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Research on the Production of New Textile Fabrics with a Silk-Cotton Mixture with a Road-Embossed Pattern

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Annotation.

In the development of the world textile industry, it is necessary to make extensive use of the range of modern weaving machines. This article is devoted to the creation of promising types of embossed fabrics with a new composition and the study of their important properties. Spun silk yarns are used in the warp, cotton fiber yarns are used as wefting, and it is recommended that the new embossed woven fabric be used for different purposes depending on the surface density.

Keywords:texture, pattern, embossing, longitudinal, transverse, rapport, embossing rate, linear density of yarn, embossing thickness, shrinkage, surface density, thickness, cotton yarn, natural silk

Yarns made of natural textile fibers, fabrics and garments made from them, the finished products have high environmental and hygienic properties. Fabrics involving cotton and silk fibers are gaining great success in world fashion. It is important to increase the processing of cotton, silk, wool and basalt fibers, the main domestic textile fibers in Uzbekistan, to create a new range of fabrics by mixing them with chemical fibers.

On February 12, 2019, the President of the Republic of Uzbekistan Sh. Mirziyoyev adopted the Resolution "On measures to further deepen the reform of the textile and clothing industry and expand its export potential."

According to him, the important directions of further reform of the textile industry of the Republic of Uzbekistan are, firstly, increasing the share of the textile industry in the economy, increasing the volume and quality of textile products, secondly, organizing the management system of the textile industry on the basis of advanced management technologies harmonization of the standardization, thirdly certification system with international requirements and standards, fourth, the widespread introduction of advanced information and communication technologies that provide reliable and timely information on the status of domestic and foreign textile markets; fifth, the development cluster, which involves the integration of production from raw cotton to finished textile products implementation of the model, sixth, the development of logistics and engineering infrastructure of network enterprises, seventh, to expand the production and export of high quality finished textile products, promote national brands to world markets, widely introduce advanced innovative technologies, know-how, design developments, localize the production of modern designs, eighth, for the textile industry in high demand specialties Improving the system of training, retraining and advanced training, strengthening international cooperation in educational institutions.[1]

In order to increase the production of new fabrics, to optimize their quality, the literature on the structure of the fabric and the importance of its determining factors in the artistic decoration of fabrics was analyzed.

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In creating a new range, the choice of tissue structure indicators is of great importance, which determine the texture properties, appearance and production conditions. N.A. Federenko's research work on the evaluation of tissue structure [2] emphasized the interdependence of the main factors that determine the structure of the tissue, such as linear density, shear, tissue density of the warp and weft yarns. It is shown that on the basis of the geometric theory of tissue structure and analytical dependencies of the design - it is possible to assess the acceptability of the tissue composition.
M.N. Nikitin's pamphlet on the artistic decoration of fabrics [3] discusses the influence of yarns with different fiber content on the surface of the fabric, the importance of dye in the decoration of fabrics, dyeing fabrics in zinc, melange, improving the aesthetic appearance of textured yarns, the effect of defective yarns on the fabric surface. illuminated. The main part of this booklet describes the influence of factors determining the structure of the tissue surface.It has been noted that the surface appearance of the fabric is relatively conspicuous when using yarns with high linear density. The smoothest surface is intended to be woven with visible texture satin (satin) braids. The importance of fine-patterned cuts in the artistic decoration of the textile surface at the expense of embossed patterns is highly valued, and the layout programs of this type of cuts are given. On the surface of the fabric it is possible to create different patterns by placing two layers of tan or weft yarn in a row with cord or pike cuts. These two cuts are not much different from each other.Both can be called by the same name, i.e., a bed with a fixed bed. This type of weave is used to create clear, bright-looking embossed patterns on the fabric surface. It is also widely used in the formation of feathers in tissues with other visible effects on the tissue surface, such as velvet-cord, flakone.
In addition, a lot of practical research has been done to study the effect of the main factors that determine its composition on the surface finish of tissue.
As a result of scientific research conducted by a French researcher for the decoration of fabrics [4], wavy lines were formed that are clearly reflected on the surface of the fabric. It is noted that these types of harvest are produced on the basis of at least 12 shods.
In the production of embossed fabrics proposed by Japanese researchers [5], polyester yarns with right and left ends were woven together, using false (lojnaya) yarns in the general direction. By relaxation processing of the tissue, embossed patterns are formed on its surface.
In order to expand the range of fabrics, T.Yu. Eroxin conducted research on the fabric adjuster of the ATPR weaving machine [6] and on the basis of its modernization it was possible to create transverse directional paths on the fabric surface.
There are many scientific studies devoted to the creation of different geometric patterns on the surface of the fabric, using different penetrations of yarns with different fiber content into the fabric. In the production of velvet-type fabrics [7], using chemical yarns with different components, a pattern was created on the surface of the fabric due to the different penetration of the components along the length of the yarn.In the production of road weaving [8] in hydraulic weaving machines, polyester tan yarns are initially hydrophobic processed depending on the liquid injectors. Simultaneously, tanda yarns of different colors are wrapped in different weaving spools, creating striped patterns on the surface of the fabric.The specific properties of textile fabrics (geometric, physical, mechanical, chemical) and the change in the appearance of the surface play an important role in the fiber composition of the warp and weft yarns. Yarns made from a mixture of natural and chemical fibers are used to improve the consumer properties of fabrics.
The appearance of the fabric, especially the surface properties, will be of great importance in their use. [9, 10, 11, 12, 13] have shown the evaluation of tissue surface properties based on human physiological conditions, reactions. New methods of calculating yarn penetration in fabric, factors influencing them, such as linear density of yarns, raw material composition, tissue density, shear reports, blade number, board width, number of tan yarns were analyzed.

