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Study of Physical and Mechanical Properties of Knitted Fabrics

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Annotation: In this article, the analysis of the physical and mechanical parameters of knitted fabrics intended for the production of an assortment of upper knitted products obtained on a 28-class Mayer machine is made, and recommendations for various assortments are based on it.

Keywords: Knitwear, textile, 28 class, Mayer, 2808, lycra, shape retention, abrasion resistance.

Today, the development of the textile-knitting sector of the light industry, the study of the technological capabilities of the knitting machines installed in the existing knitting production enterprises, the introduction of new modern computer techniques and technologies, the comparison of the structures of knitted fabrics obtained from local raw materials and their methods of production, based on this, sewing and knitting products Great attention is being paid to the improvement of the production system and the development of the theoretical scientific basis for the effective use of local raw materials, the expansion of technologies for the development of competitive sewing products, low consumption of raw materials, increasing economic efficiency, the expansion and reformation of the introduction of resource-efficient methods and computer technologies into production networks.

The machine class is of great importance in the technical specifications of knitting machines. Because it depends on the types of knitting and the main technological indicators that are designed for this machine, that is, the linear density of the threads, the density of the fabric, the length of the loop thread and similar indicators. The machine class is represented by the pitch of the needles, that is, the distance between the centers of two adjacent needles.

The low consumption of raw materials in knitted products compared to fabrics obtained on weaving looms does not depend only on the structure of the fabric. Increasing the class of knitting machines and using yarns with low linear density is a well-recognized way of reducing raw material consumption [1, 14-19b; 2., 87b].

Currently 28-42 cl. Cross knitting machines are widely used in production.

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For example, 18 cl. 22 kl from the knitting machine. when transferred to the machine, the surface density indicator decreases by 10-15%. When the machine class is increased, it is required to use yarns with a small linear density according to the rule (otherwise the surface density of the fabric will increase) [2., 87b].

Currently, the assortment of knitted products has expanded greatly. In its enrichment, new types of knitted fabric are widely used, in particular, lightweight fabrics woven on double-needle circular knitting machines. In the production of such canvases, the goal is to create new types while preserving their operational, hygienic and aesthetic properties [3., 380b].

Among the indicators describing the physical and mechanical properties of knitted fabrics, the following indicators were adopted: strength and elongation at break, elongation under the influence of tension less than the breaking strength, resistance to one-time and repeated stretching, resistance to wrinkling and fading, penetration when processed in hot-humid conditions [4; 132-144-b].

Air permeability, water absorption, hygroscopicity, heat resistance, heat retention, and electrification are often included in the parameters describing the physical properties of knitted fabrics.

In order to study the influence of silk and lycra threads in the fabric on the properties of the fabric, the physical and mechanical properties of the 4 types of knitted fabric samples were determined on the modern equipment installed in the laboratory "Testing of knitted and textile materials" at NamMTI, and the obtained results are presented in Table 1.

By adding lycra yarn to the spun cotton yarn instead of synthetic yarns, the hygienic properties of the knitted fabric are improved and the cost of the product is reduced.

Physico-mechanical parameters of knitted fabrics

1-table

Indicators		Вариантлар			
		1. green	**2. yellow**	**3. white**	**4. blue**
Weaving is the name of the knitting machine					Майер
Weaving is a class of knitting machine					28
The number of needles					2808
Number of systems					102
Surface density, M_s (gr/m^2)		167,9	184	189,9	175,6
Thickness, t (mm)		0,8	0,767	0,8306	0,83
Bulk density, δ (mg/sm^3)		209,9	239,9	228,7	211,6
Air permeability, B($см^3$/$см^2$·сек)		45,8	34,2	37,5	49,5
Breaking strength, P (H)	by height	300	118	207	145
	in width	123	573	197	138
Elongation at break, L (%)	by height	47,5	152,4	54,7	44,4
	in width	146,1	61,8	85,5	103,3
Reverse deformation (%)	by height	80	90	97	97

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	in width	79	70	97	96
Irreversible deformation (%)	by height	20	10	3	3
	in width	21	30	3	4

Air permeability refers to the air permeability of the materials themselves, and the air permeability is characterized by a coefficient that indicates the amount of air passing through 1 sm^2 of fabric in 1 second at a given pressure difference on both sides of the material.

The coefficient of air permeability of knitted fabrics used in the production of upper knitted products depends on the type of fabric, thickness and density, and is characterized by the coefficient of air permeability and is expressed as follows: V, sm^3/sm^2*sec [4; 132-144-b].

The air permeability index of textile materials often depends on the porosity and the size of the open holes, as well as the thickness of the knitting [5; 213-222b]. Air permeability properties of woven knitted fabrics were tested on the basis of the GB/5453 (ISO 9237) standard on the YG461E equipment. According to the GB/5453 (ISO 9237) standard, it was tested under normal conditions with a pressure of 100 Pa and a range size of Ø 8.0 mm for ready-made clothing fabrics [6., 43-47b; 7., 109-113b; 8].

