

A FOCUS ON THE INFLUENCE OF THE ELECTROMAGNETIC FIELD ON THE HUMAN ENVIRONMENT ONBOARD SHIPS WITH ADVANCED TECHNOLOGIES

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The electromagnetic spectrum starts at the electrostatic and magneto static fields, crosses electric and magnetic fields, electromagnetic radio and light waves until it reaches the level of ionizing γ radiations.

Depending on their intensity and frequency, electromagnetic fields are useful or harmful for humans.

The paper attempts at analyzing the intensity level of an electromagnetic field under which there can't appear any biologic effects, as compared to the intensity value of the same electromagnetic field whose exceeding triggers harmful effects.

All the aspects concerning this issue are considered for a ship where we deal with a computer-based, technology-governed activity – sources of magnetic and electric field of variable intensities themselves. There are benefits to the electromagnetic field as well.

INTRODUCTION

The words “for” and against” as far as the effects of electromagnetic fields on human bodies are concerned are to be analyzed in connection with the activities onboard a ship. Man transforms himself into an ionizer due to the fact that he is a source of electric loads, exhales carbonic gas and other product of metabolism saturated by positive ions [1]. Magnetic fields generating sources are to be found everywhere in the external electromagnetic environment of living organisms. The human body may charge itself electro magnetically by contact through conductivity, by reassigning loads form other objects, by deploying activities in a high-tech environment. No ship can be conceived as not being equipped with a surveillance system, steering, selecting, transmission and reading of information. The main means of transmitting information is the electromagnetic spectrum. Charging the environment with great amounts of electromagnetic radiation, with electric loads and magnetic fields may have effects on the navigation personnel. A thorough knowledge of the interaction mechanism between the electromagnetic field and the human body as well as of the effects on the organism allows us to answer the question: Where is the boundary between man’ s health and the effects of technology?

There is no doubt that there are effects on the human body produced by the electromagnetic fields.

There have been medical research performed on the navigating personnel that have proved that when exposed for a long period of time to low-frequency electromagnetic fields the central nervous system is disturbed, and there is damage regarding the reproductive function, the cardiovascular system, the functional stability of the body, vibrations of the hair system, diminishing of skin resistance, and malfunctions in AND, ARN synthesis. [2]

The characteristic parameter in the case of exposures with cumulative effect is the doses of electromagnetic field accumulated by the human body during a long period of time and is determined by the density of the induced current.

In the construction of board equipment, aiming at avoiding the risk of exposure to electromagnetic fields, some devices are used for screening and for a better focus of fields produced by deflection spires and other electric and electronic elements. [3]

THE ELECTROSTATIC FIELD AND THE SAILING PERSONNEL

Because of its biologic construction the human body is a bearer of electrostatic loads and the charge effect is influenced by the environmental conditions and by the activities carried on by people. There are electric loads generating mechanisms and means to load diminishing. We live in an environment where almost everything is synthetic. Electrified synthetic products provide the human body with a positive potential that increases the fatigue and reduces the potential energy.

The volume density of the electric load accumulated by the human body can result in sparks that carry enough energy to make some flammable mixture onboard ship. The effect of electric loads is influenced by the following factors:

- The behavior of the personnel onboard in time (breaks, activities during the watch, recesses)
- The interaction between the human body and the clothing, the shoes and the ship's deck
- The tendency of the personnel to change their body characteristics (perspiration, activities carried on, the labor behavior)
- The individual capacity as related to the reference deck
- Temperature (the strength of the human body decreases along with the increase in the temperature)
- Air humidity (electric loads are easily produced in a dry environment when the environment is high, electric loads spread faster)

Here are some electric loads generating mechanisms:

- Loading-unloading of oil products makes the personnel that carries on this activity stay loaded with a load equal and opposed to the load of a certain polarity specific to the working product [4]
- The moving about of the crew through the ship's compartment where there are high-resistance insulating mats causes loads to be removed and carried away along an extended track when the footwear is insulated or to be transferred again onto the deck in case of normal footwear (the load separation takes place between the deck and the mat, and the human body is charged by means of load redistribution in the case of insulating mats.
- The taking off of the protection equipment when relieved of duty produces electrization by contact between the inner and the outer clothing layer, and the body is charged by means of induction or by means of load redistribution when there is an ongoing process of generating electric loads, the maximum potential of the human body is limited, up to 50 kV, by the load leakage. The body capacity lies within 50-300 pF, and the 10-mJ energy is uncomfortable because of muscle cramps.

