3.9. LOCAL PATHOGENIG GEOMAGNETIC ZONES IN URBANIZED ENVIRONMENT: PROBLEMS OF DETECTION, CALCULATION AND ELIMINATION

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Natural electromagnetic fields of the environment is an essential ecological factor of life on earth. Their absence or deficiency arising from technogenic or natural causes have severe (and sometimes irreversible) negative effect on living organisms.

The paper deals with a problem in this area that was realized just recently: emergence of local areas, especially in cities and industrial zones, with weakened (hypomagnetic) field.

Detection of the areas is now a problem of primary importance, because stay of individuals in such zones weakens their immunity 2 – 5 times, resulting also in higher rate of cardiovascular diseases, reproduction dysfunction, mental disorders, delayed response, hypersensitiveness to artificial alternating fields. Evidences of negative effect of hypomagnetic field make it necessary to standardize geomagnetic field (GMF) attenuation level in the areas of people long-term residence. In this connection, regulations on permissible levels of field attenuation at workplaces have been developed (Sanitary Regulations and Standards 2.2.4.1191–03 "Electromagnetic Fields in Working Environment", GOST R 51724–2001 "Shielded Objects, Premises, Facilities. Methods of Measurement and Evaluation of Field Level Conformance with Technical Requirements and Regulations"). According to the regulations, attenuation level should not exceed 2.

According to Sanitary Regulations and Standards 2.2.4.1191–03, basic indices of hypomagnetic field include geomagnetic field attenuation $K_r = H_0 / H_B$, where H_0 is intensity of geomagnetic field vector magnitude (measured in open space in the direction of North-South magnetic meridian at a height of 1.5 – 1.7 m above ground or obtained by means of geomagnetic maps); H_B – maximum intensity of geomagnetic field vector magnitude, measured at a test point within exploration target. Measurement technique is described in the above-mentioned documents. In particular, technical specifications of measurement instrumentation are given in GOST R 51724–2001.

To enable workplace assessment according to the standards, the authors have developed a portable instrument IGMP-ZK to measure magnetic field intensity in the range of 0 – 200 A/m (geomagnetic field intensity is 40 to 50 A/m, depending on the region). Measurement error is below 10%. The instrument measures total field, projection of magnetic field vector and its gradient (fig. 1).

Application of miniaturized sensor based on bistable amorphous microwire allows measurement of field and gradient with high degree of locality [1]. A distinctive feature of the magnetometer is its geomagnetic field calibration using IZMIRAN bulletins.

The paper includes research results on detection of local pathogenic magnetic zones in domestic buildings and industrial areas. Some regular dependencies have been revealed concerning the emergence of pathogenic magnetic zones in domestic buildings. Timber buildings have just minor distortions of GMF level and field gradient uniformity. Inclination angle change is also negligible. Reinforced-concrete multistory buildings have several distinguished areas:

– south side, upper floors, unshielded balcony: 45 – 52 A/m. Perception: quite comfortable, invigorative;

– north side, upper floors, unshielded balcony: 38 – 39 A/m;

– south side, lower floors, window opening: 35 – 39 A/m;

– north side, lower floors, window opening: 30 – 33 A/m, i.e. the field is drawn inside by metal structures of building. Perception: discomfort. Objective medical control: decrement of adaptive capabilities.

If there are some ferrous masses on the ground floor, then GMF level on the second floor is 40 – 42 A/m in the south-side rooms and 27 – 30 A/m in the north-side rooms. Measurements performed in the rooms of reinforced-concrete building revealed more than two times reduction of GMF level in some apartments. So, magnetic field in the buildings is determined by geomagnetic field in the open space and a superposition of geomagnetic field weakened by ferriferous building elements and the field of ferriferous building elements themselves.

Detection of zones with local geomagnetic field issues a problem of the field recovery. Various possible approaches to solution of this engineering problem are considered in the report. An example of such solution based on use of magnetized ferromagnetic plate elements is described.

Another important problem in this area is in development stage now. It consists in design of new domestic buildings, industrial premises, etc. with attenuation level meeting the requirements of Sanitary Regulations and Standards 2.2.4.1191–03. Technically, the problem comes to calculation of magnetic field distribution within the building volume. Given data are: geometry, dimensions, magnetic properties and magnetic history of materials employed. Orientation of design project relative to North-South direction is also of much importance, as shown in fig. 2.

Fig. 1. IGMP-ZK appearance

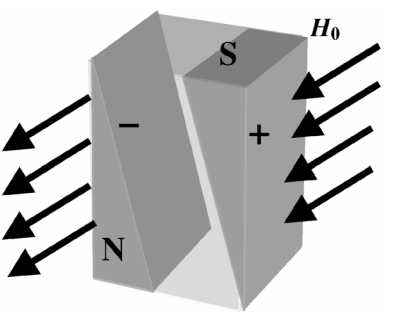

Fig. 2. A model of monolithic domestic building in geomagnetic field (N and S represent induced magnetic poles of metal mountings)

In the absence of field calculation technique one may use existing analogues of the objects. Authors have agreed about the use of analogues with the Institute of Occupational Hygiene of Russian Academy of Sciences. A trade-off approach to the problem solution is a combination of experiments and calculations including physical simulation on a smaller prototype as compared to projected building and application of the obtained results to actual objects on basis of physical similarity theory [2].

References

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