



ELASTIC WARP KNITTED FABRIC FOR REHABILITATION GOODS

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ABSTRACT: *At the current stage of the textile industry, the development of medical and prophylactic goods is one of the most actual and pressing tasks. Such products as compression garments have a constant and steady demand because they prevent ailments and normalize people's life and activity. A distinctive feature of these products is their manufacture from elastic knitted fabrics, which allows reducing the number of seams and ensure a reliable fit to the body. In this regard, the few variants of warp knitted fabrics with elastomeric threads were produced and tested. The elastomeric threads are introduced into the knitted structure with pre-tension, which provides the necessary stretching of the fabrics. At the same time, after the removal of tensile forces, the elastomeric threads restore their original dimensions and change the ground structure. The research on elastic warp-knitted fabrics was carried out and the influence of knitting parameters on the properties of elastic knitwear was established within this work.*

Keywords: *warp knitted fabric, elastomeric thread, rehabilitation good, properties.*

ELASTIČNA PLETENINA KAO REHABILITACIONO SREDSTVO

APSTRAKT: *U sadašnjoj fazi tekstilne industrije, razvoj medicinskih i profilaktičkih proizvoda jedan je od najaktuelnijih i najhitnijih zadataka. Takvi proizvodi kao kompresijska odeća imaju stalnu i stalnu potražnju jer sprečavaju tegobe i normalizuju život i aktivnosti ljudi. Posebnost ovih proizvoda je njihova izrada od elastičnih pletenih tkanina, što omogućava smanjenje broja šavova i osigurava pouzdano prijanjanje uz tijelo. S tim u vezi, proizvedeno je i testirano nekoliko varijanti osnove pletenih tkanina sa elastomernim nitima. Elastomerni navoji se u pletenu strukturu unose uz prednaprezanje, što obezbeđuje potrebno rastezanje tkanina. Istovremeno, nakon uklanjanja vlačnih sila, elastomerni navoji vraćaju svoje prvobitne dimenzije i menjaju strukturu tla. U ovom radu je sprovedeno istraživanje elastičnih pletenina i utvrđen uticaj parametara pletenja na svojstva elastične trikotaže.*

Ključne reči: *osnove pletene tkanine, elastomerni konac, rehabilitaciono sredstvo, svojstva.*

1. INTRODUCTION



Human activities aimed at illness recovery and health maintenance deserve comprehensive support in various spheres. That is why in the modern world special attention paid to the development and manufacturing the rehabilitation products that prevent the disease progression and return an active life to everyone.

The support items are a significant segment of rehabilitation products. This is a special product that covers certain areas of the human body to restore anatomical shape or function as well as to prevent possible injuries during significant physical exertion [1]. The wide range of support items that differ by constructions and end-users is represented in the world market of medical products. However, as a rule, knitted elastic materials are the basis of such products. Knitted fabrics for the manufacture of preventive products must provide a number of requirements, namely: linear dimension stability, a certain level of compression, comfort as well [2]. The necessary level of stretchability and elasticity of the knitted fabric is providing by the introduction of elastomeric threads into the fabric structure. Pre-elongation of elastomer before knitting affects the stretchability and correspondently a strain of compression product. It affects the geometric parameters of the knitted fabric, namely, increasing stitch density and decreasing loops spacing. Such structure change reduces the fabric's permeability and consequently the comfort feeling.

2. THEORY

For each consumer, the comfort of textile products is one of the important components of product quality. The comfort of compression products is even more important because they tightly fit the body. [3]. Comfort is a pleasant psychological state and physical harmony of a person. Comfort can be psychological by a feeling of confidence when wearing clothes, sensory by mechanical contact between the skin and clothing, and thermophysiological by optimal microclimate between body and clothing. Thermophysiological comfort is the main one. It has the greatest impact on the physiological state of humans. Thus, the maintenance of body thermal balance is a necessary condition of human normal vital activity [4]. In this case, elastic knitted fabrics must provide air conditioning in the underwear layer and create a normal heat exchange between the human body and the environment.

The knitted structures have a more open character when compared to other textile materials, such as woven and braided. It leads to a higher permeability. [5]. An air-permeability is the main one. The liquid and vapor permeability of the fabric are usually closely related to the value of air permeability. The value of air permeability of knitted fabric depends on the stitch density, interlooping, thickness, yarn's type and structure. Due to the variation of these factors, the indicators of physical and hygienic properties can be varied within wide limits. The stitch density, interlooping, and thickness of the fabric determine the number, size and shape of the pores that affect the airflow resistance. The air permeability is affected not only by the total number of pores, but also the size of each pore. The greater materials porosity leads to higher air permeability [6].

The introduction of elastomeric threads into the knitted structure leads to changes in the configuration of the elements of the loops structure, and accordingly the fabric porosity. It



should be assumed that the properties of the elastic warp knitted fabric will also depend on the interlooping repeat and elastomeric yarn threading. Therefore, the purpose of this work is to study the influence of technological conditions on the air permeability of elastic warp knitted fabrics.

