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Analysis of Technological Indicators and Physic-Mechanical Properties of Knit Fabric

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Abstract---*In this article, to increase production efficiency at sewing and knitting enterprises, we improve the quality of consumption of the assortment of knit fabric with the addition of natural yarn to lycra yarn in various knit fabrics and recommend them to sew and knitting enterprises. Based on the results of the analysis of technical indicators and the physical and mechanical properties of the proposed knit fabric, it can be concluded that the addition of natural lycra to the composition of various knit fabrics led to an improvement in the consumer qualities of the assortment of knit products with the addition of synthetic spool. Knit fabric with the addition of these synthetic spools of threads has high strength and hygienic properties.*
Keywords---*air permeability, cotton, fabric, fur knitwear, lycra, sewing knitwear, silk, yarn*

Introduction

One of the important tasks set by the state to experts and scientists of the textile industry is to ensure that textile products firmly take their place in world markets and contribute to the entry into the number of economically developed countries. In the Namangan region, there are more than 1000 textile and sewing-knitting enterprises producing a wide range of products (Mirziyoyev, 2016). In the strategic direction of further development and liberalization of the economy in 2017-2021, it is planned to implement industry programs that provide for 649 investment projects totaling $ 40 billion. As a result, over the past 5 years, industrial production increased by 1.5 percent, its share in gross domestic product increased from 33.6 percent to 36 percent, and the share of the processing industry from 80 to 85 percent (Aleksandrovna & Dianhua, 2021).

Expanding the technological capabilities of knitting machines through the creation of new methods for the production of knit products, increasing the assortment, and improving their quality is one of the relevant scientific and practical approaches facing industry experts. For us, the main task should be to continuously upgrade production from a technical and technological point of view, to constantly search for internal capabilities and reserves, deep structural transformations in the economy, and to continue the modernization of the industry consistently. The most important direction of our internal capabilities and reserves in this direction should be a phased increase in the deep processing of rich mineral raw materials and plant world resources on our land, as well as expansion of volumes and types of production of high value-added products (Ergashev et al., 2020; Korabayev et al., 2018).

In other words, we must move on to a 3-4-stage processing system to turn raw materials into a product that is in great demand in the world market. The essence of this system is that it involves the primary processing of raw materials at the first stage, that is, the manufacture of semi-finished products, at the next stage, the conversion of finished material into industrial, and at the third, final stage, the production of ready-to-use products (Korabayev et al., 2019; Ahmadjanovich et al., 2020). When developing and implementing programs in this direction, it becomes

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necessary to monitor the entire production process, starting from the deep processing of each type of primary raw material, that is, semi-finished products, and ending with its transformation into ready-to-use products.

Materials and Methods

Light industry is one of the most important sectors of the economy of the republic, which solves not only economic but also social issues. In particular, based on deep processing of the cotton fiber, as an industry producing a wide range of products, providing the opportunity not only to dress the population but also to create tens of thousands of new jobs. Currently, "UzTextile Industry" Association enterprises are actively working to expand the range of exported finished products. Regular technical and technological renewal of enterprises, increasing export potential, and creating new jobs are the priorities of the "UzTextile Industry" Association shortly. According to the results of the first quarter of this year enterprises of the "UzTextile Industry" Association ensured the growth rate of export of products by 104.5% compared to the same period last year (Abdullayeva, 2006).

Calculations show that as a result of the production of products with high added value in 2030, an increase in production of environmentally friendly textile and light industries is expected to be 5.6 times due to the development of production of new types of goods. From the above it follows that one of the urgent problems of today is the development of knit fabrics with high molding characteristics, effectively using domestic raw materials, the production of them from import-substituting, competitive, high-quality, meeting the requirements of the domestic and foreign market of knit products (Erkinov et al., 2020; Samatovich et al., 2020). When crocheting yarn, using various types of raw materials, adding lycra to the main thread, affects knitting and not only on the indicators of the knit texture but also on their properties.

