INVESTIGATION OF THE INFLUENCE OF THE CHANGE OF PATTERNS ON THE SURFACE OF TWO-LAYER KNITTED KNITTED FABRIC ON THE PHYSICAL AND MECHANICAL PARAMETERS OF KNITTED KNITTED FABRIC

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Abstract: In this article, using the capabilities of flat double-needle knitting machines, the patterns on the surface layer of the two-layer knitted fabric were gradually increased, and the knitting technology was developed and its physical and mechanical parameters were studied. 3 samples of knitted knitted fabric were taken, their technological indicators and physical-mechanical properties were studied experimentally, presented in a table and analyzed. Experimental samples of two-layer knitted fabrics were developed and graphically recorded on a LONG-XING LXA 252 12G (China) flat needle machine.

Key words: Knitting, polyacrylonitrile yarn, patterned knitting, double knitting, yarn, yarn, flat, bulk density, yarn height, surface density, pattern, density, yarn length.

Textiles and light industry are important sectors of the economy that make up the budget of many countries. Innovative opportunities are a strategic resource that determines the place of the national economy in the world economy system. Applying scientific achievements to production is a necessary condition for improving the quality

indicators and competitiveness of domestic products that replace imports and expanding the export structure.

It is strategically important to ensure high and stable growth rates in the textile and sewing-knitting industry in our republic, by attracting and absorbing direct foreign investments, producing and exporting competitive products, modernizing enterprises, technical and technological updating, and introducing an improved "cluster model". systematic works aimed at creating high-tech new jobs are being carried out at the expense of project implementation.

- Production of knitted products with high hygienic properties, effectively using local raw materials in the production of knitted products, is one of the current problems. As the standard of living of the people living on earth improves, the demand for textile products with high hygienic properties is increasing. Therefore, the knitting industry is considered the most important branch of the textile industry today. Knitted products are modern, practical, convenient and affordable. The knitting industry has the following specific advantages:
- in the field of expanding the product range, there is a wide opportunity to obtain various mixed fabrics that provide different properties and appearance of the knitted fabric;
- a unique consumer feature of knitted fabric, which is highly resistant to repeated deformation conditions, complex physical-mechanical properties such as friction, wrinkling, high hygienic properties (hygroscopicity, air permeability and properties that provide a number of comfort conditions), complex aesthetic indicators;

the availability of a wide technological possibility for regular and semi-regular production of products.

It allows to develop new types of patterned knitted fabrics, to increase the proportion of patterns or patterns in knitted products, to expand the assortment of knitted fabrics, as well as to develop the production technology of patterned knitted fabrics in order to expand the technological capabilities of the LONG-XING LXA 252 12G (China) flat double-needle machine. 3 samples were developed by changing the type and proportion of the pattern effect in the output. The developed samples of the patterned knitted fabric differ from each other by the change of the fabric structure in a certain degree relative to the base fabric. The technological parameters and physical-mechanical properties of the patterned knitted fabric were determined by the experimental method in the laboratory of the Namangan Institute of Engineering Technology, the measurement results are presented in the table. As a result of the conducted practical studies, the fabric structure, physical mechanical properties and external appearance were determined, which describe the quality indicators of the knitted product.

The parameters describing the structure of the knitted fabric include: surface and volume density, width and length density (number of loops per unit length), loop thread length, the angle between the rows of loops and loop columns, and the thickness of the knitted fabric. A graphic record of the newly produced two-layer knitted fabric is presented in Fig.

Polyacrylonitrile yarn with a linear density of 32*2 tex was used as raw material.

