DETERMINATION OF ACCEPTABLE VALUES OF MAIN FACTORS AFFECTING COOKED IP PRODUCTION

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Abstract: *In this article, the limit parameters of the main factors affecting the performance of the improved working part of the yarn winding machine were determined, and their optimal values were determined by the method of mathematical planning. These values were graphed and analyzed for the effect of the machine on yarn stiffness.*

Keywords. *Textiles, maturity, spinning, yarn, yarn cooking, acceptable values, factors, yarn tension, yarn winding speed, puck weight.*

Enter. Intensification of competition in the world market of textile products, further improvement of product quality due to the development of production technologies in countries producing textile raw materials, and as a result of increasing the productivity of equipment and technologies, as a result of ensuring resource efficiency in industrial enterprises, increases the need for wide use of expensive raw materials. Accordingly, one of the main processes in the field of textile production in the world market in order to improve the quality of products and reduce their cost is to identify and eliminate the factors that have a negative effect on the operation of technological processes in the processes of spinning and preparing threads for weaving, automated, creation and implementation of resource-efficient modern machines is of great importance [1,2].

Creation of the scientific basis of techniques and technologies for the preparation and cooking of spun yarns, development of normative technological parameters, after thoroughly studying the scientific and technical possibilities of modern machines and equipment suitable for the production process, is gaining special importance in the world. In this regard, targeted scientific research is carried out on changing the quality and strength indicators by baking the yarns from the spinning process, producing baked yarns that meet market requirements, ensuring resource efficiency in the production of baked yarn, and reducing the cost of the manufactured product. increase is of urgent importance [3].

Thread splicing The quality is assessed by splicing the thread at the same length and tension. Factors included as influencing factors of the splicing technological process x_1 -

thread tension, sN , x_2 - yarn winding speed, m/min, x_3 - puck weight , grams, indicators are obtained. The choice of levels and intervals of the investigated factors is presented in Table 1.

Table 1

Choice of levels and intervals of change of factors under investigation

Name and designation of factors	Change levels			Change interval
	-1	0	+1	
x_1 - thread tension, sN,	250	400	550	150
x_2 - yarn winding speed, m/min,	350	500	650	150
x_3 - puck weight, grams,	14.2	20.1	26	5.9

Change indicators were obtained as test results to determine the hardness of the studied yarn and the shrinkage in the search . Based on the central non-composite test matrix, 15 different test cases of 3 fighting factors were accepted for analysis and evaluated according to the test results (Table 2).

Table 2

Central non-composite experience matrix

No	Factors			x_1x_2	x_1x_3	x_2x_3	x_1^2	x_2^2	x_3^2	Y 1	Y 2	$S_u^2(Y_1)$	$S_u^2(Y_2)$
	x_1	x_2	x_3										
1	+	+	0	+	0	0	+	+	0	1185	3.8	68.4	0.98
2	+	-	0	-	0	0	+	+	0	921	6.8	29.8	1.2
3	-	+	0	-	0	0	+	+	0	951	7.2	48.9	0.68
4	-	-	0	+	0	0	+	+	0	695	11.5	62.7	1.26
5	+	0	+	0	+	0	+	0	+	1105	7.8	39.4	1.4
6	+	0	-	0	-	0	+	0	+	958	8.2	74.6	1.9
7	-	0	+	0	-	0	+	0	+	924	7.6	68.4	0.89
8	-	0	-	0	+	0	+	0	+	768	11.6	49.7	0.62
9	0	+	+	0	0	+	0	+	+	1108	5.8	52.7	0.14
10	0	+	-	0	0	-	0	+	+	995	7.8	72.6	0.97
11	0	-	+	0	0	-	0	+	+	820	8.2	67.4	0.78
12	0	-	-	0	0	+	0	+	+	701	10.5	94.2	0.38
13	0	0	0	0	0	0	0	0	0	1105	6.8	82.4	0.02
14	0	0	0	0	0	0	0	0	0	1128	5.9	76.9	0.14
15	0	0	0	0	0	0	0	0	0	1139	6.1	98.4	0.11

In order to determine the regression coefficients, Student and Fisher's criteria were used to check the adequacy of the mathematical model. As output factors Y $_1$ – Thread stiffness (N) selected according to [4] .

Based on the results of the experiment, we look for a second-order regression multifactorial mathematical model. As a result of this experiment, the regression model of the following general form can be obtained:

$$Y_R = b_0 + \sum_{i=1}^{M} b_i x_i + \sum_{\substack{i=j=1 \\ j\neq 1}}^{n} b_{ij} x_i x_j + \sum_{i=1}^{M} b_{ii} x_i^2$$

Or, since three factors are involved in our experiment, the above expression takes the following form:

$$Y_R = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3 + b_{11}x_1^2 + b_{22}x_2^2 + b_{33}x_3^2$$

Taking into account the determined regression coefficients, the equation is written as follows:

$$Y_{R1} = 1124 + 103{,}88x_1 + 137{,}75x_2 + 66{,}88x_3 + 2x_1x_2 - 2{,}25x_1x_3 - 1{,}5x_2x_3 - 77{,}75x_1^2 - 94{,}12x_2^2 - 93{,}75x_3^2$$