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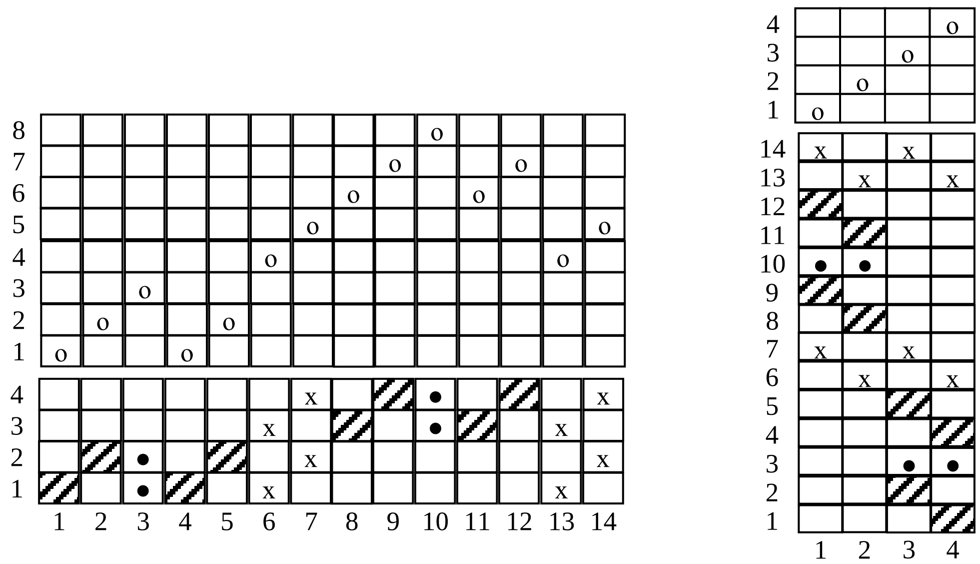
One of the factors influencing the structure of fabrics in artistic decoration is the type of yarn. A number of scientific studies have been conducted on the creation of various patterns, patterns on the surface of the fabric, using colored yarns, spun from dyed fibers (melange), shaped, various twisted yarns.
There are specific complexities in the production of longitudinal or transverse fabrics on looms. Forming a longitudinal pattern from colored yarns - starting with the selection of yarns, requires that the number of tan spools in the group with the color report be in a certain proportion. When silkworm selection is used, a decrease in process productivity is observed. When making a cross-stitch pattern from colored threads, it is necessary to equip the loom with a special "multi-loom" mechanism. This issue has been positively addressed in modern looms.
The type of mowing is recognized as one of the second major factors. In the research work, the programs of laying of road patterns with different cuts were analyzed and it was revealed that there are a number of difficulties in their production. In particular, the large number of branches in the production of longitudinal paths, the complexity of passing the threads through the branches, and so on. It was found that the simplification of the production of the analyzed harvests could be achieved by turning them to 90^0. For example, in the production of an additional warp embossed pattern (Fig. 1, a) and its transverse production (Fig. 1, b), not only the number of branches is reduced from 8 to 4, but also the transfer is much simplified.
In the practice of sewing, it has become customary to cut fabrics lengthwise. From the analysis of the studied literature it was found that longitudinal cutting has no scientific basis. At the same time, the placement of patterns of pieces of clothing on the fabric takes into account not only the longitudinal direction of the fabric, but also its pattern and surface character. This means that it does not matter to the seamstress to place the road patterns longitudinally or transversely, it depends on the width and assortment capacity of the machine.



