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Research Properties of New Two-Layer Knitted Structures

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ABSTRACT: The most promising direction in creating a new assortment of knitted fabrics is the combination of known stitches and their elements in various ways. In two-layer knitwear fabrics are connected to each other by elements of the loop structure during the knitting process. The article presents the results of a study of technological parameters and physical and mechanical properties of the newly developed structures of two-layer knitwear.

I. INTRODUCTION

In recent years, a set of measures has been implemented in the republic to develop the textile, garment and knitwear, leather, footwear and fur industries of the light industry, expand the range and range of manufactured finished products, as well as comprehensive support for the investment and export activities of enterprises in the industry One of the most important development priorities the textile industry indicated an increase in the volume of production of garment and knitwear products by 4.1 times [1].

The most important and urgent problem in the knitwear industry is to improve the quality and update the assortments of products. In a theoretical aspect, the solution to this problem lies in the further development of the theory of knitted stitchs, the creation of new types of knitwear, the development of highly efficient knitting processes with optimal parameters of the properties of knitwear.

II. LITERATURE REVIEW

The structure of double jersey of combined stitchs, when knitting of which two systems of threads are used: one for the formation of loops of the front side, the other for the seamy side, do not go to its other side.

In accordance with the peculiarities of the structure, such jersey was named by Ph.D. Pospelov E.P. as two-layer [2].

Of the indicators characterizing the physical and mechanical properties of knitted fabrics, the following are accepted: strength and elongation at break, elongation under loads less than breaking (6N), resistance to single and multiple stretching, resistance to crushing and abrasion, shrinkage during wet heat treatment, etc. [3- 4].

Of the indicators characterizing the physical properties of knitted fabrics, the most often used are: air permeability, water absorption, hygroscopicity, total thermal resistance and other indicators that determine the heat-shielding properties of fabrics, as well as electrification, etc.

The indicators characterizing the appearance of the knitted fabrics are the number and list of defects per unit length or area.

These indicators are due to the properties of the raw materials used and the method of obtaining knitted fabrics. Not all of the listed indicators should be taken to characterize the quality of all types of fabrics.

Depending on the purpose of the knitted fabric and the conditions of its operation, indicators are selected to characterize its structure, physical and mechanical properties, as well as the list of fabric defects depending on its purpose and the type of equipment on which it was obtained.

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III. RESULTS AND DISCUSSION

In order to reduce the consumption of raw materials, improve the quality of knitwear and expand the range of knitted fabrics, structures and methods for the production of 5 variants of two-layer knitwear have been developed, where the press method of joining with warp threads is used to join the layers of knitted fabric.

Samples of two-layer knitted fabrics were produced on a LongXing 252 SC two-layer flat-knit machine, which differed from each other in the structure of the stitch.

The raw material used was cotton yarn of liner density 30 tex x 2 for one side of the two-layer knitted fabric and polyacrylonitrile (PAN) yarn of 32 tex x 2 for the other side of the knit and for the weft.

The first variant of two-layer knitted fabrics was developed on the basis of semi-fan stitch. Variant I of knitted fabrics was adopted as the basic variant for comparing the physical and mechanical properties of new variants of two-layer knitted fabrics.

Physic-mechanical properties of new variants of two-layer knitted fabrics were determined according to the standard method [5-7] in the "CentexUz" laboratory at TITLI, the results are given in table1.

Knitted fabrics have a significantly higher elongation than fabrics, and therefore a more flexible structure, sensitive even to small applied forces.

Table 1

Physical and mechanical properties of two-layer knitted fabrics

Indicators		Variants				
		I	II	III	IV	V
Surface density M_S , g/m^2		508	370,7	374,4	389,4	459,3
ThicknessT,mm		1,8	1,4	1,5	2,1	1,95
Bulk densityδ, mg/sm^3		282,2	264,3	249,6	185,4	235,5
Air permeability B, sm^3/cm^2·sek		65,4	96,5	112,4	95,5	83,3
Abrasion resistance И, thousand revol.		23/31	24/34	26/32	23/31	25/32
Breaking load P, N	By wale	320	309	385	309	301
	By course	192	190	250	131	212
ElongationL, %	By wale	89	78	91	95	97
	By course	94	119	123	80	101
Irreversible deformationε_H, %	By wale	19	20	15	16	11
	By course	20	16	22	35	15
Reversible deformationε_O, %	By wale	81	80	85	84	89
	By course	80	84	78	65	85
Shrinkage У, %	By wale	5	6	7	5	7
	By course	4	4	9	-2	3

The principle of operation of finishing equipment for knitted fabrics is no different from the principles of operation of equipment for finishing fabrics. It has been established that the main cause of large shrinkage is excessive deformation of knitted fabrics in finishing operations.

