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EXPANDING THE RANGE OF PRODUCTION OF COTTON SHIRT FABRICS WITH RELIEF PATTERNS

Abstract. This article presents the design, filling calculation and parameters for production of shirt fabrics. The proposed design technique will allow to quickly determine the parameters of a new fabric threading and texture and, as a consequence, accelerate the technology of its production, expand the range of shirt fabrics, increase the competitiveness, increase the volume and sales market.

The development of the range of competitive fabrics from domestic raw materials, based on an in-depth study of the texture and properties of fabrics using modern information technologies, is one of the urgent tasks facing the textile industry.

Scientific developments in this area have shown that in each case, the issues of technology and design of fabrics require improvement, an individual approach to a scientifically grounded solution of issues in the field of creating fabrics with improved artistic and color design and quality.

Keywords: shirt fabric, interweaving, design, filling calculation, calculation technique.

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Introduction. A shirt fabric must be soft, hygienic, have good breathability and a certain breaking strength. In the study [1], a method, technologies for manufacture of fabric structures and a study of their texture were developed. The authors designed a shirt fabric based on a given tensile strength along the warp and weft.

Conditions and methods of research. The technique for calculating a cotton shirt fabric of a relief interweaving with the strength on the warp $Q_o = 36.5$ and on the weft $Q_y = 36.5$ is given. To design a shirt fabric, a cotton yarn is taken as of uniform linear density along the warp and the weft, i.e. $T_o = T_y = T$ and $K_T = 1$, for a cotton fabric $C = 1.25$. As $T_o = T_y$ then $d_o = d_y$ and $K_d = 1$. The breaking stress for a cotton yarn is taken as $\sigma_o = \sigma_y = \sigma = 13 сн/tex$. The coefficient of efficiency of the yarn's breaking strength in a fabric on the warp $\rho_o = 1$ and on the weft $\rho_y = 1$. The

coefficient of filling a fabric on the warp $K_{Ho}=0.7$. Since, according to the task, the strength of a fabric on the warp is equal to the strength of a fabric on the weft, then the density of a fabric on the warp should be equal to the density of a fabric on the weft, therefore for the design, V-order of the texture phase is taken, i.e. $K_{ho}=1.0;\ K_{hy}=1.0$. A shirt fabric is of equal density, i.e. it has a square texture. The yarn in the fabric has some crease

$$\eta_{oг}=\eta_{yг}=1.05 \quad (1)$$

and

$$\eta_{oв}=\eta_{yв}=0.93. \quad (2)$$

The design of a shirt fabric is carried out in the following order.

1. Substitute the specified parameters into the formula (5) and determine the density of the fabric on the warp

$$P_o=\frac{100(1+1)\cdot 0.7}{d_{cp}\cdot(1\cdot 1.05+0.93)\sqrt{4-1^2}}=\frac{41.8}{d_{cp}}; \quad (3)$$

2. Substitute (5) and (6) in (3) and (4) and determine the average thread diameter

$$P_o d_{cp}^{\,2}/0.00156=36.5\cdot 2000/(13\cdot 1)=5615. \quad (4)$$

$$P_y d_{cp}^{\,2}/0.00156=36.5\cdot 2000/(13\cdot 1)=5615. \quad (5)$$

$$\frac{41.8}{d_{cp}}=\cdot\frac{d_{cp}}{0.00156}=5615. \quad (6)$$

$$d_{cp}=5615\cdot 0.00156/41.8=0.21mm \quad (7)$$

3. Determine the linear density of threads by the formula (6)

$$T_o=T_y=0.1469^2/0.00156=28.2tex \quad (8)$$

Accept 28 tex.

The average thread diameter is

$$d_{cp}=0.0316\cdot 1.25\cdot\sqrt{28}=0.21mm \quad (9)$$

4. Substitute the obtained value into the formulas (3) and (4), the density of the fabric on the warp and on the weft will be obtained

$$P_o\cdot 28=5615. \quad (10)$$

$$P_o = 5615/28 = 200н/dm \quad (11)$$

$$P_y \cdot 28 = 5615. \quad (12)$$

$$P_y = 5615/28 = 200н/dm \quad (13)$$

5. Checking the calculation of the fabric strength according to the formulas (1) and (2)

$$Q_o = 200 \cdot 28 \cdot 13 \cdot 1/2000 = 36.4даН \quad (14)$$

$$Q_y = 200 \cdot 28 \cdot 13 \cdot 1/2000 = 36/4даН \quad (15)$$

The difference between the calculated and the specified values is within the error.

