The Definition Technological Parametres of One Chamber Two Saw Cylinders Gin

Azizov Shuhrat Mamatovich*, Sardorbek Isroilov, Jamoliddin Abdurakhimov and Shokir Turgunov

Namangan Institute of Engineering and Technology, Russia

Abstract

In article it is showed the definition technological parameters of one chamber two saw cylinder gin. For maintenance of efficiency of ginning and productivity increase it is necessary to choose correctly diameter of the working chamber, an arrangement corner saw cylinders under the relation of a horizontal axis. These factors are major factors influencing productivity and quality of a fiber at practical and theoretical researches of one chamber two saw cylinder gin.

Keywords: Regression Model; Optimization of Parameter; Angular Position; Saw Cylinder

Introduction

The choice of the necessary technological parameters is the main responsible stage in the design of cotton gin with new working bodies. In the process of fiber separation from the seed, the increase in productivity and the effective elimination of seed damage depend on the selected input parameters. The use of mathematical methods in planning practical experimental work in comparison with other methods of calculation, optimization parameters allows determining the influence of several factors acting together and their interaction among themselves in terms of separation. As a result, based on the few experiments that have been carried out, it is possible to obtain a mathematical model of the object under study; this model will allow obtaining optimal solutions at the time. In optimization, the main issue is this determination of the important factors affecting the process of hair removal of cotton fiber from seed this will serve for efficient fiber separation in the process of ginning [1-3]. The following parameters we chose for optimization:

$$Y1 - Fiber\ productivity,\ kg,\ /\ h.$$
$$Y2 - Seed\ damage,\ \%.$$

Using the results of the theoretical study including the literary survey of gins and also taking into account the primary one-factor experiment, the choice of the output parameters affecting the incoming factors was chosen as follows.

$$X_1 - Productivity,\ kg\ saw\ /\ hour.$$
$$X_2 - Radius\ of\ the\ working\ chamber,\ mm.$$
$$X_3 - The\ angle\ of\ the\ sawing\ cylinders\ relative\ to\ the\ horizontal\ axis,\ degree$$

Feed rolls 1 feeding the pin drum 2, a bracket and a clamping bar 3, a brush drum 4, a shaft of the brush drum 5, a saw cylinder 6, an upper grate 7, a gin working chamber 8, a lower grate 9, a cement cylinder 10, a screw 11, knife-like mesh surface 12 (Table 1) and (Figure 1).

Table 1: Factor name and numbering.

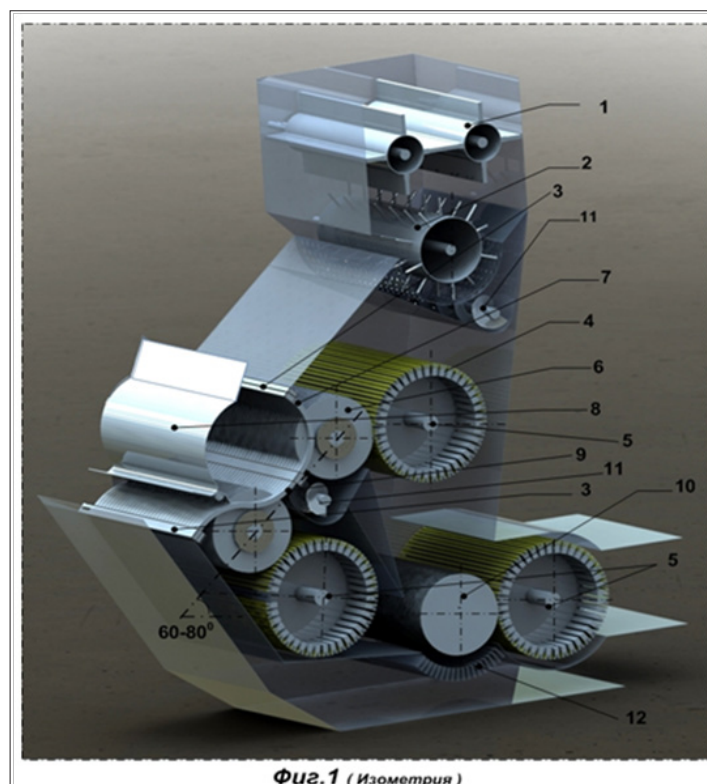| No	Factor name and numbering	Periodicity of level changes			Level of change
		-1	**0**	**1**	
1	X_1-Equipment capacity, t / hour.	1,5	2	2,5	0,5
2	X_2 - Radius of the working chamber, mm.	160	180	200	20
3	X_3 - angular arrangement of two sawing cylinders in relation to the horizontal axis, degree.	45°	60°	75°	15°

17

Figure 1: New Gin Machine.

