STUDY OF THE EFFECT OF THE SPINDLE SPEED ON THE PROPERTIES FOR THE BAKED SIRO YARN, WHICH MADE FROM COTTON AND POLYESTER FIBRES

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ABSTRACT

In this article, it has been determined experimentally the effect of the spindle speed on the properties of the spun yarn "Siro" which produced by the comparative break strength to the experimental results. When the mathematical equations were tested using the Fisher and Student criteria, their index were considered significant. The possibility of mathematical analysis of the equation based on indicators was determined by experimental results. In order to do this, yarns with numbers 20 and 29 tex were produced in 5 different spindle speeds from 9000 to 13000 min -1. The results determined that when the spindle speed was 9000 min -1, the quality of the baked

Siro yarns was improved and the fluff elaborate, and thus it became stronger more. According to the results of the analysis, the speed of spinning was one of the main factors that could be changed in the producing of baked Siro yarn. More clearly if ring-spin machine choose spindle speed correctly Siro yarn's strengthen will improve, asperity from structural circumstance will be normal and configuration of yarn will be improved.

KEYWORDS: *Baked Siro Yarn, Cotton, Polyester Fibres, Spindle Speed, Manufactured Product.*

INTRODUCTION

The 70% of spun yarn's volume correspond to the ring spinning method in the world's scope. The properties of the yarn directly affect the properties of the finished product obtained from it. A priority indicator of the properties of spun yarn is elongation during stretching and break strength. Therefore, almost all international and national normative documents define the quality category depending on the breaking strength of the yarn.

Resolution of the president of the Republic of Uzbekistan dated February 12, 2019 No PK-4186 " On measures to further deepen the reform of the textile and sewing-knitting industry and expand its export potential" and allocation of soft loans from commercial banks to sew-knitwear enterprises exporting at least 80% of finished products in 2019-2021 **[1].** Target parameters for the production and export of textile, sew-knitwear, leather-footwear and fur products with high added value based on market demand on the basis of deep processing of raw materials for 2020-2025 have developed. According to this increasing production size of textile and sew-knitwear by 3.5 times, yarn reel by 2,7 times and painted and mixed type of yarn reel by 2,6 times, and increase finished yarn fabric by 3 times, and also, increasing export of textile and sew knitwear productions by 3,3 times depending on resolution which confirmed by the President of the Republic of Uzbekistan dated September 16,2019 No PK-4553 **[2].**

Provision of high and stable growth rates in the textile and sew-knitwear industry of the Republic, involvement and acquisition of foreign direct investment, production and export of competitive products, systematic work on further deepening the structural reorganization aimed at creating new high-tech jobs through the implementation of strategically important projects of modernization of enterprises, the introduction of an advanced "cluster model" is being done.

One of the most problematic processes in the production of cotton fiber is the production of baked yarn, and in our country, several works are being done to improve and apply the ways and technologies of baking yarn. These baked yarns being used in the producing of textile sew knitwear and attorney productions. Although the production of yarn by the "Siro" method in textile enterprises was established 70 years ago, it is not used in domestic enterprises. This is due to the fact that no special ring spinning machines are used for the baked yarn production machine, and the replacement elements, wrapping and balloon forming device are not selected correctly. The production of "Siro" yarn allows to improve the quality of woven and knitted fabrics, reduce weaving breaks, the amount of fluff in the yarn and the abrasion of the fabric. By slightly changing the parameters of the ring-spinning machine, the connection of the 2 rollers to a separate crushing cylinder is achieved by the same elongation and twisting of each cylinder **[3].** The siro spinning method was discovered in the textile industry laboratory in 1975-1976 in

