E3S Web of Conferences **486**, 07008 (2024) https://doi.org/10.1051/e3sconf/202448607008
AGRITECH-IX 2023

Theoretical basis for the development of a new assortment of costume fabrics of various compositions

Dilfuza Kazakova[1*], *Sanovar* Khamrayeva[2], and *Zulfiya* Bekmuratova[2]

[1]Bukhara Engineering-Technological Institute, Bukhara, Uzbekistan
[2]Tashkent Institute of Textile and Light Industry, Tashkent, Uzbekistan

Abstract. The article covers the results of research conducted on production of fabrics of various blended composition, such as local wool + cotton + polyester and cotton + cattail, in order to develop a new assortment of costume fabrics of various compositions. The production of such costume fabrics did not require the replacement of technological equipment, only the equipment was partially improved in order to settle the new assortment of production fabrics. The model for knitting costume fabrics of various compositions that gives positive results has been developed.

1 Introduction

Theoretical basis for the development of costume fabric of various composition by designing the structure of twill fabric 2/1 that is suitable for the development of costume fabric includes the following stages:

- development of the characteristics of device parameters and knitting models of costume fabrics of various composition;
- determining the mutual pressure of the threads through the geometric model of the fabric;
- determination of the calculated diameter of the threads in the fabric;
- determination of geometric density (dimensions);
- determination of the bending wave strength of the warp and weft threads;
- fabric with even surface
- determination of the filling coefficient of the fabric according to the warp and the weft;
- determination of the shrinkage of threads in the fabric;
- determination of the calculated surface density of the fabric.

Ecological ideas of society that create a hygienic demand for clothes, is the basis for bringing to the market new and not expensive products with different blended composition, that is, local wool + cotton + polyester and cotton + cattail fibers [1,2]. The main volume of such fabrics does not require replacement of technological equipment, only the development of a new assortment of production fabric and partial improvement of equipment.

*Corresponding author: dilfuza1978bmti@gmail.com

Fabrics of various composition and variants were produced at the "SOMMET" loom at the "Educational production enterprise of the society of the blind of Uzbekistan" [3,4].

2 Materials and methods

Fabrics were developed in 2 groups:

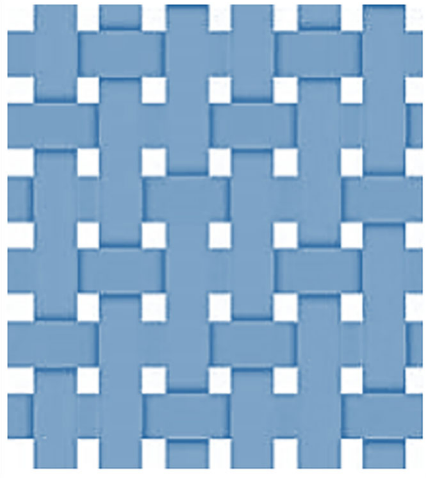
– warp thread is pure cotton and weft thread is a mixture of wool + cotton + polyester fibers;
– warp thread is pure cotton and weft thread is a mixture of cotton + cattail fibers [5,6].

In order to develop the fabric variants, 50 tack linear density warp and weft threads were used. Four variants of fabrics were obtained on the "SOMMET" loom using mixed threads for the production of costume fabrics (Table 1).

Table 1. Variants of fabrics made from threads of various composition

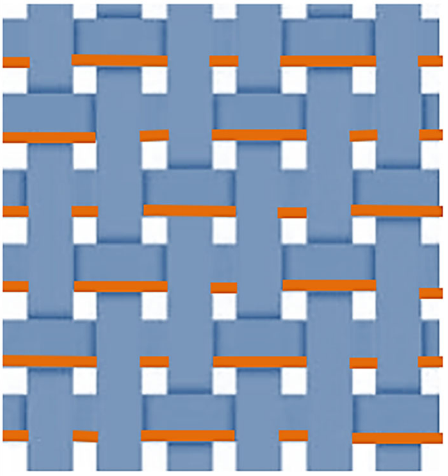
Type of fibers, in percent	Variant 1		Variant 2		Variant 3		Variant 4	
	warp	weft	warp	weft	warp	weft	warp	weft
Cotton	100	100	100	70	100	30	100	40
Polyester	-	-	-	-	-	50	-	40
Wool	-	-	-	-	-	20	-	20
Cattail	-	-	-	30	-		-	-

A model of knitting costume fabric of various composition according to options was developed (Figure 1).