Air permeability coefficient V (sm^3/sm^2*sec) is determined by the following formula.

$$B = \frac{V}{S \cdot T}, \; см^3 / см^2 \cdot сек \quad (1)$$

where: V is the amount of air passing through the fabric at a given pressure difference P, sm^3;

S - fabric area, sm^2;

The time of air passing through T`-fabric, sec.

The air permeability properties of knitted knitted fabrics varied from 34.2 to 49.5 cm^3/cm^2*sec. The lowest air permeability was observed in variant II of cotton-silk knitted fabric, and its amount was 34.2 cm^3 /cm^2*sec.

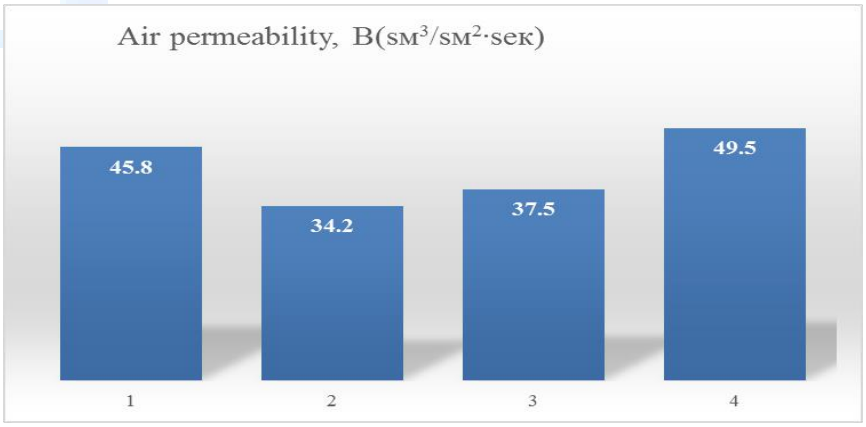

Figure 1. Air permeability change histogram

Characterization of tensile strength is the main indicator accepted for evaluating the quality of knitted fabrics. All GOSTs and TShs used for knitted fabrics include normative indicators on elongation at break and tensile strength [9-12]. Breaking strength is the force used to break a sample when stretching it at a given size and speed. The breaking force is expressed in the unit of newton [13., 42-49b].

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The strength of the materials depends on their fiber composition, the structure and linear density of the forming threads, weaving, density, and the type of finishing. The thicker and denser the thread, the stronger it is.

Lycra fiber is extremely thin, extremely strong, stretchy and highly flexible. Lycra® is produced in various thicknesses. Fiber superfine gauzes can also be used for thick heavy fabric ranges. The Lycra® fiber is observed to stretch seven times its original length and return to its original spring-like state as force is applied.

Initially, Lycra was used for tight underwear, but now it is used to create clothes that cling to the body. lycra fiber can be added to natural and artificial fabrics. Due to this, it was possible to create clothes of universal sizes and different shapes due to its elastic properties. This fabric was used by designers who create in the classical and avant-garde direction at the border of the 20th and 21st centuries. As the functional features are self-evident, the aesthetic features are mainly taken into consideration. Artificial fabrics are no longer considered secondary compared to cotton and silk and other natural fabrics [14].

Among clothing manufacturers, fabrics with "Lycra" type elastane threads are selected with great attention. In relation to raw materials with low deformation, the following consumption requirements are imposed on elastane and shape-retaining materials:

- full body coverage and shape retention.
- Less puckering at the seams.
- High possibilities in changing the design.
- Fullness and size of the division into groups of small numbers.

The main reasons for the use of fabrics with Lycra thread in the production of goods are the high elasticity and full return to their initial state after the strength is obtained. Elastane materials with "lycra" thread give the designer more opportunities to create new clothes and help to achieve a high level of comfort in these clothes. There are a number of conveniences in sewing and cutting them, that is, the seams on the collar and other parts of the clothes do not bulge, after sewing, the two details look very dense with each other, etc.

In practice, there are also variants of yarns spun from Lycra® and similar fibers, which are not recommended for use in knitwear due to their smoothness and high elasticity. In view of this, in the production of knitted goods covered with other yarns, LYCRA® yarn is wrapped on top of them with other ordinary yarn twists, and as a result, new types with physical and mechanical properties close to those of low-stretch yarns appear. Then there will be an opportunity to use them without problems in painting and finishing technology.

The tensile strength of the presented samples was determined using a "YG-026T" dynamometer according to the standard method. The breaking strength index varies from 118 N to 300 N in length, from 128 N to 573 N in width and meets the requirements of GOST 28554-90 [15].