To study the influence of various types of raw materials and the properties of lycra threads on the properties of knit fabric, the physic-mechanical properties of knit fabrics made of feathers were determined experimentally. For identifying options with high physical and mechanical properties in the obtained glove, knit fabrics were examined, and the results were compared among themselves. The test results are presented in Table 1. In the 1st version of knit fabric made of feathers, polyester yarn was used, twisted for the warp, which received the highest air permeability (122.9 cm^3 / cm^2sec). The air permeability (104.7 cm^3 / cm^2sec) of feather knit texture in the 4th option is characteristic, while silk yarn with yarn was used as the basis. Air permeability is much less than in other feather knit textures (Gong & Ozgen, 2018; Widiastuti et al., 2017).

If the air permeability of the sample of option 4 is less by 14.8% compared with the sample of option 1, then the air permeability of the sample of option 2 is less by 52.6%, option 3 is 66.7%, option 5 is 63.1%. 1st and 4th options have high air permeability due to the low surface density of the wool knit patterns. The air permeability of samples 3 and 5 is low, as lycra thread is included in the fabric, which significantly increases the density of the knit fabric. Even if the surface density of the sample of the 2nd option is low, then the use of cotton yarn, which has a high volume in the composition of knit fabric, will increase the surface filling rate (Liu, 2021).

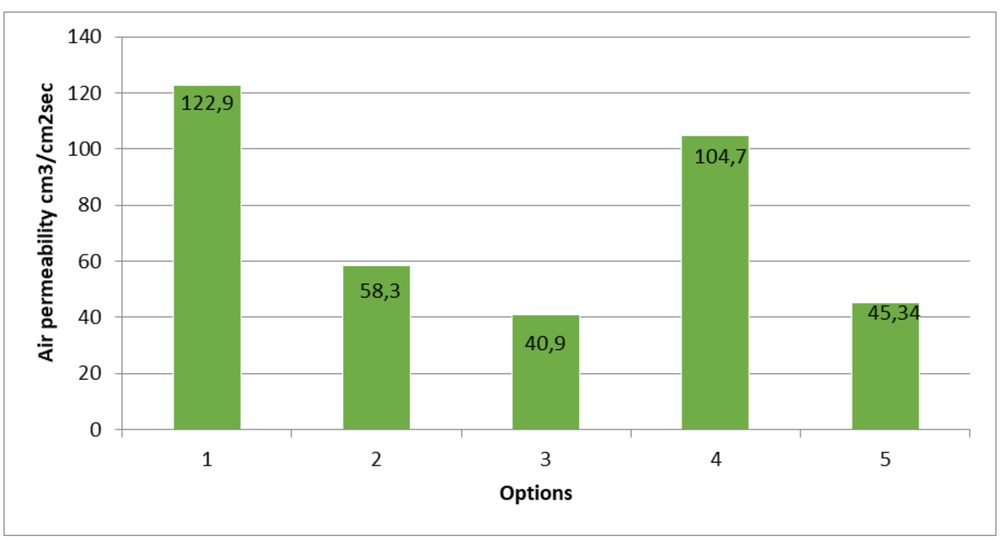

Figure 1. The degree of air permeability of the woolen knit fabric.

Indications for resistance to abrasion on all crochet patterns correspond to GOST. But the indices of resistance to friction of knit patterns in the 3rd and 5th knitting options with the addition of lycra warp yarns are higher than in other option designs (Musohon et al., 2021; Ergashev et al., 2019). Cotton yarn and lycra yarn are used as the basis, the friction of knit fabric from feathers of the 3rd option is used 22.5% more than the 2nd option, the lycra cotton yarn is used as the basis, which does not add lycra yarn.