It is known that if the calculated value of the criterion is smaller than the table value, then that coefficient is not significant and it is removed from the equation. In the studies b_{12}, it was found that the coefficient b_{13}, , $b_{23}$is insignificant for the studied parameters:

The equation with significant coefficients is rewritten:

$$Y_{R1} = 1124 + 103{,}88x_1 + 137{,}75x_2 + 66{,}88x_3 + 77{,}75x_1^2 + 94{,}12x_2^2 - 93{,}75x_3^2$$

To determine the significance of the regression coefficients on the obtained Y $_1$ - yarn hardness checking the adequacy of the equations for The test is performed using Fisher's test. The estimated value of Fisher's criterion is determined. The calculated value of the factor being optimized is calculated by putting the coded values of all the columns of the equation Y_1 matrix (–1, 0 and +1). Values are taken row-wise, not column-wise. YThe calculations for the formula are as follows, and the calculation results are included in Table 3.

Table 3

Calculation results of values coded into the equation for adequate dispersion

No	Y_1 – thread stiffness (N)				Y_2 - According to the elongation at break (%).			
	Y_{1i}	Y_{1i}	$(Y_{1i} - Y_{R1i})$	$(Y_{1i} - Y_{R1i})^2$	Y_{2i}	Y_{2i}	$(Y_{2i} - Y_{R2i})$	$(Y_{2i} - Y_{R2i})^2$
1	1185	1194	8.8	76.7	3.8	4.89	1.09	1.19
2	921	918	-2.7	7.5	6.8	7.99	1.19	1.42
3	951	986	35.0	1225.0	7.2	7.71	0.51	0.26
4	695	711	15.5	240.3	11.5	10.8	-0.69	0.48
5	1105	1123	18.3	333.4	7.8	6.99	-0.81	0.66
6	958	990	31.5	992.3	8.2	7.37	-0.83	0.69
7	924	916	-8.5	72.3	7.6	8.01	0.41	0.17
8	768	782	13.7	188.8	11.6	12	0.39	0.15
9	1108	1141	32.8	1073.2	5.8	5.59	-0.21	0.04
10	995	1007	12.0	144.0	7.8	7.77	-0.03	0.00
11	820	865	45.3	2048.5	8.2	8.69	0.49	0.24
12	701	732	30.5	930.3	10.5	10.9	0.37	0.14

$$\sum_{u=1}^{N-N_S+1} (Y_{R1.u} - \overline{Y}_{1u})^2 = 7332{,}146 \qquad \sum_{u=1}^{N-N_S+1} (Y_{R2.u} - \overline{Y}_{2u})^2 = 5{,}428$$

$S^2_{nad}\{Y_1\} = \frac{7332,146}{4} = 1833,04$ $\qquad$ $S^2_{nad}\{Y_1\} = \frac{5,428}{4} = 1,36$

It is known that if the calculated value of the criterion is smaller than the table value, that coefficient is adequate and proves that the calculations were carried out correctly [5,6]

$F_{R1} = \frac{S^2_{nad}\{Y\}}{S^2\{\overline{Y}\}} = \frac{1833,04}{128,85} = 14,2$ $\qquad$ $F_{R2} = \frac{S^2_{nad}\{Y\}}{S^2\{\overline{Y}\}} = \frac{1,36}{3,135} = 10,01$

$F_j\left[P_D = 0,95;\ f\{S^2_{nad}\{Y\}\} = 15 - 6 - (3 - 1) = 5; f\{S^2_u\} = 3 - 1 = 2\right] = 4,74$

$F_{R1} = 14,21 < 19,25 = F_j$ $\qquad$ $F_{R2} = 10,01 < 19, = F_j$

Therefore, the obtained regression mathematical models represent the researched process with sufficient accuracy.

Research results. Since the equation constructed to determine the characteristics of the output parameter for the study is three-dimensional, $X_i = 0$it is considered as one of the input factors in the analysis (the central state), and we construct a two-dimensional graph by transforming the models into 3 equations [7] .

$$Y_{R1} = 1124 + 103,88x_1 + 137,75x_2 + 66,88x_3 + 77,75x_1^2 + 94,12x_2^2 - 93,75x_3^2$$

