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Investigation of Cotton-Silk Patterned Knitted Fabrics` New Structures

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ABSTRACT: The article presents the results of a study of new structures of cotton-silk patterned knitwear. Presented are graphical records of the developed options for patterned knitwear, technological parameters and physical and mechanical properties. A comprehensive assessment of the quality of experimental samples of cotton-silk patterned knitwear was carried out, based on which the best options were recommended.

KEYWORDS: cotton-silk knitwear, patterned knitwear, structure, properties, circular knitting, knitting machine.

I.INTRODUCTION

The main tasks facing knit wear companies are increasing the country's export potential, expanding the product range, improving product quality, manufacturing import-replacing products with high physic-mechanical properties that meet the requirements of climatic and seasonal conditions through the effective use of local raw materials.

Uzbekistan ranks first in the world in the number of silk produced per capita and third in volume of production. The share of Uzbekistan in silk production in the CIS countries is more than 80% и and has great potential for the production of original silk products.

In the production of knitwear is often used mixed yarn, consisting of silk and other types of fibers. It is known that in the UK in the production of knitwear successfully used a modified yarn from a mix of silk, cotton and synthetic fibers. Today, there is a growing demand for comfortable and at the same time wear-resistant products, including for recreation and sports.

Despite the fact that natural silk has a high flatness in linear density, durable, elastic, has good air permeability and unsurpassed hygienic properties in our country it produces a very limited range of products, which mainly consists of crepe and avr (national style) fabrics. Although in the world silk is used in the development of a diverse range of products.Therefore, the task of expanding the range of products from natural silk is very relevant in Uzbekistan. The use of silk yarn in the production of knitwear will expand the range of products and improve their quality. As is known, as a result of the introduction of elements of other interlacing into the structure of knitted fabric or the use of other types of yarn, the structure and parameters of knitwear change [1-3].

Silk knitwear, retaining all the features of knitwear (elasticity, softness, durability, etc.), also acquire the unique properties of natural silk. Wearing natural silk knitwear is cool in heat and warm in cold, they will never be wet on the body, since natural silk is the most hygroscopic material. Silk knitwear does not wrinkle, little is deformed in the process of wearing and washing. Products made of silk knitwear have a very long service life, since the silk thread cannot be destroyed for a long time.

The requirements for knitwear depend directly on the technological parameters. As a result of many researches, it was found that the main indicators characterizing the structure of knitwear are the density of knitwear in length and width, the length of the thread in the loop, the angle of inclination of the loops and the thickness of the fabric.

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II. DEVELOPMENT OF NEW STRUCTURES OF COTTON SILK PATTERNED KNITTED FABRIC

One of the main indicators of knitwear is its material consumption. In the analysis of this indicator take into account the surface density, thickness and bulk density of knitwear. The material intensity of knitwear depends on its density and weave, as well as the type of raw material and the thickness of the thread.

In order to study the effect of silk yarn on the technological parameters of knitwear, new structures of cotton-silk patterned knitwear have been developed and 6 variants of experimental samples have been knitted on a Pilotelli single knitting machine. At the knitting of cotton-silk patterned knitwear used cotton yarn with a linear density of 20 Tex, silk yarn with a linear density of 16.7 Tex and lycra thread with a linear density of 8 Tex. Rapport of cotton-silk patterned knitted fabric samples consists of plane and press stitchcourses.

Knitting way of the designed structures of cotton-silk patterned knitted fabrics are presented in Figure 1.