3. RESULTS AND DISCUSSION

Elastic warp-knitted fabric is the subject of this research. Pillar stitch with closed loops from 16,7 tex polyester thread is basis interlooping. Elastomeric threads of 0.8 mm diameter are used as longitudinal inlay-in yarn and introduced into the fabric structure with preliminary elongation to ensure the required elasticity. In order to study the effect of elastomeric yarn contribution on the studied property five fabrics variants differed by threading the guide bar with elastomeric yarn were used: #1 – 1 in, 1 out (50 %); #2 – 2 in, 1 out (66.7 %); #3 – 2 in, 2 out (50 %); #4 – 3 in, 1 out (75 %); #5 – full (100 %). The transverse weft threads are laid on a whole wide of fabric at both sides in order to fully covering the elastomeric filaments. In order to study the effect of raw material on the studied property four variants of transverse weft threads were used: 33.4 tex x 4 polyester yarns, 33.4 tex x 2 polyester yarns, 29 tex x 4 cotton yarn and 29 tex x 4 linen yarn. All fabric samples were produced on a 15 gauge TCH Crochet knitting machine.

Since the studied fabrics are used for the manufacture of treatment and prevention products, on which operation the cleanliness and hygiene is a particularly important issue, it should be assumed that elastic warp knitted fabric will be subject to frequent washing. As a result of wet treatments, shrinkage of fabrics can occur, which would lead to deterioration of aesthetic appearance, dysfunction of therapeutic and prophylactic effects, or even product unusability. In addition, the changes in structural parameters of knitted fabric lead to changes in all others properties. Therefore, the produced warp-knitted fabrics were subjected to washing and ironing according to ISO 6330:2013. 50 cycles were done for each variant of developed elastic warp knitted fabrics.

Air permeability is described as the rate of air flow passing perpendicularly through a known area, under a prescribed air pressure differential between the two surfaces of a material. Tests were performed according to standard ISO 9237 using FF-12/A air permeability tester. The air pressure differential between the two surfaces of the material was 100 Pa. Ten parallel measurements were done for initial samples and after each 10th washing cycle for all fabrics variants. The mean value was used for results analysis

The research results show that the air permeability of knitted fabrics largely depends on the guide bar threading with elastomeric threads (Fig. 1). The fabric of the #1 variant with a half set of elastomeric threads (1 in, 1 out) has got the highest value (150 mm/sec) of the studied property. Moreover, the value is almost 50% higher than for the #5 variant fabric with a full set of elastomeric threads (105 mm/sec). This is due to the lack of elastomeric threads in certain wales that reduce the obstruction to the air passage through and increase the inter-loop and inter-thread holes.

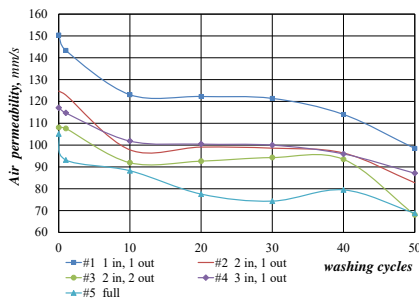


Figure 1: The effect of washing cycles and elastomeric yarn threading on the air permeability of knitted fabric with 33.4 tex x 4 PET as weft yarn

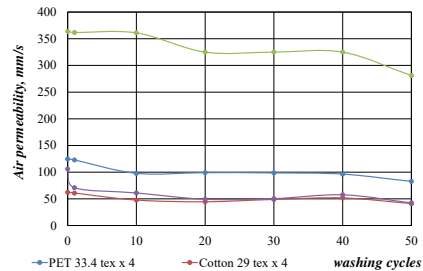


Figure 2: The effect of washing cycles and weft yarn type on the air permeability of knitted fabric with partly threading (66.7%) elastomeric yarn: 2 in, 1 out

The research result shows that the air permeability of elastic warp knitted fabrics depends on the raw material as well (Fig. 2). The air permeability of fabrics with 33.4 tex x 2 polyester yarn as transverse weft thread is almost three times higher than for similar fabrics with 33.4 tex x 4 polyester yarn. It was established that elastic warp knitted fabrics with linen or cotton yarn have the lowest air permeability. It is because of the higher volume of the natural yarn compared to synthetic filaments.

It should be noted that the air permeability of the elastic warp knitted fabric changes as a result of wet-heat treatment. Thus, with an increasing number of washing and ironing cycles, the studied indicator decreases by 30-35% within the experiment. It is due to the shrinkage and the structure compaction of knitted fabrics, resulting in a decrease in the porosity. The obtained results should be in the count for the design and development of the new high comfort products.

4. CONCLUSION

Studies of the effect of technological conditions on the air permeability of elastic warp knitted fabrics shows the following:

- raw materials affect index:
 - elastic fabric with natural yarn (linen or cotton) as weft threads has got the lowest air permeability;
 - the air permeability increases by 65% with decrease twice in the linear density of the weft yarn;
- guide bar threading with elastomeric thread affects index too:
 - the air permeability increases by 30% with a decrease from 100% to 50% the percentage of guide bar threading for fabrics with polyester threads as weft yarn;
- the effect of wet heat treatment was established as well:



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- air permeability of elastic warp knitted fabric reduces by 30-35% with the increasing the washing cycles.

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