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STUDY OF TECHNOLOGICAL PARAMETERS AND PHYSICAL-MECHANICAL PROPERTIES OF RIB FABRIC KNITTED FROM SPINNING COTTON-NITRON YARN

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Abstract:

Objective. For the purpose of effective use of local cotton-nitron yarn in the scientific work was conducted on the technological indicators and physical mechanical properties of rib stitch fabric. The purpose of research is develop and recommend the new technology of production of rib knitted fabric with high heat and shape retention properties by using mixed cotton-nitron yarn.

Method. Theoretical analysis and synthesis methods, the research of the knitting process was used, and experimental researches in the production conditions by Hanma (China) circular knitting machine were carried.

Results. A positive result of the properties of the fabric was achieved by the creation of the technology of knitting rib stitch fabric using cotton-nitron yarn.

Conclusion. Experimental samples of rib knitted fabrics obtained from spun cotton and cotton-nitron yarns were taken and their technological indicators and physical-mechanical properties were analyzed.

Keywords: knitting, cotton-nitron, rib, air permeability, abrasion, rupture, deformation.

Introduction. The range of products made from a mixture of natural and chemical fibers is systematically expanding in our country and abroad. This is due to the following reasons:

- due to the shortage of natural fibers, the need to increase the production of chemical fibers and expand their fields of application;
- purposeful creation of the necessary properties in the products - properties of shape retention, friction resistance properties;
- the need to replace natural fibers with high consumer properties with chemical fibers and their mixtures in the field of technical application.

Methods. For the textile industry of the Republic of Uzbekistan, it is an urgent issue to develop a complex technology for processing polyacrylonitrile nitrone in pure form and without mixing it with cotton fiber. This scientific work is based on the need to expand the field of application of synthetic fiber local raw material - nitron fiber. High heat storage properties, the ability to control the physico-mechanical properties of nitron fiber during its formation, as well as its light resistance serve as the basis for obtaining mixed fiber fabrics with new properties. If necessary, they can replace fabrics (lavsan) made from a mixture of cotton and polyester fibers brought to the Republic from abroad.

Chemical fibers have different haze colors, penetration, twistability, different geometric parameters, dyeing, luster and strength properties. The influence directed at the structure of polymer chains allows obtaining special properties of yarns. Resistant to various chemical effects, non-flammable and anti-bacterial, as well as high-modulus bicomponent, core and other yarns are widely used. For example, more than 400 types of textured polyester threads are used in the world, and their differences in color are an exception. High tenacity (high modulus) yarns have a wide range of potential, including metal, glass, carbon, arimide, and liquid crystalline polyester polyolefin yarns with long molecular chains.

The use of partially oriented fibers and yarns is growing, which allows to improve the properties of fabrics: high elasticity, resistance to abrasion, toughness, high penetration (more than 50%) during heat treatment, which allows to give high shape retention properties. Completely new materials and fabrics are being created on the basis of chemical fibers and threads. Textile materials are used in the field of nature protection (geotextile), radiolocation and communication, medicine, agriculture. Geotextile allows solving many important problems. Non-knitted fabrics, knitted and knitwear provide performance of mechanical (separation, protection, reinforcement, leveling along the surface, formation of barriers, reinforcement, adsorption), hydraulic (drainage, filtering), radiotechnical tasks. Composite materials are emerging.

The main types of chemical fibers used in the cotton thread and knitted production industry are ordinary viscose and polyester fibers.

Polyester fibers have a low price and are universal in terms of use. These fibers are most commonly used in blends with cotton fibers, although pure cotton fibers are used to blend yarns with cotton fibers to increase the softness of fabrics. This is achieved in two ways: creating staple fibers of different lengths and improving their sorption properties.

Many foreign scientists have been engaged in making textile products by preparing yarn spun from a mixture of natural and chemical fibers [1-8].

It is known that the spun cotton thread is used to make inner knitwear and hosiery products, and when outer knitwear products are produced, the knitwear has high hygienic properties and low shape retention properties. For this reason, in this work, parameters and physical-mechanical properties of fabrics that can be used in the production of outer knitted products using spun cotton-nitron yarn mixed with nitron and cotton fibers were studied.

In production conditions, 4 types of rib stitch fabric were knitted on the PAILUNG circular knitting machine. In the production of rib stitch knitted samples, spun cotton yarn with a linear density of 20 tex, spun cotton-nitron (85/15) yarn with a linear density of 20 tex, and lycra yarn were used. The difference between the samples is in the raw materials used in their development.