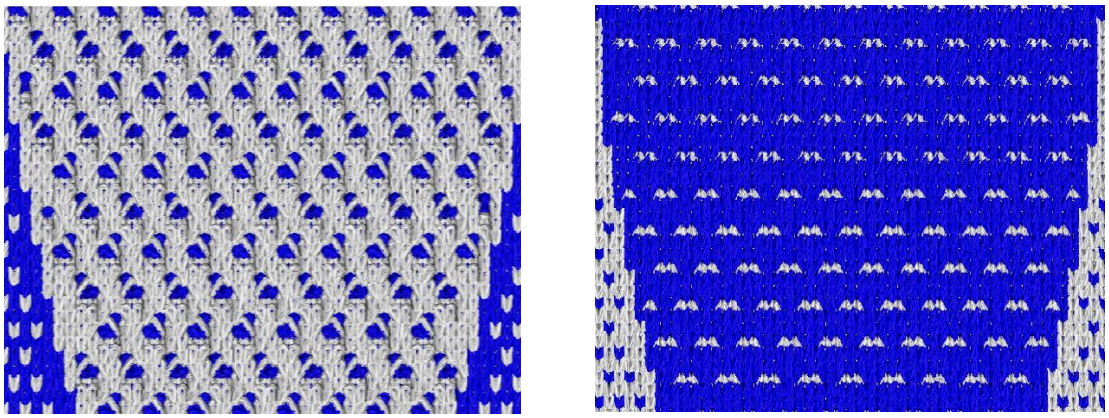

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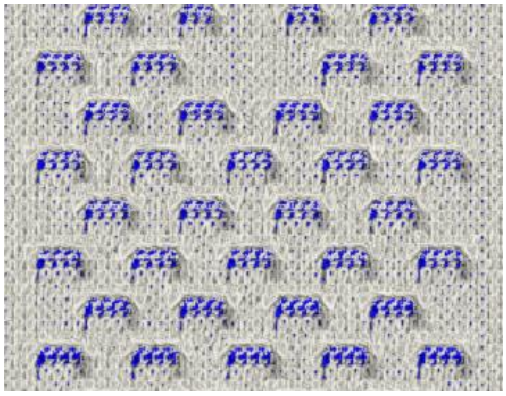
Figure 1. Option 1 is a graphic record of double-layer knitted fabric

LONG-XING LXA 252 12G flat double-needle knitting machine changes the position of loops, densities, length of loop thread and a number of other parameters automatically during the production of knitted products. This makes it easy to get a variety of knitted fabrics. On the front of the obtained sample, mesh patterns were created in order to improve the air permeability. Joining the front layer with the back layer was done by transferring 2 loops to the back in the form of 2x2 on the front needle. As a result, it was possible to obtain a knitted fabric with a unique pattern, improved shape retention and air permeability. (Figure 1)



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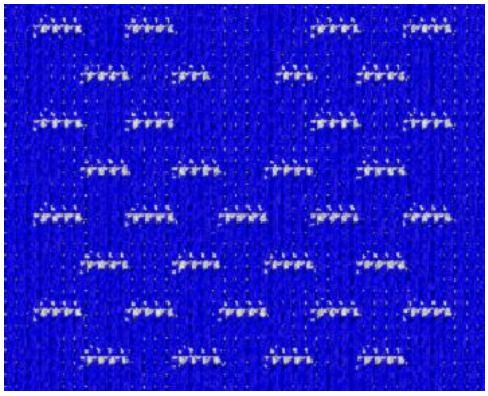

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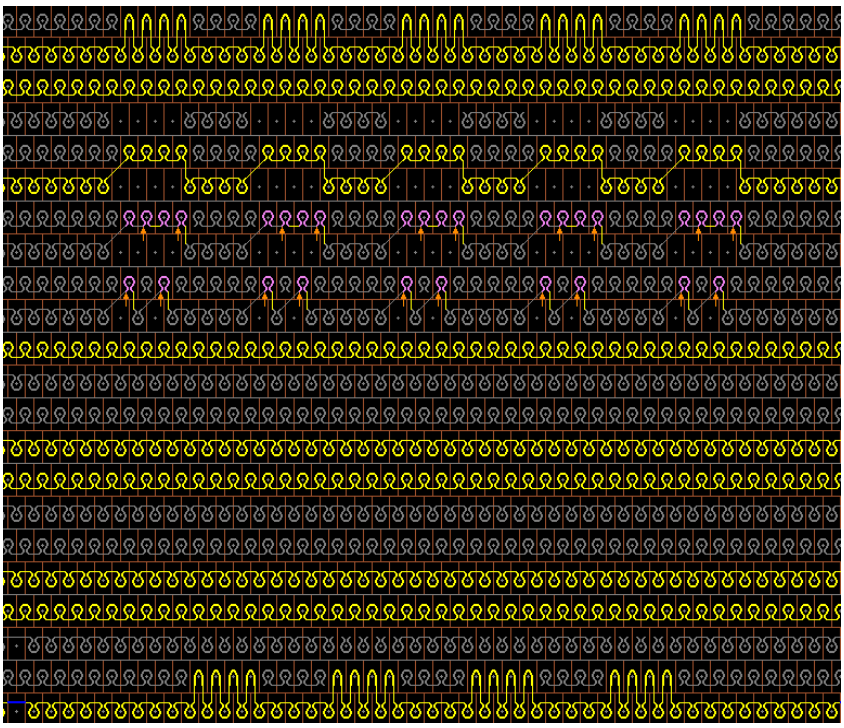
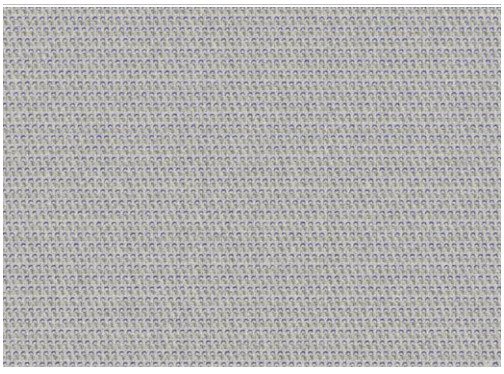


