrating that radiation causes adverse effects on health would signal a widespread public health problem. Mobile phones have been in extensive use for a relatively short period of time, and their technology has progressively changed, from analogue to digital systems. Mobile phones and base stations emit radio frequency or microwave radiation. Exposure to such a radiation could affect health directly.

In India more than 362.3 million users of mobile phones till 2009. National operators of mobile communication use systems of GSM-900 standard, range of operating frequencies of base station 925…965 MHz, mobile radiophones – 890….915 MHz, and GSM-1800 standard – 1805….1830 MHz, and 1710…1785 MHz correspondingly.

Aerials of base stations of mobile systems used by operators of the mobile communication in India emit power within the limits of 8….16 wt. These stations are installed on the roofs of buildings, chimneys, or on special masts at the heights of the 30 – 35 m over the earth surface. These aerials have circle horizontal directional patterns and sharp vertical directional pattern, which are inclined horizontally under the angle of 1…2 degrees, having the form of an umbrella or the cap of mushrooms. Mobile radiophone is a small dimensional transmitter-receiver. Its radiation power (in transmission mode) is within the range of 0,125 – 1 Wt. Power is a variable value and depends on the state of a communication channel "mobile radiophone – base station," i.e. the higher the signal of the base station is in the point of receiving, the less is the radiation power of a mobile phone. However, in real conditions, as it is known by the experience, it, on average, does not exceed 0,23Wt, in case of operation in settlement in open air. In bus, taxi electric train and other shielded environments this power can reach maximum value.

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2. How Electromagnetic radiations affects?

Human body has its own electromagnetic radiation. Human body generates and emits extremely low intensity radiation in the form of a microscopic packet of light energy called photons. All changing electric current create an electromagnetic field around them.

The human body is made up largely of water. Salts are present in the water and salts are also full with various minerals. Each of these minerals and salts will resonate at different frequencies to differentiate one from other. The water is therefore conductive medium. The millions of electrical currents flowing through the body at one moment will indisputably create a complex magnetic field around it. It causes an electric current flow through our body and our brain. This in turn creates magnetic field around body. Hence it is evident that changes to the normal and natural magnetic field of human body may cause harm to the health. Every single biological function in our entire body is triggered by a small electrical signal. Mobile phone exposes us and others nearby to large electro magnetic radiation.

So whether we are talking or messaging on mobile

phone, using a hands free kit, or even if our phone is just turned on – everyday we are being constantly bombarded with damaging electromagnetic radiation.

3. Ionizing Radiation

Ionizing radiation contains sufficient electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body (converting molecules totally or partly into ions). X-Rays and Gamma rays are two forms of ionizing radiation. Human beings are constantly exposed to low levels of ionizing radiation from natural sources. This type of radiation is referred to as natural background radiation, and its main sources are: Visible light, ultraviolet light and infrared light (sunlight), Radioactive materials on the earth's surface (contained in coal, granite, etc.), Radioactive gases leaking from the earth, Cosmic rays from outer space entering the earth's atmosphere through the ionosphere etc.

4. Non-Ionizing Radiation

The lower part of the frequency spectrum is considered non-ionizing Electromagnetic Radiation (EMR), with energy levels below that required for effects at the atomic level. Examples of non-ionizing radiations are:

- Static electromagnetic fields from direct current (0 Hz)
- Low-frequency waves from electric power (50-60 Hz)
- Extremely Low Frequency (ELF) and Very Low Frequency (VLF) fields (up to 30 kHz)
- Radio Frequencies (RF), including Low Frequency (LF), Medium Frequency (MF) High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF) and Microwave (MW) and Millimeter wave
- Infrared (IR) light, Visible light and Ultraviolet (UV) light (above 300 GHz)

Some studies suggest that potential health hazards could be linked to excessive exposure to high-power densities of non-ionizing radiation. These health hazards include:

- Cancer
- Tumors
- Headaches
- Fatigue
- Alzheimer's Disease
- Parkinson's Disease

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5. Specific Absorption Rate in Human Body

In accordance with international norms there is a limits for safe exposure to radiofrequency (RF) energy and These limits are given in terms of a unit referred to as the Specific Absorption Rate (SAR), which is a measure of the amount of radio frequency energy absorbed by the body when using a mobile phone.

Every cellphone sold officially anywhere in the world has a unique SAR value, but unlike the US and European Union, India does not mandate that handset makers declare the SAR level. Both the Federal Communications Commission (FCC) and the European Union (EU) have stringent safety standards in place on cellphone radiation levels. For instance, no cellphone can officially be sold in the US if its SAR level exceeds the 1.6 W/kg (watts per kg), while in Europe, manufacturers must ensure that the maximum SAR level of a cellphone does not exceed 2W/kg — the safety limit fixed by the EU council.

