# Draft resolution for reducing electromagnetic load on staff of a mining and processing company

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**Abstract.** Staff workplaces at industrial enterprises are equipped with a lot of electrical devices, cables, electronic means of communication and control. All these sources of electromagnetic fields (further referred to as EMF) are located in areas where humans are located, and affect human nervous, cardiovascular and endocrine systems, which results in early stages in manifestations of fatigue and reduced efficiency, and in later stages, in development of diseases. In this paper, we propose an effective method for reducing electromagnetic load on staff of mining and processing enterprises by introducing a shielding system for industrial frequency electromagnetic fields.

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**Keywords:** electromagnetic waves, industrial safety, shielding.

## Introduction

The World Health Organization declared that artificial electromagnetic fields (EMF) are the most dangerous and significant to human health factors characterized by extremely acute biological effect. EMF, being an environmental factor, may be considered from the point of view of both absolute social profitability and biological harm [1].

Biological effect on humans is estimated in terms of levels of low-frequency EMF strength and time of exposure. Thus, according to GOST 12.1.002-84 "Electric fields of industrial frequency. Permissible strength levels and requirements for monitoring at workplace" [2], the time of staff exposure to industrial frequency EMF with increased intensity is limited as follows: 5 kV/m - 8 hours; 10 kV/m - 3 hours; 15, 20 and 25 kV/m - 90, 10 and 5 minutes during the workday, respectively [3, 4]. Biological effect of a longer exposure to EMF can lead to professional diseases in staff of industrial enterprises and, consequently, to significant payments according to work incapacity certificate [5, 6].

An effective way to protect a person at the workplace and a way to ensure electromagnetic safety is to establish maximum permissible levels (MPL) and monitoring EMF parameters.

## Methods

EMF with 50 Hz frequency was evaluated separately for electric and magnetic fields, energy flux density and energy load at personnel's workplaces, depending on the time of exposure to electromagnetic field, according to the Sanitary and Epidemiological Rules and Norms (SanPin) 2.2.4.1191-03 "Electromagnetic fields in the work environment" (Table 1). [7]

In course of monitoring EMF levels at workplaces, during operation of electrical installations, applicable safety requirements and the maximum allowable distance between the operator who performs measurements and the measuring device, and live conductive parts, were adhered to.

**Table 1. MPL of a constant magnetic field**

| Exposure time per working day, minutes | Exposure conditions | | | |
|---|---|---|---|---|
| | General | Local | | |
| | MPL of strength, kA/m | MPL of magnetic induction, mT | MPL of strength, kA/m | MPL of magnetic induction, mT |
| 0-10 | 24 | 30 | 40 | 50 |
| 11-60 | 16 | 20 | 24 | 30 |
| 61-480 | 8 | 10 | 12 | 15 |

Electric and magnetic fields were measured at heights of 0.5; 1.5 and 1.8 m above the floor of premises or equipment maintenance site, and at the distance of 0.5 m from equipment and constructions, walls, buildings and structures [8, 9].

Measurement and calculation of the electric field with 50 Hz frequency was performed using an electric field meter (IEP-04) at the maximum operating voltage of electric equipment, or measured values were converted into this voltage by multiplying the measured value by the $U_{max}/U$ ratio, where $U_{max}$ is the maximum operating voltage of electrical installations, and U is electrical installation voltage during measurement [10].

Measurement and calculation of strength (induction) of magnetic field with 50 Hz frequency was performed using a magnetic field meter (IMP-05) at the maximum operating current of the power plant, or the measured values were converted into the maximum operating current (Imax) by multiplying the measured values by the Imax/I ratio, where I is the current of electrical installation during measurement [11, 12].

Measuring instruments were used in strict accordance with operation manual, ensuring necessary distance from the sensor to the floor, measuring operator's body, and objects with a fixed potential.