a) longitudinal path b)transverse path

Figure 1. Additional embossed pattern stitching planking program

In order to study the effect of transverse production of longitudinal patterns on the texture structure and some of its properties, the first test specimens were produced on the basis of

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existing crepe and embossed patterns in the literature and turned them to 90^0. A comparative analysis of the main complex indicators that determine the surface appearance, thickness, tissue structure of the samples, such as shrinkage of the warp and weft yarns in weaving, tissue penetration, strength, elongation at break and work done at break. According to him, when comparing the surface appearance of the produced samples, it was observed that the transverse paths have a clearer, more pronounced appearance than the longitudinal paths.
In addition, the results showed that the production of longitudinal pattern in the tissue by transverse placement does not affect its structure (thickness, shortening of threads) and its properties. Hence, it is expedient to produce new embossed patterns in the transverse direction, using the assortment capabilities of modern looms.
The following are the issues of production of new embossed fabrics and their substantiation. The basis of the existing methods of embossing is the presence of long mats in the mowing, and in the reinforcement of the mats are used canvas or sarja 1/2 mowings. Based on this principle, as well as in order to ensure a sharp contrast between the smooth part of the fabric and the embossed part, it is recommended to produce a new textured embossed fabric. Figure 2 shows the recommended tissue cutting layout programs.