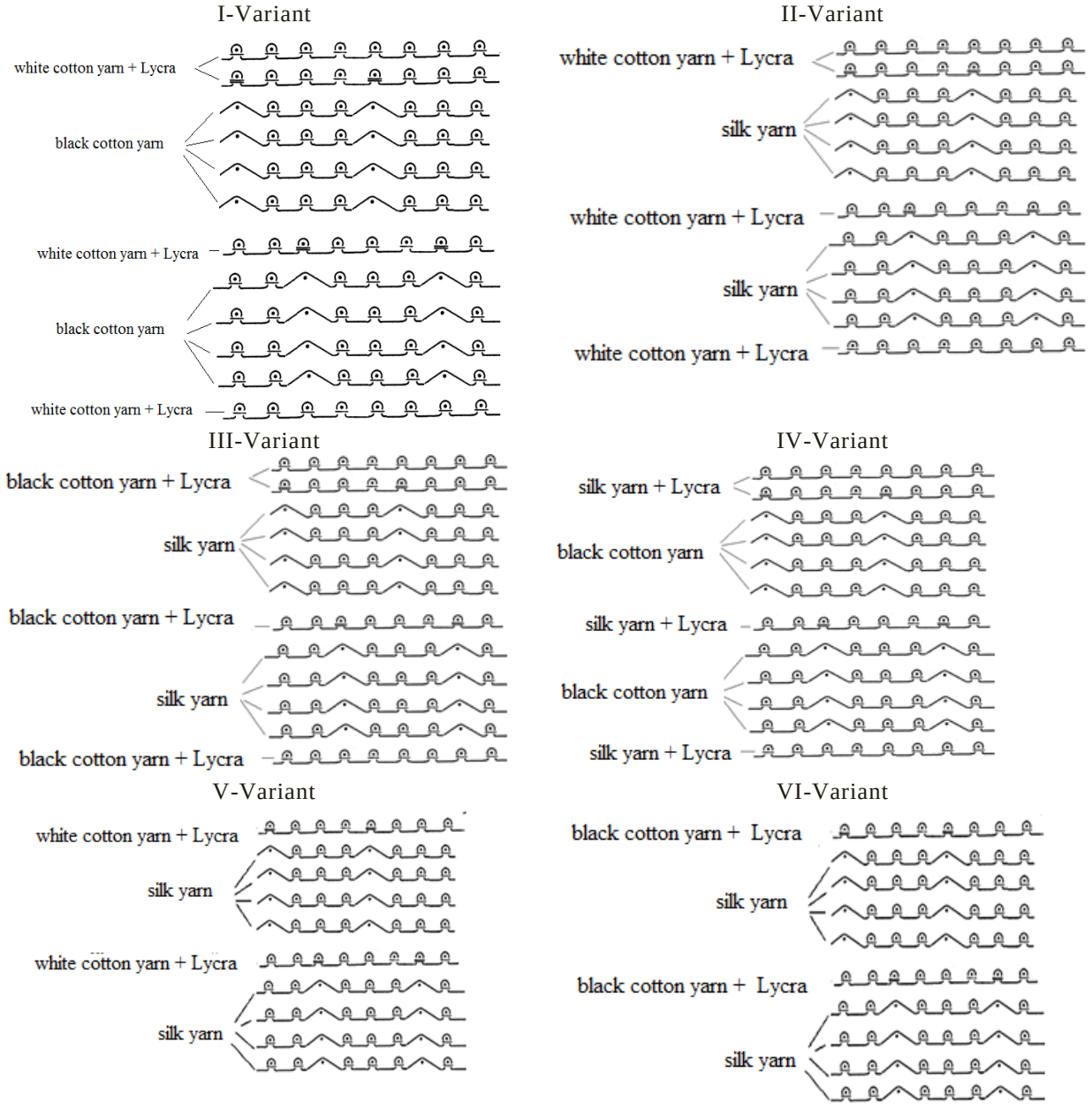

Fig. 1. Graphic recordings of cotton silk knitted fabrics

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The I-variant is taken as the base one and is made without the use of silk; it contains 97.6% cotton yarn and 2.4% lycra. The remaining variants (II-VI) contain different quantities of silk, cotton, and lycra.

III. EXPERIMMENTS AND DISCUSSION

Technological parameters and physic-mechanical properties of cotton-silk patterned knitted fabric samples are defined in the certification laboratory of Tashkent institute of textile and light industry and are listed in the table.

Table 1

Technological parameters and physic-mechanical properties of cotton-silk knitted fabric samples

Parametrs		Variants					
		I	II	III	IV	V	VI
Type and quantity of yarn (thread) in sample	Cotton 20tex	97,6	59,5	62,6	54,74	25,8	27
	Silk 16,7 tex	-	37	33,2	41,5	72,6	71,5
	Lycra 8 tex	2,4	3,5	4,2	3,76	1,6	1,5
Surface densityMs gr/m^2)		213,7	210,2	215,8	250,4	305,1	319,5
Fabric thickness T (mm)		0,65	0,7	0,67	0,75	1,15	1,15
Volume densityδ (mg/sm^3)		328,7	300,3	322,1	295,3	265,3	277,8
Absolute volume density lightness, Δδ (mg/sm^3)		-	28,4	6,6	33,4	63,4	50,9
Related volume density lightness, θ,%		-	8,7	2,1	10,2	19,3	15,5
Air permeabilityB(sm^3/sm^2·s)		85,5	128,6	102,7	94,3	124,8	126,7
Breakingload P, H	by wale	136	186	164	179	198	183
	by cource	143	119	128	184	272	228
Tensile elongationL (%)	by wale	84	99	92	108	122	143
	by cource	258	198	192	214	257	244
Ireversibledeformation εi,%	by wale	19	8	14	11	13	8
	by cource	18	14	10	13	22	17
Reversibledeformation ε_r(%)	by wale	81	92	86	89	87	92
	by cource	82	86	90	87	78	83
Shrinkage U,%	by wale	-4	+7	+7	+3	+5	+2
	by cource	-7	-1	-1	+1	-2	-3