collaboration with the Commonwealth Scientific and Industrial Research Organization (CSIRO) of the Australian Scientific and Industrial Research Center [3]. Currently, scientists around the world are conducting new research on this method. Subramaniam and Natarajan conducted research on the effect for the spacing between twisted punches on twists. The increase in the number of gaps and twists between the yarns led to an increase in the coefficient of friction for all types of yarns **[4].** According to research conducted by Chu and Cheng, Siro compared spun yarn and re-spinning yarn experimentally. It was found that the abrasion resistance of the spun yarn, the degree of fluff, the strength of the yarn and the uniformity of the twists on the surface of the yarn are better than those of the baked yarn **[5].** Typically, this method is designed for long cotton fiber, in which long cotton fiber is produced into thick and medium-density yarns **[6,7].** Medium-fiber cotton fiber is grown in our country, In order to make efficient use of existing local raw materials and create a new range of yarn, the number of changes have been made in this process. The parameters of the existing spinning machine used in production were changed and a new type of wick adjustment knobwas created **[8,9,10] .**The created wick adjustment knobwas installed on the Zinser-350 ring-spinning machine, which is available in the laboratory of the department "Spinning Technology" under TTESI. In order to determine the effect of the spindle speed on the cotton and polyester fibers spun on the ring-spinning machine, the experiments will be performed in two repetitions, a total of 10 experiments using random numbers, based on randomized experiments. **[11,12,13].**Taking into account the need to change the operating parameters of the machine to conduct experiments on the basis of this plan, a working plan is created and we take the values of the speed of the machine as following:

$n_1 = 9000\,мин^{-1}$, $n_2 = 10000\,мин^{-1}$, $n_3 = 11000\,мин^{-1}$,

$n_4 = 12000\,мин^{-1}$, $n_5 = 13000\,мин^{-1}$

The experiments are performed in two iterations, i.e. a randomized experiment is conducted using a total 10 experiments using random numbers. Based on this plan, a working plan is drawn up, taking into account the need to change the operating parameters of the machine accordingly for the experiment. Experiments are conducted on the basis of the matrix. Tables 1 and 2 are completed by setting as encode incoming parameter with $\boldsymbol{x_u}$ and outgoing parameter like the relative break force with $\boldsymbol{Y_{uv}}$.

Sequence number	Incoming parameter		Outgoing parameter indicators			
	natural	code	$\boldsymbol{Y_{uv}}$, cH		Media l,	Dispersion ,
			Iterations			
y	X_u=n*1$0^3$	x_y	1	2	$\overline{R}_u$,s	$S_u^2\{y\}$
1	9	-2	20,3	20,5	20,4	0,02
2	10	-1	19,3	19,2	19,25	0,05
3	11	0	19,6	19,8	19,7	0,02
4	12	1	20,1	20,2	20,15	0,05
5	13	2	19,4	19,7	19,55	0,045
∑					99,05	0,185

1-table

$$\overline{Y}_u = \frac{\sum\{\overline{Y}_u\}}{N} = \frac{99{,}05}{5} = 19{,}81$$

It is known from experiments that there are two types of deformations in nature, which are divided into types such as elastic and plastic. Yarns derived from natural and chemical fibers have mainly elastic deformation, when the yarns are subjected with a certain tensile force F (cN), a state of elongation is observed in them. The selected sorted cotton fiber was made in the ratio of 70% and polyester fiber in the ratio of 30%. We can also see in the example of the strip "Siro" with a texture of 19.6, spun from the sorting fibers, observed in the laboratory on the Statimat device. The results of the graphical analysis show that the elongation of the yarn is 6.8% when the maximum tensile strength reaches 389.8 sN. 1-figure