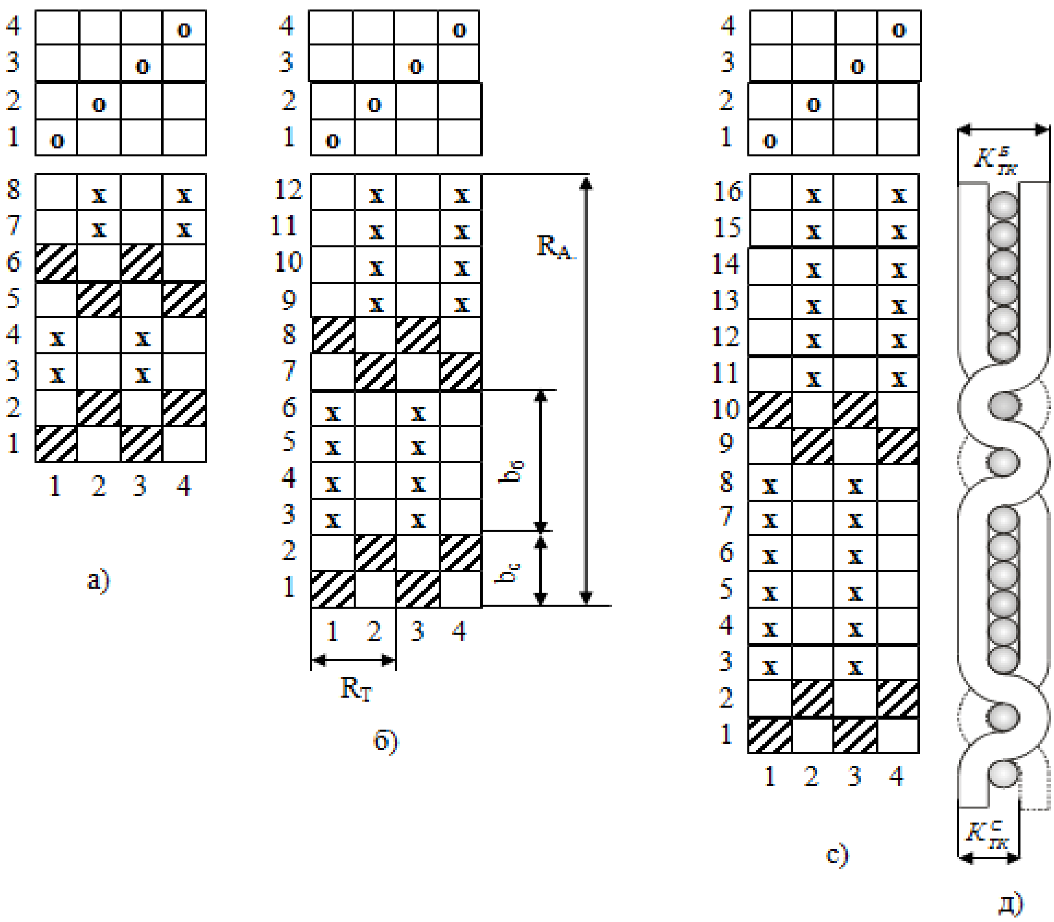

Figure 2. Weaving of embossed texture with new content
a) The embossed part is formed in the presence of 2 weft strips
b) 4 wefting threads
c) 6 wefting threads
d) geometric model of the cross section of the fabric on the warp

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From the image of the cuts in Figure 2, the recommended report of the cut of the embossed tissue is equal to the report of the smooth part on the warp. The report on the weft depends on the report of the smooth part and the number of threads forming the embossing, which is determined as follows:

$$R_A = 2 \times (R_A^C + n_A) \quad (1)$$

where: R_T, R_A - a report of the harvest on the warp and weft

R_T^C, R_A^C - report of the smooth part on the warp and weft

n_A - number of weft threads in the embossed part

In the recommended weave, the width of the rows($b_Б$) depends on the density of the fabric on the weft($P_A^Б$)and the number of weftthreads in the embossed part of the report $R_A^Б$, and on the smooth part (b_C) depends on the density of the fabric on the weft(P_A^C) and the number of threads on the report(R_A^C).

$$b_C = \frac{R_A^C}{P_A^C} \; b_Б = \frac{R_A^Б}{P_A^Б} \quad (2)$$

The fact that the surface appearance of the embossed texture depends on the thickness of the embossed part with the smooth part, it is necessary to determine the thickness of each of them separately. Since the smooth part of the proposed new composite fabric is produced by single-layer fabric cutting (Fig. 2), its thickness is determined by certain theoretical methods.
In the new fabric, the thickness of the embossed part formed as a result of throwing the weftthread in the shuttle without twisting the warp and weftthreads (Fig. 2, d) is as follows:

$$K_{TK}^Б = 2 \times d_T + d_A \quad (3)$$

where: - d_T, d_A - diameter of warp and weft threads, mm

In weaving practice, there is no objective way to assess the visibility of embossed tissue. Typically, in determining the quality of these tissues, "medium-relief" (relief), high-relief or fine-relief, etc. is called. From the analysis of the experimental samples of embossed textures cited in the literature, it was found that there was little difference in their visibility. Determining the advantage of the new proposed texture requires the development of a method of objective assessment of the visibility of the embossed pattern.
The visibility of the embossed texture depends on the difference in the paths formed as a result of the formation of parts of two different thicknesses on the surface of the fabric (Fig. 2, d). Considering this difference as the degree of embossing (BD) of the pattern in the tissue, it is recommended to determine as follows:

$$Б_Д = \frac{K_{TK}^Б}{K_{TK}^C} = \frac{2 \times d_T + d_A}{\frac{d_T + d_A}{2} + \frac{l_A - l_T}{2} \times \frac{\sqrt{3 \times (d_T + d_A)^2 - (l_A - l_T)^2}}{\sqrt{(d_T + d_A)^2 + (l_A - l_T)^2}} + d_A} \quad (4)$$

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where: $K^{Б}_{ТК}$ - embossed section thickness, mm

