

EMISSION OF ELECTROMAGNETIC FIELDS IN OUR LIVING PLACE

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ABSTRACT

This article presents knowledge about measuring of exposure to human body of electromagnetic fields in our living place. The knowledge about electric and magnetic fields is a very important for us, because electricity is used so extensively and sources of electric and magnetic fields are everywhere, every person in modern society is exposed to them.

1 INTRODUCTION

Exposure to human body of electromagnetic field is a new physical factor, which is a placed between other of physical factors for example noise, light, microclimate and so one and today is in front of commonwealth.

2 ANALYSIS

The problem with measuring and analyzing the exposure to human body of electromagnetic field (next only EMF), especially low frequency of EMF is a new problem and in our republic gave the first limit for this exposure the rule of the government no. 480/2000 digest, in latter date version of rules. The limit values of this rule, of government for EMF, outgoing from hygienic rules, for example from CENELEC (Central European Committee for Electrotechnical Standardization), ICNIRP (International committee for non-ionizing radiation protection) and IRPA (International Radiation Protection Association).

The main documents for judging the exposure to human body of EMF in our republic are:

- Rule of the government no. 480/2000 digest, in latter date version of rules.
- ICNIRP Guidelines - Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).
- ICNIRP Statement – Guidance on determining compliance of exposure to pulsed and complex non-sinusoidal waveforms below 100 kHz with ICNIRP Guidelines.

The most frequently used apparatuses for these measuring of EMF are: EFA and Maschek –

for measuring of sinusoidal time behaviour of EMF (calculate with effective values of signal) and the measuring set of digital oscilloscope with induction scope which may be 1D or 3D. This measuring set is for measuring sinusoidal, non-sinusoidal and pulse time behaviour of EMF (calculate with all time behaviour signal).

2.1 HYGIENIC LIMITS

EMF like a whole domain of non-ionizing radiation has two different limits values. The first one we called a reference value (next only RV) and the second one we called a highest admissible value (next only HAV). RV's are values for dosimeter magnitudes, for example for electric fields is it a intensity of electric field (next only *E*) and for magnetic fields is a induction of magnetic field (next only *B*). HAV's are values of induced current density (next only *J*) in human body for frequencies to 10⁷ Hz and specific absorption rate (next only *SAR*) in human body for frequencies from 10⁵ Hz to 10¹⁰ Hz. For exposure of EMF to human body in interval frequencies from 10⁵ Hz to 10⁷ Hz we have to analyze both magnitudes of HAV. The rule of government no.480/2000 digest says, that the RV can be trespass if we manifest that the HAV is not trespass. Also says, that in place of exposure of EMF if is not trespass the RV that is not trespass HAV too. In case if the time behaviour of EMF is different from sinusoidal time behaviour, we cannot compare this *E*, *B* or *J* with their RV or HAV for domain frequency. We have to compare, expect we have to make weighting for *E*, *B* or *J* with their RV and HAV for every harmonic frequency of the time behaviour magnitudes and results count up. HAV for *J* is analyzing for two parts of human body, a thorax and a head. HAV for *J* and *SAR* are defined for persons which are at work (next only Employees) and for persons except employees and persons on therapeutic procedures (next only Other persons), [1]. Very important for exposure to human body of EMF is a time factor, because for low frequency of EMF to 1 kHz we do not have any time factor, it contrasts with high frequency of EMF where the time factor exists [1]. That means that for low frequency the exposure to human body of EMF does not have to trespass the HAV any time. It is due the immediate stimulants effects of low frequency of EMF to human body.

2.2 CALCULATIONS OF EXPOSURE TO HUMAN BODY OF EMF

For non-thermal stimulation of human tissue, for frequency from 0 Hz to 10⁷ Hz, decides *J* in human body, which we have to calculate it from a record of measure set with oscilloscope. Equation for determination of trespass hygienic limit say, that sum of ratio of *i*-harmonic frequencies between calculated magnitude *J* and *J* from the Rule of the government no. 480/2000 digest, is overvalue more than one (equation 1 and 2), that means that the HAV limit is trespass (the same equation is valid for magnitude *B* and for RV limit).

$$\sum_i \frac{J_i}{J_{L,i}} \leq 1 \quad [-] , \tag{1}$$

$$\frac{J_i}{J_{L,i}} = WF_{J,i} \quad [-] . \tag{2}$$

Where *J_i* is an induced current density from *i*-frequency,
J_{L,i} is a hygienic limit HAV for induced current density from *i*-frequency,
WF_{J,i} is a weighting function of induced current density.

