ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020

Research of the Influence of the Back-Layer`S Loop Length on Technological Parameters of Two-Layer Knitted Fabric

A.Juraboyev, K. Kholikov, G.Gulyayeva, M.Mukimov

Doctoral student of Namangan engineering-technological institute
DSc, professor of Namangan engineering-technological institute
PhD, Senior lecture of Tashkent institute of textile and light industry
DSc, professor of Tashkent institute of textile and light industry

ABSTRACT: In order to study the effect of the length of the thread in the loop of the back layer of two-layer knitted fabric on its technological parameters it was created new structures of two-layer jersey, knitted samples on a flat-knitting machine and investigated them properties. Two-layer knitted fabrics were developed on the basis of semi-cardigan stitch, where connection of the layers of knitted fabric was with tucks.

KEY WORDS: two-layer knitted fabric, technological parameters, cardigan stitch, flat-knitting machine.

I. INTRODUCTION

When designing the threading of any new knitted fabric or knitted products, it is customary to operate with such parameters as the loop step A, the height of the loop row B, the loop length *l*. The surface density of jersey and its other properties depend on them. Knowing the dependence of each of these properties on the parameters of knitwear of a particular structure, it can be chosen an optimal threading [1-3].

Different in structure two-layer knitwear of weft and warp-knitted stitches can satisfy the most varied requirements to parameters and indicators of properties that are presented in the practice of cloth production and goods for technical purposes.

The parameters of any knitted fabric are influenced by the properties of raw materials, the type of stitch and finishing [4-6]. Two-layer knitwear consists of two identical or two different single knitted fabrics, one layer`s stitch may have different parameters from the other. This circumstance determines the interaction of the layers. One layer, when connected to another, can change its initial parameters, and the other, in turn, change the parameters of the first. Therefore, the density and length of the threads in the loops of the layers of two-layer knitwear cannot be determined according to the corresponding formulas for single knitted fabrics. In addition, these parameters depend on the type and method of connection [7].

It is of interest to study the interaction of knitted fabric`s layers, since it effects on its parameters. The layers will not affect each other in the plane of the knitted fabric if the parameters of the constituent stitches are the same, and the connecting elements have an equal effect on the loops of the front and back sides.

The effect of one layer on another depends on the type of yarn, its mechanical properties: the greater the elasticity of the yarn, the greater the change in parameters with an increase in its linear density.

Another factor that determines the degree of effects one layer of a two-layer knitted fabrics will affect another is the length of the thread in the buttonhole. Earlier it was noted that with a constant length of the thread in the loop of one layer, knitting processes allow changing the length of the thread in the loop of another layer within wide limits.

For jersey or weft knitted fabric, the consumption of raw materials can be determined by the formula:

$$M_S = l \cdot T / A \cdot B \quad (1)$$

where M_S is the surface density of the knitted fabric, (g);
*l*is the length of the thread in the loop (mm) per loop area A · B (mm^2);
T is the linear density of the yarn, (tex).

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020

For knitwear of each specific stitch, there is a certain dependence of the length of the thread in the loop on the area of the loop. This dependence is such that only one value of l corresponds to each value of A · B, provided that the equilibrium state of the knitted fabric is maintained, therefore, one value of the surface density.

A different type of the layers connection is found for any two-layer knitwear due to the interaction of the layers and the different degree of this interaction.

Knitwear can have different values of l, which means that different consumption of raw materials per $1m^2$ of fabric at the same knitting density of two-layer knitwear, and vice versa, can have a constant surface density at different values of knitting density. Let's explain why this happens. The formula for determining the surface density of a two-layer fabric contains two terms - the surface density of the front (M_{S1}) and back (M_{S2}) layers.

$$M_s = \frac{l_1 \cdot T_1 + l_2 \cdot T_2}{A \cdot B} \quad (2)$$

If the linear density of the yarn remains constant for both layers and the length of the thread in the loop, for example, of the front side, then the dependence of the areal density of the knitted fabric on the length of the thread in the loop of the wrong side can be established by the following reasoning.

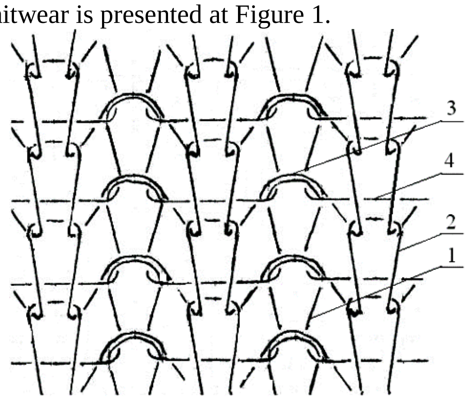
Since in two-layer knitwear, the area of the loop with an increase in the length of the thread in the loop of the seamy side increases according to a law close to parabolic and tends to a certain limit, the first term in the formula will gradually decrease, and the second will first decrease and then increase.