Figure 2. Option 2 is a graphic record of two-layer knitted fabric

In the 2nd option, the joining of the front layer with the back layer was carried out by transferring 4 people to the back in the form of 4x4 on the needle. As a result, it was possible to obtain a knitted fabric with a unique pattern, improved shape retention and air permeability. (Figure 2)



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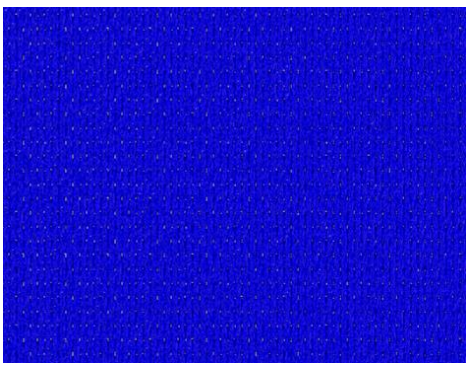

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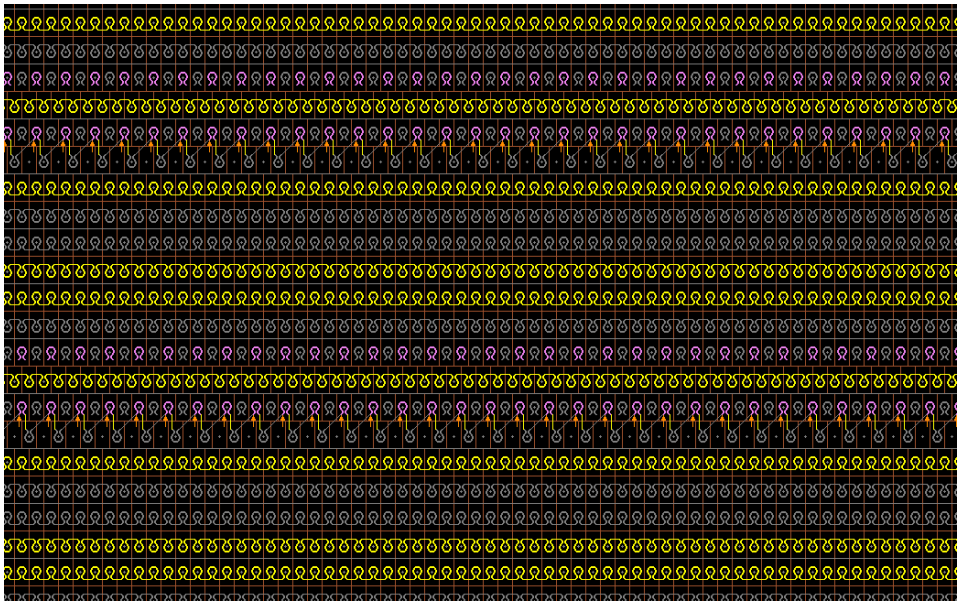


Figure 3. Option 3 is a graphic record of two-layer knitted fabric

In the 3rd option, the front layer is combined with the back layer by transferring 1 row to the back in the form of 1x1 on the needles. As a result, it was possible to obtain a knitted fabric with a unique pattern, improved shape retention and air permeability. (Figure 3)

Due to the change in the percentage of patterns in the patterned knitted fabric, it was found that the volume density index of the two-layer patterned knitted fabric in all the samples changed significantly compared to the base fabric. The volume density of knitted fabric is one of the main technological indicators, which indicates the consumption of raw materials in the knitted fabric..

