IMPACT OF WET TREATMENTS ON THE SHIELD EFFECT OF FUNCTIONAL INTERLINING FABRICS

Bosiljka Šaravanja[1], Tanja Pušić[2], Krešimir Malarić[3]
[1] *Department of Clothing Technology, Faculty of Textile Technology, University of Zagreb*
[2] *Department for Textile Chemistry and Ecology, Faculty of Textile Technology, University of Zagreb*
[3]*Department of Wireless Communications, Faculty of Electrical Eng. and Computing, University of Zagreb*
tanja.pusic@ttf.hr

ABSTRACT – The paper discusses the influence of wet treatment on the shield effect of functional interlining fabrics. The polyamide fabrics metallized with copper is used as an electromagnetic shield against the radiation on frequencies of 0.9 GHz, 1.8 GHz, 2.1 GHz as well as 2.4 GHz. The material shielding characteristics was measured in Microwave laboratory using antennas and spectrum analyzer. The results showed that the use of wet treatment significantly reduces the shielding properties of the interlining fabrics.

Key Words: wet treatment, shield effect, electromagnetic fields, interlining fabric

1. INTRODUCTION

Intensive technological development of electric and electronic devices and gadgets demands for control of negative impact of the technology as well as ways of their preventions. Many electrically conductive textile materials can be used as a protection from the high-frequency (HF) radiation and low-frequency (LF) electric fields [1, 2]. The need to develop this type of fabrics and products has its origin in the development trends in new technologies, electric and electronic devices that emit electromagnetic waves, possibly detrimental to human health. Many studies are oriented to development and investigation of electromagnetic shielding lightweight flexible materials, especially those that are textile based with different electrically conductive additives [3 - 5]. Little attention has been paid to the problems related to the performance of electromagnetic shielding materials for clothing in use, especially on wet processing.
The aim of this study was to investigate the impact of wet processing on the electromagnetic shield effect of interlining polyamide fabrics metalized with copper.

2. MEASUREMENT SETUP

The shield effect of the material is property of both absorbing and reflecting the electromagnetic wave. Shield effect (SE (dB)) of the interlining fabric is calculated according to the following:

$$SE = 20\log\frac{E_0}{E_1} \tag{1}$$

where E_0 is the level of the received field without shield and E_1 is the level of electric field with a shield. The results are given in dB and they show how much of the electromagnetic field passes through the fabric.

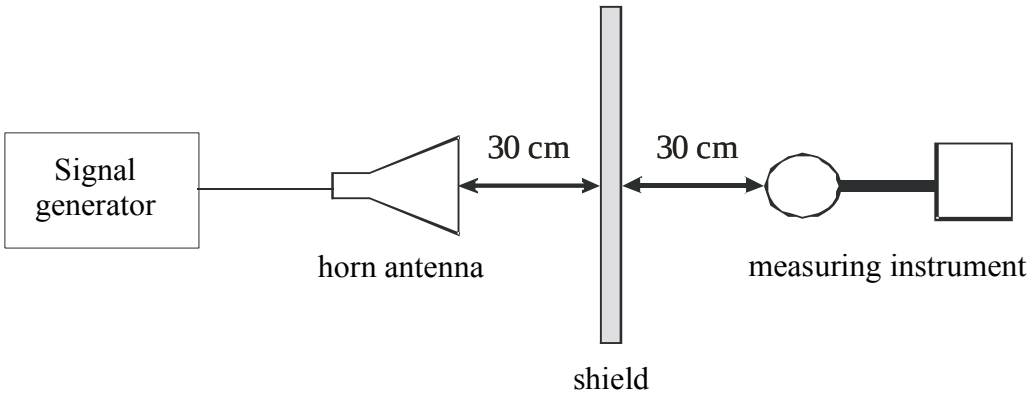

Figure 1. Measurement setup

Figure 1. shows measurement of the shield effectiveness. It consists of a signal generator, horn antenna, the fabric used as a shield as well as the measuring instrument NARDA SRM 3000.

3. MAINTENANCE OF FUNCTIONAL INTERLINING FABRICS

The concept of wet treatments is based on variation of solvents (perchlorethylene, water) and Sinner cycle parameters: chemistry, mechanical agitation, temperature and time. Interlining polyamide fabrics metalized with copper before and after ten wet treatments cycles were evaluated by shield effect at the frequencies of 0.9 GHz, 1.8 GHz, 2.1 GHz and 2.4 GHz.

4. RESULTS

Surface examination of functional fabrics before and after 10 treatment cycles was performed by scanning electron microscopy under magnification of 250x, Figure 2.

a. b. c.

Figure 2. SEM images of polyamide fabrics metallized with copper: a. untreated; b. after 10 dry cleaning cycles; c. after 10 wet cleaning cycles

SEM images of functional fabrics after 10 cycles of wet treatments (b, c) indicate on changes in surface in comparison to the untreated one (a). Distribution and magnitude of cracks are similar on fabrics treated in dry and wet cleaning.
The shield effectiveness measurements of polyamide fabrics metallized with copper on frequencies of 0.9 GHz, 1.8 GHz, 2.1 GHz and 2.4 GHz are presented in Table 1.

Table 1. SE of polyamide fabrics metallized with copper on frequencies of 0.9 GHz, 1.8 GHz, 2.1 GHz and 2.4 GHz : a. untreated; b. after 10 dry cleaning cycles; c. after 10 wet cleaning cycles

Samples	SE (dB)			
	0.9 GHz	1.8 GHz	2.1 GHz	2.8 GHz
a	19.7	21.1	25.7	21.4
b	0.9	1.9	3.1	2.9
c	0.1	0.1	0.1	0.1

Obtained results presented in Table 1 proved that both solvents degraded the shielding effect of the conductive fabrics through 10 cycles. The reduction in SE properties of fabric treated in water is higher than on fabric treated by perchlorethylene.

5. CONCLUSION

Scanning electron microscopy images of functional SE protective fabric after wet treatments showed cracked surface that may be associated with a fall in protective properties. Organic solvent, perchlorethylene has proven to be better for maintenance of cloth with integrated functional interlining fabric.

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