Electrostatic discharges through the human body can be reduced by building up a conductive passage as against the deck (the use of bracelets in order to maintain a full contact between the individual and the deck – Faraday's cage, the use of conductive footwear with a resistivity lower than $1,5 \cdot 10^5 \Omega$ and the use of special clothing that has the same value on the triboelectric scale as the material covering the deck.

ELECTROMAGNETIC RADIATION AND THE SAILING PERSONNEL

Our starting point is the method of the theoretical dosimeters by means of which a shifting of the electromagnetic field from the free space into the quantity of radiation absorbed by the body is achieved. We have made an analysis of the methods used to obtain solutions for the following equations while taking into account the particulars of the laws of the electromagnetic field, Maxwell's equations and the fact that they include the frequency from the electrostatic field to gamma radiation. Numerical methods give the opportunity to analyze

the effect of the electromagnetic field on the human body. The human body is composed into elementary units and matrices of great sizes according to their discreteness degree are built. By using the repetitive technique, which selects values initiating unknown measurements, we obtain convergent and non-convergent solutions. As for non-convergent solution we have to look for various methods of convergence enhancement: selecting appropriate initial values and changing the means to achieve repetition. Based on the results obtained we have drawn the conclusion that short-term effects of the electromagnetic field are local and consist in effects on molecular level and an increase in the body temperature; as for long-term effects they reside in malfunctions of the body.

There are two laws describing electrochemical phenomena that take place on molecular level: the Stark-Einstein law – chemical processes occur through the absorption by each molecule of an energy quantum; the Grothus-Drapper law – the process takes place after the energy absorption by molecules that are submitted to transformation. The absorption of electromagnetic radiation by molecules causes transitions of electrons from the basic energetic levels onto higher levels, passing from the fundamental state to excited states. The irradiation coming from an electromagnetic field makes molecule kinetic energy increase, energy which turns into heat, energy.

The environments within cells and among cells have specific electric resistivity lying within $100\text{-}300 \Omega \cdot \text{m}$ and relative permittivity $\epsilon_r = 80$, and cell membranes have a surface relative capacity of $0,1 - 3\mu\text{F}/\text{cm}^2$.

If a tissue is introduced into a constant electric field, as a result of electrolytic molecule dissociation, the loaded particles move along the strength lines, and bipolar molecules orient themselves. Only the fluid among the cells will lock out Ionic currents, as at a continuous pressure the cell membranes act as good dielectric insulators.

The behavior of living tissues in electromagnetic fields depends on the frequency; alongside with an increase in the frequency the tissues acquire conductive property [5]. The load of the environment onboard with large quantities of electromagnetic radiation can result in diminishing the labor capacity, in altering behavior (anxiety, walking disorders, a low-sensitivity tactile sense, dizziness, sight and taste disorders, slowdown of sleep activities) and even professional diseases (serious eye injuries, nerve alteration in the stomach plexus, splitting apart liver cells occurrence of malignant lung, stomach and brain tumors, ulcer, increase in leukocytes, decrease in trombocytes, alteration of the lymphatic tissue, spleen injuries [6], [7].

CONCLUSIONS

A wide use of the electromagnetic field has as a result an increase in the information contents onboard, a decrease in the physical effort, the closing down of the engine room during the night and the possibility of installation and machinery surveillance from the cabin, an automatic checkup and the modification of parameters according to the conditions of loading, environment and navigation area.

The human placed in the electromagnetic field onboard a ship with advanced technologies will absorb a certain amount of energy which will depend on the field orientation and parameters, on time factors – field intensity, on the characteristics, geometry and body size [7]

The proofs regarding the long-term effects of electromagnetic fields on the human health do not impede on the worldwide changes in current practice. The periods at sea for crews have become shorter with compulsory periods of recess. According to the Environment Specific Committee (CSPM-ESC) and to the Permanent Group for Medical Issues (GPPM-PGMI) this issue has to be kept an eye on.

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