Table 1
Options indicator

Options indicator	Type of raw material and quantity in fabric,%			Air permeability V, $cm^3/cm^2 sec$	Friction resistance, thous. ayl.	Breaking force P, N		Elongation at break L,% max / 6N		Irreversible deformation en,%		Reversible deformation ε_0,%		Fabric appearance У, %	
	Woolen cotton yarn	Base yarn	Lycra yarn			In relation to the height	In relation to the width	In relation to the height	In relation to the width	In relation to the height	In relation to the width	In relation to the height	In relation to the width	In relation to the height	In relation to the width
1	80,9	p/tr 19,1	-	122,9	49,6	208,2	164,5	128,7/38,1	147,1/47,2	21	18	79	82	6	0,9
2	70,4	cotton 29,6	-	58,3	58,6	138,7	171,025	95,6/20,3	112,6/26,5	30	13	70	83	3,7	4,8
3	67,4	cotton 29,95	2,64	40,9	71,8	206,03	199,09	149,8/23,6	138,8/30,9	13	17	87	87	13,2	9,8
4	78	silk 22	-	104,7	51,0	179,67	142,3	93,4/22,4	127,8/44,2	20	20	80	80	9,7	3,0
5	78,5	silk 20,6	0,9	45,34	70,5	251,85	148,65	123,8/23,4	157,7/50,7	15	10	85	90	14,7	7,5

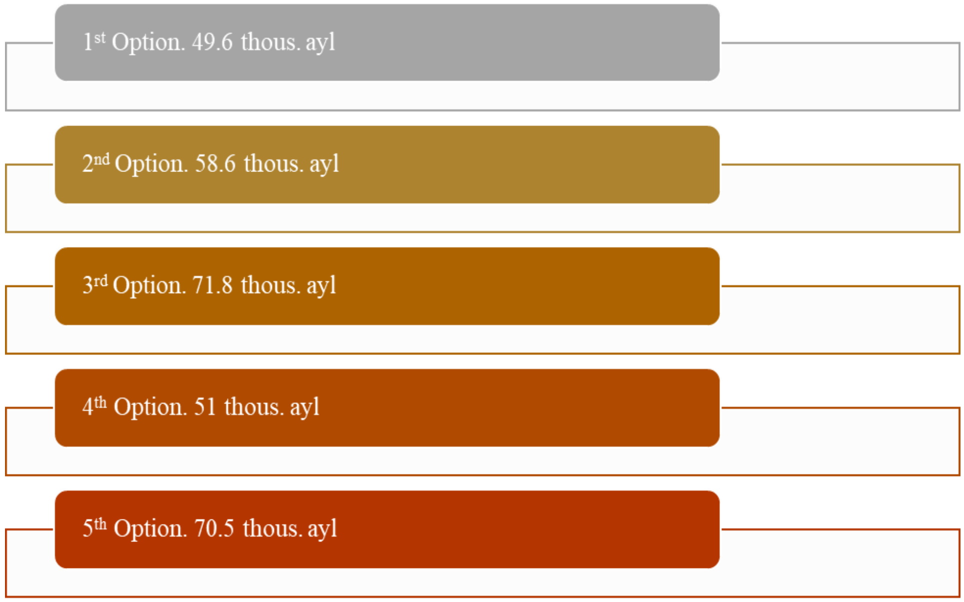

Figure 2. The break strength of the 2nd option

Analogically, the lycra yarn is not included in the composition of the fabric, for the base yarn, only the 4th option of the knit fabric used for the base yarn is applied together with the spinning silk yarn as the base yarn, in comparison with the knit fabric, the friction resistance of the 5th option of the crochet pattern is greater than 38,2%. The break strength of the 2nd option sample, obtained from 100% spun cotton yarn for the base yarn of the woolen knit fabric, is the minimum compared to other samples. It should be noted that the elongation strength of the samples in the 2nd option is 33, 4% less than in the 1st option sample, in this option the polyester yarn, which is spinning for the base yarn, was used. 2.6-figure shows the comparative break strength indicators of the feathered knit samples tested (Ugli & Ahmadjonovich, 2020; Mirzaboev et al., 2020). It was found that the tensile strength of 3rd option using cotton yarn and lycra yarn as the main loop yarns in the fabric was 1.04% less than that of option 1 (the polyester yarn was used for the base yarn).