$K^{С}_{ТК}$- thickness of smooth part, mm

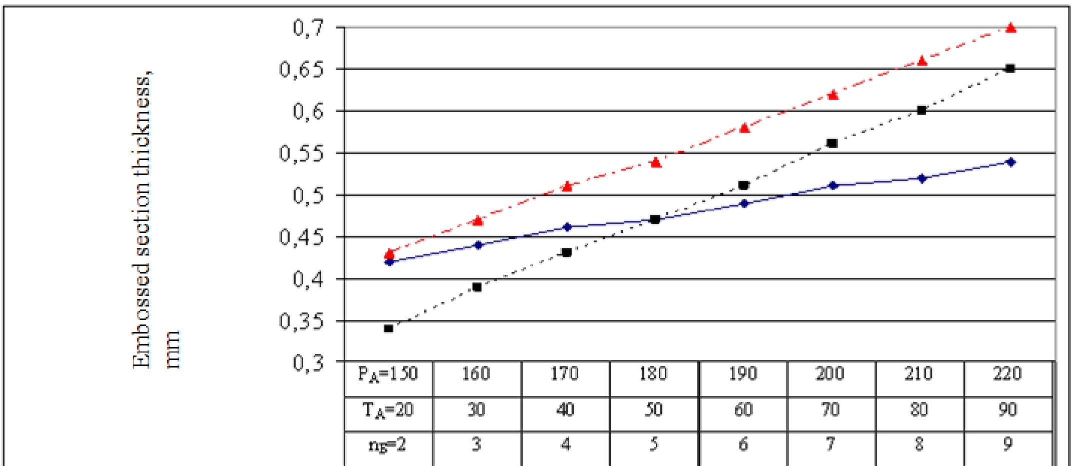
l_T, l_A- the smallest geometric density of the fabric on the body and weft, yarn / 10sm

In order to study the effect of the factors determining the structure of the tissue on the degree of swelling of the new tissue path pattern, studies were conducted using a mathematical planning method. The main factors were the density of the fabric on the weft(x1), the linear density of the weftyarn (x2) and the number of weftyarns thrown into the embossed part of the fabric (x3). Tissue thickness was taken as the outgoing indicator.

As a generalized result, the regression equation was constructed.

$$Y_K = 0{,}51 + 0{,}033x_1 + 0{,}13x_2 + 0{,}078x_3 + 0{,}033x_1x_2 + 0{,}01x_1x_3 + 0{,}05x_2x_3 + 0{,}012x_1x_2x_3 \quad (5)$$

The results of the equation show that the linear density of the wefting strip is of great importance to the embossing thickness of the cross-sectional tissue pattern, followed by the number of wefting threads thrown into the embossed part of the tissue. It was found that the proportion of tissue density on the weftrelative to these two indicators was less. Based on the constructed mathematical model, graphs (Fig. 3) were constructed reflecting the effect of the factors determining the texture structure on the embossed pattern thickness. The design of the embossed texture given the degree of embossing (BD) based on the variance analysis is given in the appendix of the work.



	P_A=150	160	170	180	190	200	210	220
	T_A=20	30	40	50	60	70	80	90
	$n_Б$=2	3	4	5	6	7	8	9
The density of the fabric on the weft	0,42	0,44	0,46	0,47	0,49	0,51	0,52	0,54
The linear density of the weft, tex	0,34	0,39	0,43	0,47	0,51	0,56	0,6	0,65
number of weft threads in the embossed part	0,43	0,47	0,51	0,54	0,58	0,62	0,66	0,7

Figure 3. Graph of the influence of factors determining the structure of the tissue on the thickness of the tissue relief

As a result of the linear density of the weft strip varying from 20 tex to 90 tex (Fig. 3), the thickness of the embossed pattern increased 1.9 times. It was found that increasing the density of the fabric on the weft from 150 thread / 10sm to 220 thread / 10sm increases the

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thickness of the embossed pattern 1.3 times, changing the number of wefting threads thrown on the embossed part from 2 to 9 increases the thickness of the pattern 1.6 times. Hence, taking into account the above, it is expedient to increase the pattern thickness in embossed textures, etc, the degree of embossing at the expense of the linear density of the wefting strip.

Tissue surface density - determines not only the amount of raw material used in production, but also its density, porosity and other properties depending on the ratio of factors that determine its structure.

It is known that the surface density of fabrics depends on the thickness of the yarn and weftyarns in their production, the number of yarns per 10 sm and the degree of bending of yarns in the fabric, ie the value of shrinkage of tan and weftyarns in weaving.

The peculiarity of determining the surface density of a new embossed tissue lies in the difference in the formation of its smooth and embossed parts on the machine, namely:

$$M_{M^2} = \frac{P_T \times 10 \times T_T}{(1-\frac{a_T}{100}) \times 10^3} + \frac{P_A \times 10 \times T_A^C \times m_C}{(1-\frac{a_A}{100}) \times 10^3 \times R_A} + \frac{P_A \times 10 \times T_A^Б \times m_Б}{10^3 \times R_A}, \text{ g/m}^2 \qquad (6)$$

where:

P_T, P_A - density of tissue on the warp and weft, thread / 10sm

T_T - linear density of the warp thread, tex

$T_A^C, T_A^Б$ - linear density of weftyarns in smooth and embossed parts, tex

a_T, a_A - shortening of warp and weftyarns in weaving,%

$m_C, m_Б$ - number of wefting threads in smooth and embossed parts in the weaving report

R_A - the report on the weftof the tissue

In recent years, methods proposed by Russian and South Korean scientists have been used to determine the shortening of the tan thread and the weftyarn in the smooth part in the new embossed texture.