The air permeability of the experimental samples of two-layer knitted fabrics varies from 65.4 to 112.4 cm^3 / cm^2 · sec (Table 1, Fig. 2.)

The air permeability indicators for the IV variant of two-layer knitted fabrics are the smallest and amount to 83.3 cm^3 / cm^2 · sec, which is 21.5% more than that of the basic stitch (I-option). The highest air permeability for the III variant of two-layer knitted fabricsis112.4 cm^3 / cm^2 · sec, which is 42% more than that of the basic stitch (I-variant).

The indicator of resistance to abrasion of knitted fabrics varies in a very wide range - from 20 to 500 thousand revolutions of the device. Since the back layer of the two-layer knitted fabrics is made of cotton yarn, and the front layer is made of polyacrylonitrile yarn, the abrasion resistance of the back layer will differ from the abrasion resistance of the front layer of the knitted fabric (Table 1, Fig. 2).

The abrasion resistance of the seamy layer of a two-layer jersey varies from 23 to 26 thousand revolutions. The highest abrasion resistance is in the III variant of knitted fabrics, which is 13% more than that of the base stitch. The abrasion resistance of the outer layer of a two-layer knitted fabric varies from 31 to 33 thousand revolutions. The highest abrasion resistance is in the II variant of the two-layer knit, which is 6% more than in the base stitch.

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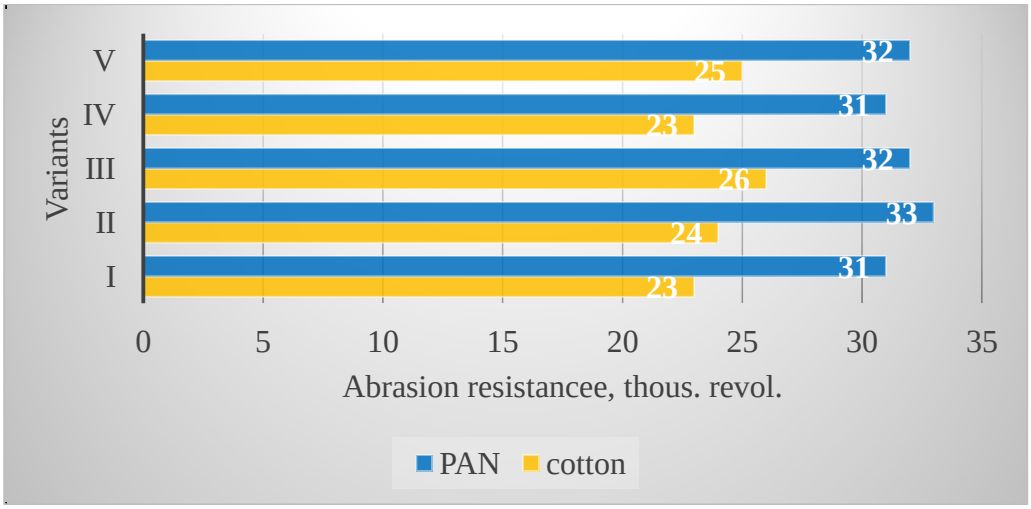

Fig. 1Histogram of change in abrasion strength of two-layer knitted fabrics

The breaking load of the presented samples was determined according to the standard method on an AG-1 dynamometer.

The breaking load along the length of the two-layer knitted fabrics varies from 301 to 385 N (Table 1). The most durable is the III-variant of two-layer knitted fabrics, where the breaking load along the length is 385 N, which is 17% more than that of the basic stitch (I-variant). The V-variant of two-layer knitted fabrics has the lowest strength along the length, with a breaking load of 301 N.

The breaking load across the width of new types of two-layer knitted fabrics varies from 131 to 250 N. The largest breaking load along the width of the III variant of two-layer jersey is 250 N, i.e. 30% more than the breaking load across the width of the base stitch (Table 1).

