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Research Article

ANALYSIS OF PHYSICOMECHANICAL PARAMETERS OF NEW PATTERNED KNITTED FABRICS OBTAINED ON KNITTING MACHINES WITH TWO CIRCULAR NEEDLES

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ABSTRACT

This article presents the analysis results of the physical-mechanical and technological parameters of 3 variants of knitted fabrics with a new structure, woven using polyester and lycra yarns, and a recommendation for the product range.

KEYWORDS

Knitting, yarn, yarn, jacquard, texture, permeability, surface density, pattern, density, polyester, lycra.

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INTRODUCTION

Today, there is a demand to expand the assortment of competitive products with good physicomechanical properties, hygienic and aesthetic quality, using local raw materials effectively, producing new structures of good quality knitted fabrics, which are beautiful in appearance, and affordable. Using new techniques and technologies, raw material-saving methods are widely used in the production of various types of knitted textile products to provide competitive products that meet the demands of the domestic and foreign markets [1-5].

Samples of 3 different types of two-layer knitted fabrics of new structures woven from high-density polyester and lycra yarns using the laboratory equipment installed in the testing laboratory of NamIET (Namangan Institute of Engineering and Technology) technological indicators and physical-mechanical properties were studied [6-9].

MATERIALS AND METHODS

It is known that if the fabric structure or thread composition of knitted fabric changes, its physical and mechanical properties also change. Air permeability is one of the main features that ensure comfortable conditions for consumers during the use of knitted products [10-14].

Air permeability coefficient V (cm^3/ cm^2·sec) is determined by the following formula

$$B = \frac{V}{S \cdot T} \; см^3 / см^2 \cdot sec \qquad (1)$$

where: V is the amount of air passing through the fabric at a given pressure differenceΔR, cm^3;

S - fabric area, cm^2;

T` - the time of passage of the air passing through the fabric, sec.

Table 1. Physical-mechanical indicators of knitted fabrics

Indicators	Options			By default
	I	II	III	
Type of thread, line density	Polyester 150D 20 texx2			
Knitted surface density Ms, (gr/m^2)	289	273	153	
Thickness t, (mm)	2.58	1.22	0.78	
Bulk density d (mg/cm^3)	112	223	196	
Air permeability V (cm^3/cm^2·sec)	44.9	15.7	56.2	*Outerwear 40-100* GOST 31410-2009

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Breaking strength R (N)	By height	282	173	139	*At least 80N GOST 28554*
	By width	172	194	169	
Elongation to break L (%)	By height	188.3	386.8	79.2	*group 1- Up to 40% at 6N;* groups 2- 40-100% at 6N *GOST 28554*
	By width	420.8	450.3	195.2	
Irreversible deformation en (%)	By height	3	12.8	30	*Not more than 15-20%* GOST 28882
	By width	8	68	59	
Return strain eo (%)	By height	97	87.2	70	
	By width	91	32	41	
Fabric permeability K (%)	By height	32.5	10	5	*8-10% at most* GOST 26667
	By width	10	17.5	0	*Most b-n 8-10%*
Abrasion resistance I (thousand cycles)		Above 40000	Above 40000	Above 40000	*30-60 years 61-120 solid GOST*16486

The resulting patterned knitted fabrics have the same raw material composition and are produced using 20x2 tex polyester and lycra yarn. The air permeability of the knitted fabric samples under study varied from 15.7 cm3/cm2 sec to 56.2 cm^3/cm^2 sec.