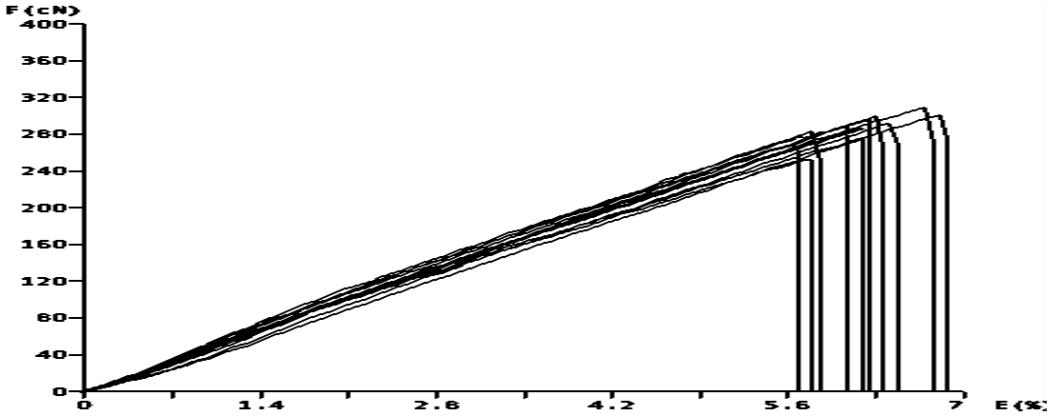

Figure 1. Graph of elongation of the "Siro" thread under the influence of force

If the elastic deformation in the manufactured product is the effect of external force stopped , and take into account to the product returns to its primer state, 19.6 Tex "Siro" yarn, which is made of cooked in a ratio of 70/30% cotton and polyester fibers, is also shown to have a high degree of elastic deformation property.

2-TABLE BREAKING STRENGTH INDICATORS

U	$x_u = n_t * 10^3$	$x_u - \bar{x}$	$(x_u - \overline{x})^2$	$\overline{Y}_u$	$(x_u - \bar{x}) \cdot \overline{Y}_u$
1	9	-2	4	20,4	-40,8
2	10	-1	1	19,25	-19,25
3	11	0	0	19,7	0
4	12	1	1	20,15	20,15
5	13	2	4	19,55	39,1
$\sum$			10	99,05	-0,8

$Y_f = a_0 + a_1 x$ *or* $Y_f = d_0 + d_1(x - \bar{x})$*note::* $Y_f = a_0 + a_1 x$

we use the equation when working with encoded values.

here: $\bar{x} = \frac{1}{N}\sum_{u=1}^{N} x_u \quad (N = 5)$

$$d_0 = \frac{1}{N}\sum_{u=1}^{N} y_u = \frac{99{,}05}{5} = 19{,}81;\ d_1 = \frac{\sum_{u=1}^{N}(x_u - \bar{x})\overline{y_u}}{\sum_{u=1}^{n}(x_u - \bar{x})^2} = -\frac{0{,}8}{10} = -0{,}08$$

$$Y_f = a_0 + a_1 x = 19{,}81 + [(-0{,}08)(x - 11)] = 20{,}69 - 0{,}08x$$

$$Y_f = 20{,}69 - 0{,}08x; x - considered\ as\ a\ factor.$$

We determine the calculated sizes of the output parameter. To do this, we obtain the numerical values of the output parameter by substituting the experimental values of the variable into the equation Y = 20.69–0.08x. The effect of the input parameter that is velocities on the relative breaking force of the output parameter is shown in the graph in Figure 2. Based on the results obtained, we complete. Table 3