The degree of influence of the ratio of the lengths of the threads in the loops on the surface density of two-layer knitwear depends on the type and method of connection. When connecting with sketches from the main threads, the changes are more significant than when connecting with additional threads. This is due to the original shape of the loop and the length of the threads in the loops. In the first case, the loop broaches are enlarged and bent into the outline. With an increase in the length of the thread in the loop of the opposite side, the thread from the outline passes into the island and the distance between the loops increases due to the straightening of the broach. In the second case, with the same initial loop area, the length of the thread in the loop is shorter, since the sketches are formed from additional threads. The increase in the loop area occurs only due to the straightening of its elements.

The consumption of yarn for joining layers of knitted fabrics of a press connection is less than knitted fabrics of the cover type of connection, therefore, its overall surface density is also lower. With an increase in the length of the thread in the loop of the cover connection and constant lengths of the threads in the loops of the sides, the area of the loop decreases, due to which the consumption of yarn per unit area of knitted fabric increases.

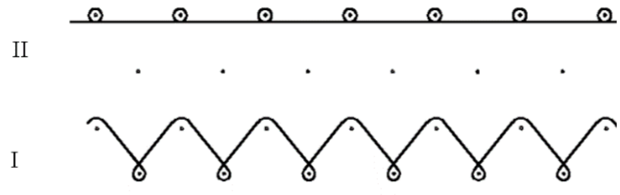
II. EXPERIMMENTS AND DISCUSSION

In order to study the influence of the length of the thread in the loop of the back layer of two-layer knitwear on its technological parameters, seven variants of two-layer knitwear were knitted on a Long Xing 252 SC flat-knitting machine. The variants of the two-layer knitwear differed from each other in the length of the thread in the loop of the back layer of the knitted fabric. Two-layer knitwear was developed on the basis of semi-cardigan stitch (half of the loops have tucks), where the one layer is connecting with second layer with loop tucks from mane thread. the structure and graphic recording of two-layer knitwear is presented at Figure 1.



a

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020



b

Fig. 1. Structure (a) and graphic record (b) of the production of two-layer knitwear

The structure of two-layer knitwear is illustrated in Fig. 1, a. The jersey consists of elongated back loops 1,face loops 2, tucks 3 and broaches 4.

In the formation of one rapport of the proposed two-layer knitwear on a flat-knitting machine, two knitting systems are working.

The first system knit cardigan row, and the second system, on the needles of the back bed, forms plane rows (Fig. 1, b).

Cotton yarn with a linear density of 30 tex x 2 was used as a raw material for the back side of a two-layer knitted fabric, and polyacrylonitrile yarn (PAN) with a linear density of 32 tex x 2 was used for the face side of knitwear.

The technological parameters of two-layer knitwear were determined according to the standard method [8, 9] in the "CentexUz" laboratory at TITLI, the results are shown in Table 1.

The analysis of the obtained results shows that changing the length of the thread in the loop of the back layer of knitted fabric affects all technological parameters of two-layer knitted fabric.

When calculating the material consumption of knitwear, it is advisable to consider knitted fabric as a three-dimensional structure, i.e. take into account the thickness of the jersey.