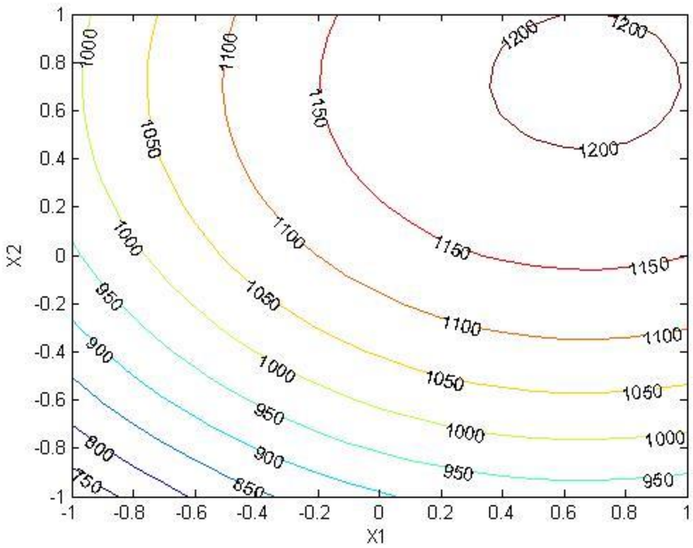

Figure 1. Graphs of the yarn tension dependence model of yarn winding speed

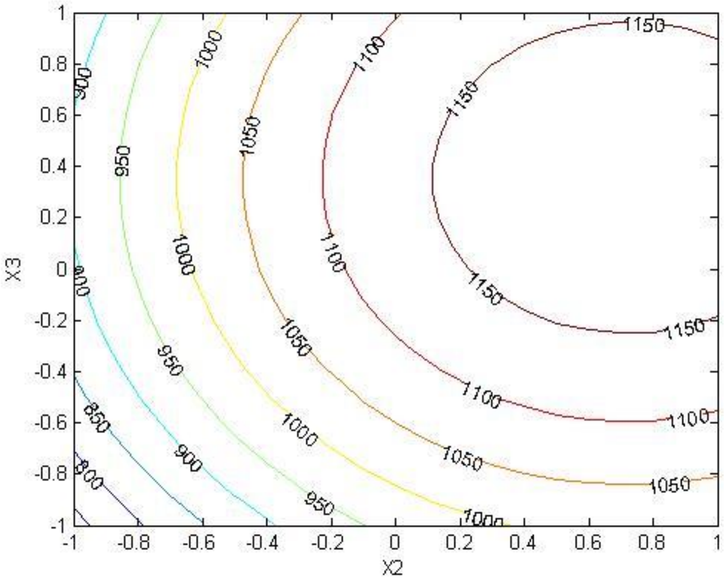

Figure 2. Graphs of the model of the dependence of the weight of the puck on the winding speed

The graphs in Figure 1 illustrate the effect of two x_1 (yarn tension) on yarn stiffness as a function of $x_{2 \text{ (yarn winding speed)}}$. As in any experiment, in this study, the influence of the input factors was studied. The output parameter Y_1 values should be selected in case of maximization.

The graphs in Fig. 2 show the effect of two other main factors x_2 (winding speed) on yarn stiffness as a function of $x_{3 \text{ (puck weight)}}$. In this case, the study of the effect of two factors on the output parameter was carried out using the method of small experiments, and the main values were determined through optimization.

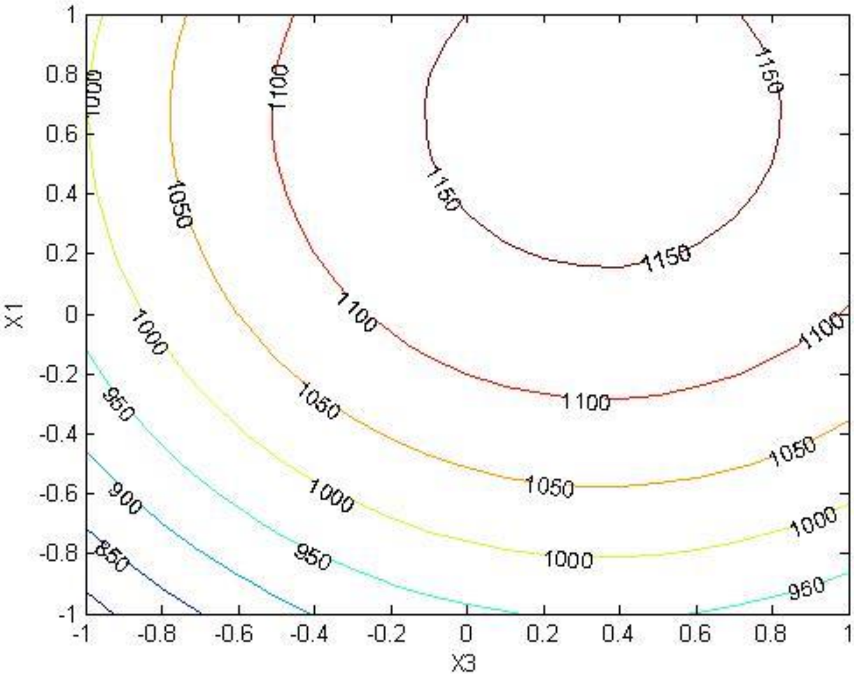

Figure 3 . Graphs of the model of the dependence of the string tension on the weight of the puck

The graphs in Figure 3 illustrate the effect of x_1 (thread tension) on thread stiffness as a function of $x_{3\ (puck\ weight)}$. We determine the output parameter values for all cases.

Summary. In these studies, the deviation of the surface of the isolines of yarn stiffness obtained (analysis) of yarn tension (sN) , yarn winding speed (m/min) and puck weight (grams) in yarn adding device is described. , as can be seen from the graphs, the maximum stiffness is achieved when the thread tension X_1 =400 sN is high , the thread winding speed X_2 =500 m/min and the weight of the tensioning washer X_3 = 20.1 grams.

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