$$Y_{f1} = 20{,}69 - 0{,}08 * 9 = 19{,}97$$

$$Y_{f2} = 20{,}69 - 0{,}08 * 10 = 19{,}89$$

$$Y_{f3} = 20{,}69 - 0{,}08 * 11 = 19{,}81$$

$$Y_{f4} = 20{,}69 - 0{,}08 * 12 = 19{,}73$$

$$Y_{f5} = 20{,}69 - 0{,}08 * 13 = 19{,}65$$

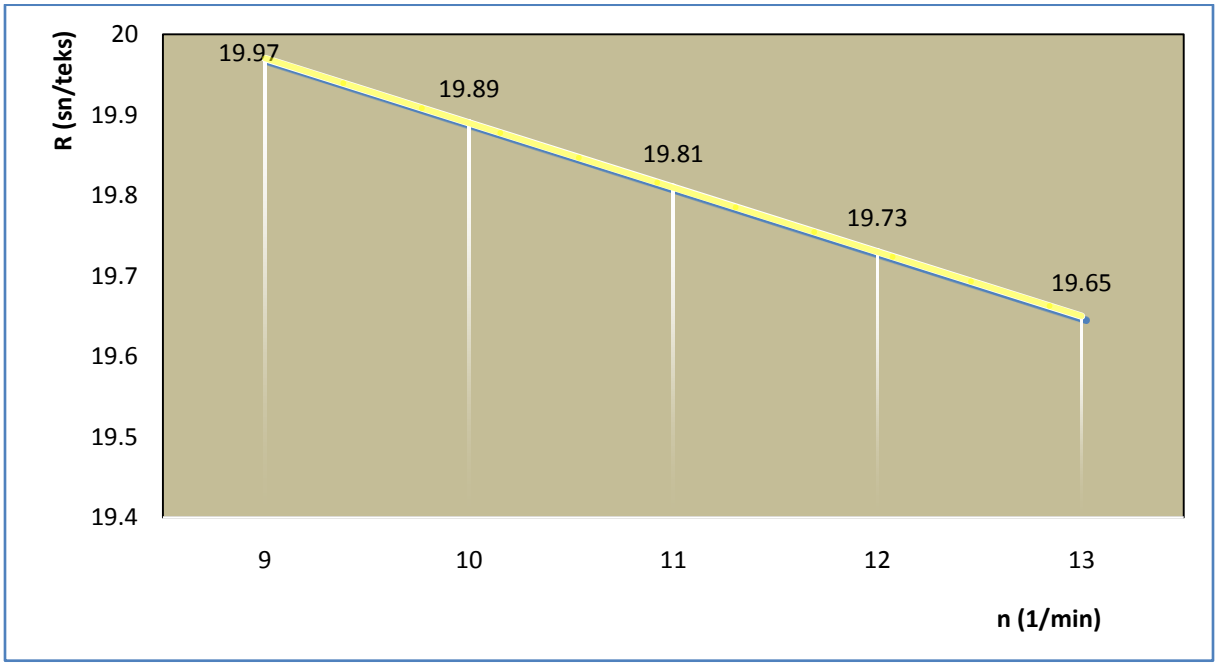

Figure 2. Graph of the effect of an input parameter on an output parameter

As can be seen from the graph, the input parameter of the yarn at 10,000 rpm for the production of spun yarn "Siro" shows the speed, the output parameter has a high effect on the relative tensile strength.

TABLE 3 COMPUTATIONAL VALUES OF THE OUTPUT PARAMETER

U	Y_{fu}	$\overline{Y}_u$	$\overline{Y}_u - Y_{ru}$	$(\overline{Y}_u - Y_{ru})^2$
1	19,97	20,4	0,43	0,1849
2	19,89	19,25	-0,64	0,4096
3	19,81	19,7	-0,11	0,0121
4	19,73	20,15	0,42	0,1764
5	19,65	19,55	-0,1	0,01
∑	99,05			0,793

We check the adequacy of the equation. To do this, we calculate the variances using the sizes in Table 3.

Fisher's criterion (where the formula is chosen depending on whether the fraction is greater or less than the value)

$F_r = \frac{S^2_{(2)}\{y\}}{S^2_{(1)}\{y\}}$ ёки $F_r = \frac{S^2_{(1)}\{y\}}{S^2_{(2)}\{y\}}$

$S^2_{(1)}\{y\}$ −mean variance or repetition variance.

$S^2_{(2)}\{y\}$ −the experimental values of the variance show the distribution of $\overline{Y}_u$ relative to the straight line $\overline{Y}_u = f(x)$

$$S^2_{(2)}\{y\} = \frac{m}{N-2}\sum_{u=1}^{N}\left(\overline{Y}_u - Y_{ru}\right)^2 = \frac{2}{5-2}\cdot 0{,}793 = 0{,}5286$$

$S^2_{(1)}\{y\} = \frac{1}{N}\sum_{u=1}^{N} S^2_U\{y\} = \frac{1}{5}\cdot 0{,}185 = 0{,}37;\ S^2_{(1)}\{y\} = 0{,}37$

We calculate the Fisher criterion as follows.

$F_r = \frac{S^2_{(2)}\{y\}}{S^2_{(1)}\{y\}} = \frac{0{,}5286}{0{,}37} = 1{,}428;\ F_r > 1$we do not have to find its inverse value because it is.