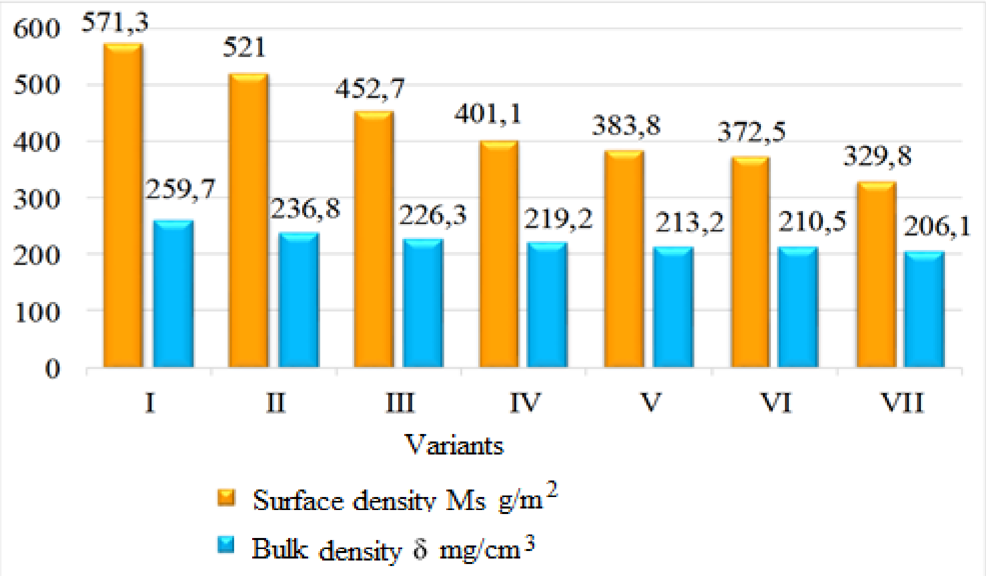


Fig. 2. The change in surface and bulk density of a two-layer knitwear

This indicator of the material consumption of knitted fabric is the bulk density δ (mg / cm^3), which is the ratio of the surface density M_S (g / m^2) to the thickness of the knitted fabric T (mm). The change in surface and bulk density, depending on the change in the length of the thread in the loop of the back layer of a two-layer knitwear, is shown in Fig. 2.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020

Table 1. Technological parameters of two-layer knitwear

Indicators		Variants						
		I	II	III	IV	V	VI	VII
Type and linear density of yarn	Face layer	PAN (polyacrylonitrile) 32 texx 2						
	Back layer	Cotton yarn 30 tex x 2						
The content of threads in the fabric, %	Face layer	68	66,5	64,4	63	62	61	60
	Back layer	32	33,5	35,6	37	38	39	40
Loop width A, mm	Face layer	2,17	2,27	2,27	2,38	2,38	2,5	2,6
	Back layer	2,17	2,27	2,27	2,38	2,38	2,5	2,6
Hight of loop rowB, mm	Face layer	1,25	1,43	1,35	1,61	1,67	1,79	1,92
	Back layer	1,1	1,25	1,35	1,56	1,67	1,79	1,92
Horizontally density $P_{h,}$loops in a 50mm by the course	Face layer	23	22	22	21	21	20	19
	Back layer	23	22	22	21	21	20	19
Vertically density $P_{v,}$loops in a 50mm by the wale	Face layer	40	35	37	31	30	28	26
	Back layer	45	40	37	32	30	28	26
Length of thread in the loop l , mm	Face layer	15,4	15,4	15,4	15,4	15,4	15,4	15,4
	Back layer	6,18	6,78	7,0	7,5	7,82	8,4	9,16
Surface density M_S , g/m^2		571,3	521	452,7	401,1	383,8	372,5	329,8
ThicknessT,mm		2,2	2,2	2,0	1,83	1,8	1,77	1,6
Bulk densityδ, мг/см^3		259,7	236,8	226,3	219,2	213,2	210,5	206,1
Absolutely bulklightnessΔδ, mg/sm^3		-	22,9	33,4	40,5	46,5	49,2	53,6
Relative bulklightness, θ , %		-	9	13	16	18	19	21

If the areal density of the I-variant of two-layer knitwear is Ms = 571.3 g / m^2 and the thickness is T = 2.2 mm, its bulk density is δ = 259.7 mg / cm^3. In this case, the indicators of the volumetric lightness of the II-variant of two-layer knitwear compared to the I-variant will be as follows:

$$\Delta\delta \quad = \delta_b - \delta \quad = 259{,}7 - 236{,}8 = 22{,}9 mg/sm^3$$

Here:

Δδ - volumetric ease, mg / sm^3;

Δb - bulk density of the base variant, mg / sm^3;

δ - bulk density of the investigated variant mg / sm^3;

Relative lightness is determined by:

$$\theta = (1 - \frac{\delta}{\delta_б}) \cdot 100\% = (1 - \frac{236{,}8}{259{,}7}) \cdot 100\% = 10\ \%$$

Indicators of absolute and relative bulk lightness of the other variants of two-layer knitwear are shown in Table 1 (Fig. 3).

