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A STUDY OF THE EFFECT OF THE SPACING OF IMPROVED PILE COMPACTORS ON THE UNEVENNESS OF "SIRO" YARN TURNS

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Abstract
The article deals with the effect of the distance between the Siro yarn production and the yarn compactor on the quality of the yarn formed with twin-spindle compactors on a medium staple cotton spinning machine. Also, the types and pitch of the spindles installed in the spinning machine "Siro" yarn, the width of the triangle of torsion when forming a yarn with a linear density of 14 tex, based on experiments to evaluate the effect on the quality of the "Siro" yarn. The increase in the tensile strength of the yarn and the decrease in the degree of fineness of the yarn and the cut of the yarn and the reduction of irregularities in the twists are described in detail.

Keywords. “Siro” spinning method, silver, roving, the linear density of yarn, elongation, tensile strength, elongation of yarn,

Introduction
By developing the textile industry and introducing new innovative technologies in our republic, comprehensive measures are being taken to create new types of resource-saving, competitive and exportable products, and certain results are being achieved. In 2022-2026, the development strategy of the Republic of Uzbekistan of New Uzbekistan, including the industrial policy aimed at ensuring the stability of the national economy and increasing the share of industry in the gross domestic product, is being continued.

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To increase the production volume of industrial products by 1.4 times, to increase the production volume of textile industry products by 2 times, to study the impact of textile industries on production in the membership of the World Trade Organization, to carry out deep processing of yarn and skein, to establish complete recycling of yarn and skein by 2026, important tasks for developing national brands for finished products and increasing their export were defined. In the implementation of these tasks, among other things, it is important to increase the quality of fabrics woven from spun yarns, reduce the breakage of yarns in the process, and produce a new range of fabrics with improved consumption characteristics [1,2].

The quality of textile products mainly depends on the unevenness, thin-thick areas, hairiness and cleanliness of the thread. The quality of the thread depends on the methods of its preparation. Based on the above-mentioned tasks, it was considered one of the most important and urgent issues to determine the factors affecting the physical and mechanical parameters of the yarn and the yarn in the production of "Siro" yarn.

Materials and Methods

Although more than 70 years have passed since the creation of the Siro thread production method, it is not widely used in production due to the lack of information in enterprises, insufficient studies have been conducted to base the twisting and winding parameters of ring spinning machines for the production of Siro thread.

Scientists around the world are currently conducting new research on this method, including abroad, Subramaniam and Natarajan conducted research on the effect of the distance between the pile compactor on the coils. An increase in the distance between the piles and the number of twists led to an increase in the coefficient of friction for all types of yarns [3].

Emrah Temel conducted research on the production of Siro yarn of different linear densities from 100% polyester and cotton and polyester fibres [4].

Typically, this method is for long-staple cotton, where long-staple cotton is used to produce coarse to medium linear density spun yarn. Due to the increase in the population of the world, the demand for natural and chemical fibres is increasing.

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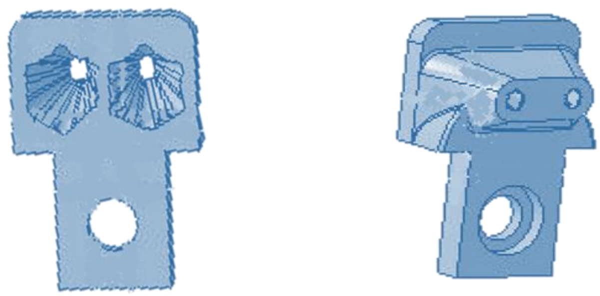
Several changes have been made to this process in order to effectively use local raw materials available in our country and to create a new assortment of yarn. A new mixing method was created by modifying the parameters of the existing spinning machine used in production [5].

It is known that unevenness in the thread is one of the important indicators that determine the quality indicators of the thread. To solve this problem, there is a need to develop optimal technological parameters for the "Siro" thread. Experiments on the evaluation of the effect of the types of pile compactors installed in the production of "Siro" thread on the ring spinning machine and the distance between them on the width of the twisting triangle and the quality of the thread were carried out in the production conditions of the "OSBORN TEXTILE" LLC enterprise in the Bostonliq district of the Tashkent region and at the Tashkent Institute of Textile and Light Industry "Yigirish" researches were carried out on the Zinser 350 ring spinning machine in the educational laboratory of the "technology" department.

The effect of changing the distance between the piles, the speed of rotation of the spindle and the number of times twisting on the quality of the yarn was studied. "Siro" yarn with a linear density of 14 tex was produced on the Zinser 350 ring spinning machine installed in the laboratory. For the experiment, the working organs that affect the quality indicators of the Siro thread and the twists in the thread, namely, the types of double tensioners (Fig. 1, the distance between the slits of the thread tensioner is 8 mm, 10 mm, 12 mm), the stretching tool, the thread guide, the cylinder quencher, the runner, the speed of the thread, and winding devices were used [6,7].



a) front side b) backside

Figure 1. Improved compactor

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The physical and mechanical parameters of the yarn directly depend on the properties of the selected fibre. The higher the quality of the fibre, the higher the quality of the yarn obtained from it. In addition, in the production of high-quality yarn, the properties of hemp products obtained in technological processes are an important factor [8].

