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Experimental Studies on the Phisico –Mechanical Properties of Electrically Conductive Non-Woven Textile from Recycled Fibers for Safety Footwear Midsole

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Abstract: This study presents the experimental investigation of new non-woven textile with electrically conductive properties from the waste conductive yarn and fabrics.
Conductive yarn had the following characteristics: composition - 60% cotton, 40% electrically conductive fiber neutron (ECFN), linear density - 50×2 tex, tensile strength - 90 cN/tex, elongation at break - 14.0%, a linear resistivity of 18-20-kOhm/m. As a result of research established the basic physical-mechanical and electrical properties of non-woven textile which can be used as part for safety footwear providing protection against electrical fields, as well as antistatic, conductive footwear

Keywords: Electrically conductive non-woven textile, recycled fibers, physical–mechanical properties, safety antistatic and conductive footwear**.**

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1. Introduction

Different manufacturing industry cause the variety of specific environmental conditions in which the person works. The enterprises are widely used and produced in large quantities of substances and materials with dielectric properties, which contributes to the emergence of static electricity. One of the means of protection from the occurrence and accumulation of static electricity charges is antistatic (conductive) shoes. Antistatic and conductive properties of safety shoes depend on the properties of the materials used. [1]
Currently, along with the development and improvement of technology for producing polymer materials, in particular fibers, research on giving special properties of these materials conducted intensive:. Heat resistance, high strength, electrical conductivity, etc. One of the representatives of such materials are conductive fibers. They have unique properties: high electrical conductivity characteristic of metal; lightness, flexibility and other valuable characteristics peculiar textile materials [2].
Methods for preparing metallic fibers and fabrics can be divided into physical (foil, vacuum deposition, sputtering, etc.); Physicochemical (gas- and liquid-phase plating, electrochemical deposition, and others.) and chemical (usually by chemical reduction or decomposition of metal compounds unstable when heated. The purpose of this study is determine the possibility of using conductive nonwoven waste conductive fabrics and fibers as a contact element of system "feet-insole-midsole-outsole" at the antistatic footwear

1. Materials and methods

As objects of research it has been used experimental samples of conductive non-woven fabric made from conductive yarn waste on the basis of conductive fiber Nitron (CFN) and fabrics of different composition made from a mixture of cotton and CFN.
The conductive yarn has the following characteristics:

composition - 60% cotton, 40% CFN.
Linear density – 50X2 tex
Tensile strength - 90 cN / tex
Elongation at break - 14.0%
The linear electrical resistivity -18-20 kOhm/m

Experimental samples of electrically conductive nonwoven fabric (ECNWF) obtained by mechanical means needlepunched [5]. Fig. 1 a, b, c shows the photographs of the electrically conductive non-woven fabric (ECNWF) a)

top view (x40 to-fold increase), b) top view (x10-fold increase, c) a cross-section (magnification x40)

We conducted the study of the complex characteristics developed ECNWF. ECNWF main properties are: surface density, breaking strength, breathability, the electrostatic voltage, the surface resistivity, etc. Brief technical characteristics, the test of the experimental sample of the nonwoven material is shown in table 1

The strength of textile materials characterized by tenacity Pp (measured in Newtons N) - the largest force withstand material at the time of rupture.

Elongation textile materials characterized by their deformation under a tensile load is measured in millimeters, but more often in% relative to the clamping length of the fiber.

For the tests were cut by 3 sample sizes 30cm × 5cm material.

Breathability describes the ability of textiles to pass air. It is an indicator of hygienic and heat-shielding properties of materials used in footwear. Studies have shown that the electrically conductive yarn is more loose structure than yarn of pure cotton, which explains the higher breathability and at the same time maintain good thermal insulation properties.

The surface density of the nonwoven fabric is of great importance in the manufacture of any kinds of products. Studies of this indicator showed that the content of metallic filaments webs does not increase the areal density. This is natural, as metalized yarn heavier weight fabric.

To determine the index of the surface density of the material used 8 forms a circle the size of the samples the diameter of 10 cm.

Textile materials have a complex porous structure consisting of fibers and air-filled pores. Pores are located both between the fibers and inside them; the shape and size of their varied: micro - and microcapillaries, through and closed. heat transfer in such materials with non-uniform porous structure is carried through fiber conduction and air in the closed pores, through convection through the pores, radiant walls of the pores. Therefore, the thermal conductivity of textiles conditions: it characterizes the ability of a material to transmit heat energy not only because of the thermal conductivity, but also by convection and thermal radiation [3].