The theoretical studies, it was justified to create a new design for two-cylinder gin. The main working body of the new design is an additional saw cylinder, which allows uniform rotation of the raw roller of productivity. To ensure the efficiency of fiber separation and increase productivity, it's necessary to choose the diameter of the working chamber correctly, the angle of the sawing cylinders in relation to the horizontal axis. These factors are the main factors effecting the productivity and quality of fiber in practical and theoretical studies. The process of ginning associated with many factors is investigated by modern mathematical methods of planning and is calculated by modern computer programs with the help of a computer [4-6]. These methods allow you to get the optimal solution with the least cost. On the basis of the indicators of natural factors, we turn to the coded indicators. The full-factorial test results showed that the investigated process is expressed by the high-level equation. Because of this, to obtain a regression mathematical model of the second degree, this model is considered to be simple and convenient in comparison with other methods, and also in the primary cotton processing enterprises, a non-method method is widely used in technological processes. It was chosen and used in the conducted experiment. The results of the central non composite experimental matrix are given in Table 2.

Table 2: Central non-composite experimental matrix.

No	Factors			$x_1 x_2$	$x_1 x_3$	$x_2 x_3$	x_1^2	x_2^2	x_3^2	$\overline{Y_1}$	$\overline{Y_2}$	$S_u^2\{Y_1\}$	$S_u^2\{Y_2\}$
	x_1	x_2	x_3										
1	+	+	+	+	0	0	+	+	0	7.3	1.01	11.32	0.34
2	-	-	-	-	0	0	+	+	0	9.11	2.1	10. 85	0.46
3	-	-	0	-	0	0	+	+	0	8.7	1.82	11.22	0.48
4	+	+	0	+	0	0	+	+	0	8.7	1.95	11.09	0.49
5	+	0	+	0	+	0	+	0	+	9.9	1.91	11.65	0.09
6	-	0	-	0	-	0	+	0	+	10.1	2.02	12.64	0.11
7	-	0	+	0	-	0	+	0	+	10.2	1.11	12.51	0.23
8	+	0	-	0	+	0	+	0	+	11.21	1.29	11.03	0.19
9	0	+	+	0	0	+	0	+	+	12.1	2.15	12.8	0.19
10	0	+	-	0	0	-	0	+	+	12.9	2.19	11.92	0.09

11	0	-	+	0	0	-	0	+	+	13.1	1.91	11.77	0.09
12	0	-	-	0	0	+	0	+	+	12.8	1.93	12.12	0.025
13	0	0	0	0	0	0	0	0	0	12.3	2.01	12.8	0.12

For each experiment it is necessary to use instruments with high accuracy of measurement. In our studies, to change the dimensions of the working chamber, we used already prepared working chambers of different diameters.The fiber performance we determined by the existing method and formula. When using a new working chamber, 100 kg of raw cotton was shipped from the feeder hopper. Each variant of the experiment was conducted five times. In the course of the experiment, the angular arrangement of the saw cylinders with respect to the horizontal axis exerted a great influence on the productivity. The design of the working chamber was made with a high level of measurement. The experiments were conducted according to the principle of randomization. After each experiment (at a certain time), the fiber yield level is determined. After the experiment, the samples were tested according to standard requirements in special laboratories for fiber and mechanical damage to the seeds. Based on the results obtained during the experiment, we use a multifactorial regression mathematical model of the second degree.

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

$$Y_R = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_{12} x_1 x_2 + b_{13} x_1 x_3 + b_{23} x_2 x_3 + b_{11} x_1^2 + b_{22} x_2^2 + b_{33} x_3^2$$

В уравнении

$b_0 ... b_1 ...$ - Regression coefficients,

x_1, x_2, x_3 - coded factor indices.