**Main part**

As the object of the study, the largest in Republic of Mordovia mining and processing enterprise was chosen, namely JSC «Mordovcement», that manufactures 8.4% of all cement in Russia [13]. In course of the study, attention was focused on those workplaces that are located directly in the cement production shops.

In course of analyzing statistic data of JSC «Mordovcement» about frequency of diseases in employees of these shops, it was found that 21% of the employees suffer from polyneuritis (the main cause of which is the electromagnetic load), and the enterprise spends 1.2 million rubles for their treatment and rehabilitation (Fig. 1).

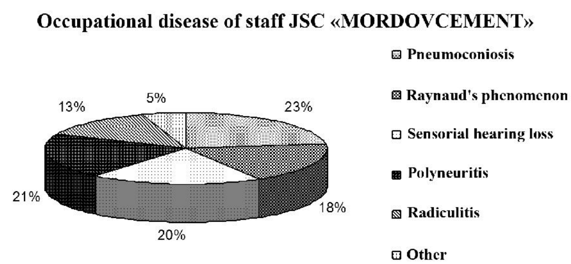


**Fig.1. Occupational diseases of employees of Mordovcement**

In order to assess electromagnetic loads at workplaces in dry and wet clinker shops, "dander circles" were built for electric and magnetic fields (Fig. 2, 3) [14].

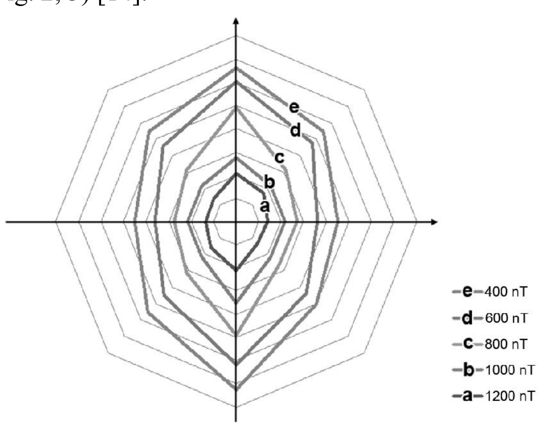


**Fig. 2. Low frequency (5 - 2000 Hz) electric field strength 1.5 m above the floor level**

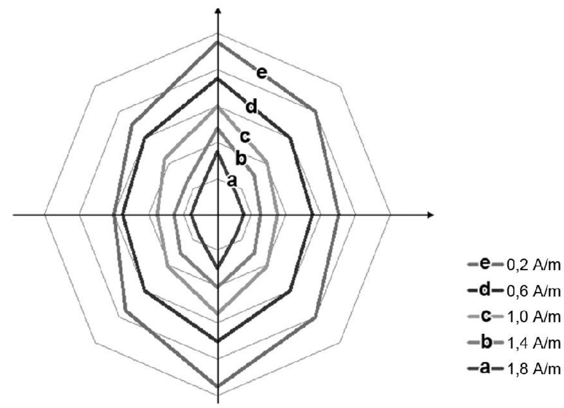


**Fig. 3. Strength of EMF magnetic component 1.5 m above the floor**

In course of analysis of electric and magnetic fields distribution shown in Figures 2 and 3, it was found that the main burden falls on the front and rear planes with a point source in the center of them.

In order to reduce the negative effect of electromagnetic fields in specific workplaces, it was proposed to use net-and-mesh screens with the following characteristics: material - aluminum, conductivity - 37.9 microohm·m, cell diagonal - 7.2 cm, mesh thickness - 0.9 mm.

Before and after installation of screens at workplaces, EMF was measured, and energy flux density and electric load values were calculated. Results are shown in Table 2.