6. Determine the coefficient of filling the fabric on the weft by the formula (7)

$$K_{Ну} = 200 \cdot 0.21(1 \cdot 0.93 + 1.05)\sqrt{4 - 1^2}/[100(1+1)] = 0.7 \quad (16)$$

7. The coefficient of filling the fabric by the formula (8)

$$K_{Тк} = 0.7 \cdot 0.7 = 0.49 \quad (17)$$

8. Run-in on the warp by the formulas (9-12)

$$L_o = \sqrt{0.5^2 + 0.1953^2} = 0.537mm \quad (18)$$

$$l_{уф} = L_{To} = 100/200 = 0.5mm \quad (19)$$

$$h_o = 0.21 \cdot 0.93 \cdot 1 = 0.1953mm \quad (20)$$

$$a_o = \frac{0.537 - 0.5}{0.537} \cdot 100 = 6.9\% \quad (21)$$

9. Run-in on the weft by the formulas (13-16)

$$l_{оф} = L_{Ty} = 100/200 = 0.5mm \quad (22)$$

$$h_y = 0.21 \cdot 0.93 \cdot 1 = 0.1953mm \quad (23)$$

$$L_y = \sqrt{0.5^2 + 0.1953^2} = 0.537mm \quad (24)$$

$$a_y = \frac{0.537 - 0.5}{0.537} \cdot 100 = 6.9\% \quad (25)$$

10. The surface density of the fabric (17-25)

$$q_c = \frac{200 \cdot 28}{100 - 6.9} + \frac{200 \cdot 28}{100 - 6.9} = 120 g / m^2 \quad (26)$$

Research results and discussions. Let's state the filling calculation and selection of the parameters for production of the designed shirt fabric. Textile machines are chosen depending on their assortment capabilities, taking into account high productivity and high quality fabrics.

When determining the assortment capability of the machine, the possibility of fabric production is determined depending on:

1 – kinds of warp and weft, types of weft (one-color, multicolor, etc.);
2 – linear density of threads in a fabric;
3 – obtaining the required interweaving;
4 – obtaining the required fabric width;
5 - the possibility of obtaining a certain density of threads in a fabric;
6 – the degree of tension in the process of fabric production.

The intensity of the fabric production process depends on interweaving, density and thickness of threads in a fabric and can be characterized by the coefficient of filling the fabric with fibrous material or the coefficient of connectivity of the fabric. With increase in the coefficient of filling or connectivity of the fabric, the intensity of the weaving process increases, the fabric production becomes more difficult and tense (Table 1,2,3) [2].

Table 1

The calculated filling parameters of the experimental fabrics.
Summarized data of technical calculation of a shirt fabric

No.	Parameter	Unit of measure	Indicator			
			1 variant	2	3	4
1	Coefficient of connectivity		5.6	5.6	5.6	5.6
2	Coefficient of filling		0.49	0.49	0.49	0.49
3	Finished fabric width	cm	155	155	155	155
4	Crude fabric width	cm	176	176	176	176
5	Reed filling width	cm	180	180	180	180
6	Interweaving		Relief interweaving 5 harness machine			
7	Thread thickness, tex On the warp On the weft	tex	 28×2 28	 28×2 15.4	 28×2 36	 28×2 20
8	Warp thread density	thread/dm	200	200	200	200
9	Weft thread density	thread/dm	200	200	200	200
10	Warp thread number, total	threads	3520	3520	3520	3520
11	Reed number	tooth/dm	90	90	90	90
12	Warp mass in 100 m of crude fabric	kg	21.17	21.17	21.17	21.2
13	Weft mass in 100 m of crude fabric	kg	10.2	5.85	13.68	7.6
14	Linear density of a fabric	g/m	318	270	348	288
15	Surface density of a fabric	g/m^2	180	153	198	163

Table 2

The calculated filling parameters of the fabrics produced on shuttleless weaving machines

