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A Review on the Effects and Defects of Electromagnetic Field to Human

M.E. Emetere and M.L. Akinyemi
Department of Physics, Covenant University Canaan Land, P.M.B 1023, 122333 Ota, Nigeria

Abstract: Electro Magnetic Field (EMF) has found a recommendable application to better the living of Human. More specifically, the effects of the EMF can be seen medical applications aside the known application in the communication industry. The recent documentation of the defects of the EMF application calls for urgent attention as it threatens the human existence. This study examines the recent defects and effects of EMF applications. Useful recommendations were suggested to reduce the continuous risk faced by human.

Key words: Electromagnetic field, human sustenance, health, threatens, living

INTRODUCTION

The electromagnetic theories have shown great successes in modern times in electronics, medicine, telecommunication, satellite applications, geophysics and computing. However, this success comes with some challenges. When the four basic electromagnetic equations were enacted, it looked like just an academic exercise. The need to extend from just a mere pilot project to a more physical and worth while called for further work on the initial principle of the Maxwell's:

$$\Delta.E = \frac{\rho}{\varepsilon_0} \quad (1)$$

$$\Delta \times E = -\frac{\partial B}{\partial_t} \quad (2)$$

$$\Delta \times B = \mu_0 j + \mu_0 \varepsilon_0 \frac{\partial E}{\partial_t} \quad (3)$$

$$\Delta B = 0 \quad (4)$$

Equation 1-4 represents the Coulomb's law where E is the electric field, ρ is the charge density, ε_0 is the permittivity of free space. Permittivity is the inherent property of materials to conduct electric field. Equation 2 represents the Faraday's law where is the magnetic induction. The negative sign can be justified using the Lenz law. Equation 3 is the Ampere's law where μ_0 is the permeability of free space. Permeability is the is the inherent property of a material to allows an applied magnetic field to form magnetic field within itself. This property is very vital for analyzing the Electro Magnetic Field (EMF). J is the current density. Equation represents the Gauss's law. Many researchers had recently extended the use of the ab-initio principles (Uno and Emetere, 2011; Emetere, 2014) which has shown significant progress in medicine-specifically to the Magnetic Resonance Imaging (MRI) machine, communication-antenna and propagation, electronics, industrial and electrical applications. The foremost threat of EMF application to human is the emission of electromagnetic pulse.

MATERIALS AND METHODS

Effects and defects of Electromagnetic Pulse (EMP): Electro Magnetic Pulse (EMP) is defined as packets of minute burst/surge of electromagnetic energy. Electromagnetic pulse destroys electronic devices when the magnetic field it is quite large. This is possible because the moving magnetic field (from literature) induces an Electromotive Force (EMF) which extends to the circuit boards within the electronics device. The conductors within the circuit board behaves like a transmitting device (antenna) and collects the magnetic signal from the electromagnetic pulse to convert some energies to voltage which destroys components and circuits of electronics equipment. Pulse could emanates via different known sources, i.e., man-made or naturally occuring EMP. The magnitude of the pulse depends on the source of production. The control of EMP effects on health, electronic, equipments is the main focus of Electromagnetic Compatibility (EMC) engineering. The negative side of the high-energy EMP are used (via pre-determined parameters) for the creation of EMP weapons. The technique for harvesting the high-energy EMP can be seen in two forms, i.e., nuclear and non-nuclear devices. The pulse waveform and frequency

Corresponding Author: M.E. Emetere, Department of Physics, Covenant University Canaan Land, P.M.B 1023, 122333 Ota, Nigeria

spectrum are vital for creating the EMP weapons, hence could be improved or remodified via the remodelled Maxwell's equation (Uno and Emetere, 2011; Emetere *et al*., 2014) or the Fourier transform. Electromagnetic pulse can appear in different forms namely magnetic field, electrical conduction, electric field and electromagnetic radiation. This four forms of EMP can be prevented using the Faraday cage. Faraday cage can be used to exclude pulse from the interior of the chamber of devices.

