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# Technological Indicators of New Structure Two-Layer Knitted Fabrics Analyzed

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Maqolada ikki yassi ignadonli trikotaj to'quv mashinalarining texnologik imkoniyatlaridan foydalanib ishlab chiqarilgan ikki qatlamli trikotaj to'qima na'munalarining texnologik ko'rsatkichlarini tahlil natijalari keltirilgan.
**Kalit so'zlar:** ikki qatlamli trikotaj, yuza zichlik, qalinlik, hajm zichlik, texnologik ko'rsatkich.
В статье использованием технологических возможностей двухфонтурных плосковязальных машин исследована результаты технологических параметров двухслойных трикотажных полотен.
**Ключевые слова:** двухслойный трикотаж, поверхностная плотность, толщина, объемная плотность, технологические показатели.
In the article technological capabilities of double bed flat knitting machines results of analyses of technological parameters double-layer knitted fabrics.
**Key words:** double-layer knitting, surface density, thickness, wolume density, technological parameteres.

Standard, experimental and calculation methods are used in the design of the main indicators of knitted fabrics [1-4].

The type and composition of the raw materials used, the structure and characteristics of the structure, as well as during the dyeing process, change their properties. This is a factor that directly affects the properties of the fabric produced from it [5,6].

In order to reduce the consumption of raw materials and expand the assortment of knitted products, 6 variants of two-layer knitted fabrics of a new structure were produced on the Long Xing type flat double-needle knitting machine.

A graphical representation of the double-layer knitted fabric in the proposed new structure is shown in Figure 1.

One of the most promising directions for the creation of a new assortment of knitted fabrics is the production of mixed fabrics using different methods, using existing fabrics and their elements, using new technologies.

A common feature of two-layer knitted fabrics is that each layer of the fabric is a single-layer fabric of basic, derived, patterned or mixed. Fabric or layers are attached during knitting by means of any elements in the ring structure in such a way that the fabric of one layer can be removed and the second layer can be preserved without disturbing the ring structures.

Due to the use of different single-layer fabrics in one fabric, it is possible to eliminate the negative properties of these knitted fabrics and maintain their positive properties. In this way, for example, it is possible to reduce the deformation of the length and width of the fabric, to increase the shape retention and strength properties of the knitted fabric, to improve the appearance of the heat retention property, or to change the surface densities on both sides of the fabric.

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Two-layer knitted fabric layers can be connected using a base or a weft thread, the right side and the reverse side can differ in fiber composition, linear density and color.