The sum in equation (1) goes for harmonic frequencies components of time behaviour of EMF from 0 Hz to 10^7 Hz.

Calculation of exposure to human body of EMF is a new problematic for health institutes which is provided the measurements of EMF in our living places. The calculation is made by the special non-commercial software for sinusoidal, non-sinusoidal and pulse time behaviour. In this time we have in Czech Republic only a few laboratories which are prove these special measurements especially for no-sinusoidal and pulse time behaviour. In our laboratory i made the one of the special non-commercial software in computer language Visual Basic in tables processor of MS Office Excel, because it is a software use for everybody, i called its ELMAG1.0. For this software was made a validation and was tested on some special measurements and model simulations. The software from record of induced voltage on oscilloscope measuring set can calculate time behaviour of variation of magnetic induction, magnetic induction, induced current density and their spectrum of frequencies by Fourier analyses, which are dominative in this signal of EMF. By Fourier analyze we can weight induced current density for each dominative harmonic frequency of this signal of EMF by induced current density from the Rule of the government no. 480/2000 digest, see above (equation 1). In our living place is a distribution of signal of EMF by time behaviour almost 30 % for sinusoidal time behaviour and 70 % for non-sinusoidal time behaviour of EMF.

2.3 SOURCES OF EMF

From measuring of EMF we know that the high values of exposure to human body of EMF in this time are especially in industry. Few examples are in table Tab. 1. If we know that the dangerous time behaviour of J is non-sinusoidal-pulse signal of EMF, that we know that the problems are near workplaces like welding, especially dots welding, where used a welding current like a number of tens kA. In this case is a problem that the employees are so close to the machine like till half meter from its and we find here values round HAV.

	Sinusoidal	Non-sinusoidal	Non-sinusoidal-pulse
Examples	Induction heat	Converter stations	Dots welding
	Electric high voltage lines	Transformers	Magnetodeflectoscopic
	Stations for transformation of electric power	Railways	Automotive industry
		Tram, trolley bus	Magnetotherapy

Tab. 1: *Main sources of EMF by different time behaviour.*

2.4 EMF IN WELDING INDUSTRY

This example is present dots welding like a source with non-sinusoidal-pulse time behaviour with parameters: welding current 12kA, frequency 50Hz, time behaviour of induced voltage from oscilloscope measuring set, the machine is on Fig. 1.

Result of this measuring is on figure Fig. 2, where is a time behaviour of weighting function of induced current density. In this case was the hygienic limit HAV trespass. We used the software ELMAG1.0 for calculation of this measuring.



Fig. 1: *Machine for dots welding.*

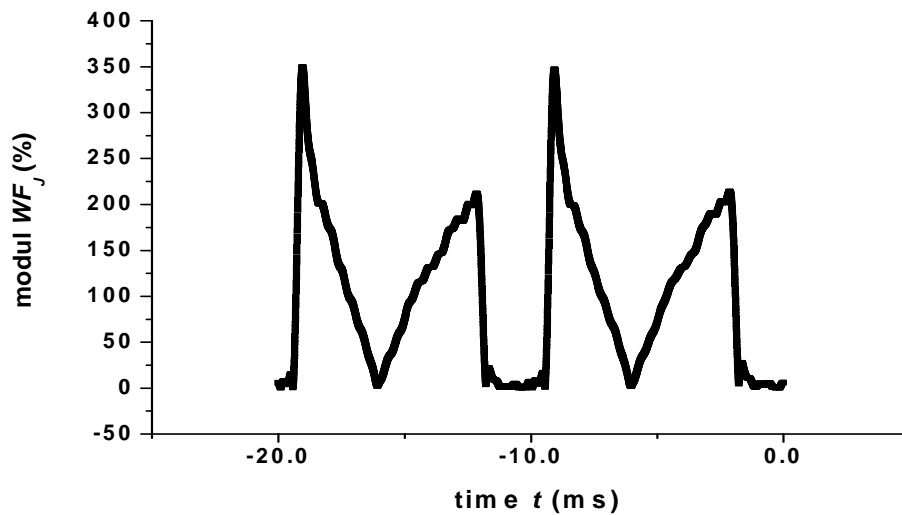


Fig. 2: *Weighting induced current density in percent from hygienic limits HAV.*

3 CONCLUSION

Emission of EMF is stand one of the part of component of our living place and its just the question of time when we will to know a compact summary about this emission of EMF, especially in industry.

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REFERENCES

[1] Rule of the government no. 480/2000 digest, in latter date version of rules.