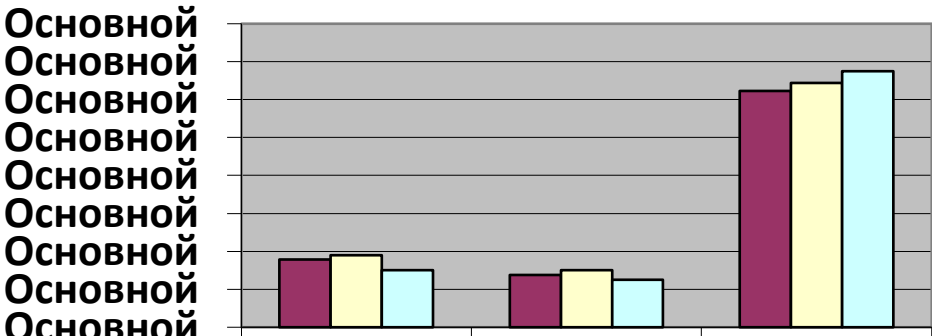
Technological parameters of knitted fabric

Table 1

Indicators	**Samples**		
	1	**2**	**3**
Thread type and linear densities	**Polyacrylonitrile 35 tex x2**	**Polyacrylonitrile 35 tex x2**	**Polyacrylonitrile 35 tex x2**
	Polyacrylonitrile 35 tex x2	**Polyacrylonitrile 35 tex x2**	**Polyacrylonitrile 35 tex x2**
Ring step A (mm)	1.79	1.9	1,5
Row height B (mm)	1.38	1.5	1,25
Horizontal density R_h	28	28	28
Vertical density R_v	43	43	43

Ring strip length L (mm)		6.22	6.44	6,74
Knitted surface density Ms (gr/m^2)		362	473	543
Knitting thickness T (mm)		2.41	2.52	2.61
Volume density δ (mg/sm^3)		150.2	181.5	226.4
Air permeability		39.32	43.052	48.68
Breaking force	height	489	543	548
	width	434	425	440
Elongation at break (mm)	height	158,6	98,1	100,7
	width	234,4	239,3	231
Stretching to break (%)	height	46,3	45,35	48,35
	width	109,2	106,15	110,5
Consumption energy at interruption (J)	height	23,8	20	24,2
	width	27,7	29	30,2
Revensible deformation , $\varepsilon_н$, %	height	23,5	20,7	21,8
	width	34,3	31,5	28
Irrevensible deformation, ε_o, %	height	76,5	79,3	78,2
	width	65,7	68,5	72

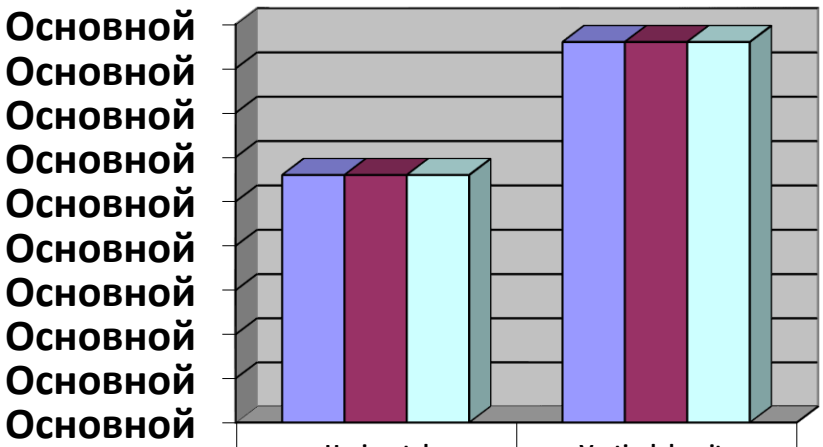
A number of technological indicators have been observed to change due to the gradual change of the base fabric and the fabric structure of the knitted fabric, and the most optimal option is selected by comparing these indicators.



	Ring step A (mm)	Row height B (mm)	Ring strip length L (mm)
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной	Основной

Figure 4. A histogram of the warp pitch, warp row height, and warp thread length of a patterned knit

In all samples, we can see that the pitch and row height vary from sample to sample. We can see that the yarn length has changed slightly due to the change in the patterned knitting fabric. (Figure4)



	Horizontal density Rh)	Vertical density Rv
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной

Figure 5. Horizontal and vertical density histogram of patterned knitted fabric

Horizontal and vertical densities are the same in all samples, that is, the number of 50 mm long rings is 28 and 43, respectively. (Figure 5)