**Table 2. Key EMF indicators at the object of studies**

| Parameter | Values obtained | | MPL |
|---|---|---|---|
| | before screening | after screening | |
| H, A/m | 0.61 | 0.15 | 0.2 |
| E, V/m | 38.3 | 23.7 | 25 |
| I, W/sq. m | 23.4 | 3.6 | 5 |
| E.l., W*h/sq. m | 84 106.8 | 12 960.0 | 18 000 |

Data in Table 2 show that before screening, the key indicators of EMF at the object studied exceeded the maximum permissible levels established by hygienic standards. So, the magnetic field strength (H) exceeded the MPL 3.1 times, electric field strength (E) - 1.5 times, energy flux density (I) - 4.7 times, and energy load (E.l.) - 4.7 times. As a result, the working conditions class was set to 3.3 (harmful) by electromagnetic parameters.

After installation of screens, the key EMF indicators were brought in line with the hygiene requirements and did not exceed the maximum permissible levels, which made it possible to change labor conditions class to 2 (acceptable).

**Conclusion**

The proposed method of protection from negative electromagnetic industrial frequency fields' effect made it possible to considerably reduce the electromagnetic load on employees in their working conditions at JSC «Mordovcement».

1. An effective method for reducing electromagnetic load on staff of mining and processing enterprises by introducing industrial frequency electromagnetic fields shielding system is proposed.
2. Screening at workplaces made it possible to reduce the magnetic field intensity 4.1 times, and electric field intensity - 1.6 times.
3. EMF energy load (at 50 Hz frequency) on employees that used net-and-mesh screens decreased 6.5 times.

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**References**

1. Apollonskij, S.M., T.V. Kaljada and B.E. Sindalovskij, 2006. Health and safety of the person in electromagnetic fields. Politehnika, pp: 264.
2. Sanitary rules and norms “Electromagnetic fields under production conditions” of 30.01.2003 Volume 2.2.4.1191-03.
3. Bessonov, L.A., 2002. Theoretical bases of electrical equipment. Electromagnetic field. Vysshaja shkola, pp: 246.
4. Hygiene standards “Maximum permissible levels of magnetic fields at 50 Hz in residential and public buildings and residential areas” of 10.11.2007 Volume 2.1.8/2.2.4.2262-07.
5. Gordienko, V.A., 2006. Physical fields and health safety. Astrel, pp: 320.
6. Brzezinski, S., T. Rybicki, I. Karbownik, G. Malinowska, E. Rybicki, L. Szugajew, M. Lao and K. Sledzinska, 2009. Textile Multi-layer Systems for Protection against Electromagnetic Radiation. FIBRES & TEXTILES in Eastern Europe, 17(2): 66-71.
7. Yutyaev, E.P., G.I. Korshunov, S.V. Kovshov, R.S. Istomin and I.V. Kurta, 2012. Information measuring systems as a fundamental element of industrial safety at the mine. GIAB, 5(2): 31-36.
8. Mardirossian, G., 2000. Natural Ecocatastrophes and Aerospace Techniques and Instrumentation for their Study. Sofia, pp: 384.
9. Cleveland, R.F. and T.W. Athey, 1989. Specific Absorption Rate (SAR) in Models of the Human Exposed to Hand-Held UHF. Portable Radios. Bioelectromagnetics, 10: 173-186.
10. Recommendation of the German Commission on Radiological Protection “Protection against electromagnetic radiation from mobile wireless sets” of 13.12.1991.
11. Velkoski, S., G. Kotevski, G. Zlateva-Velkoska and G. Mardirossian, 2005. Effect of the electromagnetic radiation on the cell function and protection with BIO-SPH. SENS, pp: 12.
12. Bhattacharajie, A. and I. Michael, 1964. Mass and Magnetic Dipole Shielding Against Electrons of the Artificial Radiation Belt. American Institute of Aeronautics and Astronautics Journal, 2(12): 2198-2201.
13. Shalin, A.I., 2006. About Effectiveness of New Relay Protection Devices, Power Engineering and Industry of Russia, 1(65): 12-14.
14. Panov, V.V., 1993. Several Aspects of Generating Soft Kill SHFmeans. Foreign Radioelectronics, 12: 3-10.

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