Specific absorption rate or SAR is the time derivative of the incremental energy (dW) absorbed by or dissipated in an incremental mass (dm) contained in a volume (dV) of a given density ( ):

$$SAR = \frac{d}{dt}\left(\frac{dw}{dm}\right) = \frac{d}{dt}\left(\frac{dw}{dv}\right)$$

SAR should be considered an "absorbed dose rate" and is related to electric fields at a point by:

$$SAR = \sigma E^2$$

Where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m3)

E = rms electric field strength (V/m)

SAR can also be a calculated rate of temperature rise at a given point. This method is used in some basic research. However, for commercial testing of radiating devices, electric field measurements are normally used. The limits, which apply in general for mobile telephones and similar apparatus, are drawn directly from the applicable source documents:

ANSI/IEEE C95.1 for the US and ICNIRP for Europe and most of the rest of the world. Two limits are used: a lower value for exposure averaged over the whole body and a higher value which is applicable to local exposure to parts of the body (e.g. the head). This partial-body SAR is

averaged over a volume of tissue defined as a tissue volume in the shape of a cube

Power flux density of electromagnetic field emitted Π by the aerial is computed, using the Expression

$$\Pi = \frac{PG}{4\pi r^2} F(\theta).F(\phi).k$$

Where P – power of aerial radiation, G – aerial gain, $F(\theta)$, and $F(\phi)$ – normalized function of the aerial orientation, r – distance in free space between the aerial and point of observation.

6. SAR Test Standards

The new IEEE and IEC standards (IEEE1528 and IEC62209) are similarly structured or harmonized with only minor variations in emphasis between them. The following shows the general structure of SAR Test.

- Scope, normative references and definitions
- Measurement system specifications
- Phantoms
- Measurement probe and equipment
- Scanning system
- Protocol for SAR assessment
- Preparation
- Measurement procedure
- Post-processing
- Uncertainty assessment
- Measurement reporting requirement

7. The SAR Measurement System

The test shall be performed using a miniature probe that is automatically positioned to measure the internal E-field distribution in a phantom model representing the human head exposed to the electromagnetic fields produced by wireless devices. From the measured E-field values, the SAR distribution and the maximum mass averaged SAR value shall be calculated. Test systems should also include components for positioning the equipment under test and aligning the scanning system; for measuring the dielectric properties of the tissue simulant liquid; and for checking and validating the measurement accuracy.

The SAR values are shown in Table 1. The results in Table 1 show that the SAR, for 1W radiated, is well within the ICNIRP guidelines for the particular case presented here.

Table 1 SAR and Power Results for Half-Wavelength Dipole Radiating 1W at 1800 MHz.

f=1800 MHz	Distance from	Absor -bed	SAR average	Max. SAR
	head surface in wavelengths	power in head, W	over whole head, W/kg	(10g ave.), W/kg
Antenna in front of the head	0.5	0.076	0.02592	0.768
	1	0.037	0.01259	0.242
	2	0.014	0.00489	0.069

Table 2 Maximum Permitted Powers at 1800 MHz

Authority	Method	Max. power at 0.08m (W)	Max. power at 0.32m (W)
NRPB	PFD	5.54	78.2
	SAR	13.0 (10g)	72.2 (WB)
ICNIRP (public)	PFD	0.521	7.35
	SAR	2.60 (10g)	14.4 (WB)

Where

WB = Whole body averaging, 10 g = 10 g averaging.

PFD= power flux density

By dividing the values of maximum SAR in Table 1 by the limiting values specified in the safety guidelines the maximum power that may be radiated by the dipole may be calculated. The implications of SAR and PFD- based assessment can be succinctly compared, at the limits of the distance range studied, in Table 2. The key results for the maximum power that can be transmitted while satisfying safety guidelines are included. It is evident that the power flux density (PFD) criteria, being based on approximations, contain conservative estimates that restrict the maximum allowable powers, in most cases, to a lower level than those permitted by the SAR method

8. Conclusion

1. It is always a good idea to avoid unnecessary radiation exposure whenever possible.
2. EMR exposure at the highest frequencies (X-Rays, Gamma rays) is a source of serious biological damage. Health effects from exposure to this form of radiation vary from no effect at all to death, and

can cause diseases such as leukemia or bone, breast, and lung cancer.

3. Using a mobile phone, do not put the palm or fingers on the rear cover of the mobile phone. Our body absorbs an electromagnetic wave reducing signal from the base station that makes the phone operate with the increased power.
4. Do not use a mobile phone driving the car, because it diverts driver's attention.
5. Do not buy mobile phones second hand without corresponding technical documentation, remember SAR index.

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