S-6524 selection variety 4-I-80%, 4-II-20% selection was used as raw material for thread production. Table 1 shows the physical and mechanical properties of cotton fibre.

Table 1. Physical and mechanical properties of cotton fibre

Type	Selection variety	variety	Microneuri	Staple length, 32/inch, cod	Upper Average Length, Inch*100, Inch*100	Relative tensile strength, gk/tex	UI - uniformity index, %	RD - light reflection coefficient %
1	2	3	4	5	6	7	8	9
4	C-6524	I	4,5	36	112	31,2	83,1	77,5
		II	4,2	36	112	29,9	-	-
Average indicators		-	4,4	36	112	30,5	83,1	77,5

The quality of cotton fibre was evaluated according to the requirements of UzDST 604-2016 standard.

Hamaki products (combed wick, "0" transition wick, canvas and re-combed wick) were prepared using the technological equipment of the JSC "OSBORN TEXTILE" enterprise. "Siro" yarn with a linear density of 14 tex was developed from the prepared rough products on a Zinser 668 piling machine and a Zinser 350 ring spinning machine installed in the teaching laboratory of the TTESI Spinning Technology Department.

The physical and mechanical parameters of the thread were evaluated by comparison with the standards of the company's regulatory documents and USTER STATISTICS [9].

For experimenting, the working bodies that affect the quality parameters of Siro yarn and the number of twists in the yarn, that is, the types of double compactors (the distance between the slits of the pile compactor 8 mm, 10 mm, 12 mm) were used [10].

Experimental Part

The effects of the above working parts on yarn hairiness, specific breaking strength, roughness and number of yarn breaks were studied. Experiments were evaluated based on the results of retesting in triplicate. physicomechanical properties of the product were determined using standard methods, cross-sectional unevenness and external appearance defects on the USTER TESTER5-S 400 (Switzerland) equipment. The Siro method of thread formation on a ring spinning machine is different from other methods. In this method, great demands are placed on the contamination of fibres in each pass, the degree of cleaning of the equipment, the indicators of straightening and parallelization of fibres, and the quality of the rough product [11].

If the fibres come to the spinning machine in the form of complex fibres without complete separation, a large non-texture will appear in the yarn. To obtain a smooth and dense yarn, the supply pile must have the same smoothness, so it is necessary to try to achieve the straightening and parallelization of the fibres at the stage of preparation of the rough product. Taking into account the above, the quality indicators of rough products in combing and combing processes were determined [12].

Quality indicators of rough products were checked on USTER TESTER5-S 400 equipment. The test results are summarized in Table 2. As can be seen from Table 2, Hamaki products meet the requirements. Experiments on the application of preliminary research results to production were planned.

Table 2. Quality indicators of raw products

№	Indicators	Combed slits	"0" switch	Holstcha	Re-combed slits	"I" switch	slits
1	Linear density, ctex	5000	5000	70000	3000	3000	310
2	Metric name	0,2	0,2	0,014	0,25	0,33	3,22
3	Name Ingiliz	0,118	0,118	0,0084	0,147	0,196	1,90
4	Coefficient of variation by sections C_m	2,65	-	-	2,18	-	3,4

Experiments were conducted on the KONO (KO2) matrix TOT 32-9 variant of the full factorial planning method to study the effect of the distance between the improved pile densifiers and the number of twists in the yarn on the yarn quality parameters of the knitting yarn with a linear density of 14 tex spun by the re-combing method. That is, the amounts of irreversible combinations between all factors are taken into account. Because in textile research, this method is considered to be the most effective method in searching for the optimal option [13]. The experimental quantities of the factors are presented in Table 3.

Table 3. The degree of change in factors

Factors	Value			Range of variation
	-1	0	+1	
X_1 – the distance between compactors, мм	8	10	12	2
X_2 – the number of twists in the thread, tw/m	900	1000	1100	100

Table 4. Extended planning matrix based on experimental results.

Options	Planning matrix					Optimization parameters
	x_1	x_2	$x_1 x_2$	x_1^2	x_2^2	$У_1$- coefficient of variation for twists in the thread, %
1	+	-	-	+	+	2,48
2	+	0	0	+	0	2,504
3	+	+	+	+	+	2,715
4	0	-	0	0	+	2,37
5	0	0	0	0	0	2,41
6	0	+	0	0	+	2,42
7	-	-	+	+	+	2,46
8	-	0	0	+	0	2,465
9	-	+	-	+	+	2,47

$У_1$- coefficient of variation for twists in the thread, %
$y_1 = 2{,}477 + 0{,}051x_1 + 0{,}049x_2 + 0{,}056x_1x_2 + 0{,}038x_1^2 + 0{,}0088x_2^2$.