To obtain the I-variant of the rib stitch fabric, the spun cotton-nitron (85/15) yarn with a linear density of 20 tex and the lycra yarn were used.

To obtain the II-variant of the rib stitch fabric, a spun cotton-nitron (85/15) thread with a linear density of 20 tex was used.

Option III was made using lycra yarn and spun cotton yarn with linear density of 20 tex.

A spun cotton thread with a linear density of 20 tex was used to obtain the IV-variant rib stitch fabric.

Results. Technological parameters and physic-mechanical properties of the obtained rib stitchknitted samples were analyzed experimentally in the "CENTEX UZ" laboratory and the results are shown in Table 1.

According to the results in the table, technological parameters and physic-mechanical properties of knitwear are

changed depending on the type of raw material.

The surface density of the rib fabrics were higher in the samples made with lycra. The surface density of the 1st variant knitted by adding lycra to the cotton-nitron yarn is 25.7% higher than the surface density of the second variant knitted from the cotton-nitron yarn. The surface density of the III-variant knitted fabric by adding lycra to the spun cotton yarn is 25.2% higher than the surface density of the IV-rib stitch fabric knitted from the cotton yarn.

If we compare the surface density of the rib stitch fabric knitted from cotton yarn with the same linear density to the rib fabric knitted from cotton-nitron yarn, the surface density of cotton-nitron knitted fabric is 5.6% less than the surface density of cotton-containing rib stitch fabric.

Table1

Indicators		Variants			
		1	2	3	4
Types of threads, linear density		Cotton-nitron yarn (85/15) 20 tex +lycra	Cotton-nitron yarn (85/15) 20 tex	Cotton thread 20 tex+lycra	Cotton thread
Surface Density (gr/m^2)		193.7	154.1	204.3	163.2
Fabric thickness (mm)		0.7	0.55	0.8	0.6
Bulk density (mg/sm^3)		276.7	280.2	255.4	272
Air permeability (см^3/см^2·сек)		162.2	211.9	141.1	211.9
Abrasion resistance, thousand/rotation		22.5	20.0	24.0	18.1
Tensile strength, N	Height	290.6	322.5	394.4	340.8
	Width	124.0	95.5	154.8	94.5
Stretching to break (%)	Height	16.4	8.9	12.96	7.4
	Width	121.0	98.9	102.7	79.3
Irreversible deformation (%)	Height	10.0	26.3	23.6	26.7
	Width	12.3	26.1	14.6	17.1
Reverse deformation, (%)	Height	90.0	73.7	76.4	73.3
	Width	87.7	73.9	85.4	82.9
Shrinkage, (%)	Height	14.0	12.5	16.5	12.0
	Width	4.0	1.5	2.0	4.0

The analysis of the thickness of the knitted fabric showed that the options knitted from the spun cotton thread are thicker. The thickness of knitted samples with lycra thread will be greater than the thickness of non-lycra options. Then the thickness of the I-variant was 27.3% greater than the thickness of the I-variant, and the thickness of the II-variant was 33.3% greater than the thickness of the IV variant.

Discussions. The indicator that can fully show the consumption of raw materials of knitting is the bulk density. This indicator shows the consumption of raw materials in the production of knitwear, taking into account not only the surface of the knitted fabric, but also the thickness.

In the obtained rib knitted samples, the change in thickness changed more intensively than the change in surface density. As a result, variant III with the highest thickness has the lowest bulk density, and it was determined that its bulk density is 7.7% less than variant 1, 9.7%

less than variant II, and 6.5% less than variant IV.