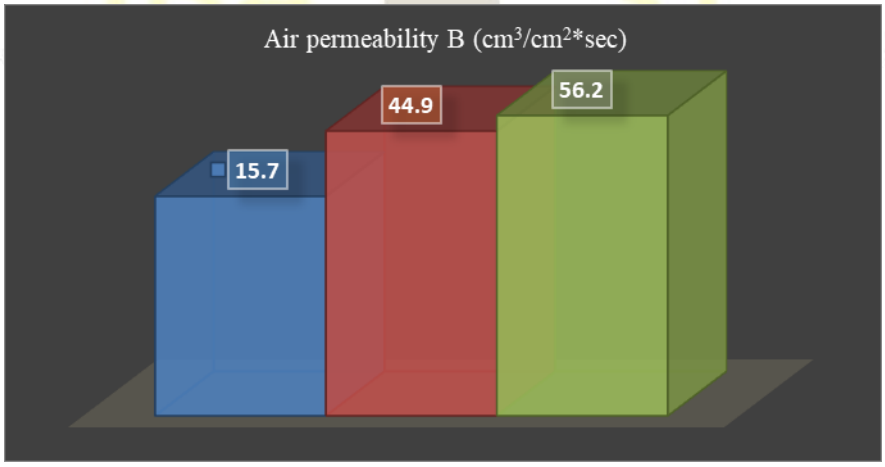

Figure 1. Air permeability histogram of double layer knitted fabric

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The lowest air permeability was determined in the 2nd version of the mixed knit with a pattern and its index was 15.7cm³/cm²·sec, the most air permeability is in the 3rd option. Air permeability in option 3 is 56.2cm³/cm²·constituted sec.The air permeability of patterned knitwear is 72% less than that of option 2 fabric. It was determined that the 3rd variant of knitted fabric with a polyester thread on the basis of Glad fabric has high heat retention properties [15-18].

One of the parameters that determine the quality of knitwear is its stiffness. The maturity characteristic of knitwear is formed in its breaking strength and elongation to break indicators.

All GOSTs and TShs used for knitted fabrics include normative indicators for elongation at break and tensile strength. Breaking strength is the force used to break a sample when stretched at a given size and speed. Breaking force is expressed in newtons. The tensile strength of the tested knitted samples was determined using a "YG-026T" dynamometer according to the standard method.

The analysis of tissue stiffness, that is, breaking strength, shows that the most mature tissue in terms of length is option 1, its indicator is equal to 282 N, and the lowest indicator is option 3, and its indicator is equal to 139 N. (Table 1, Figure 2). The stiffness of the fabric across the width was observed in the 2nd option, the tensile strength across the fabric width was 194 N, and the lowest tensile strength was observed in the 3rd option, its indicator was 169 N.

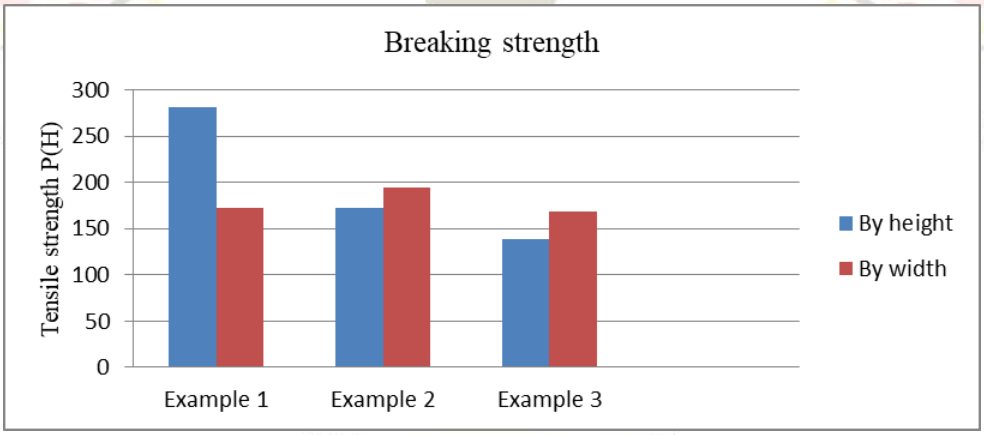

Figure 2. Histogram of changes in tensile strength of the double-layer knitted fabric

Polyester fibres are soft and do not harm the skin, they wrinkle less. The fibre has a non-straightening twist and produces less pilling than other synthetic fibres. Washes well with water and dries quickly, has good heat retention properties. Products made of polyester thread can be washed many times without losing their original appearance. Due to the presence of all the

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specified properties, it can be used in the textile industry in the production of knitwear from polyester yarn, mixed with other fibres (wool, viscose, cotton fibre) in the production of wool gauze.

The composition and amount of elements in the row of loops affect the length of the yarn in the row of loops and thus the stretchability of the knitted fabric. The stretchability of knitted fabrics is understood as its stretching under the influence of applied force. Elongation is characterized by the elongation of the sample being tested. Elongation is expressed in absolute or relative units. During the testing of knitted fabrics of length 100 mm clamped on the YG-026T dynamometer, their absolute and relative sizes are the same. The lower the fabric elasticity, the higher the shape retention properties of the knitwear.

RESULTS AND DISCUSSION

The elongation of patterned knitted fabric is from 79.2% to 386.8%. The highest elongation in terms of length was observed in the 3rd version of the knitted fabric and it was 386.8% (Table 1). The lengthwise elongation of the patterned knitted fabric variant III was the least, and it was 79.2%.

The widthwise elongation of knitted fabrics varied from 195.2% to 450.3%. The greatest stretch in width was observed in the 2nd version of knitting and it was 450.3%. The minimum width elongation was observed in the 3rd version of the knitted fabric and it was 195.2%.

In conclusion, it can be said that the length and width of the knitted fabric stretch depend on the structure of the knitted fabric and the type of threads in it, GOST28554 meets the requirements and can be recommended for the range of outerwear. When designing products, it is important to know the tensile properties of knitted fabrics [3].

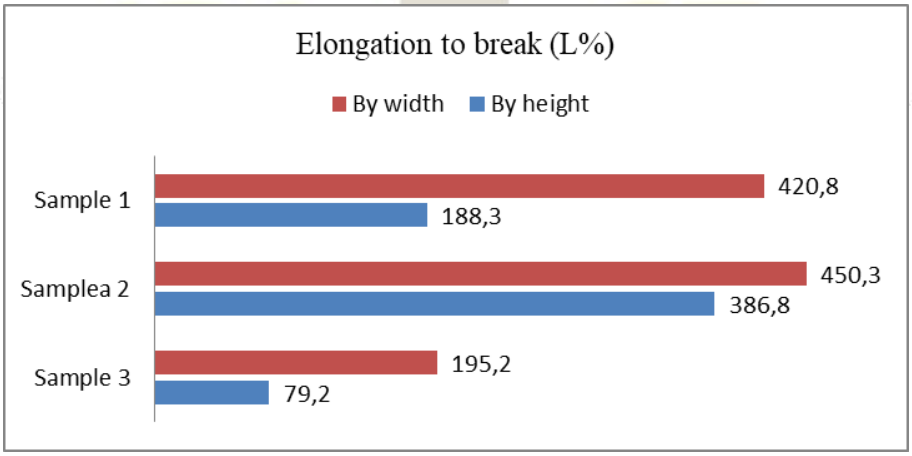

Figure 3. Histogram of the change in elongation to break of a double-layer knitted fabric

One of the most important features of knitted products is shape retention. The shape-keeping

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feature of knitwear is characterized by its elasticity, reversible and irreversible deformation and permeability.

The total deformation e is as follows: the test specimens of the strap part eq return at high speed after 30 minutes when the loads are removed; elastic deformation ee develops at a small speed, due to the passage of the relaxation process; plastic deformation ep does not return after the loads are removed from the samples.

$$\varepsilon = \varepsilon_K + \varepsilon_Э + \varepsilon_П, \% \quad (2)$$

The deformation of the knitted fabric changes with the change of the thread thickness, singleness and the number of loops. Not only the description of the deformation but also the condition of the knitting is determined internally by two main forces: the elastic force of the yarn bending towards the neck tends to straighten and change the shape of the yarn. As a result, a frictional force appears between the yarns, prevents the placement of the yarns in the loop and interferes with the structure of the knitted fabric [4,5].

In the tested double-layer knitted fabric samples, the percentage of longitudinal irreversible deformation varied from 3% to 30%, and the percentage of transverse irreversible deformation varied from 8% to 68% (Table 1, Figure 4).

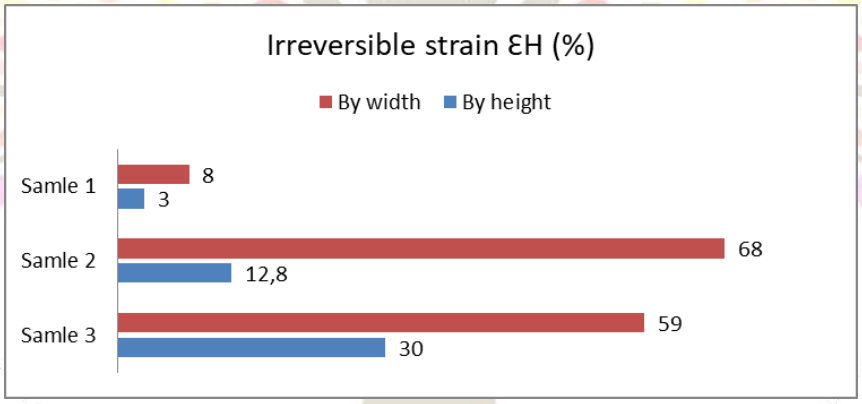

Figure 4. Histogram of change in irreversible deformation εн (%) of double-layer knitted fabric

In the tested double-layer knitted fabric samples, the percentage of longitudinal recovery deformation varied from 70% to 97%, and the percentage of transverse deformation varied from 32% to 91% (Table 1, Figure 5).

Such indicators of the percentage of recovery deformation indicate that the double-layer knitted fabric quickly returns to its original state after stretching.

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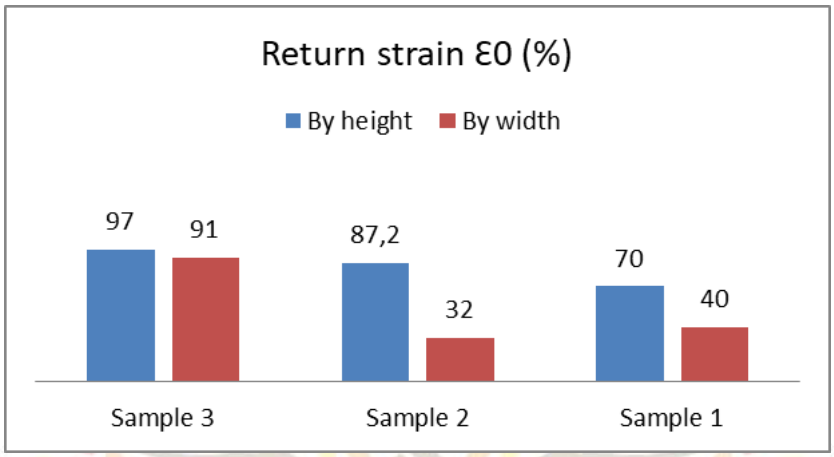

Figure 5. Histogram of change in return deformation ε0(%) of double-layer knitted fabric

Knitwear permeability refers to the change in the size of knitwear during wet processing. Patterned knitted fabrics based on Glad belong to the group of low permeability in terms of length and width.

When processing knitted fabrics, the less the knitted fabric penetrates, the higher its shape-keeping properties. Studies were conducted to study the effect of the amount of polyester and lycra threads in double-layered mixed knitted fabrics on permeability properties. From the results of the penetration study of the double-layer knitted fabric samples, it was found that the length penetration varied from 5% to 32.5% and the width penetration varied from 0% to 17.5% (Table 1, Figure 6).

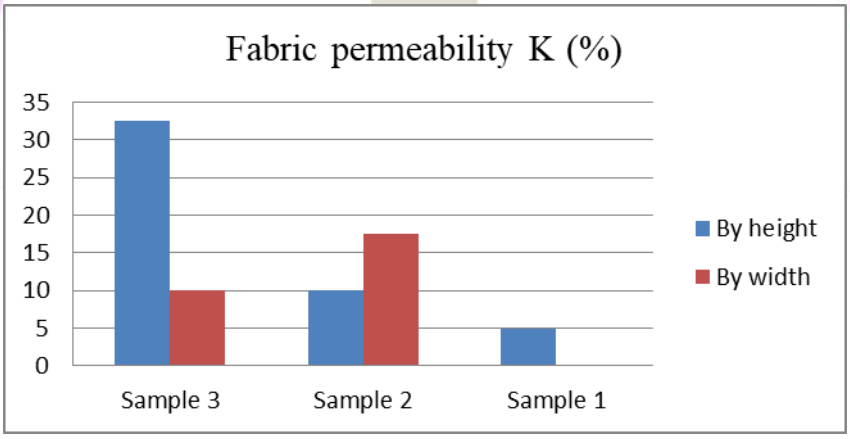

Figure 6. Introduction of double-layer mixed knitted fabric histogram

Knitted fabrics are significantly more elastic than textile fabrics, and have a highly flexible structure even under the influence of small stresses. The

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principle of operation of machines designed for finishing knitted fabrics is almost no different from machines designed for finishing textile fabrics. It has been determined that one of the main reasons for high penetration is excessive deformation of knitted fabrics during finishing operations.

Conclusion

In conclusion, due to the effect on the structure of the patterned mixed knitted fabric obtained based on ring rows, its thickness, warmth and shape retention properties have increased.

Knitted fabric based on GladThe abrasion resistance of the tissues is high in all three options, and the abrasion resistance of the I, II and III options is 40,000 thousand. was found to be higher than (Table 1).

From the analysis of the physical and mechanical properties of patterned knitted fabrics, it was found that, as a result of changes in fabric structures, positive effects on air permeability properties, hardness, stretchability and friction resistance properties of knitted fabric, the properties of shape retention of knitted fabric are strengthened.

The production of knitted fabrics from polyester and rubber threads based on smooth, openwork fabrics allows obtaining knitted products with high hygienic and shape-keeping properties, durability and beautiful appearance.

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