No.	Parameter	Unit of measure	Indicator			
			1 variant	2	3	4
1	Coefficient of connectivity		5.6	5.6	5.6	5.6
2	Coefficient of filling		0,49	0,49	0.49	0.49
3	Finished fabric width	cm	155	155	155	155
4	Crude fabric width	cm	176	176	176	176
5	Reed filling width	cm	180	180	180	180
6	Interweaving		Relief interweaving 8 harness machine			
7	Thread thickness, tex On the warp On the weft	tex	28×2 28	28×2 15.4	28×2 36	28×2 20
8	Warp thread density	thread/ dm	200	200	200	200
9	Weft thread density	thread/ dm	200	200	200	200
10	Warp thread number, total	threads	3520	3520	3520	3520
11	Reed number	tooth/ dm	90	90	90	90
12	Warp mass in 100 m of crude fabric	kg	21.17	21.17	21.17	21.2
13	Weft mass in 100 m of crude fabric	kg	10.2	5.85	13.68	7.6
14	Linear density of a fabric	g/m	318	270	348	288
15	Surface density of a fabric	g/m^2	180	153	198	163

Table 3

The calculated filling parameters of the fabrics produced on shuttleless weaving machines

No.	Parameter	Unit of measure	Indicator			
			1 variant	2	3	4
1	2	3	4	5	6	7
1	Coefficient of connectivity		5.6	5.6	5.6	5.6
2	Coefficient of filling		0.49	0.49	0.49	0.49
3	Finished fabric width	cm	155	155	155	155
4	Crude fabric width	cm	176	176	176	176
5	Reed filling width	cm	180	180	180	180
6	Interweaving		Relief interweaving based on rep on the warp 8 harness machine			
7	Thread thickness, tex On the warp On the weft	tex	25×2 28	25×2 15.4	25×2 36	25×2 20
8	Warp thread density	thread/ dm	200	200	200	200

1	2	3	4	5	6	7
9	Weft thread density	thread/ dm	200	200	200	200
10	Warp thread number, total	threads	3580	3580	3580	3580
11	Reed number	tooth/ dm	80	80	80	80
12	Warp mass in 100 m of crude fabric	kg	19.3	19.3	19.3	19.3
13	Weft mass in 100 m of crude fabric	kg	10.2	5.5	12.96	7.2
14	Linear density of a fabric	g/m	295	248	323	265
15	Surface density of a fabric	g/m^2	167	140	183	150

Based on the obtained design data and technical calculation of the fabric, the technological process for the production of fabric for clothing was selected.

The technological process at the enterprise should be the most rational, i.e. should include the least number of transitions necessary to prepare the warp and weft for weaving, provide for perfect working methods, advanced equipment, mechanization and automation of labor-intensive work and transportation of goods.

When choosing the technological process and equipment at the enterprise, the kind, type and characteristics of the yarn (threads) for the warp and weft, the types of incoming packages and the nature of the fabrics produced are taken into account (Fig. 1).

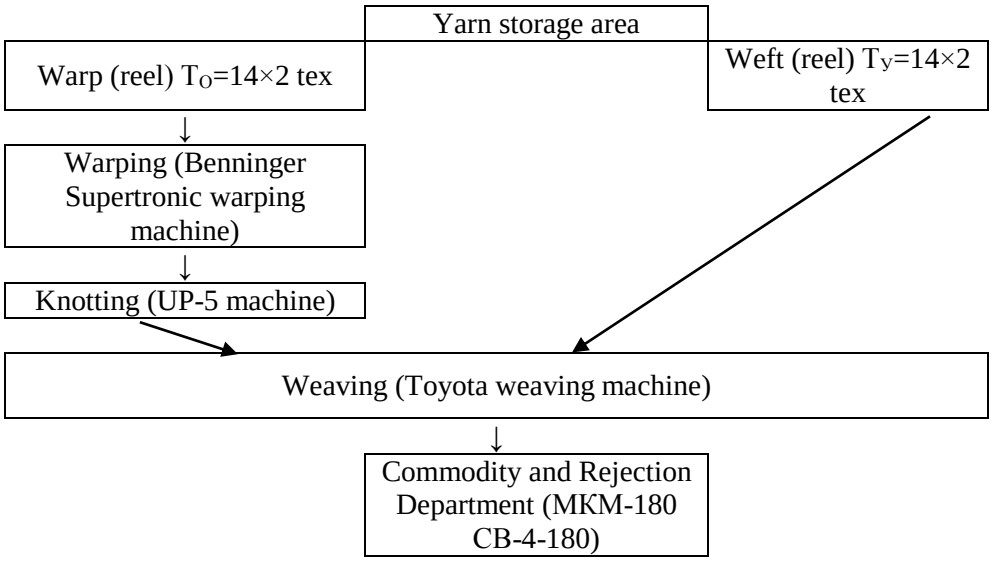

Figure 1. Technological process for production of a shirt fabric

A review of literary sources devoted to the influence of the fabric texture on its physical and mechanical properties, the main modern directions of designing fabrics, methods of designing fabrics, expanding the range of possibilities of the weaving machine [3], as well as optimizing the technological process of weaving has been performed. Fabrics and textile fabrics for household and technical purposes after technological processes of weaving and finishing industries should have optimal texture parameters and characteristics of operational properties, which allow

the best possible technological processes of finishing, impregnation of fabrics with special solutions and emulsions, and in the future, allow fabrics and textile fabrics perform their work functions qualitatively, reliably and durably [4]. The above analysis showed that the technology of fabrics includes a whole range of tasks that must be solved in the process of creating fabrics of a new type.