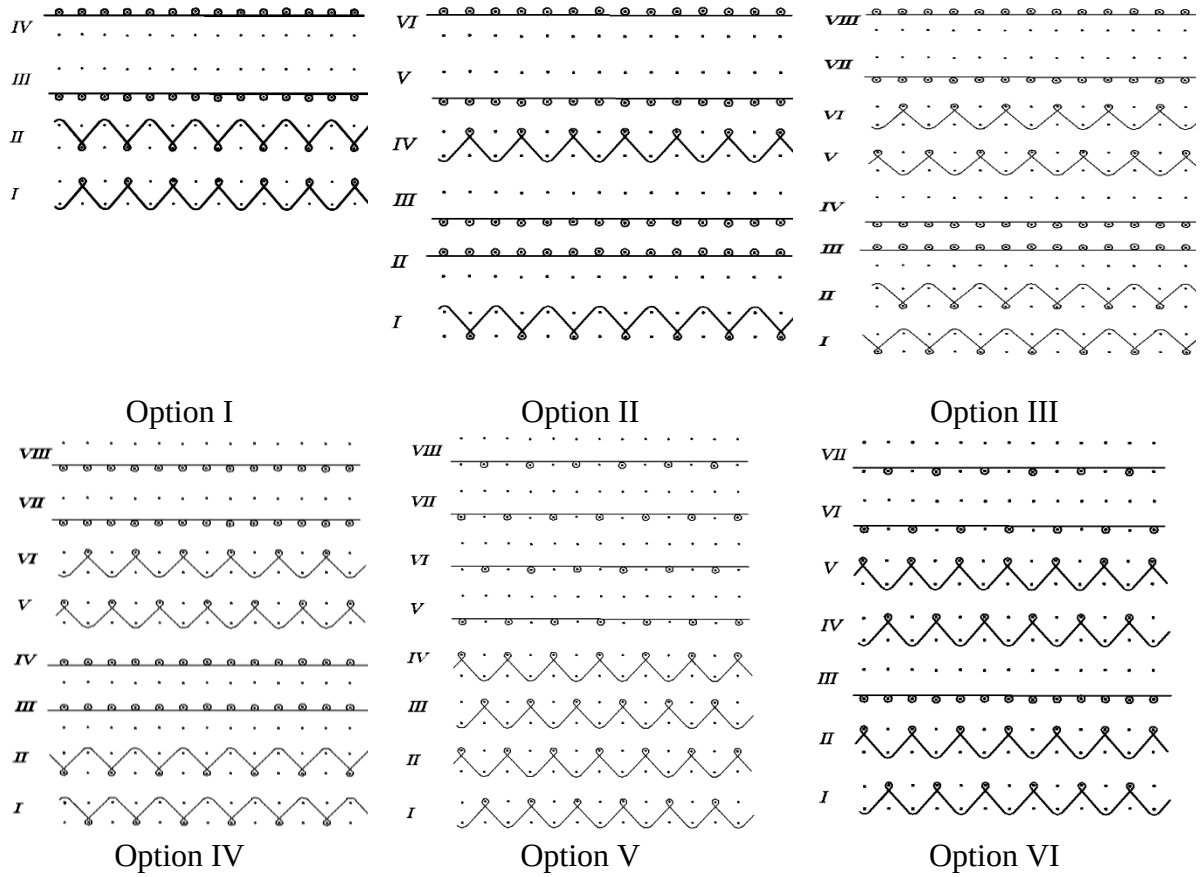


**Figure 1. A graphic record of two-layer knitted fabrics in a new structure.**

In the production of two-layer knitted fabrics, the quality indicators and assortment can be increased by choosing the type of fabric for each layer, connecting elements, the order of alternating layers, the type of yarn, the linear density and color, the ratio of the optimal indicators of the layers, changing the location and position of the knitting needles of the knitting machine. expansion problems are partially solved.

The two-layer knitted fabrics of the new structure with the needles arranged in an interlocking order, produced above, differ from the samples of the two-layer knitted fabric of the new structure with the needles arranged in the elastic order in terms of tissue ratio, structure, the state of mutual arrangement of the needles, technological indicators and physical-mechanical properties. It was noticed during the production process that the quality indicators of the two-layer knitted fabrics of the new structure with the needles arranged in an interlocking order are better than the quality indicators of the two-layer knitted fabrics with the needles arranged in a rubber arrangement. In order to prove their reliability, research was carried out on the technological indicators and physical-mechanical properties of two-layer knitted fabrics of a new structure with interlocking needles.

The performance of any knitted fabric is influenced by the nature of the raw material, the type of fabric and the processing method.

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Based on the results of the above scientific work, scientific research was carried out in order to study the method of obtaining two-layer knitted fabrics of a new structure and the effect of changes in the fabric structure on the technological indicators of knitting.

The technological parameters of the two-layer knitted fabrics of the new structure were tested in the "CentexUz" laboratory using the available test equipment in a standard way, the obtained results are presented in Table 1.