Table 1

Influence of factors determining fabric structure on warp and weftstrip shrinkage and surface density in new embossed fabric

№	Factors determining fabric structure			Shirinkage of yarns in the fabric, %		The surface density of the fabric, g/m^2
	P_A	T_A	$n_Б$	Warp	Weft	
1.	180	29	2	8,3	3,8	108
2.	220	29	2	11	3,9	123
3.	180	29x3	2	14	3,6	218
4.	220	29x3	2	17	3,5	256
5.	180	29	6	3,8	3,7	105
6.	220	29	6	5,7	3,8	119
7.	180	29x3	6	8,1	3,6	215

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8.	220	29x3	6	12	3,5	250

From the results of Table 1, an increase in the linear density of the weft strip and the density of the tissue on the weft leads to an increase in the percentage of shrinkage of the warp strip, and an increase in the number of weft strands in the bulge of the tissue leads to a decrease in shrinkage.

The weft strip shortening was detected only for the smooth part. Since the warp and weft threads are not intertwined in the embossed part, the length of the weft strip is equal to the width of the board along the blade.

Mathematical models were obtained based on experimental results to study the effect of weft -to- weft density, weft -line linear density, and number of weft -threads thrown on the embossed part on the warp and weft -to- weft contraction in the fabric.

$$Y_{a_T} = 10 + 1{,}42x_1 + 2{,}77x_2 - 2{,}57x_3 \quad (7)$$

$$Y_{a_A} = 3{,}6 - 0{,}011x_1 - 0{,}125x_2 - 0{,}025x_3 \quad (8)$$

During the research, some physical and mechanical properties of the newly embossed tissue were studied and analyzed. Mathematical models were obtained to represent the effect of the factors determining the structure of the tissue on the strength (Y_I,Y_{II}) of the new composition of the embossed tissue on the warp and weft.

$$Y_I = 301{,}87 + 6{,}46x_1 + 18{,}29x_2 + 13{,}46x_3 \quad (9)$$

$$Y_{II} = 543{,}3 + 7{,}48x_1 + 46{,}7x_2 + 53x_3 - 38{,}57x_2x_3 \quad (10)$$

In the research work, graphs were drawn at different values of the influencing factors and their generalized view is shown in Figure 4.

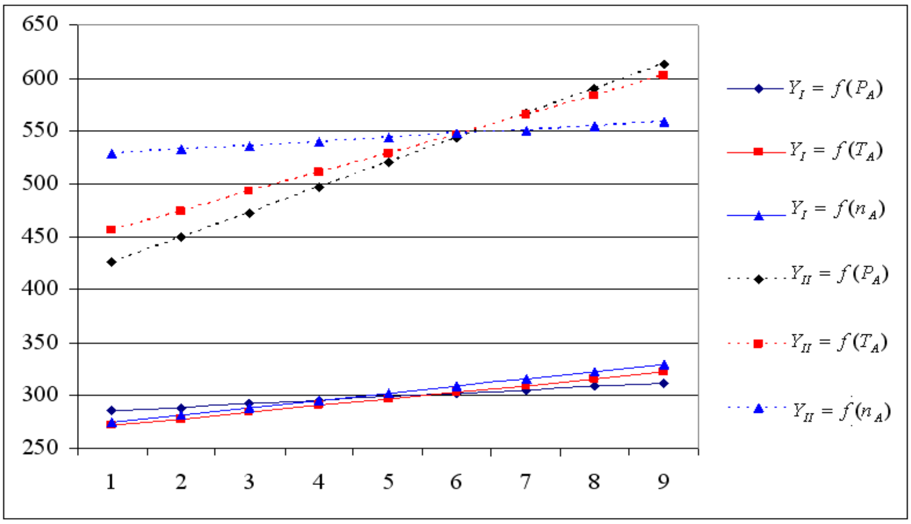

Figure 4. Influence of factors determining tissue structure on strength

It was observed that the change in the factors determining the structure of the embossed tissue (Fig. 4) had almost no effect on the strength on the warp. With the change in the linear density of the weft strip and the density of the tissue on the weft, the strength on the weft