Based on the indicators of the breaking load of the experimental samples of two-layer knitted fabrics, we can conclude that a two-layer knitted fabrics, the back layer of which consists of three stitch rows of the smooth surface (variant III) in the stitch rapport, is more durable than knitted fabrics, the back layer of which consists of one stitch row of the surface (Variant I).But at the same time, the indicators of breaking load of all variants of two-layer knitted fabrics are of high importance and meet the requirements for outer knitted fabrics.

As can be seen from the results of the analysis of the physical and mechanical properties of two-layer knitted fabrics, the elongation at break of the proposed options are close to each other (Table 1).

Elongation at break along the length of the proposed options for two-layer knitted fabrics varies from 78 to 97%.

The lowest elongation along the length of the II variant of two-layer knitted fabrics is 78%, i.e. 14% less than the elongation at break of the base stitch (variant I). The highest elongation along the length of the V variant of two-layer knitted fabrics is 97%, i.e. 9% more than base stitch. Elongation at break of two-layer knitted fabrics in width varies from 80 to 123%.

The lowest elongation in width for the IV variant of two-layer weft knitted fabrics is 80%, i.e. 17% less than base stitch. The presence of a weft thread in the knitted fabrics structure, which is located along the stitching row between the layers of two-layer knitted fabrics, reduces the extensibility of the knitted fabrics in width and increases the dimensional stability of the knitted fabrics.

The highest elongation in width is in the III variant of two-layer knitted fabrics and is 123%, i.e. 31% more than the stretch in width of the base stitch.

A significant decrease in the extensibility of knitted fabrics in width is explained by the presence of a weft thread in the structure of a two-layer knitted fabric.

In terms of the proportion of reversible deformation, the elastic properties of knitted fabrics are judged. The greater the proportion of reversible deformations the canvas possesses, the better the products made from it should maintain their shape [6-7].

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The proportion of reversible deformation of samples of two-layer knitted fabrics along the length varies from 80% to 89%, while the proportion of reversible deformation along the width varies from 65% to 85% (Table 1).

Such indicators of the proportion of reversible deformation indicate the ability of the studied samples of two-layer knitted fabricsto quickly take on the original dimensions after stretching.

One of the important properties of knitted fabrics during the operation of products is the preservation of their linear dimensions after the action of wet heat treatments.

The results of the study of the shrinkage process in the prototypes of two-layer knitted fabrics showed that the shrinkage in length ranges from 5 to 7%, in width from - 2 to 9% (Table 1).

IV. CONCLUSION AND RECOMMENDATION

To identify the best options for two-layer knitted fabrics with different stitch structures, it is necessary to take into account a large number of factors that form the structure and properties of fabrics.

Therefore, to process the obtained test results, a method for constructing a complex diagram and a histogram for assessing the quality indicators of two-layer weft knitted fabrics was chosen (Fig. 2,3).

The results of the complex diagram and the histogram of the quality indicators of two-layer knitted fabrics showed that the best options for two-layer weft knitted fabrics are variants III, IV and V.

They are most suitable for the manufacture of topsides, because have high dimensional stability and reduced material consumption.