**Table 1**

**Technological indicators of two-layer knitted fabrics of a new structure.**

| Indicators | | Options | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI |
| Thread type and linear density, tex | Front layer | PAN 30 tex x 2, 100% | | | | | |
| | Back layerort | | | | | | |
| Ring step A, mm | Front layer | 1,66 | 1,78 | 2,2 | 1,92 | 1,66 | 1,56/1,47 |
| | Back layerort | 1,66 | 2,0 | 3,1 | 3,8 | 1,43 | 1,43 |
| The height of the ring row is V, mm | Front layer | 1,25 | 1,0 | 1,1 | 1,35 | 0,9 | 1,13/2,9 |
| | Back layerort | 1,25 | 1,78 | 2,2 | 1,92 | 1,0 | 1,1 |
| The density of rings in horizontal, Rg, Ring | Front layer | 30 | 28 | 23 | 26 | 30 | 32/34 |
| | Back layerort | 30 | 25 | 16 | 13 | 35 | 35 |
| The density of rings in the vertical Rv, Ring | Front layer | 40 | 50 | 46 | 37 | 55 | 44/17 |
| | Back layerort | 40 | 28 | 23 | 26 | 50 | 46 |
| The length of the ring thread is L, mm | Front layer | 4,7 | 5,0 | 5,0 | 5,8 | 6,6 | 6,5/5,3 |
| | Back layerort | 6,25 | 7,2 | 7,1 | 6,8 | 6,8 | 6,3 |
| Surface density of knitted fabric Ms, $g/m^2$ | | 367,2 | 309,7 | 308,4 | 240,3 | 373,1 | 447,5 |
| The thickness T, mm | | 1,7 | 1,45 | 1,4 | 1,15 | 1,97 | 2,1 |
| Volumetric density of knitted fabric d, $mg/cm^3$ | | 216 | 213,6 | 220,3 | 209 | 189,4 | 213,1 |
| Absolute volumetric density Δδ, $mg/sm^3$ | | - | 2,4 | -4,3 | 7 | 26,6 | 2,9 |
| Relative lightness θ, % | | - | 1,11 | -1,9 | 3,2 | 12,3 | 1,3 |

The technological indicators of the two-layer knitted fabric of the new structure were compared. In this case, the first option of knitted fabric was taken as the base fabric (Fig. 2). The front layer of the base tissue consists of glad and a semi-ring of press tissue (nabroska), and the back layer is formed of a simple ring of press and is interconnected.

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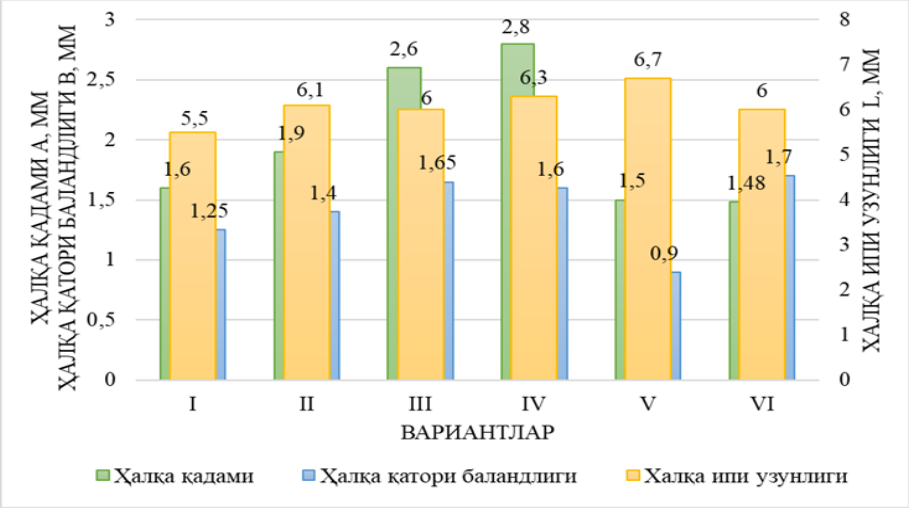


**Figure 2. Histogram of the influence of the change of the ring pitch and the height of the ring row on the length of the knitting of the two-layer knitted fabric of the new structure.**

Hence, the ring pitch for the front layer of the knitted fabric varied from 1.47 mm to 2.2 mm, and for the back layer from 1.43 mm to 3.8 mm. Among them, the largest ring pitch in both layers was observed in variant IV, and the smallest ring pitch was observed in variant VI. When comparing the loop row height index of the knitted fabric, the index of the front layer varied from 0.9 mm to 2.9 mm, and for the back layer from 1.0 mm to 2.2 mm. Among them, the smallest ring pitch in both layers was observed in variant V, the largest ring pitch was observed in variant VI in the front layer, and variant III in the back layer. Also, the length of the ring thread, which directly affects the raw material consumption, has changed from 4.7 mm to 6.6 mm in the front layer, and from 6.25 mm to 7.2 mm in the back layer. Therefore, due to the change of the fabric structure and the use of glad, press and derivative knitting loops, the loop pitch, loop row height and loop yarn length also changed (Fig. 2).