Aside the challenges the electromagnetic application possess to electronics, satellite communication, medical equipment and industrial application, its health hazard is alarming. Monitoring the Electromagnetic Fields (EMF), starts within the regulation of the EMF levels which may trigger biological effects if it exceeds certain level. National and international guidelines have been established to control the exposure of lifeforms to excess electromagnetic fields which might emerge from cell phone, microwave ovens, televisions and radios, military radar systems and Magnetic Resonance Imaging (MRI) devices. Among the potential dangers of the EMF are neurological impairment, ear pain and hearing problems, vision troubles, weakens the immune system, autism, depression, cancer, sterility, etc. Scientist have discovered that if cell phone is placed around delicate organs in the body like the women breast can cause cancer or cause renal failure when moved over the kidneys. Radio Frequency Radiation (RFA) from equpments are absorbed at different magnitude by the body tissue. The absorbed internal energy from the RFA causes heating. The exposure of life-forms to EMP sources determines the safety or danger levels. If any life forms is exposed to a powerful radar transmitter, it stands the risk of high-potential dangerous. For example if the lens of the eye is exposed to a high-energetic EMF, the absorbed internal energy may damage the eye lens by heating or lead to more develop disease like cataracts. The following disease are adduced to EMF exposure to cancer, daily headaches, chronic fatigue, brain cancer, lyme diseases, asthma, heart problems, chest pain, allergies, high blood pressure, brain fog, forgetfulness, digestive disorder, brain tumors, leukemia, lymphoblastic leukemia, birth defects, insomnia, stress, nausea, skin conditions, erratic pulse, weak immune system, alzheimer's disease, rheumatoid arthritis, parkinson's disease, fibromyalgia and so on.

RESULTS AND DISCUSSION

The blood barriers is simply defined as a tight junction barriers made-up of cell layers of same design

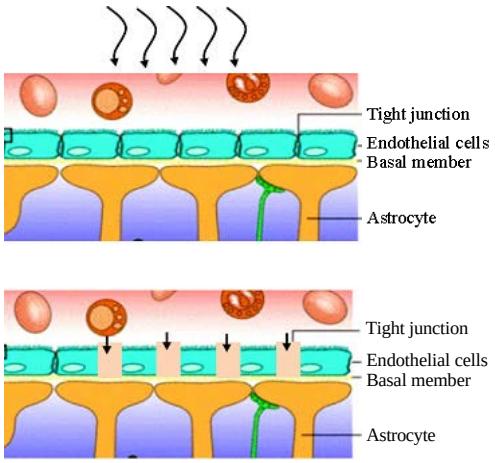

Fig. 1: The EMF action on the blood brain barriers

which protects some parts of the human body from excess influenced by other activities within the human body. These barriers are usually closed but have the involuntary impetus to allow calcium ions entrance into the cells. Blood barriers may allow unscheduled calcium entry when the body is exposed to electromagnetic exposure. This action makes the tight junction barriers to open to all calcium entry. Blood barrier may be in form of blood brain barrier (Ballabh *et al*., 2004), the blood liver barrier, etc. The blood brain barrier is operationally designed to prevent possibly large toxic substances from the blood stream entering the brain (Fig. 1). One of the recent and most common EMF radiation source is the cell phones which can open the blood brain barrier and exposes the brain to untold dangers. When the barrier opens-up via the cell phone radiation, there is the continuous loss of functional neurons as shown in Fig. 1. The loss of neurons can result in early Alzheimer or dementia's disease in humans. Also the EMF penetration into human skull has been established (Emetere, 2015) as shown in Fig. 2.

When the barriers of the tracts in the liver became permeable due to the destruction of the barriers, substances which supposed to follow a particular tract or channel in the liver move wrongly and cause complex reactions like inflammation and other liver diseases. This idea simply suggests that the common placing of cell phones at the waist-in the trouser or skirt, breast pocket or hanging wallet are potentially risky to the body. Long term exposure to high electromagnetic radiation increases the stress hormone in the saliva. The stress hormone is known as cortisol. It is produced in the adrenal glands and controlled by the entrance of calcium level into the cells. The basic function of the cortisol is its natural

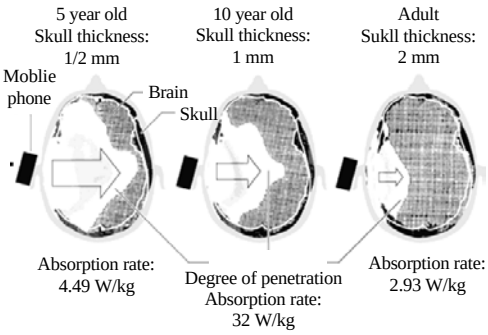

Fig. 2: EMF penetration through the human skull

tendency of its mechanism to put the body into an agitated state (fight or flight mode). In the agitated state, more sugar is released into blood and the immune system is compromised. Most embarrassing is the information that high electromagnetic radiation leads to suppression of the immune system. The suppressed immunity of the body certainly increases the risk of infection or tumors from precancerous cell. Adrenalin initiates the adrenergic receptors to increase the calcium concentration in the cytosol and synthesize the adrenal medulla in response to signals from the adrenal medulla. The adrenal medulla in turn, responds to the signals emanating from the sympathetic nervous system. The response of the adrenal medulla by doing energetic or dangerous things creates a pleasurable sensation to some people. This may lead to the addiction nature of some phone users.