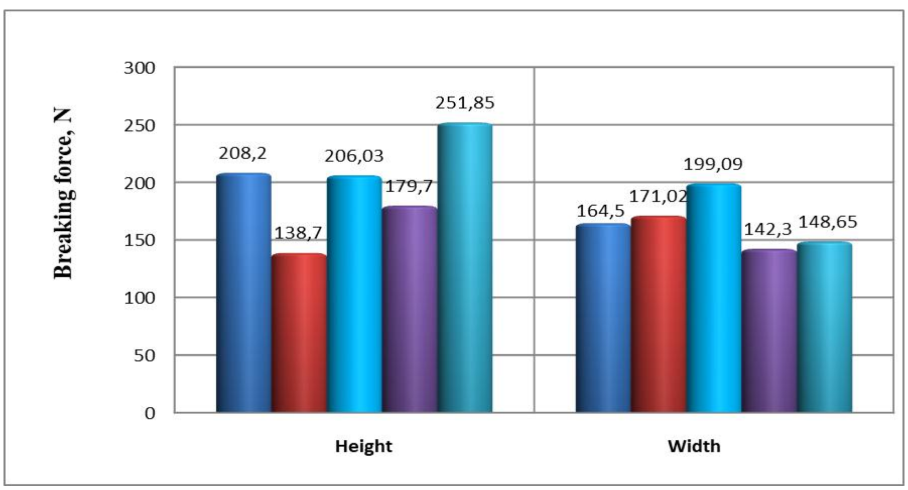

Figure 3. Comparative histogram of tensile strength of the woolen knit fabric

It was found that the tensile strength of the 5th option using yarn and lycra yarn as the main loop yarns in the woolen knit fabric was 40.2% higher than that of the 4th option using only spun silk yarn as the lycra yarn in the fabric composition. The elongation index (in percent) of a knit fabric is characterized by its elongation under the influence of constant tensile stress of 600 hertz (6N). The size of the seam allowance is set according to the elongation parameters, the mode of laying the fabric during the cutting process is determined and the machines are selected to prevent deformation and elongation of the seams during sewing and wet-heat treatment (Lawrence, 2015; Gajjar, 2011).

Results and Discussion

When comparing the experimental parameters, it became clear that the elongation indices of the 1^{st}, 3^{rd} and 5^{th} options patterns of woolen knit fabric are high both in length and width, i.e. polyester, spun as the base strip cotton yarn was used in conjunction with lycra, and the elongation at break of the hairy tissue to which the silk thread was added was close to each other. The elongation at break of 2^{nd} and 4^{th} options, which did not include lycra, was also similar and was 30-59% lower than that of 1^{st}, $3^{rd,}$ and 5^{th} options. In this case, the elongation of all samples along the length under the force of 6 N is close to each other. Thus, under the action of a force of 6 N, the elongation index of knit fabrics with lycra yarn in the fabric does not differ much from the elongation index of knit fabrics without lycra yarn in the fabric (Wilson, 2011; Gibson & Charmchi, 1997).

Elongation is inherent in knit fabrics, which means the value of reversible deformation, that is, the elongation of knit fabric provides comfort to knit products, and the proportion of reverse deformation indicates that in the process of operation, knit products tend to return to their original state. At the same time, when samples of feathered knitwear are given a voltage of 6 n, the indices of their extensibility are close to each other, the proportion of reverse deformations of samples with the addition of yarn in the fabric of lycra is much larger than for samples to which lycra is not added (Abou-Okeil et al., 2013; Ünay & Zehir, 2012). This means that the knit fabric, in which the lycra thread is present, has a high storage form.