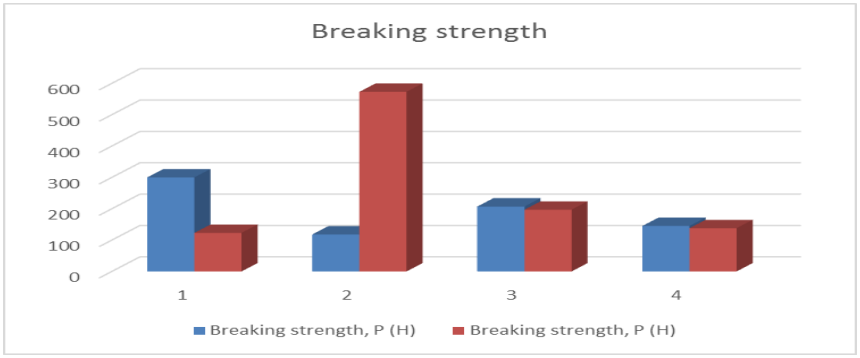

Figure 2. Histogram of breaking strength change

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Stretchability of knitted fabrics is understood as its stretching under the influence of applied force. Elongation is characterized by the elongation of the sample being tested. Elongation is expressed in absolute or relative units. When testing knitted fabrics with a length of 100 mm clamped to the tool, their absolute and relative sizes are the same. The stretch index of knitted fabrics is in the range of 20-200%. The stretchability of knitted fabrics with cotton threads obtained on a circular needle machine is 50-150%, depending on the linear density of the yarn, the type of fabric, and the class of the machine. Taking into account this indicator, corrections are provided in the design of the product in accordance with the size of the product determined on the basis of anthropometric data.

All knitted fabrics are divided into three groups depending on the stretch index. The first group includes tissues with an index of elasticity not exceeding 40%, the second - tissues with an index of elasticity from 40% to 100%, and the third - more than 100%. Fabrics belonging to the first group are sewn with a seam allowance compared to the main size, where the size of the seam allowance is determined according to the function and model of the item. Fabrics belonging to the second group have a seam allowance of no more than 2 cm, as well as in accordance with the function and model of the product. Fabrics belonging to the third group are shortened, their size is selected taking into account the intended use and model of the item [16; 232-245-b].

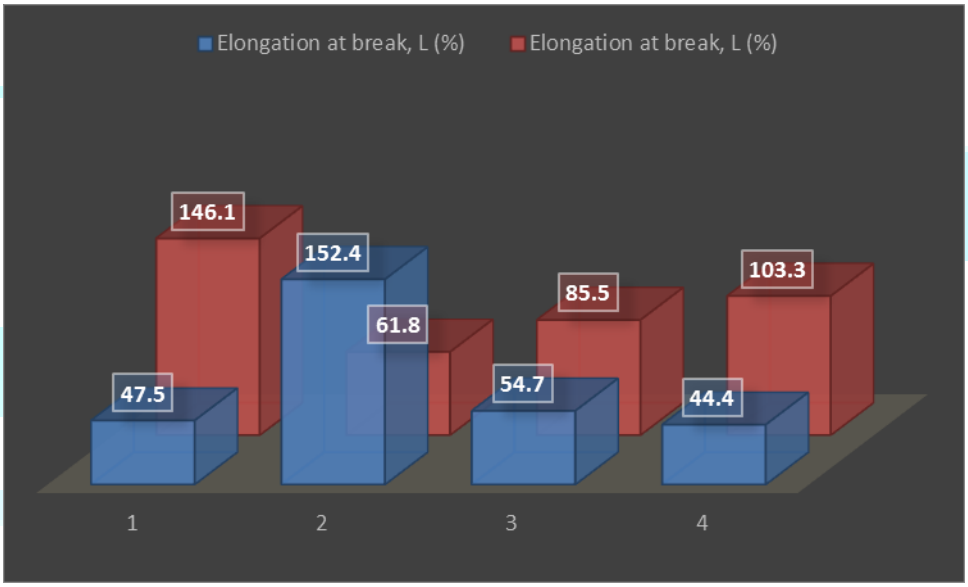

Figure 3. Histogram of change in elongation at break

The lengthwise elongation at break of cotton-lycra knitted fabrics varied from 44.4% to 152.4%. The highest elongation at break rate was observed in option II of knitted fabric and it was 152.4% (Table 1).

In conclusion, it can be said that the length and width of cotton-lycra knitwear depends on the structure of the knitted fabric and the type of yarns it contains.

When designing products, it is important to know the elastic properties of knitted fabrics [17; 215-218-b].

Complete deformation includes elastic, elastic and plastic deformations.