I. Calculation of the productivity of the fiber. Define the coefficients of regression:

$$b_0 = \frac{1}{N_{\ddot{o}}} \sum_{u=1}^{N_{\ddot{o}}} \overline{Y_u} = \frac{1}{3}(12.3 + 10.9 + 9.9) = 11.03$$

$$b_i = g_3 \sum_{u=1}^{N} x_{iu} \overline{Y}_u$$

$g_2 = 0,166;$ $g_3 = 0,125;$ $g_4 = 0,25;$ $g_5 = 0,125;$
$g_6 = 0,0625;$ $g_7 = 0,3125$

$b_1 = 0,125(12.21 + 12.1 - 12.9 - 13.1 + 12.8 + 12.3 - 10.9 - 9.9) = 0.33$

$b_2 = 0,125(7.3 - 9.11 + 8.7 - 8.7 + 9.9 + 10.1 - 10.2 - 11.21) = -0.40$

$b_3 = 0,125(9.9 - 10.1 + 10.2 - 11.21 + 12.1 - 12.9 + 13.1 - 12.8) = -0.21$

$$b_{ii} = g_5 \sum_{u=1}^{N} x_{iu}^2 \overline{Y}_u + g_6 \sum_{i=1}^{M} \sum_{u=1}^{N} x_{iu}^2 \overline{Y}_u - g_2 \sum_{u=1}^{N} \overline{Y}_u$$

$\sum x_1^2 \overline{Y}_u = 8.45$ $\sum \overline{Y}_u = 9.54$

$\sum x_2^2 \overline{Y}_u = 10,35$ $\sum_{i=1}^{M} \sum x_i^2 \overline{Y}_u = 10.22$

$\sum x_3^2 \overline{Y}_u = 12,73$

$b_{11} = \mathbf{0}.125 \cdot 8.45 + 0.0625 \cdot 10.22 - 0.166 \cdot 9.54 = 1.06 + 0.64 - 1.58 = 0,12$

$b_{22} = 0.125 \cdot 10.35 + 0.0625 \cdot 10.22 - 0.166 \cdot 9.54 = 1,29 + 0,64 - 1,58 = 0,35$

$b_{33} = 0.125 \cdot 12.73 + 0.0625 \cdot 10.22 - 0.166 \cdot 9.54 = 1,59 + 0,64 - 1,58 = 0,65$

Write the equation according to a certain regression coefficient:

$$Y_R = 11.03 + 0.33 x_1 - 0.4 x_2 - 0.21 x_3 - 0,45 x_1 x_2 + 0,2 x_1 x_3 -$$
$$-0.28 x_2 x_3 + 0.12 x_1^2 + 0.35 x_2^2 + 0.65 x_3^2$$

Let us determine the regression coefficient by acceptability.

To do this, we define the variance of the output parameters

$$S^2\{Y\} = S_m^2\{Y\} = \frac{1}{N_{\ddot{o}} - 1} \sum_{u=1}^{N_{\ddot{o}}} S^2\{\overline{Y}\}$$

$$S^2\{\overline{Y}\} = \frac{1}{3-1} \cdot 790 = 395$$

And based on the determination of the regression coefficient, we calculate the variance:

$S^2\{b_0\} = g_1 S^2\{\overline{Y}\} = 0.2 \cdot 395 = 79$

$S^2\{b_i\} = g_3 S^2\{\overline{Y}\} = 0,125 \cdot 395 = 49,375$

$S^2\{b_{ij}\} = g_4 S^2\{\overline{Y}\} = 0,25 \cdot 395 = 98.75$

$S^2\{b_{ii}\} = g_7 S^2\{\overline{Y}\} = 0,3125 \cdot 395 = 123.438$

When determining the regression coefficient, we determine the standard deviation:

$S\{b_0\} = 5.34$ $S\{b_i\} = 4.25$ $S\{b_{ij}\} = 7.94$ $S\{b_{ii}\} = 8.525$

After this, using the following equation, we determine the indications by the Student's criteria:

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

$$t_{\mathit{æ}}\left[P_{\ddot{A}} = 0,95; \ f\{S_{\ddot{o}}^2\} = 3 - 1 = 2\right] = 2.77$$

It is known that if the calculated criterion data are lower than those given in the data table, then the coefficient is not important and we derive the data from equation It was found that for the parameters under study, the coefficients of the experiments are not important and necessary:

Let us re-write the equations with significant coefficients:
$$Y_R = 11.03 + 0.33 x_1 - 0.21 x_3 - 0,45 x_1 x_2 + 0.12 x_1^2 + 0.65 x_3^2$$

