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STUDY OF THE PHYSICAL AND MECHANICAL PROPERTIES OF HOSIERY PRODUCTS MADE OF RAW MATERIALS WITH DIFFERENT COMPOSITIONS

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Abstract
During the research, 4 different samples with different compositions were produced on a single-needle 156-needle sock knitting machine of the Chinese company Kejun KJ6F606 model, and their physical and mechanical properties were studied.

Keywords: Socks, cotton, polyester, spandex, KJ6F606

Introduction

Currently, due to the development of technology and equipment, the hosiery industry is growing rapidly. Due to the improvement of the capabilities of modern hosiery knitting machines, it is possible to produce new types of hosiery assortments. Scientific research on determining the composition of new types of raw materials is increasing day by day. As a continuation of these studies, 4 sock samples were produced by mixing cotton yarn, which is a local raw material, with spandex and polyester yarn in different proportions.

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Composition of different sock samples

Table 1

№	Samples
1	100% cotton
2	90% cotton 10% spandex
3	80% cotton 20% spandex
4	80% cotton 10% spandex 10% polyester

Experimental Part

In the production of samples, 35 tex cotton yarn was used, and the rubber part was made of 110 d rubber, 100 d polyester and 30/75 d spandex yarn. Initially, taking into account the fact that cotton yarn has better air permeability and moisture absorption properties than artificial and synthetic yarns, we developed socks from 100% cotton, aiming to improve the quality of the socks and have a positive effect on human health. Then, taking into account the shape retention and deformation properties, we developed socks samples in the remaining percentages and tested their physical and mechanical properties in the "Textile Products Testing Laboratory" of Namangan State Technical University.

In the experiment, the density of 1 sock was measured on a ZK200C electronic scale. The thickness was determined on a YG141D device in the testing laboratory of Namangan State Technical University. Initially, we measured the weights of the samples on an electronic scale and obtained the following indicators.

Weight and thickness of the obtained samples

Table 2

№	Samples	Weight, g	Thickness, mm
1	100% cotton	29	2.21
2	90% cotton 10% spandex	33	3.12
3	80% cotton 20% spandex	25	2.76
4	80% cotton 10% spandex 10% polyester	31	3.17

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From these results, it can be concluded that when using spandex yarn, the density of the socks increases and this affects its weight. The thickness, in turn, changed depending on the ratio of yarns. In samples 1 and 3, the raw material consumption was also lower than in the other samples, and the thickness also gave an average indicator.

Physical and Mechanical Characteristics of Hosiery Products

Table 3

Indicators		**Options**				**Standarts**
		I	II	III	IV	
Yarn type and linear density		100 % cotton	90% cotton 10% spandex	80% cotton 20% spandex	80% cotton 10% spandex 10% polyester	
Air permeability V($sm^3/sm^2 \cdot sec$)		49	40	32	28,5	*GOST 12088-7730 -100*
Breaking strength R (N)	height	214	225	192	295	*GOST*
	width	102	233	93	269	*28554*
Stretching until breaking L (%)	height	47	100,4	113,6	97,9	*GOST*
	width	132,2	181,4	96,6	145,1	*28554*
Irreversible deformation ε_n (%)	height	14	16	13	15	GOST
	width	18	20	17	19	28882-90
Reversible deformation ε_o (%)	height	86	84	87	85	GOST
	width	82	80	83	81	28882-90
Abrasion resistance I (thousands of revolutions)		30	34	36	39	GOST 16486-93

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Air permeability is the amount of air that can pass through a given surface under a pressure of 100 kPa. This indicator of hosiery products was studied on the YG461E device for determining the air permeability of knitted products installed at Namangan State Technical University. High air permeability of hosiery products allows you to improve their hygienic properties. Since the composition is in different proportions, the standard required a scale of different sizes in the device. In option 1 and option 3, it was determined using a scale with a diameter of 14.5 mm, while options 2 and 4 used a scale with a diameter of 8 mm. The 100% cotton sample had an air permeability of 116.8 cm3/cm2*s, while the 90% cotton 10% spandex sample had an air permeability of 30.5 cm3/cm2*s due to the small diameter of the scale. The indicators of all samples are presented in the diagram below.