Raw material consumption is an indicator of consumption of the mass of textile yarn per unit of product or one square meter of knitted fabric. The consumption of raw materials for knitted fabric is characterized by the "surface density" MS indicator, and its unit of measurement is g/m$^2$.

According to the theory of knitting [7], the surface density of two-layer knitted fabrics is determined by the following formula: tamara

$$M_S = 2 \cdot 10^{-4} \cdot P_g \cdot P_v \cdot l \cdot T_{um} \qquad (1)$$

where: $P_G$ and $P_V$ are the number (density) of horizontal and vertical rings located in 100 mm in the tissue; l - the length of the ring thread, mm; Tum - total (total) linear density of threads, tex.

It can be seen from the formula that the variation of the raw material consumption of the knitted fabric depends on the horizontal and vertical density, the length of the loop thread and the linear density of the threads.

The effect of surface and thickness changes of two-layer knitted fabric samples on the texture and volume density index of the new structure was studied. According to him, the

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surface density of the base fabric of the first option was MS=367.2 g/m$^2$, and when the thickness was equal to T=1.7 mm, the volume density index of the sample was 216 mg/cm$^3$ (Table 1). Also, the highest surface density indicator was observed in option VI and was 447.5 g/m$^2$, and the lowest surface density indicator was 240.3 g/m$^2$ in option IV. According to the thickness index, the smallest index was 1.15 mm observed in the IV option, and the largest index was 1.97 mm observed in the V option. However, among the knitted samples, variant V was noted as the sample with the least consumption of raw materials, and its volume density was 189.4 mg/cm$^3$. In terms of raw material consumption, the greatest value was observed in option III, and accordingly, its volume density was 220.3 mg/cm$^3$.

So, the best result in terms of consumption of raw materials compared to the base fabric was observed in option V at the value of 189.4 mg/cm$^3$, its absolute volumetric lightness index was 26.6 mg/cm$^3$, and the relative lightness index was 12.3%. As a result, this variant representssurface density of knitted fabric, g/m2a reduction of 26.6 mg/cm$^3$, i.e. 12.3%, compared to the base tissue. Also, the worst indicator of consumption of raw materials compared to the base fabric was recorded in option III, 220.3 mg/cm3, its absolute volumetric lightness indicator was -4.3 mg/cm$^3$, and the relative lightness indicator was -1.9%. , this variant indicates a weight gain of 4.3 mg/cm$^3$, i.e. 1.9%, relative to the base tissue (Fig. 3).

The volume density indicators of the two-layer knitted fabrics of the new structure were determined and found by the following formula:

$$\delta = M_s / T \qquad (2)$$

$\delta$ - volume density of knitted fabric, mg/cm$^3$;

$M_s$ - surface density of knitted fabric, g/m$^2$;

T - thickness of knitted fabric, mm.