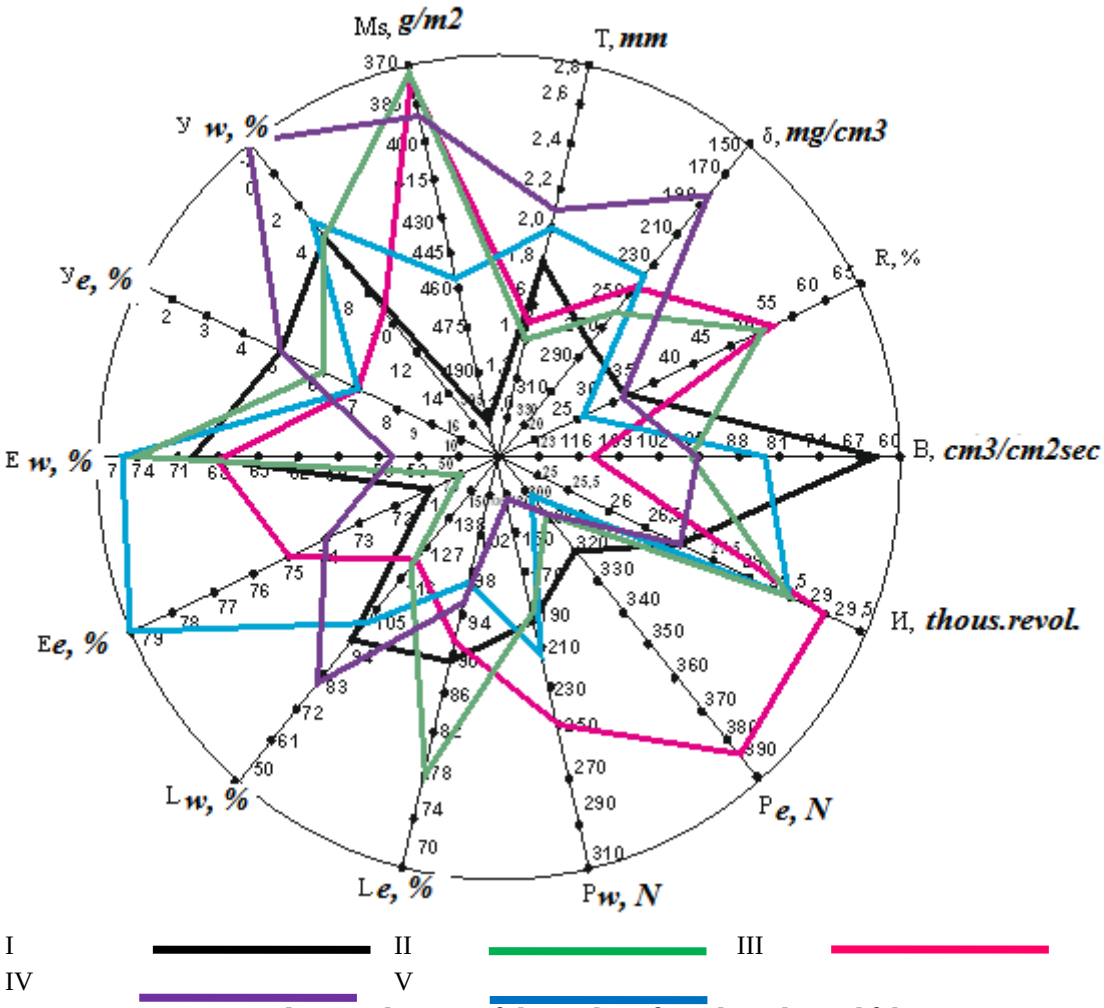

Fig. 2Comprehensive diagram of the quality of two-layer knitted fabrics

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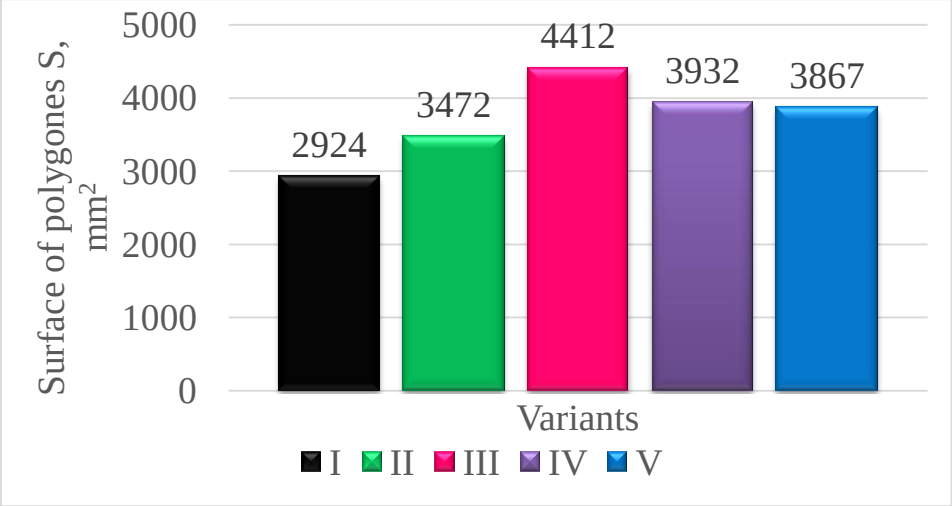

Fig. 3Histograms for assessing the quality indicators of two-layer knitted fabrics

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