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020

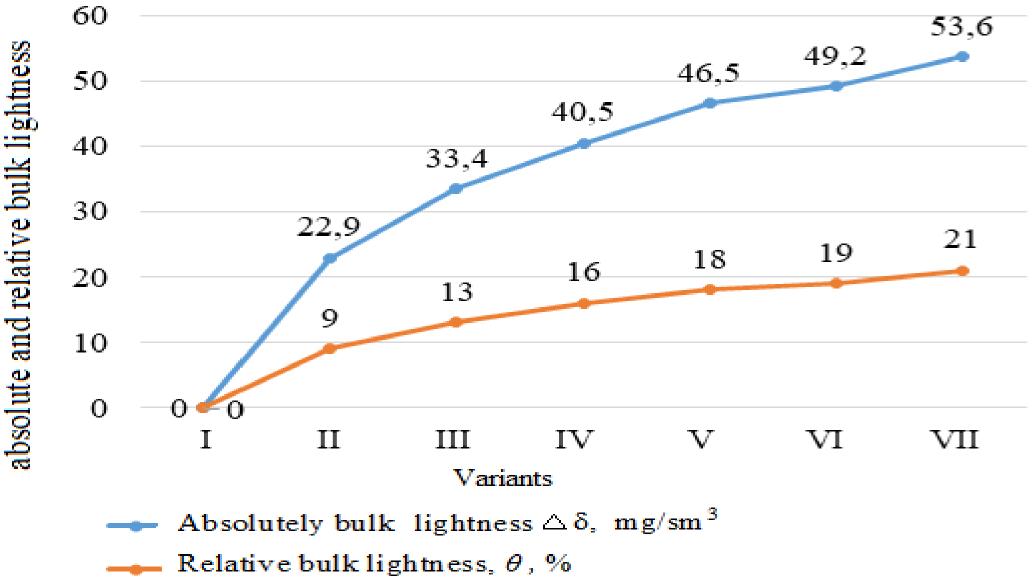


Fig. 3. Graph of change in absolute and relative bulk lightness versus thread length in the loop of the back of a two-layer knitted fabric

As a result, the decrease in the length of the thread in the loop of the back later of a two-layer knitted fabric by 48%, the surface density of the knitted fabric decreases by 42.3%, the thickness by 27.3%, and the bulk density by 20.5% (Table 2).

Table 2. Change of technological parameters of two-layer knitted fabric depending on the length of the thread in the loop of the back layer of knitted fabric

Indicators		Variants						
		I	II	III	IV	V	VI	VII
Indicators of back layer	Thread length of plane loopL_{pl} , (mm)	6,18	6,78	7,0	7,5	7,82	8,4	9,16
	%	-	9,7	13,2	21,3	26,5	35,9	48
	Loop width A , (mm)	2,17	2,27	2,27	2,38	2,38	2,5	2,6
	%	-	4,6	4,6	9,7	9,7	15,2	19,8
	Height of loop rowB , (mm)	1,1	1,25	1,35	1,56	1,67	1,79	1,92
	%	-	13,6	22,7	41,8	51,8	62,7	74,5
	Area of loopA·B , (mm^2)	2,4	2,8	3,1	3,7	4,0	4,5	5,0
	%	-	16,7	29,2	54,2	66,7	87,5	108,3
Surface density M_S , g/m^2		571,3	521	452,7	401,1	383,8	372,5	329,8
%		-	8,8	20,8	29,8	32,8	34,8	42,3
Thikness T, mm		2,2	2,2	2,0	1,83	1,8	1,77	1,6
%		-	-	9,1	16,8	18,2	19,6	27,3
Bulk densityδ, $мг/см^3$		259,7	236,8	226,3	219,2	213,2	210,5	206,1
%		-	8,82	12,86	15,6	17,9	17,3	20,5

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 7 , July 2020

With a decrease in the length of the thread in the loop of the back layer of the knitted fabric, the surface density and thickness of the two-layer knitted fabric decrease. Due to the fact that the degree of decrease in the surface density is greater than the degree of decrease in the thickness of the knitted fabric, the surface density of the knitted fabric decreases more intensively than the bulk density (Table 2).

It has been established that all variants are characterized by an increase in the loop step, the height of the loop row and loop area, and the latter to the greatest extent. With a decrease in the length of the thread in the loop of the back layer of a two-layer knitwear by 48%, the loop step A of the purl of the knitwear decreases by 19.8%, the height of the loop row B - by 74.5% and the area of the loop A · B - by 108.3% (Table 2, Fig. 4).

In accordance with this, in two-layer knitwear, there should be a significant change in the parameters of one layer under the influence of the other with an increase or decrease in the length of the thread in the loop of one of them (Fig. 3).