Another characteristic of hosiery products is their durability and resistance to various physical and mechanical stresses. To study these indicators, it is necessary to determine their breaking strength and elongation at break. The breaking strength characteristic is the main indicator accepted for assessing the quality of knitted fabrics. All GOSTs and TSHs used for knitted fabrics include normative indicators for breaking strength and breaking strength. Breaking strength is understood as the force required to break a sample when it is stretched at a certain size and speed.

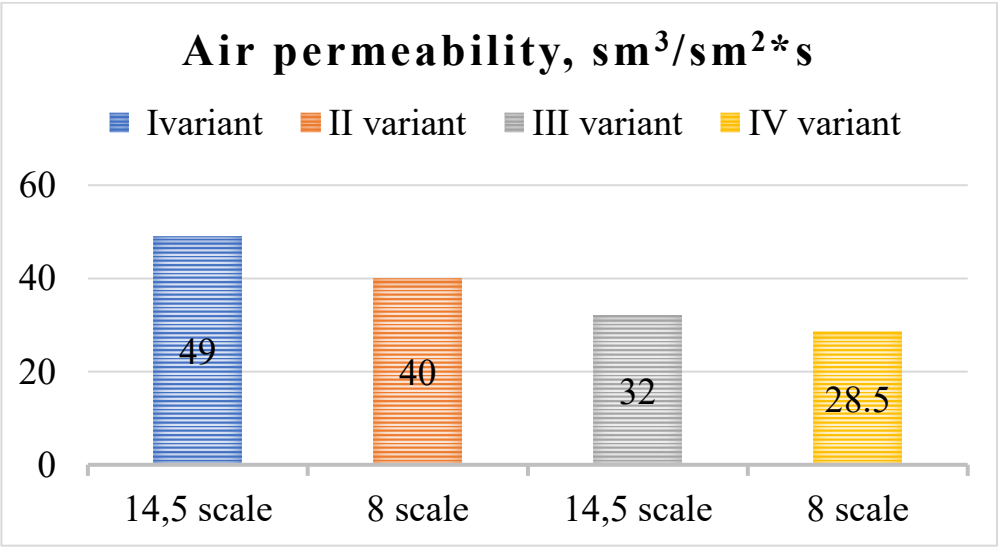

Figure 1. Comparative diagram of air permeability of samples

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The breaking strength is expressed in N (newtons). The breaking strength of the submitted samples was determined using a "YG-026T" dynamometer according to the standard method. The elongation of knitted fabrics is understood as their elongation under the influence of an applied force. Elongation is characterized by the elongation of the tested sample. Elongation is expressed in absolute or relative units. When testing knitted fabrics with a length of 100 mm clamped to the device, their absolute and relative sizes are the same.