After removing non-significant coefficients, the regression equation is:

$y_1 = 2{,}477 + 0{,}051x_1 + 0{,}049x_2 + 0{,}056x_1x_2 + 0{,}038x_1^2$

The adequacy of the resulting equation was checked by Fisher's test.

$$F = \frac{S_{ag_i}^2}{S_{y_i}^2}$$

The variance of the adequacy of the S_{ad}^2- equations is calculated through the equation.

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The computational value of the adequacy variance optimization parameter is a measure of the deviation between $У_{cou}$ and the factual value $У_{rea}$.

If F_{cou} <F_{jad} the model is considered adequate. At 95% confidence, equal to $k_1 = N-(k+1)=6, k_2 = N(m-1)=9$ $F_{маб} = 3{,}37$.

The adequacy variance of the equation:

$S^2_{ад1} = \frac{\sum (y_{ф1} - y_{p1})^2}{N-X}$ where x is the significant number of model coefficients

$$S^2_{ад1} = \frac{0{,}649032}{5} = 0{,}1298064$$

$$F = \frac{S^2_{адi}}{S^2_{y_i}} = \frac{0{,}1298064}{0{,}068961} = 1{,}88 < F_{маб} = 3{,}37$$

Convinced of the adequacy of the equations, it can be concluded as follows:

The distance between the holes of the double-filament tensioner and the increase in the yarn thickness affect its breaking strength. In order to interpret the regression equation (a graph of surface isolines was obtained in the Mathcad computer program), it is presented in the graphical form [14].

Analyzing the surface constructed for the regression equation, it can be said that by changing the accepted factors X_1 and X_2, the value of the specific breaking strength of the yarn u1 can be obtained in the range of 13,945-15,134 cN/tex [15].

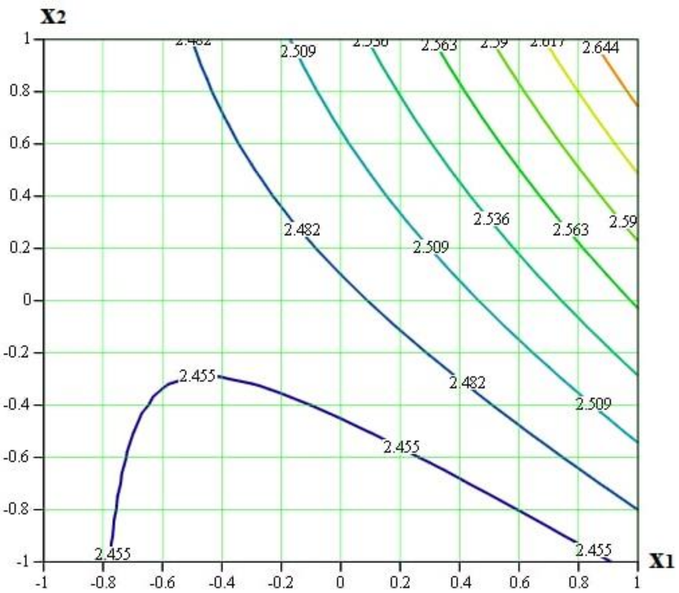

Figure 2. Isolines of the coefficient of variation of the yarn by a twist

Spinning in a spinning machine by adding two piles improves the properties of the yarn, the increase in twists leads to an increase in its breaking strength, these results can be achieved by the correct selection of the distance between the holes of the compactor. From the obtained results, it can be seen that the distance between the holes of the compactor from 8 to 10 mm and the increase of twists led to the improvement of the breaking strength of the thread.

Results and Discussion

As can be seen from Figure 2, it can be observed that the coefficient of variation u1 increases with the increase of the distance between the notches of the compactor from 0 to +1 and the value of the turns from 0 to +1. In practice, this is when the distance between the grooves of the compactor exceeds 10 mm, and the number of baking is 1000 tw/m. When the distance between the slots of the compactors (the distance between two piles on the spinning machine) is L=10 mm. With the help of mathematical models built in the form of regression equations, it is possible to plan the degree of influence of each factor (the distance between the holes of the compactor and the number of twists in the thread) on the quality indicators of the yarn, and the quality indicators of the yarn by changing the selected factors. The optimal option between the holes of the thickeners (when using two piles on a spinning machine) is L-10 mm, which provides control over the movement of fibres in the stretching device.

Conclusion

When the results obtained from the experiment are processed according to the relative breaking strength, it was determined by the experiment that the properties of the "Siro" yarn depend on the distance between the slits and the number of twists of the yarn. When the constructed mathematical equations were tested using Fisher and Student criteria, their indicators were considered significant. This shows that the constructed equation can be mathematically analyzed. Thus, in the production of the "Siro" thread, if the distance between the pile thickener is chosen correctly, it is possible to increase the strength of the "Siro" thread.

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