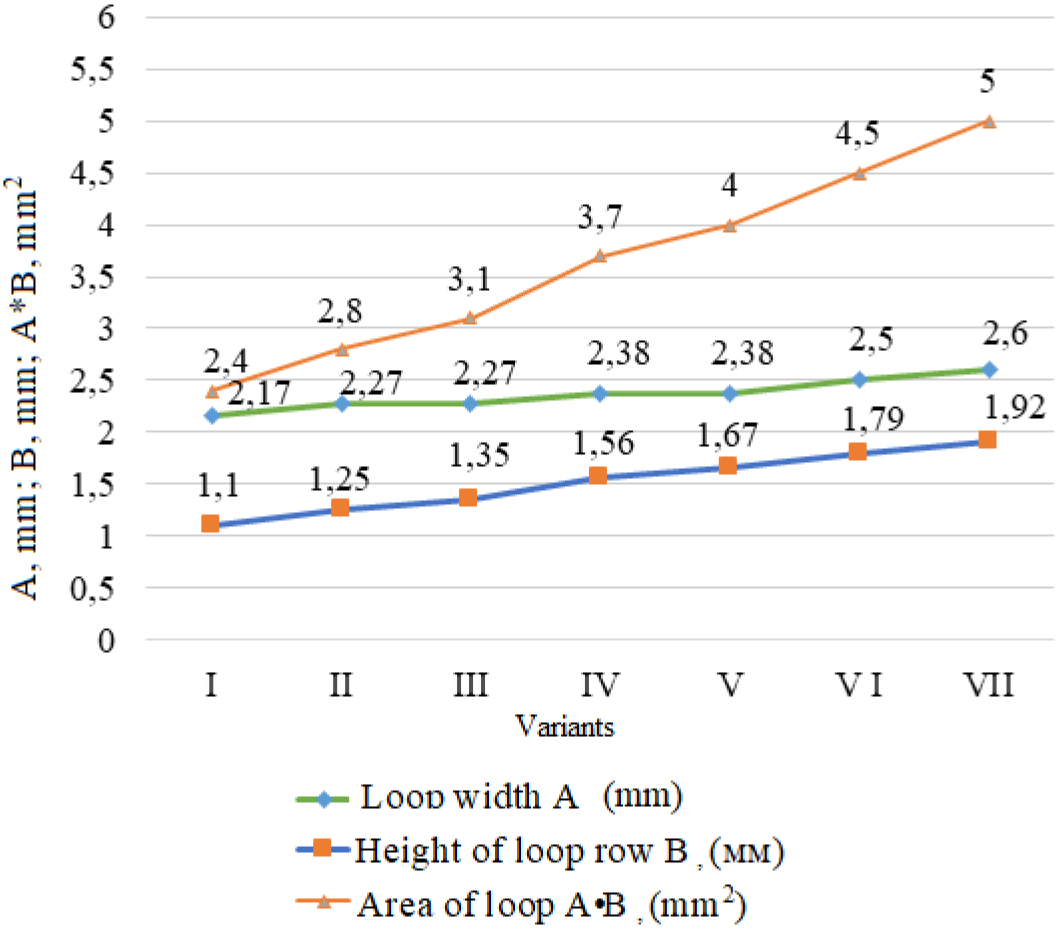


Fig. 4. Graph of dependence of the parameters of the loop (A, B, A · B) of two-layer knitwear on the length of the thread in the loop of the back layer of knitwear

III. CONCLUSION

The study of the influence of the length of the thread in the loop of the back layer of a two-layer knitwear on the technological parameters of knitwear made it possible to reveal the patterns of such parameters as the loop step, the height of the loop row, loop area, surface and bulk density of knitwear.

Thus, by changing the length of the thread in the loop of one layer of two-layer knitwear, a decrease in raw material consumption, an improvement in the quality of knitwear and an expansion of the range of knitted fabrics is achieved.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 7 , July 2020

REFERENCES

[1]. Kudryavin L.A., Shalov I.I. Fundamentals of knitting technology. M. Legprombytizdat, 1991. -from. 480.
[2]. Kudryavin L.A., ShustovE.Yu., ShustovYu.S. Development of methods for visualizing the structure of knitwear in its automated design: Monograph. M .: MGTU, 2005. -from. 139.
[3]. Kukin G.N., Soloviev A.N. Textile materials science. In 2 volumes. T II. M :. Light industry. 1964 - 378 p.
[4]. Kukin G.N., Soloviev A.N., Koblyakov A.I. Textile materials science (fibers and threads): Textbook for universities. M :. Legprombytizdat, 1989 - 352 p.
[5]. Laboratory workshop on textile materials science / Under. ed. A.I. Koblyakov. M :. Legprombytizdat, 1986 - 344 p.
[6]. Laboratory workshop on the technology of knitwear production: Textbook for universities / Under. ed. L.A. Kudryavin. M :. MGTU, -476 p.
[7].Pospelov E.P. Two-layer jersey. - M .: Light and food industry -1982 -206 p.
[8]. Torkunova Z.A. Knitwear tests. -M .: Light industry, 1975, -224 p.
[9]. ShustovYu.S. Fundamentals of Textile Materials Science. -M.: OOO SovyazhBevo 2007 - 300 p.