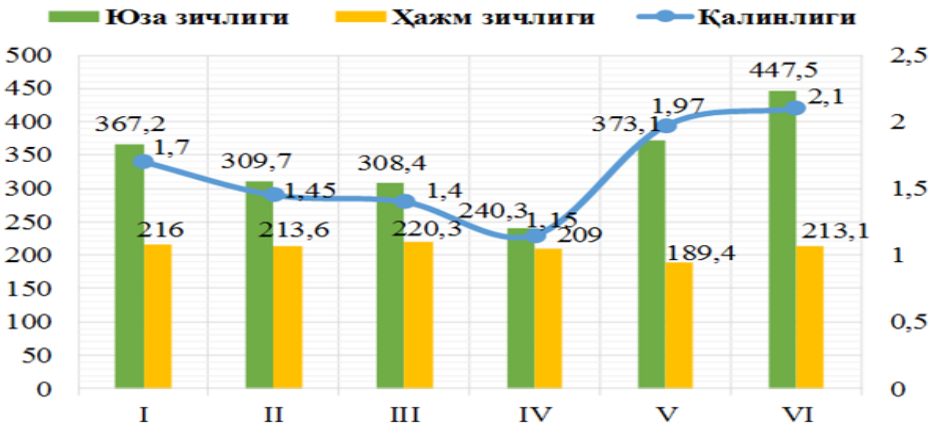


**Figure 3. Histogram of the effect of surface and thickness changes on volume density of two-layer knitted fabric in a new structure**

The volumetric and relative lightness indicators of the two-layer knitted fabrics of the new structure were determined by the following formulas:

$$\Delta\delta = \delta_I - \delta_{II} = 216 - 213{,}6 = 2{,}4\ mg/sm^3 \qquad (3)$$

here: $\Delta\delta$ - true volumetric density, mg/cm$^3$;

$\delta_I$ - volume density of the base tissue, mg/cm$^3$;

$\delta_{II}$ - volume density of experimental knitted fabric, mg/cm$^3$

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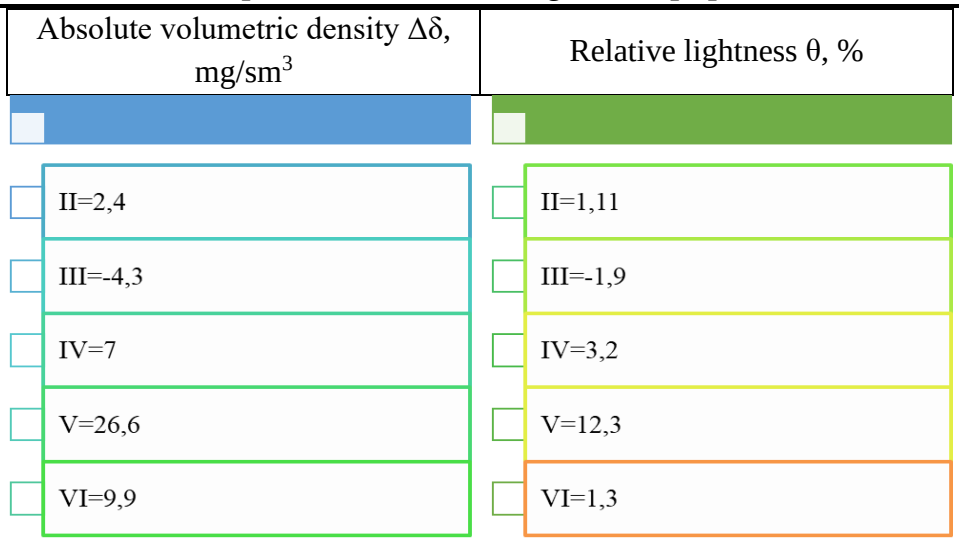


**Figure 4. Absolute and relative lightness indicators of two-layer knitted fabrics of a new structure**

Relative lightness is defined as follows:

$$\theta = (1 - \frac{\delta_{II}}{\delta_I}) \cdot 100\% = (1 - \frac{213,6}{216}) \cdot 100\% = 1,11\% \quad (4)$$

here: θ - relative lightness of the fabric, %.

The change values of the absolute and relative lightness indicators of the two-layer knitted fabric in the new structure are presented below (Fig. 4).

After researching the technological parameters of the two-layer knitted fabric samples produced in the new structure, it is possible to come to the conclusion that the change in the ratio and structure of the fabric due to the interlocking arrangement of the needles of the flat-needle knitting machine during the production of the knitted fabric has been found to affect its technological parameters. As a result, it was found that the parameters of raw material consumption of two-layer knitted fabrics of the new structure IV and V in comparison to the base fabric are lower among fabric samples.

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