The inclusion of silk yarn in cotton knitwear improves its hygienic properties, gives a beautiful appearance, and the use of lycra improves the dimensional stability and comfort of knitwear. Analysis of the technological parameters of cotton-silk patterned knitwear showed that the inclusion of lycra in the composition of knitwear increases its thickness by increasing the density.

Thus, it was found that the bulk density of the II-VI variants decreased in comparison with the base sample by 2.1-19.3% (Fig. 2).

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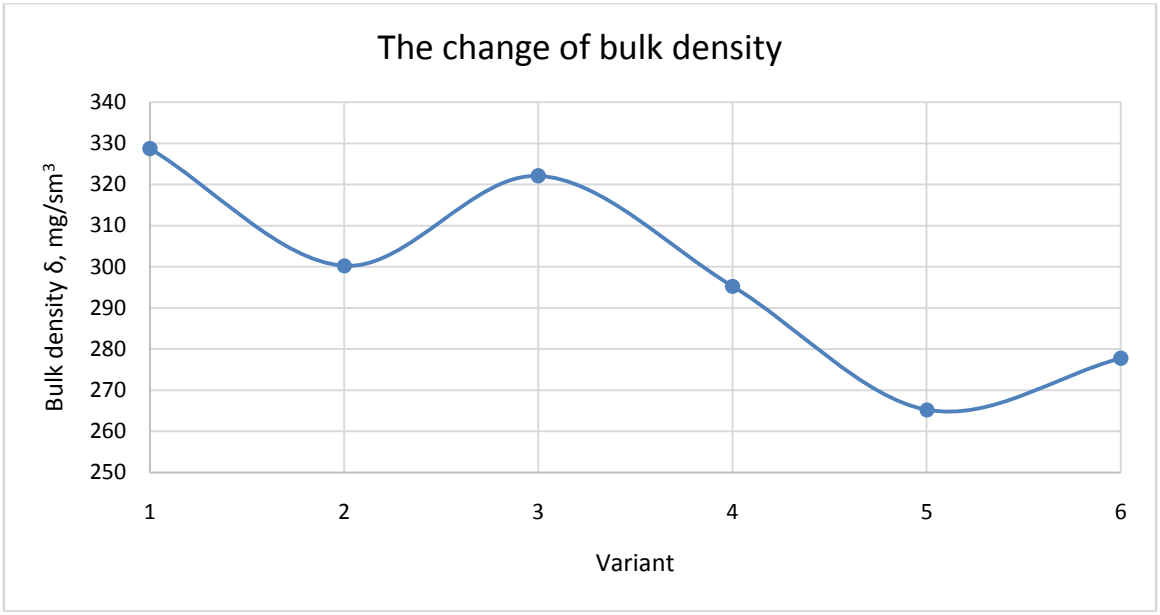

Fig. 2. The change in the bulk density of cotton-silk patterned knitted fabrics

Hygienic properties of knitwear provide comfort products made from it. Investigating the hygienic properties of knitwear, intended for light upper and linen products, first of all we investigate the air permeability. Analysis of the results showed that the air permeability of the II-VI variants of knitwear is greater than that of the base I variant (Fig. 3). Air permeability of variant II is 50.4% more than in the base case, for variant III the difference is 20.1%, for variant IV - 10.3%, for variant V - 45.9%, for variant VI - 48.2 %