We determine the tabular value of the Fisher criterion:

$$F_{ж} = \{p = 0{,}95;\quad f\{S^2_{(1)}\} = 5;\ f\{S^2_{(2)}\} = 3\},i.e$$

$$f\{S^2_{(1)}\} = N(m-1) = 5$$

$F_{ж} = \{p = 0{,}95;\quad f\{S^2_{(1)}\} = 5;\ f\{S^2_{(2)}\} = 3\} = 5{,}41$equal.

So we have $F_{хис}=1{,}428;F_{жад}=5{,}41;F_{жад}>F_{хис}=5{,}41>1{,}428$

The equation is considered as an adequate because the calculated value of the Fisher criterion is smaller than its tabular value.

We determine the significance of regression coefficients. The Student Criterion is used for this. The calculated value of Y is determined as follows.

$$t_R\{d_i\} = \frac{|d_i|}{S\{d_i\}}$$

d_i −the mean square deviation value of the regression coefficient

d_0 and d_1 the following formulas are used to determine the variances of the regression coefficients.

$$S^2\{d_0\} = \frac{S^2\{y\}}{m * N} = \frac{S^2\{\bar{y}\}}{N}$$

$$S^2\{d_1\} = \frac{S^2\{y\}}{m * \sum_{u=1}^{N}(x_u - \overline{x})^2} = \frac{S^2\{\bar{y}\}}{\sum_{u=1}^{N}(x_u - \overline{x})^2}$$

$S^2\{y\}$the random variable is the sum of the variances of Y and is determined as follows.

$$S^2\{y\} = \frac{(m-1)N * S^2_{(1)}\{y\} + (N-2)S^2_{(2)}\{y\}}{mN - 2}$$

Here :$(f)S^2\{y\}$ −the degree of freedom is its value.

Equal to $\{S^2_{(1)}\} = N(m-1)$.

Ina working puzzle

$$S^2\{y\} = \frac{(2-1) * 5 * 0{,}37 + (5-2) * 0{,}5286}{2 * 5 - 2} = 0{,}04294$$

d_0 and d_1 the variances of the regression coefficients are found.

$$S^2\{d_0\} = \frac{S^2\{y\}}{m * N} = \frac{0{,}4294}{2 * 5} = 0{,}04294;$$

so

S$\{d_0\}$ =$\sqrt{0{,}04294} = 0{,}020722$

$S^2\{d_1\} = \frac{S^2\{y\}}{m*\sum_{u=1}^{N}(x_u - \overline{x})^2} = \frac{0{,}4294}{2*10} = 0{,}02147$; in this case

S$\{d_1\}$=$\sqrt{0{,}02147} = 0{,}01465$

$equal\ to\ F_{ж} = \{p = 0{,}95; \quad f = N - 2 = 3\} = 3{,}18.$

The estimated value of the student criterion t_r:

$t_r\{d_0\} = \frac{19{,}81}{0.20722} = 95{,}6; \quad t_r\{d_1\} = \frac{0{,}08}{0{,}014{,}65} = 5{,}46$

We compare the calculated values of both criteria to 95.46 and 5.46 with the tabular values of the criterion to 3.18, i.e.

$$t_r\{d_0\} = 95{,}46 > t_j\{d_0\} = 3{,}18$$

$$t_r\{d_1\} = 5{,}46 > t_j\{d_1\} = 3{,}18$$

Regression coefficients are important because they are.

CONCLUSION

It has been determined experimentally the effect of the spindle speed on the properties of the spun yarn “Siro” which produced by the comparable break strength to the experimental results. When the constructed mathematical equations were examined using Fisher and Student criteria, their performance was considered significant. The possibility of mathematical analysis of the equation based on the indicators was determined on the basis of experimental results. According to the results of the analysis, the speed of spinning was one of the main factors that could be changed in the producing of baked Siro yarn. More clearly if ring-spin machine choose spindle speed correctly Siroyarn’s strengthen will improve, asperity from structural circumstance will be normal and configuration of yarn will be improved.

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