To determine the above regression mathematical model for adequacy and inadequacy, we use the test data of the Fisher criteria.

$$F_R = \frac{S_{i\ddot{a}\ddot{a}}^2\{Y\}}{S^2\{\overline{Y}\}}$$

$$S^2\{\overline{Y}\} = \frac{\sum_{u=1}^{N} S^2\{Y\}}{N_{\ddot{o}} - 1} = \frac{31.2}{3 - 1} = 15.6$$

Here,

$$S^2_{i\,àä}\{Y\} = \frac{\sum\limits_{u=1}^{N-N_ä+1}(Y_{Ru}-\overline{Y}_u)^2}{N-N_{ê.\acute{y}i}-(N_ö-1)^2};$$

$$N-N_{ê.\acute{y}i}-(N_ö-1)^2 = 15-7-(3-1)^2 = 4$$

$$N-N_ä+1 = 15-3+1 = 13$$

$$Y_R = 11.9 + 0.1x_1 - 0.31x_3 - 0,53x_1x_2 + 0.19x_1^2 + 0.41x_3^2$$

$$Y_R = 11.03 + 0.33x_1 - 0.21x_3 - 0,45x_1x_2 + 0.12x_1^2 + 0.65x_3^2$$

For the results of the output parameters, we use the three factorial two-power regression mathematical model of the equation:

$Y_{R1} = 11.03 + 0.33 - 0.21 + 0.12 = 11.27$

$Y_{R2} = 11.03 + 0.33 + 0.21 + 0.12 = 11.69$

$Y_{R3} = 11.03 - 0.33 + 0.21 + 0.12 = 11.03$

$Y_{R4} = 11.03 - 0.33 - 0.21 + 0.12 = 10.61$

$Y_{R5} = 11.03 + 0.33 + 0.45 + 0.12 - 0.65 = 11.28$

$Y_{R6} = 11.03 + 0.33 - 0.45 + 0.12 - 0.65 = 10.38$

$Y_{R7} = 11.03 - 0.33 + 0.45 + 0.12 - 0.65 = 10.62$

$Y_{R8} = 11.03 - 0.33 - 0.45 + 0.12 - 0.65 = 9.72$

$Y_{R9} = 11.03 + 0.21 - 0.45 + 0,65 = 11.44$

$Y_{R10} = 11.03 - 0.21 - 0.45 + 0,65 = 11.02$

$Y_{R11} = 11.03 + 0.21 - 0.45 - 0,65 = 10.14$

$Y_{R12} = 11.03 - 0.21 - 0.45 - 0,65 = 9.72$

An analysis was made of the data obtained from the three factor mathematical regression model taking into account the necessary regression coefficients by the Student's criterion and also the results of the models tested for Fisher's adequacy.

After In order to simplify the calculations, we create a Table 3:

$$\sum\limits_{u=1}^{N-N_ä+1}(Y_{Ru}-\overline{Y}_u)^2 = 22.5925$$

$$S^2_{i\,àä}\{Y\} = \frac{22.5925}{4} = 5.64$$

Table 4: Regression model

Table 3: Indicators of the Student's test can be taken from the application:

$$t_R\{b_0\} = \frac{1.0}{5.3} = 2.0 \qquad t_R\{b_2\} = \frac{-0.5}{7.9} = 0.0$$

$$t_R\{b_1\} = \frac{0.3}{4.3} = 0.0 \qquad t_R\{b_3\} = \frac{0,2}{7.9} = 0,025$$

$$t_R\{b_2\} = \frac{-0.4}{4.3} = 0.0 \qquad t_R\{b_3\} = \frac{-0.8}{7.9} = 0.035$$

$$t_R\{b_3\} = \frac{-0.2}{4.3} = 0.0 \qquad t_R\{b_1\} = \frac{0.2}{8.525} = 0.014$$

$$t_R\{b_2\} = \frac{0.3}{8.525} = 0.0 \qquad t_R\{b_3\} = \frac{0.6}{8.525} = 0.076$$

It is known that if the data of the calculation criteria is lower in comparison with the data given in the table, then this coefficient is adequate and this makes the calculations correct.

$$F_R = \frac{S^2_{i\,àä}\{Y\}}{S^2\{\overline{Y}\}} = \frac{5.64}{0.51} = 11.05$$

$$F_æ\left[P_{\ddot{A}} = 0,95; \quad f\{S^2_{i\,àä}\{Y\}\} = 15-6-(3-1) = 5; \quad f\{S^2_u\} = 3-1 = 2\right] = 19,3$$

$$F_R = 11.05 < 19.3 = F$$

From this it follows that the regression mathematical model obtained fully characterizes the process of investigation (Table 4) and (Figure 2).