Variant 1

Warp and weft are pure cotton



Variant 2

- Warp is pure cotton

-Weft is 30% cattail and

- 70% cotton

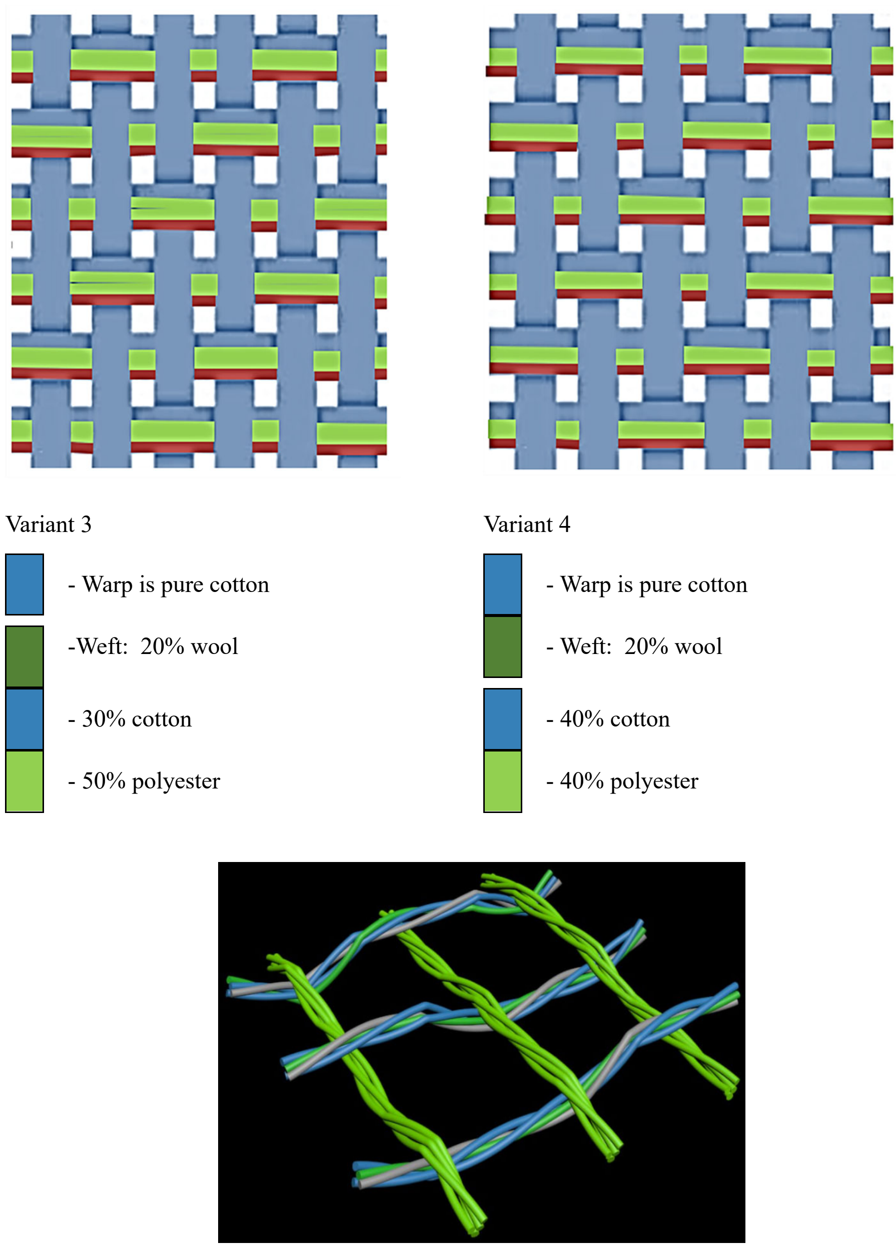


Fig. 1. Formation pattern of serge 2/1 costume fabric of various composition.

The characteristics of the fabrics to be developed for research are presented in Table 2 [7, 8].

The surface density of the fabric is understood as the mass corresponding to 1 m^2.

The surface density of costume fabric should not exceed 200-300 g/m^2

3 Results and discussion

Basic standard methods were used to research the characteristics of the selected fabrics.

In the process of fabric production on the loom, the warp and weft threads are formed under mutual pressure. Therefore, using the formulas of professor E. A. Onikov, *the value of the mutual pressure of the warp and weft* threads in one element of serge 2/1 costume fabric was determined (Figure 2), when $F_t=30\ kN$, $F_a=15\ kN$, $T_t=50\ tack$, $T_a=50\ tack$ [9].

$$N_t = 2F_t \cdot sin27^0 = 2 \cdot 30 \cdot 0.4539 = 22.695;$$

$$N_a = 2F_a \cdot sin23^0 = 2 \cdot 15 \cdot 0.390 = 11.7$$

The distance between the centers of the warp and weft threads (geometric density):

$$l_o = l_y = d_o + d_y = 0.252 + 0.252 = 0.504\ mm$$

Determining the calculated diameter of the fabric in terms of warp and weft threads:

$$d = 0.0357\sqrt{\frac{T}{\delta}} = 0.0357\sqrt{\frac{50}{1}} = 0.252mm$$

Table 2. Characteristics of the fabrics of blended composition.