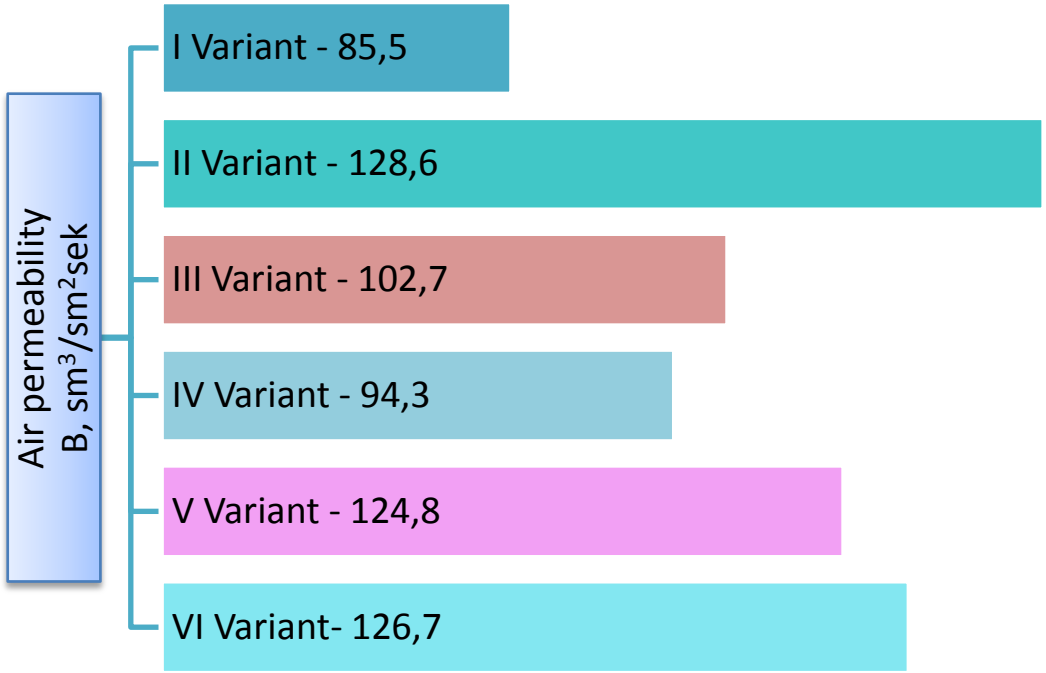

Fig. 3. Air permeability of cotton-silk patterned knitted fabrics

One of the most important properties of textile fabrics is strength, since textiles are designed for frequent use and must be reliable in operation. An analysis of the breaking load of the knitwear samples studied showed that the samples containing silk yarn in their composition are more durable in length than the base sample. In width, IV, V and VI variants turned out to be more durable.

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In the manufacture of knitwear always special attention is paid to dimensional stability, which is characterized by indicators of elongation, the ratio of reversible and irreversible deformations and shrinkage. These characteristics are influenced by the type of weave, the type of raw material, the density of knitting and other factors.

An analysis of the tensile properties of the knitwear samples examined showed that the tensile properties along the length of cotton-knit knit samples are greater than those of the base sample, which does not contain silk yarn. In turn, the stretch ability across the width of all patterns of patterned knitwear containing silk yarn is less than that of the base pattern.

Such a change in stretch ability of knitwear in length is due to the fact that silk is more elastic than cotton and the presence of lycra in the composition also contributes to stretch ability of knitwear.

The elasticity of silk yarn also had a positive effect on the rate of reversible deformation of knitwear, which indicates a rapid restoration of the original form of knitwear after stretching.

The size of cotton-silk knitted fabric after wet-heat treatment does not change significantly, and the shrinkage rates of the fabric meet the requirements of the standards.

IV. FINALY COMPARISON ANALYS AND CONCLUTION

Using the method of integrated quality assessment, we will perform a comparative analysis of experimental knitwear samples according to indicators of technological parameters and physic-mechanical properties.

The complex diagram is constructed in such a way that the largest contour shows the best quality indicators of knitted fabrics produced, that is, the closer the contour is to the outer one, the higher the quality indicators of knitted fabrics and the closer they are to the requirements (Fig. 4).