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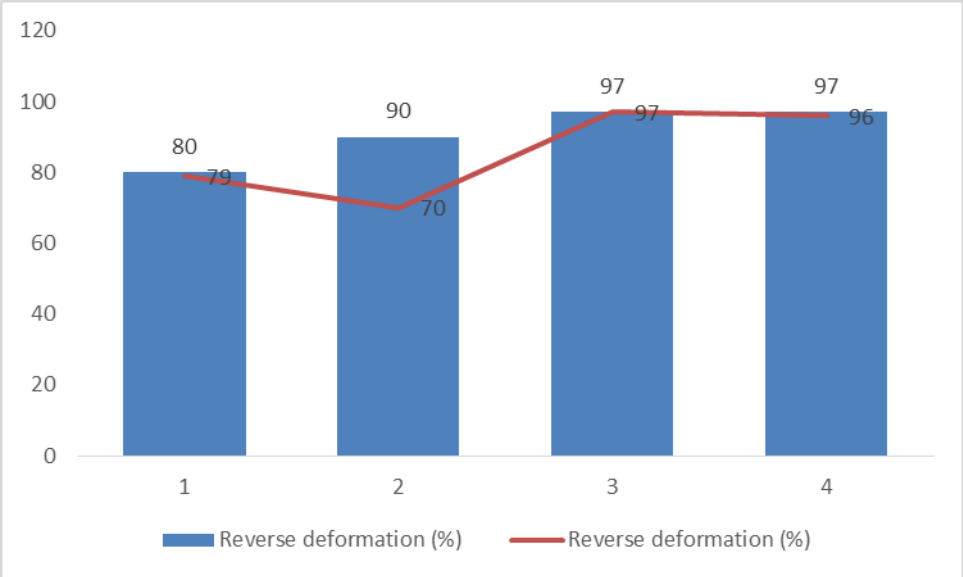

Figure 4. Reverse strain change histogram

In cotton-lycra knitted fabric samples, the amount of longitudinal deformation varies from 80% to 97%, and the amount of transverse deformation varies from 70% to 97% (Table 1, Figure 4). , indicates a quick return to its original state.

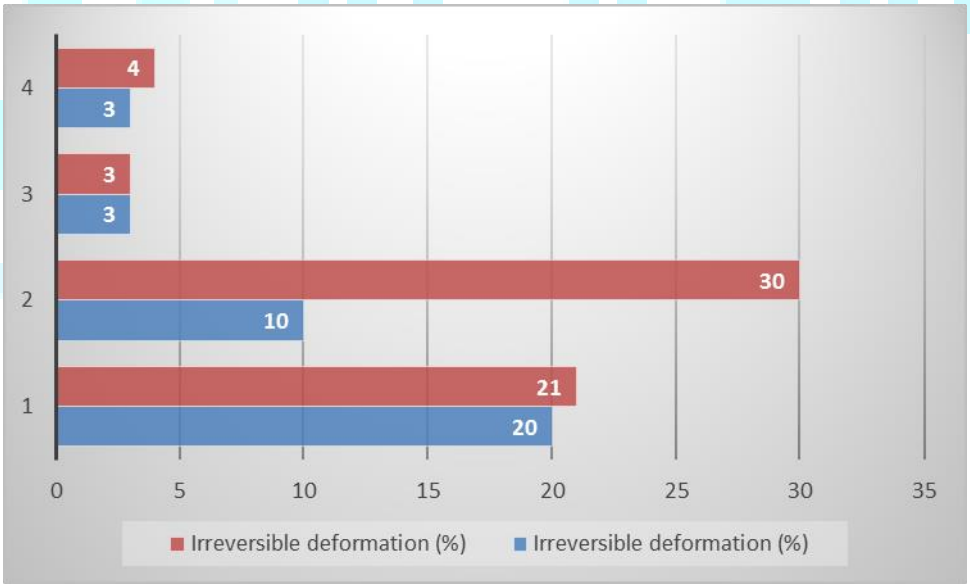

Figure 5. Histogram of permanent deformation change

In cotton-lycra knitted fabric samples, the amount of irreversible longitudinal deformation varies from 3% to 20%, and the amount of irreversible deformation in width varies from 3% to 30% (Table 1, Figure 5).

Mixing knitted fabrics with cotton and lycra threads allows to obtain knitted products with high hygienic and physical-mechanical properties, artistically decorated appearance.

The main reasons for using fabrics with "Lycra" thread in the production of knitted fabrics are high stretchability and full return to its original state after taking force, i.e. high shape retention properties. Due to the superior

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stretchability and shape retention properties of Lycra yarn, it gives the designer more opportunities to create new assortments of knitted clothes with a new look and helps to achieve a high level of comfort in these clothes. There are a number of conveniences in sewing and cutting them, that is, the seams on the collar and other parts of the clothes do not bulge, after sewing, the two details look very dense with each other, and they are distinguished by other aspects.

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