№	Factors			Productivity per fiber, kg, saw / hour
	Productivity of the machine, t / h	Diameter of the working chamber, mm.	The position of the saw cylinders relative to the horizontal axis degrees	
1	3	200	75°	7.3
2	2	160	45°	9.11
3	2	160	60°	8.7
4	3	200	60°	8.7
5	3	180	75°	9.9
6	2	180	45°	10.1
7	2	180	75°	10.2
8	3	180	45°	11.21
9	2,5	200	75°	12.1
10	2,5	200	45°	12.9
11	2,5	180	60°	13.1
12	2,5	160	45°	12.8
13	2,5	160	75°	12.3

Conclusion

Comparison of the obtained data by the experimental method and the obtained regression mathematical model fully characterizes the process of research with accuracy. Thus, the optimal technological parameters of the single-chamber double-cylinder gin were determined. It can be seen from Figure 2 that when the saw cylinders are positioned at 450-600 degrees relative to the horizontal axis with a working chamber diameter of 180 mm, it makes it possible to increase the productivity by synchronizing the fiber quality. From this it follows that when designing a two-

cylinder gin, it is necessary to comply with the optimal regime for improving fiber quality and productivity.
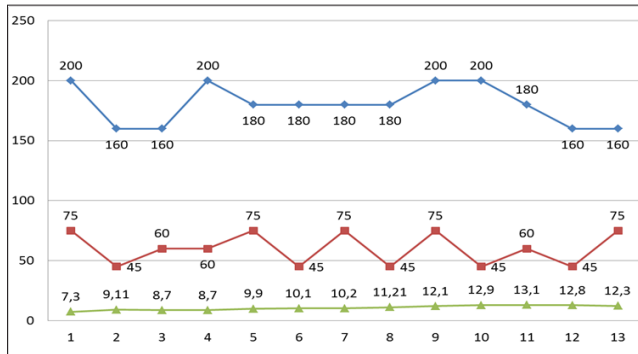

Figure 2: Graph of the regression model.
Blue line – diameter of chamber;
Red line - saw cylinders positioned at 450-600 degrees relative to the horizontal axis;
Green line – capacity of fiber kg/hour.

References

1. GI Miroshnechenko (1972) Bases of Designing of Machines of Primary Processing of Cotton Book Theory of Ginning Machine, Moscow, USA.

2. SN Nikiforov (1966) Resistance of materials Publishing house "Higher school", Moscow, USA.

3. Mamatovich, A Sh, Axmedhodjaev XT (2015) Theoretical Analysis of Gin Cylinder for Simulating Dual Saw Cylinder Chamber Gin for Increasing Wear proof, Energy Efficient, Saving Resources. Scientific Research 3(3): 91-99.

4. Shuhrat Mamatovich Azizov, Xamit Tursunovich Axmedhodjaev (2016) the Optimal Modeling of an Angular Position of Saw Cylinders in Single-Chamber Two Cylinders Gin. American Journal of Mechanical and Industrial Engineering 1(3): 103-106.

5. Mamatovich, A Sh, Abdusamat K, Arras P (2013) The Mathematical Simulation of Brush Drums in a Dual Saw Cylinder Chamber Gin for the Purpose of Increasing the Quantity of Captured Cotton Fiber from Saw. World Journal of Mechanics 3: 58-61.

6. Mamamtovich AS (2016) Analysis of the Influence of Geometric Characteristics of the Saw and the Gasket of Saw Gin on the Life of Saw at Different Distances between the Saw. J Textile Sci Eng 6: 256.

LTTFD
Latest Trends in Textile and Fashion Designing
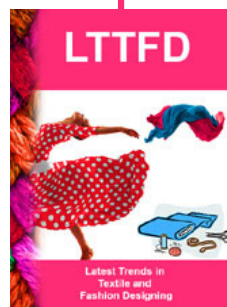
Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles