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ANALYSIS OF PHYSICAL AND MECHANICAL PROPERTIES OF TWO-LAYER KNITTED FABRICS OF NEW STRUCTURE

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Abstract:

In the article technological capabilities of modern double bed flat knitting machines results of analyses of physical-mechanical properties double-layer knitted fabrics.

Keywords: double-layer knitting, air permeability, breaking load, breaking elongation, physical and mechanical properties.

The main physico-mechanical properties of two-layer knitted fabrics are the characteristics that determine the limits of their use.

Among the indicators describing the physical and mechanical properties, such as strength, elongation at stress less than the breaking strength, resistance to one-time and repeated deformation, air permeability and friction resistance, penetration after heat-moistening treatment were adopted. Also, the number and number of defects in relation to the surface or unit of length are indicators that describe the appearance of knitted fabrics.

The specified indicators depend on the nature of the raw materials used and the method of obtaining knitted fabrics. It is not necessary to accept the quality indicators given above to describe the quality of all types of fabrics.

In the next study, as a result of the analysis of the technological indicators and physical-mechanical properties of knitted fabric, it was determined that the consumption of raw materials per product unit was reduced from 10% to 12% due to the use of the structure and production method of the double-layered knitted fabric presented in the preparation of knitted products ‧ 1 -4‧ . The effect of the type of yarn used on the parameters and properties of the two-layer knitted fabric was studied in detail in the scientific work under analysis [5-9]. Bonds have been studied for cotton, wool and synthetic yarns made by different methods.

Based on the results of the above-mentioned scientific research work, to expand the assortment of knitted fabrics, as well as to expand the range of types of knitted fabrics, as well as with low consumption of raw materials and high quality indicators, 6 variants of two-layer knitted fabrics of a new structure were woven on the Long Xing LXA 252 SC flat double-needle knitting machine. The method of obtaining knitted fabrics and the effect of fabric structure on the technological performance of knitting were studied.

A graphical record of the two-layer knitted fabric of the new structure produced is shown in Fig. 1. The physico-mechanical parameters of the two-layer knitted fabrics of the new structure were tested in the standard method at the "CentexUz" test laboratory at TTESI, the obtained results are presented in Table 1.

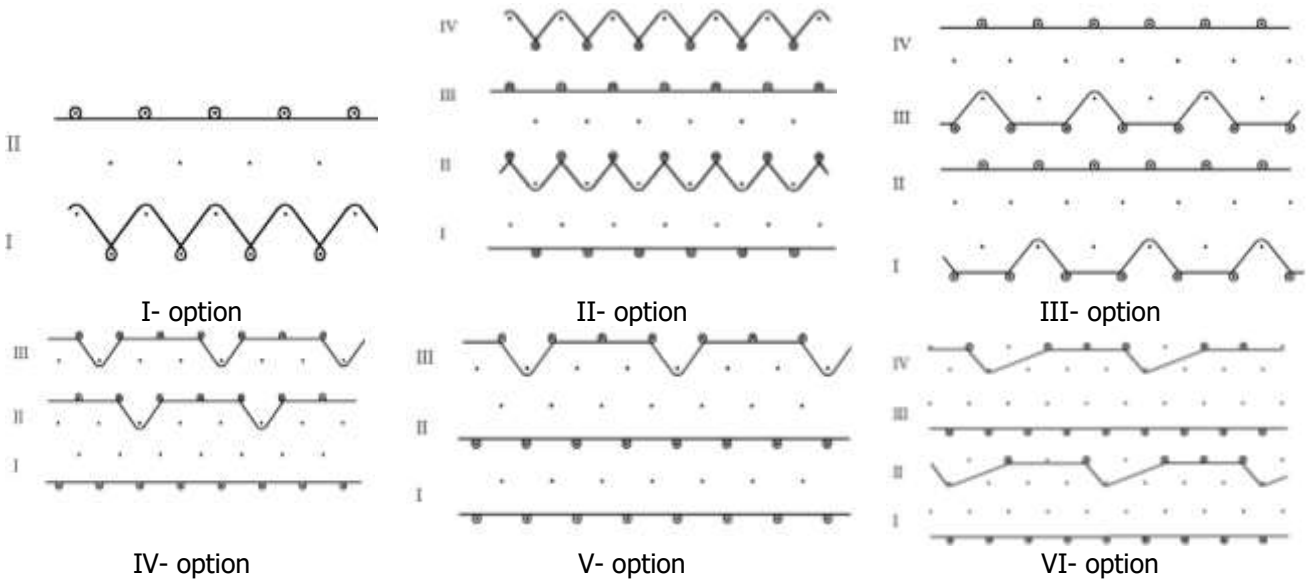

Figure 1. A graphic record of two-layer knitted fabrics in a new structure

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In the table, air permeability, tensile strength, elongation at break, penetration, shape retention characteristics, which are the main quality indicators for two-layer knitted fabrics, were determined and analyzed by the specified test instruments.

Table 1

Physico-mechanical properties of double-layer knitted fabric with a new structure

Indicators		Options					
		I	II	III	IV	V	VI
Thread type and linear density, tex	Front layer	PAN 30 tex 2, 100%					
	Back layer						
Surface density of knitting Ms, g/m^2		358,6	362,7	370,3	363,6	356,7	346,6
Thickness T, mm		1,5	1,8	1,6	1,77	1,92	1,5
Bulk density δ , mg/cm^3		239	201,5	231,4	205,4	185,8	231,1
Absolute volumetric lightness Δδ, mg/cm^3		-	37,5	7,6	33,6	53,2	7,9
Relative lightness θ, %		-	15,7	3,2	14	22,2	3,3
Air permeability B, cm^3/cm^2·сек		154,2	146,6	155,8	138,4	158,4	156,2
Abrasion resistance I, thousand ayl.		11,6	12,6	11,2	11,4	11,5	11
Breaking strength R, N	by height	236	269	270	262	271	267
	in width	221	248	229	184	244	202
Elongation in interruption L,%	by height	86	94	74	96	102	98
	in width	98	122	109	106	102	97
Stretching at 6N,%	in width	32	42	38	28	30	47
Irreversible deformation $\varepsilon_н$, %	by height	22	26	24	13	18	23
	in width	27	27	26	18	22	29
Reverse deformation $\varepsilon_о$, %	by height	78	74	76	87	82	77
	in width	73	73	74	82	78	71
Introduction K, %	by height	-3	+2	+2	+3	-2	-2
	in width	-5	-3	-2	-3	-2	-2

When determining the quality indicators of knitted fabrics, the air permeability characteristic specified in the standard must be determined. Air permeability is understood as the ability to pass air through 1 m2 of the fabric itself in 1 second, and it is characterized by the coefficient of air permeability, which indicates the amount of air that passes through the surface.

The air permeability of the two-layer knitted fabric of the new structure varied from 138.4 to 158.4 cm3/cm2 second due to the method of obtaining the fabric and the structure (Figure 2).

Figure 2. Air permeability indicators of two-layer knitted fabrics of a new structure

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The V-variant two-layer knitted fabric sample has the highest air permeability index, which was 158.4 cm3/cm2sec, which is 2.7% higher than the base fabric. The lowest air permeability index is observed in the IV option, which is 138.4 cm3/cm2 cm2 was 10.2% less than the base tissue. Also, the air permeability indicators of the remaining options in relation to the base fabric became invisible at high values. This is expressed by an increase in the amount of press semi-rings in the composition of knitted fabrics and the placement of needles in a rubbery manner.

The ability of textile fabrics to resist decay factors for a long time is called their resistance to decay. During the production and finishing processes of textile fabrics, and especially when using them to make articles, the structure of the fabrics changes and their properties gradually deteriorate. This process is called aging of gases. As a result of wear and tear, fabrics are eroded. If the surface of the fabric is completely eroded, the erosion in this case is called general erosion. If the surface of the fabric is partially eroded, the erosion in this case is called local erosion. General wear and tear completely destroys items.

Knitted fabric is not exempt from such degradation. In the process of using the product, the knitted fabric is exposed to friction when it touches the surrounding objects, and as a result of the friction, some parts of the product become unusable.

In the course of the research, the abrasion resistance indicators of the two-layer knitted fabrics of the new structure were studied. Due to the participation of glad and press semi-rings in all variants of two-layer knitted fabrics, the abrasion resistance index also recorded values close to each other.

The abrasion resistance of knitted fabrics varied from 11,000 cycles to 12,600 cycles. The greatest value of the abrasion resistance index was observed in the II-variant two-layer knitted fabric, which was 12,600 circular cycles. This is 8.6% more than base fabric I option. At the same time, the smallest friction resistance indicator was observed in variant VI, which was 11 thousand cycles. This is 5.1% less than the baseline (Figure 3).

From the analysis of the abrasion resistance indicators of the obtained two-layer knitted fabrics of the new structure, it was found that the abrasion resistance indicators of the fabrics decrease accordingly due to the increase in the amount of press semi-rings in the structure of the fabric and the reduction of glad ring rows.

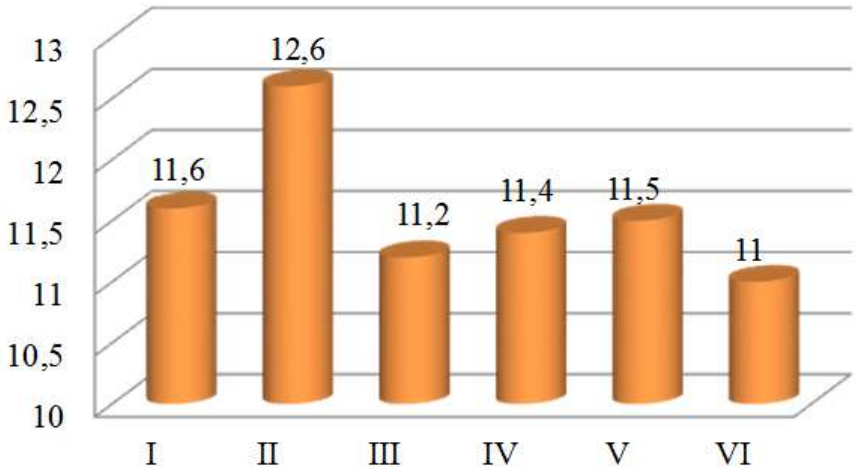

Figure 3. Histogram of change of friction resistance indicators of two-layer knitted fabrics of new structure.

One of the most important parameters of knitting is the tensile strength and elongation to break. Breaking strength is defined as the amount of load required to first stretch and then break fabric samples measuring 20 cm by 5 cm as a result of the movement of a cutting tool with a certain force. Breaking force is expressed in newtons.

In the course of research, the effect of the method of obtaining knitted fabrics and changes in structure on the tensile strength and elongation to break indicators of the samples was determined. The tensile strength and elongation to break parameters of the two-layer knitted fabrics with a new structure being tested were determined using the "AG-1" dynamometer according to the standard method.

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The longitudinal tensile strength values of the two-layer knitted fabric samples in the new structure ranged from 236N to 271N, and the width tensile strength values ranged from 184N to 248N.

Among the samples, the highest tensile strength index was observed in the V-variant and was 271N. This indicator is 14.8% more than the value of the base tissue. The value of the smallest tensile strength along the length belongs to the I-variant base fabric. The largest value of the width breaking strength indicators of two-layer knitted fabrics was observed in option II, which was 248N. This indicator is 12.2% more than the base fabric. The smallest breaking strength value in terms of width belongs to option IV, it was found to be 16.7% less than the base fabric (Fig. 4).

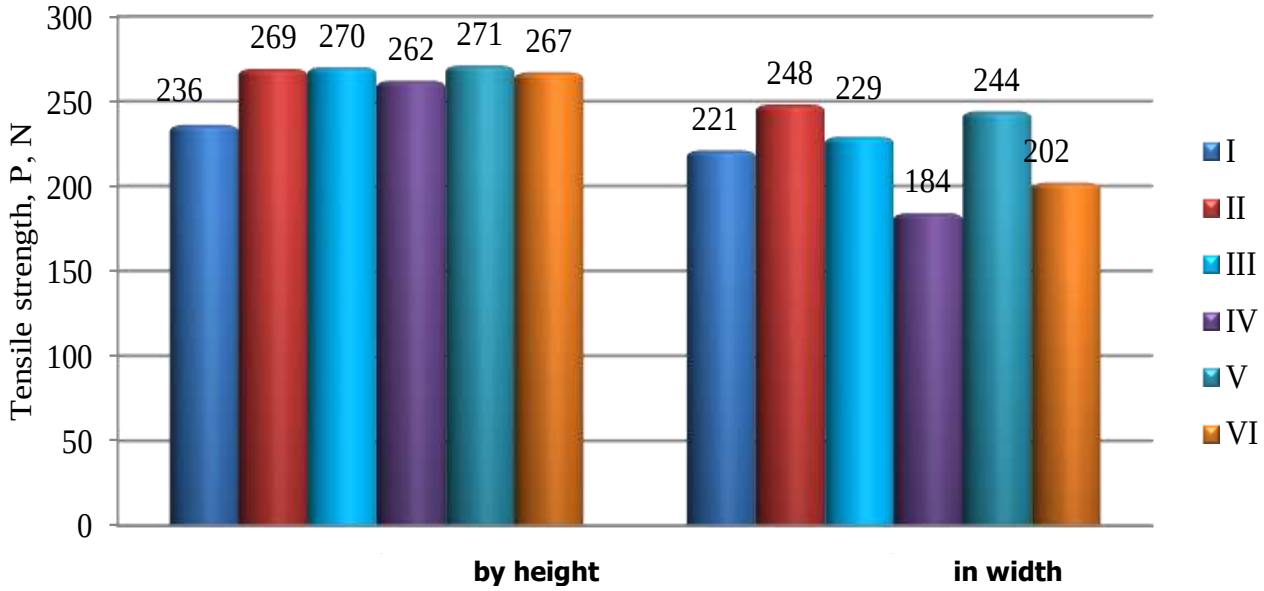

Figure 4. Tensile strength histogram of two-layer knitted fabric in new structure

From the analysis of the tensile strength indicators of the two-layer knitted fabrics of the new structure, it can be concluded that the tensile strength indicators of the samples increased by 12.2% due to the inclusion of additional full glad ring rows in the composition of the fabric. The tensile strength indicators of the two-layer knitted fabrics with the new structure produced are in accordance with the standard requirements, and the standard requirements of all samples are not less than 80N.

Its elongation at break is understood under the influence of force, which is called the elasticity of knitted fabric. Elongation is characterized by the elongation of the sample under test. Elongation in elongation is expressed in absolute and relative units. As can be seen from the results of the analysis of the physico-mechanical properties of the two-layer knitted fabrics of the new structure, the longitudinal elongation at break of the produced variant samples varied from 74% to 102%, and the elongation at break in width varied from 97% to 122% (5 -picture).

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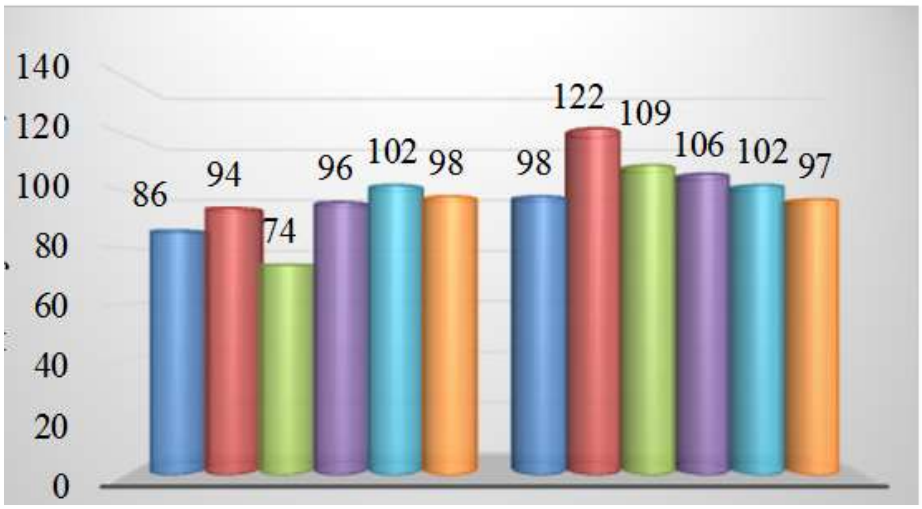

Figure 5. Elongation at break histogram of two-layer knitted fabric in new structure

However, the highest elongation at break was observed in the V-variant two-layer knitted fabric, which was 102%, which is 18.6% more than the elongation at break of the base fabric (86%). The lowest elongation at break in length was observed in variant III two-layer knitted fabric, which was 74%, which is 13.9% less than the elongation at break of the base fabric (86%). In terms of width, the VI-variant two-layer knitted fabric has the lowest value of elongation at break (97%), it is 1.02% less than the base fabric. The elongation at break of the two-layer knitted fabric of option II has the largest value of 112%, which is 24.5% more than the elongation at break of the two-layer knitted fabric of option I.

When the width of the two-layer knitted fabric of the new structure was investigated, the elongation at 6N was 32% in the base fabric, the largest value was 47% in variant VI, which was 46.8% more than the value of the base fabric, and the smallest value was It was observed in option IV and its value was 28%. It turned out that this indicator is 12.5% less compared to the base tissue (Fig. 6).

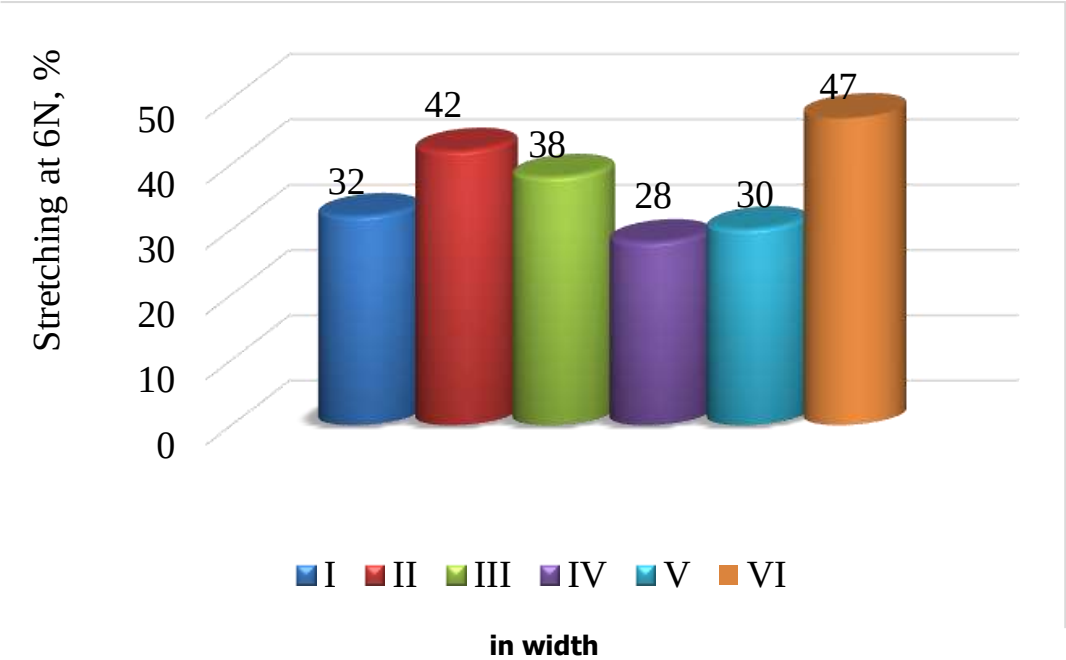

Figure 6. Elongation histogram at 6 N of the two-layer knitted fabric of the new structure

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From the analysis of the elongation at break indicators of the two-layer knitted fabrics of the new structure, it was found that due to the increase in the number and number of press half-rings in the fabric, the elongation at break indicators of the samples also increased. The elongation at break and elongation at 6N of the produced two-layer knitted fabrics are in accordance with the standard requirements of groups I and II.

When designing knitted products, it is very important to know in advance what kind of elasticity the fabric has. This is because knitted fabrics are made up of loops, so the stretch properties are high. This has a negative effect on the properties of fabric and products.

The method of obtaining two-layer knitted fabrics of a new structure and the effect of changing the structure on their shape retention properties were studied. It is known that the use of the percentage of return deformation in expressing the properties of shape retention of knitted fabrics and products is insufficient. Therefore, the amount of irreversible deformation, which indicates the degree of difference from the original size of the fabric, is considered an important indicator in the evaluation of knitted fabrics.

The above-mentioned method makes it possible to understand the difference between reversible and irreversible deformation indicators not only in tissues made from different kalava threads, but also in tissues formed from one thread, but with different structures. This is one of the most important features, especially for double-layer knitted fabrics. The percentage of return deformation of these samples was determined, in which the belt returns at a high speed after the loads are removed from the samples undergoing deformation-experiment; elastic deformation-develops at a low speed; plastic deformation - the percentage of irreversible deformation that does not return after the load is removed from the samples.

The percentage of length recovery of the tested two-layer knitted fabric samples varied from 74% to 87%, and the percentage of width recovery varied from 71% to 82% (Figure 7).

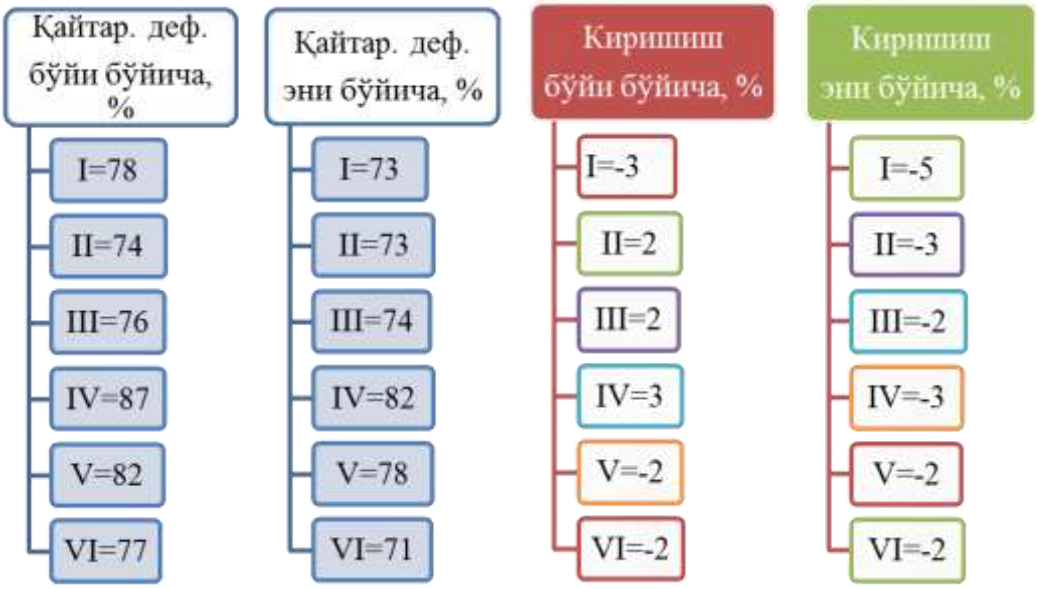

Figure 7. Shape retention parameters of two-layer knitted fabrics of new structure

The largest return deformation amount of double-layer knitted fabric in the new structure was 87% and was observed in option IV. This indicator is 11.5% more than the rate of return deformation of the base fabric I option. The smallest amount of return deformation was 74% and was observed in option II, and the amount of return deformation of the base tissue is 5.1% less than that of option I. The largest amount of back deformation in terms of the width of two-layer knitted fabrics was observed in option IV and made 82%, which is 12.3% more than the share of back deformation of base fabric in option I. The smallest amount of return deformation was 71% and was observed in option VI, and it was found in research processes that the base tissue is 2.7% less than the share of return deformation of option I.

Such indicators of the percentage of recovery deformation indicate that double-layer knitted fabrics quickly return to their original dimensions after stretching.

Since both layers of two-layer knitted fabrics are independent of each other in terms of structure

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and properties, permeability indicators are also different from each other. The two-layer knitted fabric samples tested had lengthwise penetration values ranging from -3% to +3%, and widthwise penetration values ranging from -5% to -2%.

The highest permeability index of the length of two-layer knitted fabric in the new structure was observed in option IV, +3%, and the lowest permeability index was +2%, observed in options II and III. At the same time, the highest permeability indicator in terms of the width of two-layer knitted fabric was -2% and was observed in variants III, V and VI. And the lowest permeability index was -5%, and it was found that it belongs to the base tissue.

Physico-mechanical properties of two-layer knitted fabrics of the new structure were revealed from the analysis of research results, in which the method and structure of the two-layer knitted fabric include the addition of full glad ring rows to the fabric rapport along with press half-loops to reduce the volumetric density of the knitted fabric, air permeability, length and width. it has been proved that it is possible to increase the strength, to reduce the elongation at break and to reduce the permeability properties. As a result, the shape retention properties of knitted fabrics are improved, which in turn has a positive effect on the consumer properties of the two-layer knitted fabric samples of the new structure.

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