The lowest air permeability was observed in sample I- of knitted fabric with a pattern and its amount was 39.32 cm3/cm2□sec. The highest air permeability was observed in sample III of knitted fabric samples, and its amount was 48.68 cm3/cm2□sec, which is 23.80% more than that of fabric (variant III). (Figure 6)

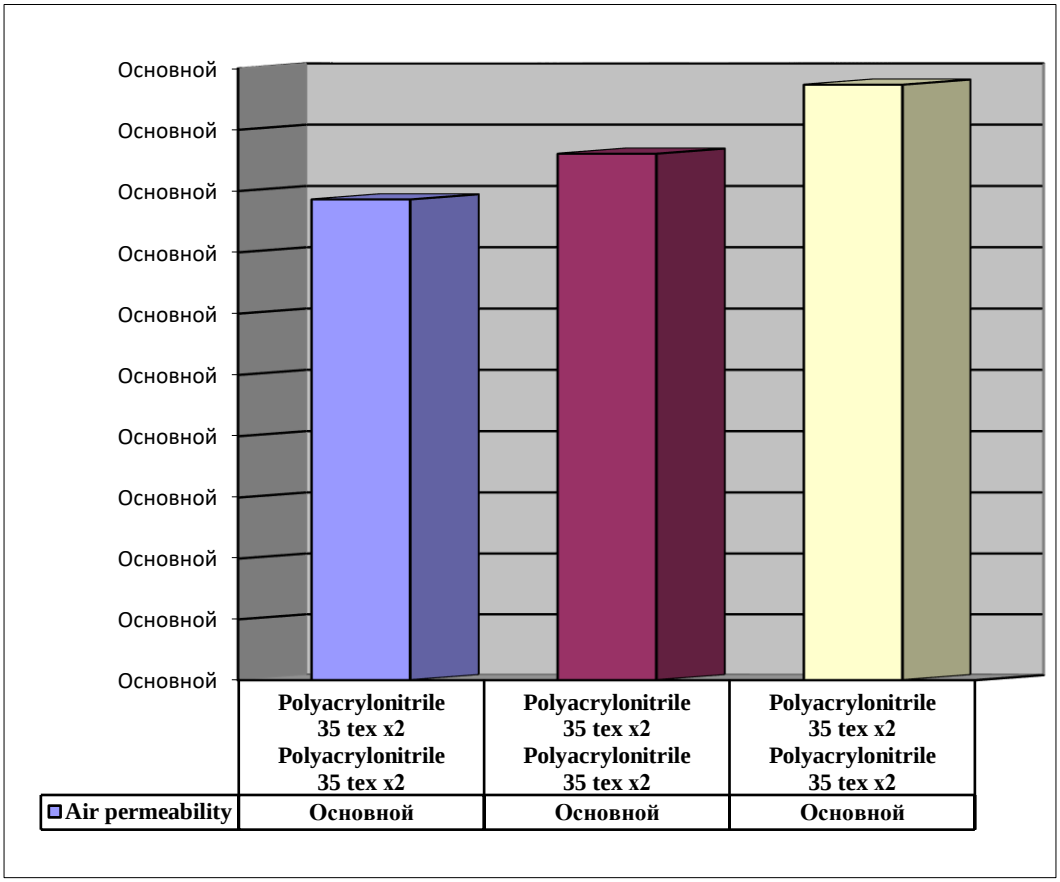
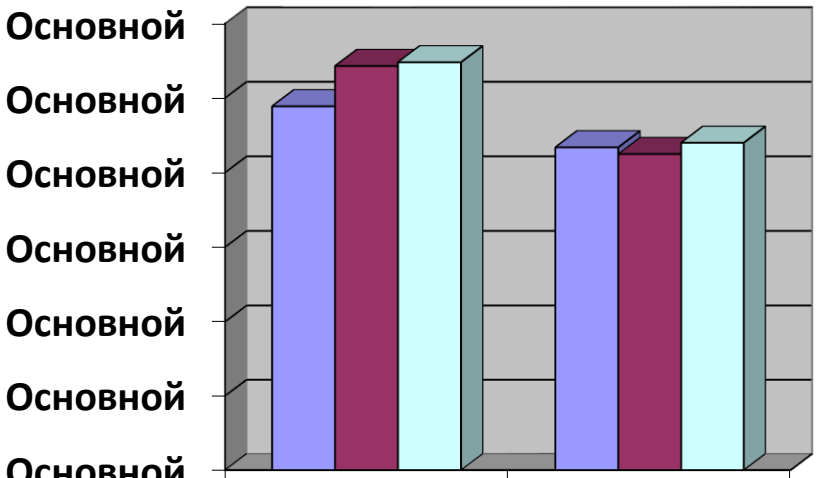


Figure 6. Air permeability histogram of patterned knitted fabric

The break characteristic is the main parameter accepted for evaluating the quality of knitted fabrics. 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 Newton (N). The tensile strength of the presented samples was determined using a "YG-026T" dynamometer according to the standard method.

