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SCOPE OF SHIELDED ROOMS

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Annatation

This article reflects the effectiveness of electromagnetic shielding is achieved using honeycomb holes (waveguide filters). The air exchange system is carried out by an air conditioner, the indoor unit of which must be located outdoors and the air is cooled by means of air ducts. Air ducts are connected to the screen of the room through a dielectric insert and a waveguide filter. All power lines, fire and burglar alarms are filtered, wiring throughout the room is carried out in pipes or shielded braid.

Keywords: electromagnetic radiation, radio absorbing materials, prototype, attenuation coefficient, multifunctional, highly efficient.

Main part

Such materials make it possible to create exclusive electromagnetic shields to meet the needs of any industry and produce multifunctional, highly efficient in a wide frequency range (from 50 Hz to 100 GHz and more) mobile shielded volumes, such as:

- Portable shielded cameras;
- Mobile screened volumes and elements;
- Quickly deployed shielded working modules;
- Optically transparent shielded modules, etc.

The scope of shielded premises, volumes and structures is large. Thanks to the advent of mobile shielded volumes, it became possible to protect against an increased level of electromagnetic radiation of any technical means and objects, including temporarily occupied (rented) premises; users have the opportunity to independently equip a technical facility that requires protection; quickly deploy shielded shelters both outdoors and indoors.

Moreover, universal mobile shielded volumes can be manufactured in accordance with the technical and dimensional requirements of a particular custom

If we talk about the effective protection of server rooms in offices, the solution of such problems requires the provision of specialized complex shielding, as in other cases, in accordance with special requirements and standards documents.

Previously, for shielding from electromagnetic radiation of premises, for example, for placing servers, electronic equipment, etc., steel panels with a thickness of 1.2-2.0 mm were made. The panels were interconnected by contact welding, and then welded with a continuous seam. To prevent metal corrosion, the panels were painted on both sides. The effectiveness of electromagnetic shielding is achieved using honeycomb holes (waveguide filters). The air exchange system is carried out by an air conditioner, the indoor unit of which must be located outdoors and the air is cooled by means of air ducts. Air ducts are connected to the screen of the room through a dielectric insert and a waveguide filter. All power lines, fire and burglar alarms are filtered, wiring throughout the room is carried out in pipes or shielded braid. All local network lines are wound up in metal pipes, special filters with radio-absorbing material are installed at the ends of the pipes. Power and information inputs to the premises are carried out through special filters.

PEMIN attenuation measurements (certification of screen structures) are made after installation and, as a result, a measurement protocol and a room passport are usually issued.

One of the ways of penetration of electromagnetic interference into secondary circuits is the presence of capacitive and/or inductive couplings between circuits. The weakening of the connection is achieved by shielding electromagnetic fields. To weaken the electric field, structures made of highly conductive materials are usually used. The weakening of the magnetic field is carried out using screens made of ferromagnetic materials. High-frequency fields are screened with ferromagnetic materials or highly conductive non-magnetic materials.

As a rule, such materials are quite expensive, so room shielding is an expensive solution.

Recently, composite materials have appeared that can be an effective and fairly cheap solution.

This work is devoted to the study of shielding using the Novafor composite material prototype based on the well-known ECOM resistive composite.

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Prototype

The prototype was a composite material "EKOM", which is composed of three finely dispersed components: graphite, iron oxide, corundum and one liquid component: phosphoric acid. In order to enhance the suppression of electromagnetic interference in a material, it is desirable to have a higher electrical conductivity and magnetic permeability. To this end, it is necessary to add components having high magnetic permeability and electrical conductivity. In this case, simply adding graphite is inefficient, because. accompanied by a decrease in the mechanical strength of the material. It has been proposed to add iron ore based on Fe_3O_4, SiO_2, Al_2O_3 as a magnetic component (μ~20) and graphite as an electrically conductive element. At the same time, mechanical strength was provided by additional technological operations: tiles from the base material were ground, graphite and phosphoric acid were added to the grinding. It was found that the weakening of the electric field is quite significant.

The increase in the attenuation coefficient of the magnetic field and the weakening of the attenuation coefficient of the electric field with increasing frequency is quite obvious, this is due to the transition from the electrostatic and magnetostatic modes to the electromagnetic shielding mode.

Indeed, the highest attenuation coefficients in the high-frequency region have samples with a lower resistivity and a shallower skin depth. And in experiments with the highest-resistance sample 125, no high-frequency weakening of the electric field was recorded. Let us estimate the skin depth for sample 125.

The total attenuation of the field is determined by the reflection P at the interface between the media and the absorption A in the sample material. For the wave mode, the attenuation coefficient due to reflection is determined by the relation $K=Z_0/Z_e$ from the expression.

$$P = 20 \lg \frac{\left|(1+K^2\right|}{4|K|} \quad (1)$$

and the coefficient of attenuation due to absorption can be determined by the expression

$$A=8.7\cdot h/\lambda \quad (2)$$

For a frequency of 30 MHz, the value of λ is 3.7 mm. If the wall of the shielding tile is in the far zone of the source, then the wave impedance of space Z_0 = 377 Ohm, and the wave impedance of the tile $Z_e=\sqrt{2}/(\sigma\lambda)$ at a frequency of 30 MHz for the best sample will be $Z_e \approx 1.9$ Ohm, respectively, the attenuation coefficients for the sample

371 should have been approximately A=14.5, P=46. In fact, the wave resistance of space in quasi-static modes has significantly different values for electrostatic and magnetostatic modes. Therefore, the attenuation coefficient due to reflection has significantly lower values. If we consider the distance from the source to the screen to be approximately 1 mm, then the reflection coefficient for the electrical component should be more than 90, and the reflection coefficient for the magnetic component should be approximately 8. The reflection estimates for the electrical component clearly do not correspond to the experiment. Whereas the total attenuation in the magnetic field P+A≈22.5 slightly differs from the experimental value of 26. In a composite material, the reflection coefficient may have features. In particular, a size effect should appear in it, in which the reflection coefficient will be much smaller compared to reflection from a homogeneous material with the same conductivity. Let us consider the skin effect in a dispersed material composed of a composition of conductive and nonconductive powder materials. Pushing the current into a thin near-surface region should lead to a new effect. The fact is that in a composite material, with a change in the concentration of the conductive component, the current changes nonmonotonically. At a low concentration value, the electrical conductivity is small, and at a certain value, called the conductivity threshold, it increases sharply by several orders of magnitude. For three-dimensional flow, the threshold concentration is much lower than for two-dimensional flow.

By choosing the actual concentration so that it is above the "bulk" percolation threshold but below the "surface" percolation threshold, it can be obtained that the resistivity of the material near the surface will be significantly higher than the volume resistivity. This should lead to the features of not only reflection, but also the absorption of electromagnetic interference (EMI).

Conclusions

Highly promising is the further study of the properties of the new composite material of the Novafor class (in comparison with the prototypes). The new material has a sufficiently high absorption, both in terms of the magnetic and electrical components of the EMF. An analysis of the behavior of a composite material under the influence of fields shows that it may have anomalies in the reflection and absorption coefficients. Modifications of such a material can be widely used in solving problems of electromagnetic compatibility in a number of areas, in particular, in creating anechoic room

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