Variants	Fiber composition	Knitting	The number of threads in 10 cm		Linear density of threads, tack		Fabric surface density, mass of 1m^2
			warp	weft	warp	weft	
1	Warp and weft threads are pure cotton	Serge 2/1	250	210	36	50	244.2
2	Warp thread - 100% cotton, weft thread - 70% cotton and 30% cattail	Serge 2/1	250	210	36	50	242.0
3	Warp thread - 100% cotton, weft thread - 30% cotton, 20% wool and 50% polyester	Serge 2/1	250	210	36	50	250.0
4	Warp – 100% cotton weft - 40% cotton, 20% wool and 40% polyester	Serge 2/1	250	210	36	50	248.3

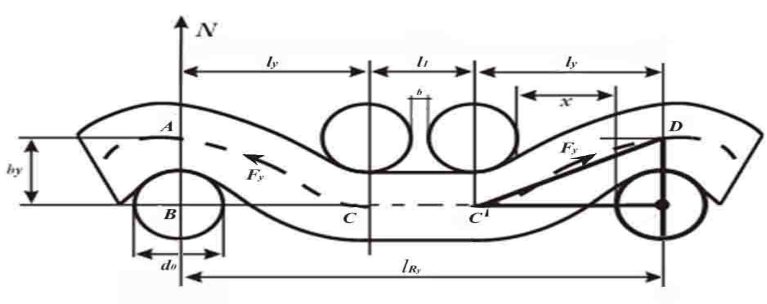


Fig. 2. Geometric model of serge 2/1 knitting even surface costume fabric in warp direction.

One rapport knitting length on warp and weft in serge 2/1 knitting even surface costume fabric [10,11]:

$$l_{R_o} = \frac{R_o \cdot 10}{P_y} = \frac{3 \cdot 10}{250} = 1.2\ mm.$$

$$l_{R_y} = \frac{R_y \cdot 10}{P_o} = \frac{3 \cdot 10}{253} = 1.19\ mm.$$

In serge 2/1 knitting, the distance of the junctions, taking into account the coefficient *b* and the angle of rotation at the intersection of the warp and weft threads:

$$x_o = d_o + b_o/R_o = 0.252 + 0.115 / 3 = 0.122\ mm;$$

$$x_y = d_y + b_y/R_y = 0.252 + 0.011 / 3 = 0.088\ mm;$$

$$b_o = l_{R_o} - l_o + d_o = 1.2 – 0.504 + 0.252 = 0.948\ mm;$$

$$b_y = l_{R_y} - l_y + d_y = 1.19– 0.504 + 0.252 = 0.938\ mm;$$

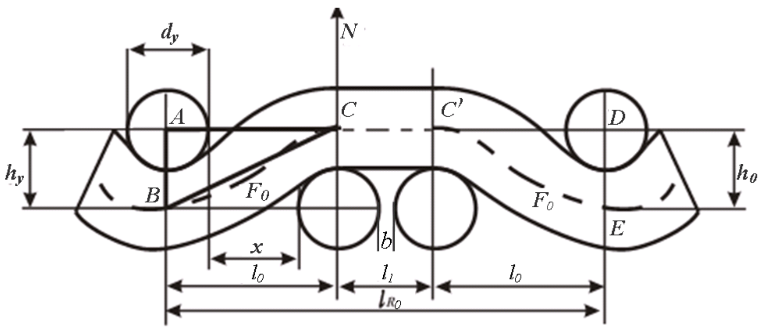


Fig. 3. Geometric model of serge 2/1 knitting even surface costume fabric in warp direction.

4 Conclusion

The final distance between the centers of the warp and weft threads in serge 2/1 knitting (Figure 3).

$$l_y = d_y + d_o + b_y/R_y = 0.504 + 0.948/3 = 0.481\ mm.$$

$$l_o = d_y + d_o + \frac{b_o}{R_o} = 0.504 + \frac{0.938}{3} = 0.480\ mm$$

Bending wave heights of warp and weft threads in serge 2/1 knitting even surface costume fabric:

$$h_o = \frac{N_o \cdot l_o'}{2 \cdot F_o} = \frac{22.695 \cdot 0.81}{2 \cdot 30} = 0.306\ mm$$

$$h_y = \frac{N_y \cdot l_y'}{2 \cdot F_y} = \frac{11.7 \cdot 0.80}{2 \cdot 15} = 0.312\ mm.$$

The filling coefficient of the fabric on warp and weft was determined by the following formula:

Let us determine the percentage of filling of the used fabric.