Analysis of tissue toughness, that is, breaking strength, shows that the most mature tissue in terms of length is sample III, its index is equal to 548 N, which is 12% higher than sample I (Table 1, Figure 7).

The transverse stiffness of the fabric was also observed in sample III, the tensile strength of this fabric was 440 N, which is 1.4% higher than that of sample I.



	heigh t	width
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной
Polyacrylonitrile 35 tex x2 Polyacrylonitrile 35 tex x2	Основной	Основной

Figure 7. Histogram of tensile strength of patterned knitted fabric

Calculated breaking energy is defined as the amount of energy used to break a sample when stretching it at a given size and speed. The energy stored in the break is expressed in the unit of Joule (J). The rated breaking energy of the presented samples was determined using a "YG-026T" dynamometer according to the standard method.

The analysis of tissue toughness, i.e., the amount of total energy at break, shows that the most mature tissue in terms of length is sample III, its average energy at break is equal to 24.2 J, and it was found that the hardness is 1.7% higher than that of sample I (1 -table, Fig. 8).

The stiffness of the tissue along the width was also observed in the III-sample, the averaged energy in the rupture of the tissue along the width is 30.2 J, which is 9.02% more than the tissue of the I-sample.

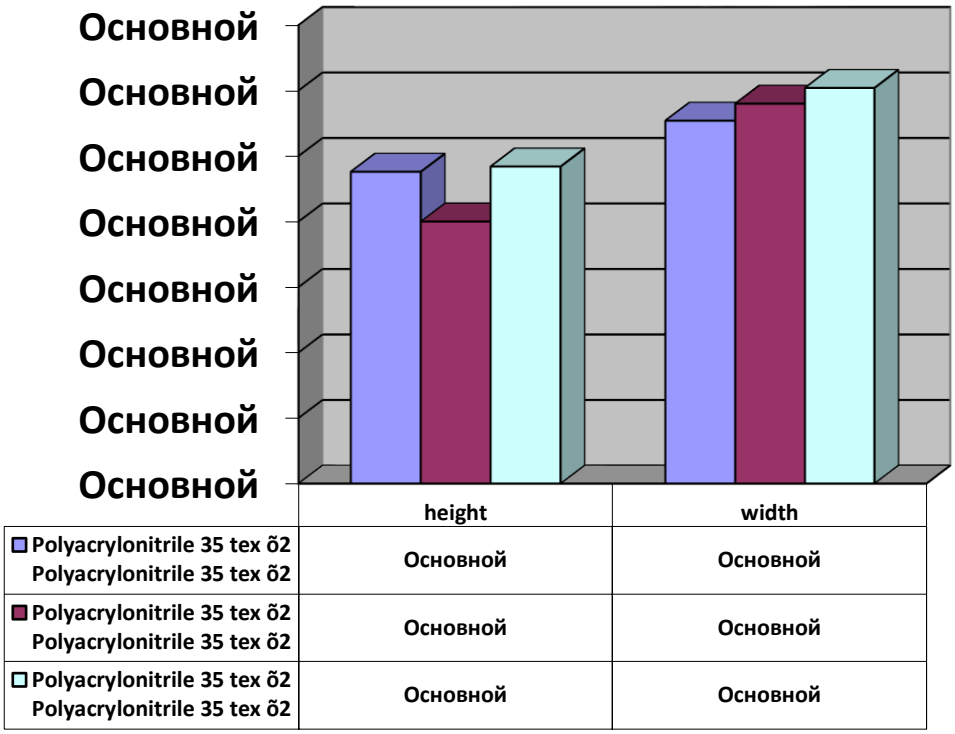


Figure 8. Histogram of the normalized breaking energy of a knitted fabric

From the analysis of the physical and mechanical properties of the above-mentioned patterned knitted fabrics, it was found that the optimal sample with improved shape retention properties was found as a result of the change in the percentage of the patterns formed by transferring the loops in the fabric, as well as the positive effect on the air permeability properties, hardness and stretchability of the knitted fabric. It was also found that the number or equal ratio of the moving rings in moving the rings serves to improve the properties of shape retention.

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