The fraction of reversible deformations in knit knitwear samples with a new composition was studied, which includes knit deformation and the main part of the elastic deformation formed over a certain period, and the proportion of irreversible deformations. The percentage of irreversible strains, in turn, consists of plastic and elastic strains that do not have time to return within the "fatigue" of the sample. The percentage of reverse deformations is determined by the formula (1):

$$\varepsilon_0 = \frac{l_2 - l_1}{l_1 - l_0} \cdot 100\% \qquad (1)$$

Here l_0- the initial length of the sample;
l_1- the length of the sample after power is applied;
l_2-the length after "fatigue" time.
The percentage of irreversible deformation is determined by the following formula (2):

$$\varepsilon_н = 100 - \varepsilon_0 \qquad (2)$$

A comparative histogram of the reversible deformation rates of the woolen knit fabric is shown in Figure 4.

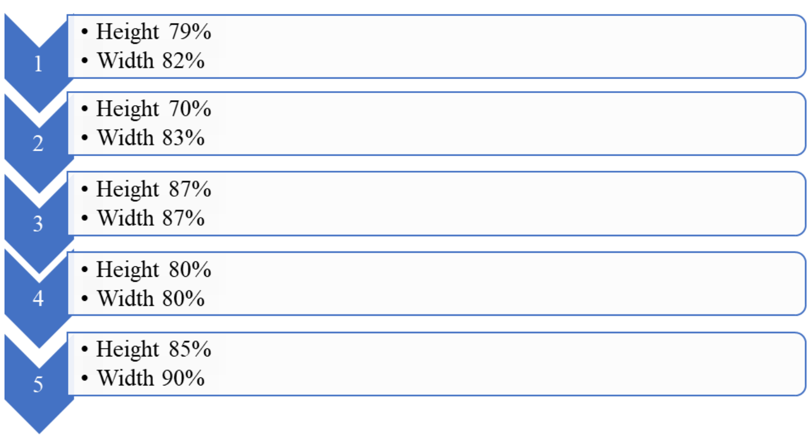

Figure 4**.** Comparative histogram of the rate of re-deformation of hairy knit fabric.

According to the experiment results, it became known that in the absence of a proportion of reverse deformations of woolen knit fabric samples, which include lycra yarn, and in width it is also larger than that of samples from other options (Behery, 2010; Apsari & Purnomo, 2020). For example, the percentage of reversible deformation of the sample of the 3rd option, in which cotton yarn with lycra yarn not included in the main thread of the fabric is used as the basis for the fabric composition, is more than the sample of the 2nd option in which lycra yarn is used 24.3% in length and 4.8% in width. Similarly, the percentage of reversible deformation of the sample of 5th option, in which silk yarn and lycra were used as the basis, silk yarn was used as the basis, lycra yarn was used, as compared to sample 4, which had a length of 6, 25% and width over 12.5%.

Thus, the elongation index of woolen knit fabrics in the 3rd and 5th options, which contain lycra yarn at a voltage of 6 N, is close to the elongation index of other samples without lycra yarn, at a voltage of 6N, the percentage of back deformation is significantly higher. In addition, samples with lycra yarn in the fabric have the same elongation properties as other specimens, and return to their original position is somewhat better, i.e., higher retention. Similarly, the rate of penetration of textures affects the indicator of the shaping properties of knit fabric. The refractive index depends on the process of relaxation and refraction of fibers and filaments during wet processing. At the same time, the structure of knit fabric changes: the configuration of the rings changes, the context of the strands shifts, the role, and height of the rings located in the ring change. The penetration rate of knit fabrics is greater than that of textile fabrics, which is associated with high mobility in the textile structure (Prasad et al., 2020; Merdan et al., 2004). As can be seen from the data in Table 1, the introductory rate of woolen knit fabric patterns with lycra yarn (options 3, 5) included in the fabric is higher than other samples (options 1,2,4). However, knit fabrics made of lycra yarn have high permeability, i.e., they return to their original shape after deformation during use.

Conclusion

Based on the results of the analysis of technical indicators and the physical and mechanical properties of the proposed knit fabric, it can be concluded that the addition of natural lycra to the composition of various knit fabrics led to an improvement in the consumer qualities of the assortment of knit products with the addition of synthetic spool. Knit fabric with the addition of these synthetic spools of threads has high strength and hygienic properties.

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