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THERMOPHYSICAL PROPERTIES OF KNITTED FABRIC FOR EMR SHIELDING

Purpose *of the research is to study the thermophysical properties of knitted fabric for electromagnetic radiation (EMR) shielding.*
Keywords: *EMR shielding, thermophysical property, knitted fabric.*

Objectives. Textile materials for protection against electromagnetic radiation are more and more popular in our life. Production volumes of shielding textile are growing every year. The main publications on electromagnetic radiation shielding concern new textile materials [1] and production methods [2] as well as their functional properties [3]. Some publications cover the mechanical, antibacterial and antimicrobial properties of such fabrics. However, with the increasing use of electromagnetic interference (EMI) screens in casual wear [4], it is of particular interest to study the comfort of such textiles, especially it`s thermophysiological aspect. It is associated with the thermal balance of the human body, which maintains a constant body temperature about 37°C.

Methodology. Hybrid knitted fabric for EMR shielding were produced on 8 gauge flat knitting machines. The hybrid knitted fabrics are formed by the alternation of 2 courses of rib 1x1 from 30 x 2 tex cotton yarn and 2 courses of rib 1+1 / Milano rib / half cardigan / tuck stitch from a 0.12 mm diameter stainless steel wire according to the interlooping repeat. Fabrics samples are differed by steel wire positioning in the structures and its content. The produced hybrid knitted fabrics have the ability to EMR shielding which was measured according to ASTM 4935-10 in the previous study [5]. The instrument ALAMBETA was used for the thermophysical properties testing. The measurement was carried out at 10 °C temperature difference and pressure on the sample P = 200 Pa.

Research results. The ability of textile materials to conduct and absorb heat is characterized by thermal conductivity (λ), thermal resistivity (R), thermal absorptivity (b) and thermal diffusivity (a). The hybrid knitted fabrics for EMR shielding are characterized by wide range values of studied properties (table).

Table 1 – **Thermophysical properties of hybrid knitted fabric**

Knitted structure	Composition, %		$\lambda \cdot 10^{-3}$, $W \cdot m^{-1} \cdot K^{-1}$	b, $W \cdot s^{1/2} \cdot m^{-2} \cdot K^{-1}$	$R \cdot 10^{-3}$, $K \cdot m^{2} \cdot W^{-1}$	$a \cdot 10^{-6}$, $m^{2} \cdot s^{-1}$
	SS	Cotton				
-/Rib 1+1	0	100	69.0±0.84	117.3±5.51	37.4±0.53	0.347
Milano rib/ Rib 1+1	7	93	54.6±0.79	80.8±4.83	39.5±0.51	0.399
Rib 1+1/ Rib 1+1	29	71	53.7±1.97	85.0±4.40	41.5±1.37	0.460
Half cardigan/Rib 1+1	30	70	56.7±1.92	66.7±5.33	50.8±1.45	0.681
Tuck stitch/ Rib 1+1	51	49	55.2±1.73	80.9 ±5.06	46.3±1.54	0.467
Rib 1+1/-	100	0	41.5±1.56	50.3±1.97	30.0±1.66	0.679

The research results of the thermophysical properties of hybrid knitted fabrics showed that the introduction of stainless-steel wire into the cotton fabrics structure leads to significantly changes of their thermophysical properties. This is due to the significant difference in the thermal conductivity of cotton ($\lambda = 69.0 \cdot 10^{-3}$ $W \cdot m^{-1} \cdot K^{-1}$) and steel ($\lambda = 45.5 \cdot 10^{-3}$ $W \cdot m^{-1} \cdot K^{-1}$). The proposed hybrid knitted fabrics provide a comfort for consumers given their thermal sensations.

Conclusion. It was established that an increase of the steel wire content in hybrid knitted fabrics leads to a decrease of thermal conductivity coefficient (λ) and thermal absorptivity (b). Hybrid knitted fabrics become more comfortable and “pleasant to the touch” with increased steel wire content.

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