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increases by a factor of 1.5. It was observed that an increase in the number of wefting threads thrown into the tissue embossed part had little effect on the strength along the wefting. The paper obtained and plotted mathematical models representing the effect of the above factors on the relative elongation at break in the torso and weft.
It also provides a comparative analysis of the existing embossed cotton texture structure and some important indicators of the new composition of cotton fabrics. The results of the study showed that the degree of swelling of the new tissue was on average 17%, 34% higher on the weft and 24% higher on the weft.

In order to increase the range of mixed fabrics, to apply them to silk-cotton mixed fabrics with embossed weaving, test samples were produced.

The purpose of producing blended fabrics is to save valuable natural silk and increase the fabric finish or smoothness by using the surface gloss of natural silk or chemical yarns. In fabrics produced using a new weave, the silk thread forms its surface appearance, as the warp surface is basically a tan thread. The weft yarn, which forms the embossed pattern of the fabric, is located between the tanda yarns, while in the smooth part, the cotton yarns participate as a weft cover on the surface of the fabric. In order to quantify the proportion of two types of yarn on the fabric surface, it was recommended to determine the content of the fabric:

$$K_T = \frac{S_T}{S_A} \times \frac{E_T}{E_A} = \frac{Q_T \times P_T \times d_T}{Q_A \times P_A \times d_A} \times \frac{E_T}{E_A} \quad (11)$$

S_T, S_A - the level occupied by the warp and weft yarns on the surface of the tissue surface

Q_T, Q_A -1 tanda in rapport, number of weft coverings

l_{Q_T}, l_{Q_A} - rapport single warp, length of weft coverings, mm

E_T, E_A - coefficient taking into account the actual surface area occupied by the warp and weft yarns.

The effect of tissue density on the weft, linear density of the weft yarn and type of weave on the composition of the fabric in the proposed silk-cotton mixed fabric [14] was studied and analyzed. In addition, the strength and abrasion resistance of cotton yarn and silk-cotton mixed fabrics were checked. The abrasion period of silk-cotton blended fabrics was found to be 33% higher than that of cotton yarns.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

1. In order to take full advantage of the range of modern weaving machines, the existing embossed fabrics were analytically analyzed and the need to create new types was identified.
2. From the comparative study of the direction of placement of road patterns on the fabric, the advantages of producing patterns in the transverse direction on wide, multi-colored looms have been proved.
3. From the study of the factors influencing the structure and surface appearance of the embossed tissue, it was found that the diameter of the wefting strip is important for the

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thickness of the embossing, and the number of wefting threads thrown into the embossed part is important for the width of the pattern.

4. Based on the head and one-and-a-half-layer tissue weaving, a new tissue composition with embossed pattern was developed. The “passive” weft throw to its embossed part made it possible to use high-density linear yarns.

5. It was found that the visibility of embossed textures depends on the difference between their smooth and embossed part thicknesses. An indicator describing the visibility of the embossed pattern - the concept of the degree of embossing - was proposed, and a method of its theoretical and practical determination was developed.

6. Given the specificity of the composition of the new embossed texture - the fact that the weft threads in the embossed part are not twisted, a formula for the theoretical determination of surface density was proposed. New fabrics were found to consume 6% less raw materials.

7. Some important properties of embossed textures of existing and new composition were studied. It was observed that the thickness of new fabrics is 26% higher, the work performed in cutting is 34% higher on the warp, and 24% higher on the weft.

8. The approval of the application of the new weave in silk-cotton blended fabrics was determined, and the formula of the composition indicator, which quantitatively represents the release of valuable yarn on the fabric surface, was proposed.

9. It is recommended that the new textured embossed texture be used for different purposes depending on the surface density.

a)surface density for cotton fabrics:

-100-150 g / m^2 - men's shirt fabric

-160-250 g / m^2 - suit texture

Above -250 g / m^2 - outerwear (jacket, coat)

b) surface density for silk-cotton blended fabrics:

-90-140 g / m^2 - shirt fabric

-120-220 g / m^2 - recommended for suit tissue.

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