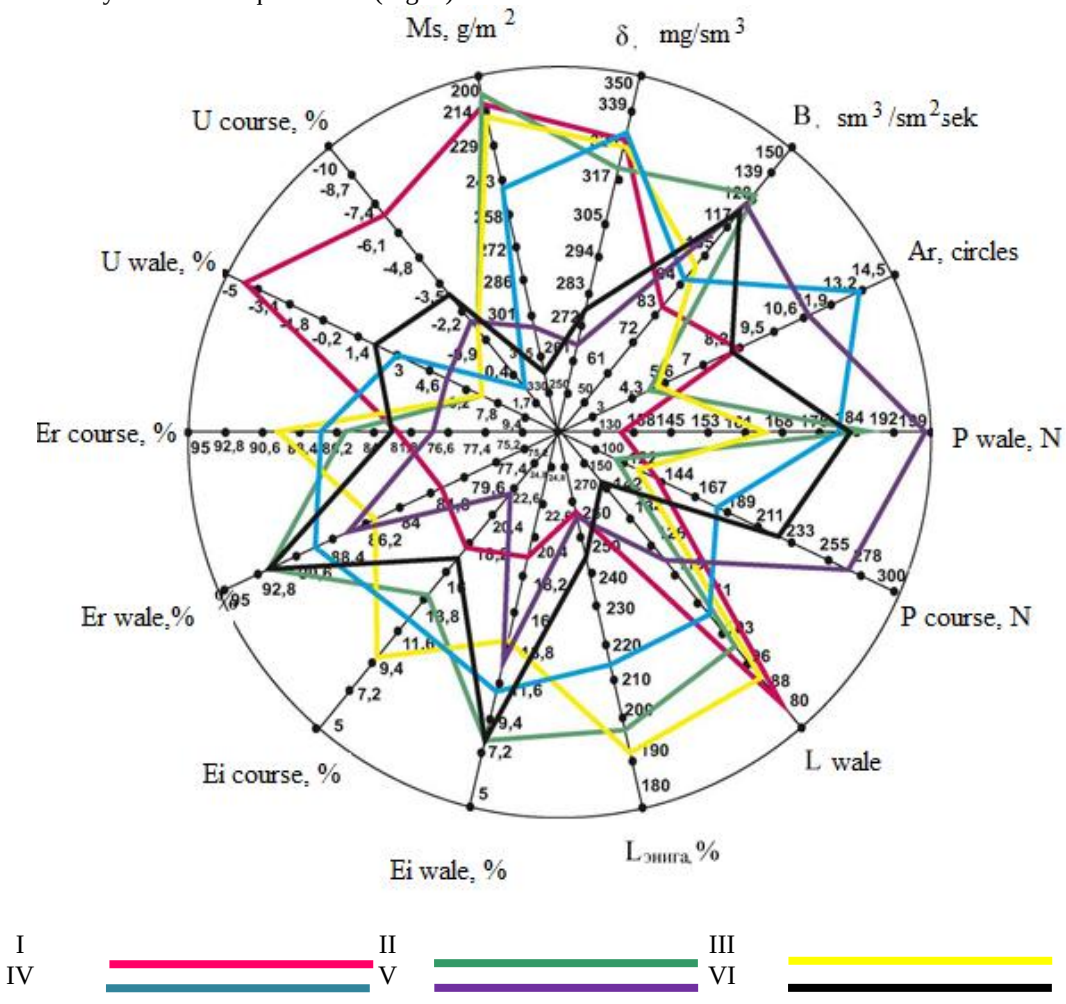

Fig. 3. Complex assessment of cotton-silk knitted fabrics quality

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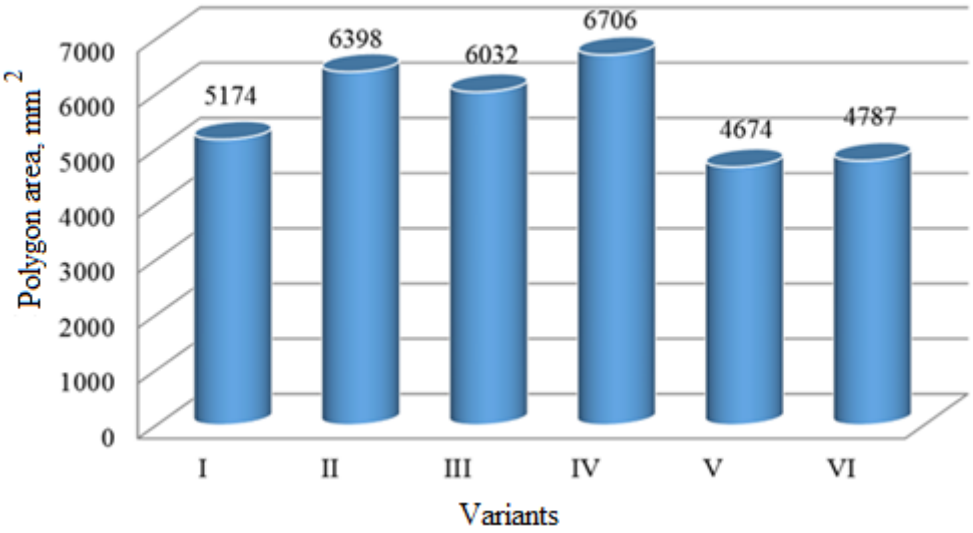

Fig. 4. Histogram of cotton-silk knitted fabrics quality

Thus, it has been established that the II, III and IV variants of cotton-silk knitted fabric are the most rational in terms of quality and material indicators. They have high quality indicators and have a lightweight structure, which allows to increase the competitiveness of products and reduce its cost.

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