Biophysical effects of electro-magnetic field to human: Fig normally scientists with outstanding achievements like James clerk Maxwell studied electric and magnetic fields in the mid 1800 during which the visible, infrared and ultraviolet were the only forms of light known.

The importance of electromagnetic waves in our society can never be over emphasized virtually everything operates with the knowledge of electromagnetic waves. In the world of medical science huge diseases that caused increase in the death rate and decrease in the manpower of a nation were resolved using the knowledge of electromagnetic waves sicknesses and diseases such as cancer, lupus, rodent ulcer and epithelioma were now cured. These sicknesses killed a lot of people and were formerly referred to as incurable, speaking of incurable most diseases and sicknesses treated by the use of electromagnetic waves such as x-rays are not curable but their cells can be killed to reduce further complication in the patient. We shall discuss more on this in the subsequent pages.

One of the results of the knowledge of electromagnetism was the discovery of radiography, radiography was discovered by Wihlem Rotenger in the year 1895. Radiography has help in the treatment of various bone complications which was very difficult or impossible to survive. Radiograph is used most times as diagnostic tool (Murphey *et al*., 1990). Recently, medical sector is faced with many contagious diseases like HIV and AIDS, the EBOLA virus, the CHIKEN POX and a host of other diseases. Hence, EMF can be seen as an effective tool for sterilizing hospital equipments.

The use of hot water was initially used for sterilizing clinical tools but hot water had it's boiling point at 100°C and most viruses could live and withstand a temperature of over 100°C. Later, scientist discovered that ultraviolet rays could kill germs to an accuracy of over 9% and it was implemented in medicine for the treatment of hospital tools like surgery knives and so on. EMFs are used in performing delicate operations, perform internal diagnosis and in detecting defects without opening the body of a patient. Although, there are side-effects the advantages and achievements far outweigh the disadvantages. Difficult operations, like destroying cancer cells can be done with ease. In addition, EMFs have aided in the discovery of new therapies. Electromagnetic fields can be used in different areas in medicine such as follows: bio-electromagnetic diagnosis, electro-medicine, germinal irradiation. Bio-electromagnetic diagnosis involves the the use of both thermal and non-thermal means to assess or aid in the diagnostic process of a patient such as: electromyography, tomography, ultrasound, magnetic resonance, electromagnetic tracking and radiography.

Another vital application of EMF is electromagnetic tracking. This involves the use of tiny electronic devices to navigate and conduct diagnosis in organs and body systems that are delicate or too small to check using conventional operations. There are two types of electromagnetic tracking systems-a wired system and wired system. This can be used to conduct diagnosis and assist in imaging, during radiotherapy, delicate organs like the heart, respiratory track and reproductive organs. It is used for a number of medical applications including image-guided interventional therapy and surgery, endoscopic navigation and in tracking systems for prostrate radiotherapy. Before the invention of this technology, optical tracking systems where used which required proper line of sight between light emitting diodes and the tracking system camera.

Magnetic resonance imaging utilizes radio waves in combination with strong magnetic fields to create images of the body. MRI used to read electromagnetic transmission at a selected frequency by firstly inducing it with radio waves. It is used to study mental activities in the brain and other bio-analysis of the body. In our previous sections we discussed on the adverse

danger of EMP. In medicine, EMP may be used for electro-medicine-Pulsed Electromagnetic Field (PEMF). PEMF requires the use of electromagnets to induce magnetic fields for orthopaedic treatment of bone injuries and fracture, congenital pseudarthrosis and depression. It simple used to stimulate cellular regeneration in body tissue. Another type of EMp is the transcranial pulsed electromagnetic therapy used for treating depression. Malaria kills millions of people in the world, particularly in developing countries and to worsen the case, mosquitoes are now becoming more resistant to anti-malaria drugs and this is becoming alarming. Scientist have been investigating on a new approach for malaria using an alternating magnetic field (Lai and Singh, 2010).

CONCLUSION

High exposure levels have been controlled by international exposure guidelines which are meant to regulate the human safety. Till date, there are no established health guidelines towards subtle exposure acquired from domestic equipment's, e.g., cell phones. World Health Organization (WHO) revealed that users of a mobile phone are more at risk of RF exposure than persons living near a cellular base station. In Europe, international commission on non-ionizing had raised awareness campaigns to the general public's exposure to environmental EMFs. The commission defined EMF exposure is with respect to the whole body average Specific Absorption Rate (SAR). SAR is the measure of known amounts of energy a body absorbs per kilogram from an EMF source. It is observed that SAR safety limits are gradually becoming high for mobile telephones users. Therefore, mobile phone manufacturers are counseled to provide their users with information on the SAR for each of the GSM models released to the market or outlet.

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