Conclusion. As a result of the experimental work, prototypes of fabrics were developed, produced on "СТБ", "JAT" machines with a relief pattern. Cross stripe patterns. For production of compound weaves, which form stripes across the fabric, it is possible to take all known weaves, the threads of which make their way to the same number of harness frames. For example, four harness frames are selected and various weaves are drawn that can be worked out on them. Notable for shirt fabrics are patterns with longitudinal stripes. Compound weaves are also produced, which form stripes along the fabric. Each weave that is part of the compound has its own parting pattern. As a rule, each weave requires its own harness frames. Only in rare cases weaves can be combined on the same harness frames. When forming longitudinal compound weaves, it is very important to evaluate the quality of the fabric, which will ensure the compound weave. If the weaves are very different from each other in relation to intersections in the repeat redistribution. In some areas, thinning of the fabric may be formed. This can lead to the appearance of loose (slack) threads in the warp. This requires a high density of warp threads in stripes with the main effect, i.e. the warp threads will have a large number of intersections and their run-in will increase.

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РЕЛЬЕФТІ СУРЕТТЕРІ БАР МАҚТА МАТАЛАРЫН ӨНДІРУДІҢ АССОРТИМЕНТТІК МҮМКІНДІКТЕРІН КЕҢЕЙТУ

Аңдатпа. Бұл мақалада тоқылған маталардың дизайны, жанармай құю есебі және өндіріс параметрлері келтірілген. Ұсынылған жобалау әдістемесі жаңа матаның құрылымы мен жанармай құю параметрлерін жедел анықтауға және нәтижесінде оны өндіру технологиясын жеделдетуге, Маталардың ассортиментін, бәсекеге қабілеттілігін кеңейтуге, көлемі мен нарығын арттыруға мүмкіндік береді.

Заманауи ақпараттық технологияларды қолдана отырып, маталардың құрылымы мен қасиеттерін терең зерттеуге негізделген отандық шикізаттан бәсекеге қабілетті маталар ассортиментін әзірлеу – Тоқыма өнеркәсібінің алдында тұрған өзекті міндеттердің бірі. Осы саладағы ғылыми әзірлемелер әрбір нақты жағдайда маталарды жобалау және технологиясы жетілдіруді, жақсартылған көркемдік-колористикалық безендіру мен сапа маталарын жасау саласындағы мәселелерді ғылыми негізделген шешуге жеке көзқарасты қажет ететіндігін көрсетті.

Тірек сөздер: тоқылған мата, тоқу, жобалау, жанармай құюды есептеу, есептеу әдісі.

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РАСШИРЕНИЕ АССОРТИМЕНТНЫХ ВОЗМОЖНОСТЕЙ ВЫРАБОТКИ ХЛОПЧАТОБУМАЖНЫХ СОРОЧЕЧНЫХ ТКАНЕЙ С РЕЛЬЕФНЫМИ РИСУНКАМИ

Аннотация. В данной статье приведены проектирование, заправочный расчет и параметры производства сорочечных тканей. Предлагаемая методика проектирования позволит оперативно определить параметры строения и заправки новой ткани и как следствие ускорить технологию её производства, расширить ассортимент сорочечных тканей, конкурентоспособность, увеличить объём и рынок сбыта.

Разработка ассортимента конкурентоспособных тканей из отечественного сырья, основанная на глубоком изучении строения и свойств тканей с использованием современных информационных технологий – одна из актуальных задач, стоящих перед текстильной отраслью промышленности. Научные разработки в этой сфере показали, что в каждом конкретном случае вопросы технологии и проектирования тканей требуют совершенствования, индивидуального подхода к научно-обоснованному решению вопросов в области создания тканей улучшенного художественно-колористического оформления и качества.

Ключевые слова: сорочечная ткань, переплетение, проектирование, заправочный расчет, методика расчета.