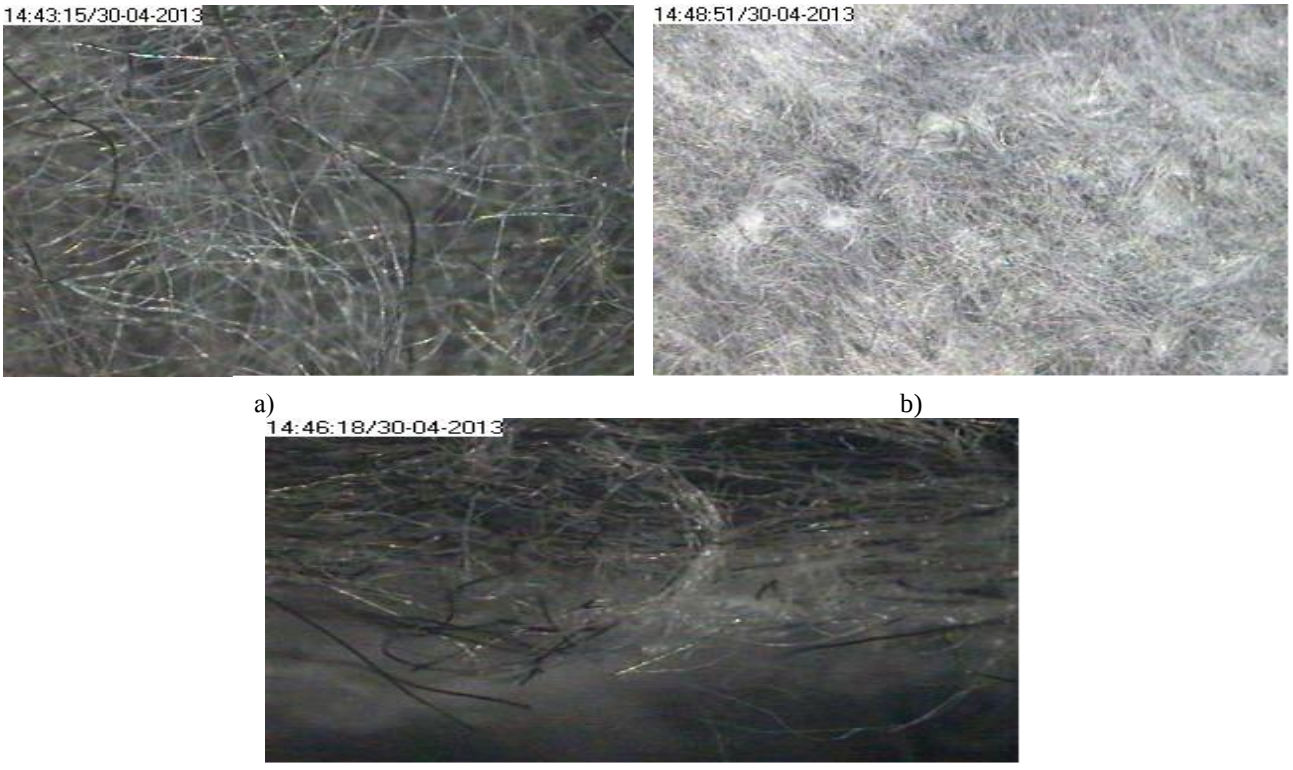

Figure 1: Photographs of the electrically conductive n woven fabric (ECNWF) a) top view (x40 to-fold increase), b) top view (x10-fold increase, c) a cross-section (magnification x40)

e the thermal conductivity of five samples were asuring 30 × 30 cm.

Electrification of textile has a surface effect and results from the interaction (friction) between the two surfaces. When friction electrification increases, because there are new and are destroyed previous contacts rubbing surfaces. Electric charges can arise not only in friction, but also in tension and compression [6].

Electrified, as a physical quantity is determined by the following indicators: the electric field, the charge value of the surface density of the charge polarity, volume resistivity, surface resistivity. Thus electrified can be regulated both by

the specific surface electrical resistance in Ohm • m, the electrostatic field, as well as the electrostatic voltage, V. However, the first feature is not very useful due to the strong dependence of the index on the atmospheric conditions. Characterize electrified textile materials possible through electrostatic potential [7].

Electrical conductivity is the capacity of material to allow to passage of an electrical current. Resistivity is the invers of conductivity One must distinguish resistance which characterize the physical element and the resistivity which define the intrinsic the material constituting the elements as two object may be constituted materials with different resistivity but share the same electrical resistance value in ohms. The surface resistivity characterize flat materials and it is expressed in ohm or in Ohm squared

Table 1: Technical characteristics, the test of non-woven materials.

3. The Results and Discussion

Data of physical - mechanical and electrical properties of samples new non-woven fabric from recycled fibers shown in table 2

For comparison mechanical and electrical data of batting and a new non-woven fabric for the intermediate bottom parts of footwear (midsole) are given in table 3

From the table above it is clear that on the physical - mechanical properties (breaking strength, the surface density, breathability and the electrostatic voltage in friction, surface electrical resistivity), the resulting material for the intermediate parts of footwear bottom (midsole) close to batting, and has stable conductive properties.

Electrical properties (the electrostatic voltage, surface electrical resistivity) are significantly different from that existing analogue. This suggests that we obtained a new nonwoven fibrous waste material from the textile industry, which has stable electrical properties, which can be used as application of antistatic and conductive footwear [8]

Table 2: Table of physical - mechanical and electrical properties of new non-woven fabric

Table 3: Comparison of mechanical and electrical data s of a new electrically conductive non-woven fabric and batting

4. Conclusion

1. A new non-woven fabric with conductive properties of the waste conductive fabrics and fibers for spacer's special footwear
2. Conducted comprehensive studies of the properties of the experimental non-woven fabric as a result, which established its main physical, mechanical and electrical properties
3. Non-woven fabric can be recommended for using as midsole in safety footwear with antistatic and conductive properties.

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Author Profile

Ilkhamova Malokhat received the Engineer of footwear technology degree at Tashkent Institute of Textile and Light Industry in 1991. Senior science researcher at Tashkent Institute of Textile and Light Industry. During 09/2000-12/2000, she stayed in Textile Department of Gent University (Belgium) to studied "Quality control of Textiles and Educational system in EUROPE", research: "Electro conductive textile fabrics", "Electro-textiles". During the last years M Ilkhamova is doing research on development

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