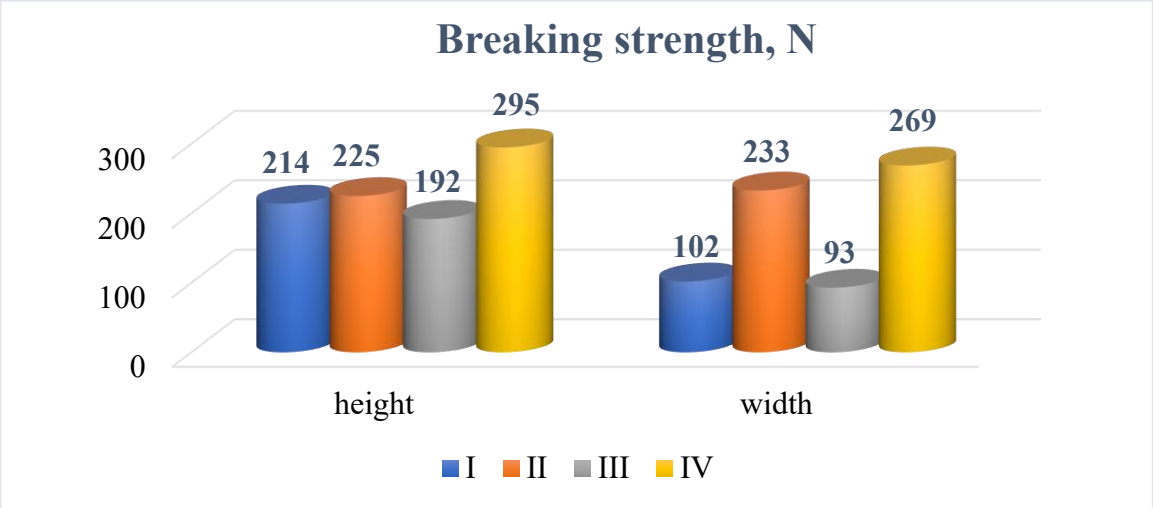

Figure 2. Diagram of tensile strength along the length and width

This device not only measures the breaking strength of the sock product, but also its elongation, energy consumption, and breaking time.

Deformation is the effect of a certain load on a sample taken from a hosiery product for a certain period of time. Deformation is reversible and irreversible, and is determined based on specific formulas. When preparing a sample, a 5x10 cm cut is cut at different points of the hosiery product and a load is hung for 30 minutes, and the length h that has been extended during this time is determined. Then it is left in an unloaded state for 10 minutes and h1 is found. From this, irreversible deformation is determined as follows.

$$D_R + D_{IR} = 100\%$$

$$D_{IR} = h_1/h * 100$$

Here:

D_R- reversible deformation

D_{IR}- irreversible deformation

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This indicator was studied using the YG026A-III equipment installed in the testing laboratory. The samples were prepared with a length of 30x5 cm and subjected to a force of 454 g x 3 (13 N) for 30 minutes. During the study, the irrecoverable deformation index of the sample taken from cotton yarn along the length was 14% and the recoverable deformation index was 86%, which corresponded to the current standards. In general, the recoverable deformation along the length of the samples ranged from 98% to 84%. This indicates that the hosiery product has a good ability to return to its original state.

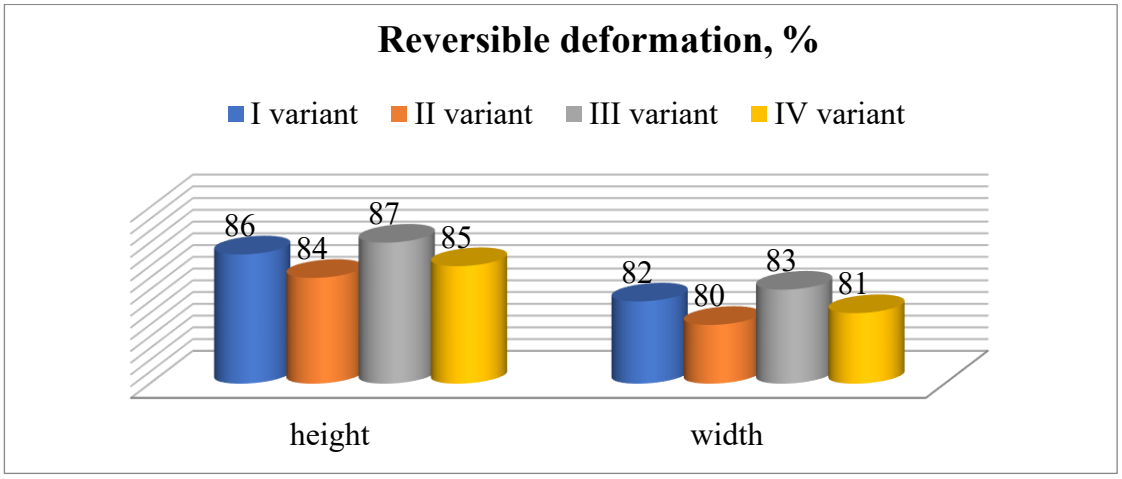

Figure 3. Comparative diagram of recovery parameters

This diagram shows that the hosiery products meet the standards set for them and the newly produced hosiery products have good shape retention properties. Knitted fabrics have significantly higher elongation than woven fabrics and have a highly flexible structure, even under the influence of small stresses. The principle of operation of machines designed for finishing knitted fabrics is practically no different from machines designed for finishing woven fabrics.

Conclusion

As a result of the study, it was found that the air permeability of the sample using cotton yarn was higher than the others. On the contrary, the strongest sample was option 4, while option 3 was studied for its better shape retention, that is, the index of reversible deformation.

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