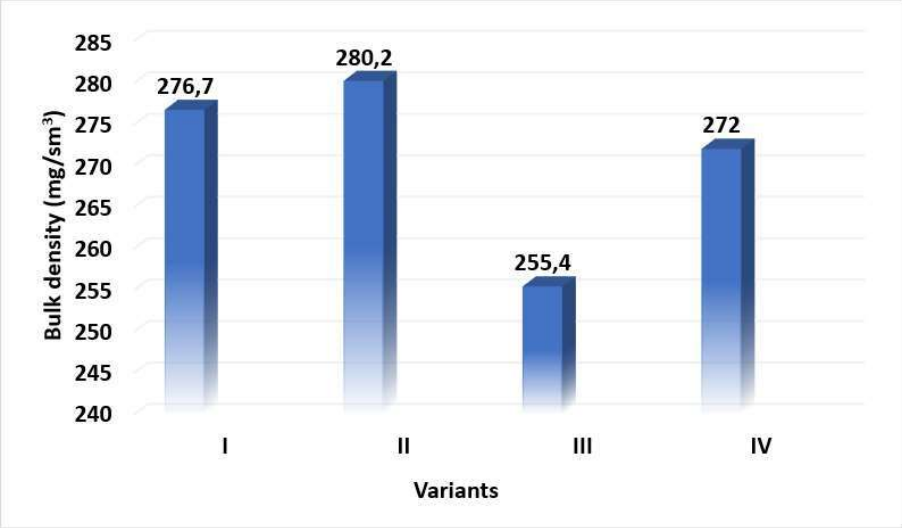

Figure 1. Change in volume density of rib stitch knitted fabrics

A feature of special importance for outer knitwear is the moisture retention property of knitwear. The air permeability of the knitted samples under study is lower than the knitted samples with lycra, which means that their heat retention properties are higher. The air permeability of the samples obtained from spun cotton-nitron yarn decreases by 6.5% when lycra yarn is knitted into it, and by 6.6% for knitted samples obtained from spun cotton yarn (Fig. 2).

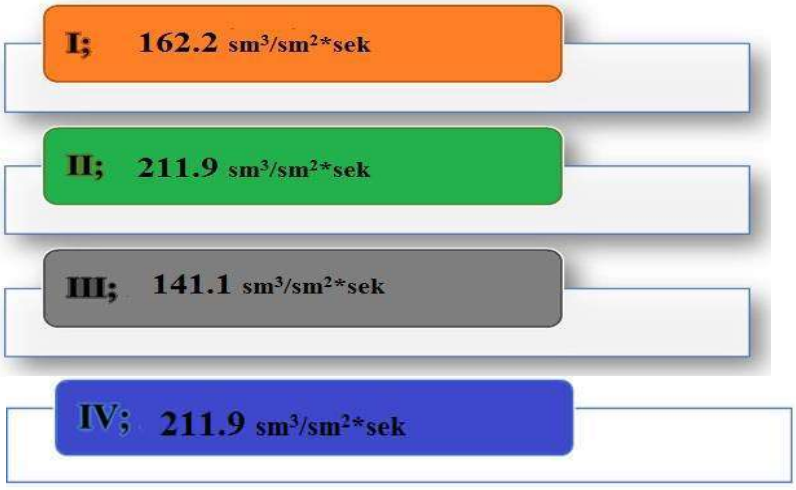

Figure 2. Change in air permeability of rib stitch knitted fabrics

The strength of the knitted fabric is determined by its abrasion resistance and breaking strength. The analysis of the change of abrasion resistance of the knitted fabric samples under study shows that the abrasion resistance of the IV variant obtained from the spun cotton thread is lower than the other variants, but the abrasion resistance of the III variant, which consists of cotton yarn and lycra yarn, is the highest. It should be noted that the abrasion resistance of rib stitch fabric obtained from cotton thread (option IV) is significantly different from the abrasion

resistance of knitwear knitted by adding lycra to spun cotton thread (III option), the difference is 32.6%, compared to the cotton-nitron thread itself (II -variant) and the abrasion resistance of the rib stitch knitted fabric knitted by adding lycra yarn to spun cotton-nitron yarn (I-variant) differs by 12.5%.

One of the most important features of knitted products is shape retention. The shape-keeping feature of knitwear is characterized by its stretchability, irreversible deformation and permeability.

The experiment leads to the conclusion that the change of irreversible deformation of rib stitch knitted samples when adding lycra to the composition of the knitted fabric leads to an increase in the percentage of its reversible deformation. At the same time, it was found that the return deformation of the samples obtained from the cotton yarn is less than the return deformation of the knitted samples obtained from the cotton-nitron yarn.

When adding lycra yarn to the composition of the knitted fabric, its return deformation increased by 22.1% in length and 18.7% in width for knitted fabric made from cotton-nitron yarn, and by 4.2% in length and width for knitted fabric made from cotton yarn increased by 3% (Figure 3).

Figure 3. Return deformation of rib stitch knitted fabric

Conclusion. Analysis of the penetration properties of knitwear shows that the penetration of knitted samples obtained from cotton-nitron yarn is less than the penetration of knitted samples obtained from spun cotton yarn.

From the analysis of the technological and physical-mechanical properties of rib stitch knitted fabrics obtained from different raw materials, it was found that the knitted fabric made from cotton-nitron yarn is lighter, more resistant to friction and has higher shape retention properties than the knitted fabric made from cotton yarn.

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