UDC:677.53

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STUDY OF THE EMR SHIELDING EFFECTIVENESS BY THE TEXTILE SCREEN

Purpose. Research of shielding properties of industrial fabrics, which are intended for electromagnetic radiation shielding (EMR).

Key words: *electromagnetic radiation, textile screen, shielding efficiency*

Introduction. Currently, there are many sources of electromagnetic pollution such as power lines; cellular and satellite radio communications; navigation and radiolocation systems; household appliances and other technical means; medical devices. It is known that EMR causes very negative consequences for human health and excite malfunctions of electronic devices. Reliable protection against EMF can be achieved through the use of textile screens, which are obtained using various technologies.

Materials and methods. Woven fabrics with shielding properties against EMI effects available on the market of Ukraine were chosen for the study. The characteristics of the materials are presented in Table 1.

Table 1 – **Characteristics of fabrics**

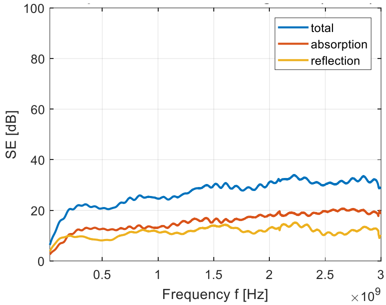
Sample	Composition	Mass per unit area, [g/m^2]
#1	Cotton 68%, PET 16%, Stainless steel 15%	190
#2	Cotton 50%, PET 35%, Silver 15%	150

The EMI shielding effectiveness (SE) of the samples was experimentally measured using a far-field electromagnetic plane wave by the method in ASTM D 4935-18 [1] for planar materials. The EMR shielding efficiency (SE) of a material is defined as the ratio of transmitted power to incident power and is expressed in the form of:

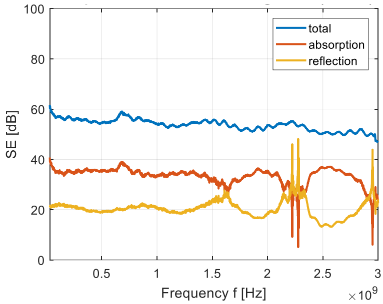
$$SE\ [\text{dB}] = -10\log P_T/P_I = SE_A + SE_R + SE_M;$$

where, P_T and P_I in subscript refer to transmittance power and incident power respectively. And SE_A, SE_R, and SE_M describe the shielding effectiveness due to absorption, shielding effectiveness due to reflection and shielding effectiveness due to multiple reflections respectively.

Results. The results of the study of shielding efficiency in the frequency range from 9 kHz to 3 GHz are presented in the graphs of Fig. 1 in terms of the main mechanisms of EMR attenuation: absorption and reflection.



a.



b.

Fig. 1. **SE versus frequency for sample #1 (a) and sample #2 (b)**

It should be noted that studied textile materials have different EMR shielding ability according to the classification of FTTS-FA-003 Specified Requirements of Electromagnetic Shielding Textiles [2], namely:

– sample #2 has "very good" shielding ability (60 dB ≥ SE > 50 dB);
– sample #1 has an "average" shielding ability (40 dB ≥ SE > 30 dB).

Such differences can be explained by the electrical conductivity of the screen material, namely the metal grid. In sample #2, the silver mesh provides high shielding efficiency (SE = 55 dB), which is explained by the highest electrical conductivity of silver compared to other metals (σ_{silver} = 60.7 - 62.5 MSm/m and σ_{steel} = 10.3 - 13.7 MSm /m).

Also, it should be noted that the shielding efficiency of the fabric #2 (Fig. 1.b) is provided mainly by the absorption mechanism, while the shielding effeciency of the fabric #1 (Fig. 1.a) is provided by the mechanisms of absorption and reflection in almost equally parts.

Conclusion. Woven fabrics for protection against EMR, which are available on the Ukrainian market, have a high ability to shield EMR in the frequency range from 9 kHz to 3 GHz.

Acknowledgement: *This work was supported by the International Visegrad Fund.*

References

1. ASTM 4935-18 Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Materials, ASTM International, 2018.
2. FTTS-FA-003 Specified Requirements of Electromagnetic Shielding Textiles. – p.4.