The percentage of filling of the fabric with warp threads is determined as follows:

$$\mathrm{E}_{\mathrm{T}}^{/} = \mathrm{P}_{\mathrm{T}}^{/} \cdot d_T \cdot 100 = 2.50 \cdot 0.252 \cdot 100 = 63.0$$

The percentage of filling of the fabric with weft threads is determined as follows:

$$\mathrm{E}_{a}^{/} = \mathrm{P}_{a}^{/} \cdot d_a \cdot 100 = 2.53 \cdot 0.252 \cdot 100 = 63.76$$

where: $d_a$is the diameter of the weft thread.

The percentage of filling of the fabric threads is determined as follows:

$$E_{Tp}^{/} = E_T^{/} + E_a^{/} - \frac{E_T^{/} \cdot E_a^{/}}{100} = 63.0 + 63.76 - \frac{63.0 \cdot 63.76}{100} = 86.59$$

where: $E_T^{/}$ and $E_T^{//}$are the filling of existing and projected fabric with warp threads; $E_a^{/}$ and $E_a^{//}$are the filling of existing and projected fabric with weft threads.

- the formula proposed by A.A. Martynova [9] was used to determine the shrinkage of threads in fabric.

Shrinkage of fabric by warp:

$$a_t = (1 - \frac{l_a \cdot t_{t.\text{ўp}} + (R_a - \cdot t_{t.\text{ўp}}) d_{\text{ўp}}}{K_{ha} \cdot t_{t.\text{ўp}} (d_a + \sqrt{h_t^2} + (l_a / K_{ha} - d_a)^2 + (R_a - t_t) d_{\text{ўp}}})100=9.8\%$$

$$a_a = (1 - \frac{l_t \cdot t_{a.\text{ўp}} + (R_t - \cdot t_{a.\text{ўp}}) d_{\text{ўp}}}{K_{ht} \cdot t_{a.\text{ўp}} (d_t + \sqrt{h_a^2} + (l_t / K_{ht} - d_t)^2 + (R_t - t_a) d_{\text{ўp}}})100=8.8\%$$

R_t, R_{a} are knitting rapports;

$t_{t.\text{ave}}$, $t_{\text{a.ave}}$ are the number of intersections of warp and weft threads;

h_t, h_{a} are bending wave heights of warp and weft threads;

lt, la are geometric density of warp and weft threads; K_{Nt}, K_{Na} are the percentage of filling the fabric with warp and weft; dt, da are calculated diameter of the warp and weft threads, mm.

The calculated surface density of the fabric was determined:

$$M^2 = \frac{m \cdot 100}{L \cdot B} = \frac{0.398 \cdot 100}{1 \cdot 1.65} = 241.212\ g$$

In this case, m is the mass of warp and weft threads used for 100 meters of fabric; L is the length of the fabric sample, 1 meter; B is initial width of fabric, cm.

On the basis of the research results, based on the requirements for costume fabrics, the solution in the stages of the theoretical basis for the development of costume fabric of various blended composition has been found.

References

1. L.I. Toshpulotov, F.R. Taniberdiev, S.A. Khamraeva, Development of science and technology, Bukhara **1**, 183-187 (2023)
2. Patent of Republic of Uzbekistan No. IAP 07115, 30.09.2022
3. S. Khamraeva, D. Giyasova, D. Kazakova, Journal of Hunan University of Natural Sciences **65(1)**, 3703-3710 (2022)
4. A.A. Martynova *Structure and design of fabrics*(Moscow State Textile University, 1999), p. 485
5. S.E. Mardonov, Journal Globus: technical sciences **75(41)**, 26-29 (2021)
6. S.E. Mardonov, Journal of Physics: Conference Series **2388,** 012168 (2022)
7. S.E. Mardonov, Modern Innovations, Systems and Technologies **2(1)**, 76-82 (2022)
8. M. Khodjiev, A.Ashurov, K. Rakhimov, IOP Conference Series: Earth and Environmental Science **1112(1)**, 012046 (2022)
9. I. Mavlonova, S. Fayziev, Kh. Rakhimov, M. Vokhidova, Journal of Physics: Conference Series **2388(1)**, 012125, (2022)
10. F. Kazakov, N. Sattarova, O. Aripova, IOP Conference Series: Earth and Environmental Science **1112(1)**, 012143, (2022)
11. R. Nurboev, M.Khudayberdiev, A. Abdullaev, O. Sharofov, O. Aripova, Journal of Physics: Conference Series **2094(4)**, 042079 (2021)