# DETERMINATION OF THE MAIN PARAMETERS OF THE IMPROVED COTTON REGENATOR BASED ON MULTIFACTOR EXPERIMENTS

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**Abstract.** The article presents the results of determining the main parameters of the improved cotton regenerator by the method of multi-factor experiments, as a result, the distance between the first grid columns in the regeneration drum is 45 mm, the taper angle of the valve is $22^0$, and the number of revolutions of the saw drums is 300 rpm.

**Keywords.** Colosnic grid, regenerator, valve, multifactor, input parameters, regression equation.

According to the results of the preliminary experiments, the main factors affecting the quality of the cotton regenerator were determined and multifactorial experiments were conducted. Experiments were carried out on Sultan selection grade, II-industrial grade, grade 2 initial dirt - 9.8%, moisture content - 8.6%, cotton.

The regenerator's cleaning efficiency U1 and the amount of cotton pieces in the waste U2 were taken as the criterion limit for evaluating the quality of the cotton separated in the regeneration. The main factors influencing the specified criteria: X1 – the distance between the first grid columns in the regeneration drum, mm, X2 – the taper angle of the valve, $^0$S, X3 – the number of revolutions of saw drums, rev/min, were accepted.

Based on preliminary experiments, the step and range of factors affecting the performance quality of the regenerator are presented in Table 1.

Table 1

Range of factors and their steps

| № | Factors | Measurementбирли и | Identification of factors | | Step | Calculation range of factors | | |
|---|---|---|---|---|---|---|---|---|
| | | | Natural | Encoded | | -1 | 0 | +1 |
| 1 | The spacing of the first grid columns in the regeneration drum | mm | h | $X_1$ | 5 | 40 | 45 | 50 |
| 2 | The taper angle of the valve | $^{0}C$ | α | $X_2$ | 10 | 10 | 20 | 30 |
| 3 | The number of revolutions of saw drums | rpm | V | $X_3$ | 50 | 250 | 300 | 350 |

The fully factored PLANEXP-2 second-order $B_3$ planning method was used for the experimental tests.

According to the criterion of purification effect U1, the table index of Student's criterion was equal to T(28)=2.048, the table index of Cochran's criterion was equal to G(2,14)=0.3539, the arithmetic index of Cochran's criterion was equal to =0.2627458, and the variance of reproducibility was equal to 0.0607145.

In this case, we get the following regression equation:

$$У_1 = 88,42084 + 0,21X_1 + 0,86X_2 + 1,25334X_3 - 0,93749X_1^2 + 0,45833X_1X_2 - 1,42082X_2^2 - 0,35833X_2X_3 - 2,02084X_3^2 \quad (1)$$

Checking the adequacy of the mathematical model (1) showed that: the adequacy variance is equal to 3.513349E-02, the calculated index of Fisher's criterion is equal to 1.736002, the table index of Fisher's criterion is equal to FT(5, 8) = 2.56, which shows the adequacy of the obtained model.

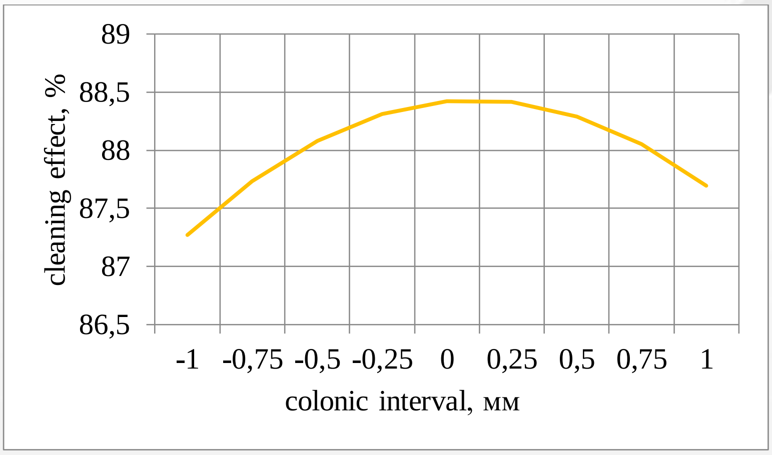
According to the criteria for the amount of cotton pieces in the waste according to U2, the table indicator of the Student's criterion is T(28)=2.048, the table indicator of the Cochrane criterion is G(2, 14)=0.3539, the calculation indicator of the Cochrane criterion is equal to 0.1166667, the dispersion of reproducibility = 1.428571E- 02 was equal.

In this case, we get the following regression equation:

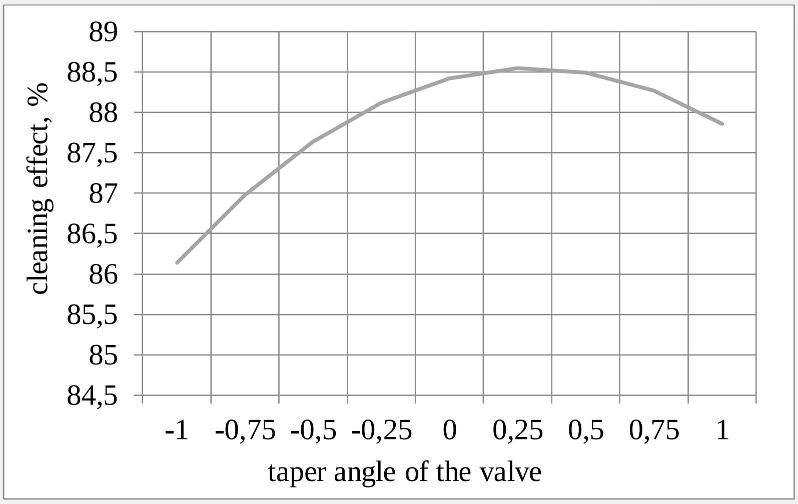
$$У_2 = 2,38125 - 0,05X_1 + 0,33X_3 + 0,48542X_1^2 + 0,10417X_1X_3 + 0,07917X_2X_3 + 0,25208X_3^2 \quad (2)$$

Checking the adequacy of the mathematical model (2) showed that: the adequacy variance is equal to 9.726857E-03, the calculated index of Fisher's criterion is equal to 2.04264, the tabular index of Fisher's criterion is equal to FT(6, 28 ) = 2.44, which indicated the adequacy of the obtained model.

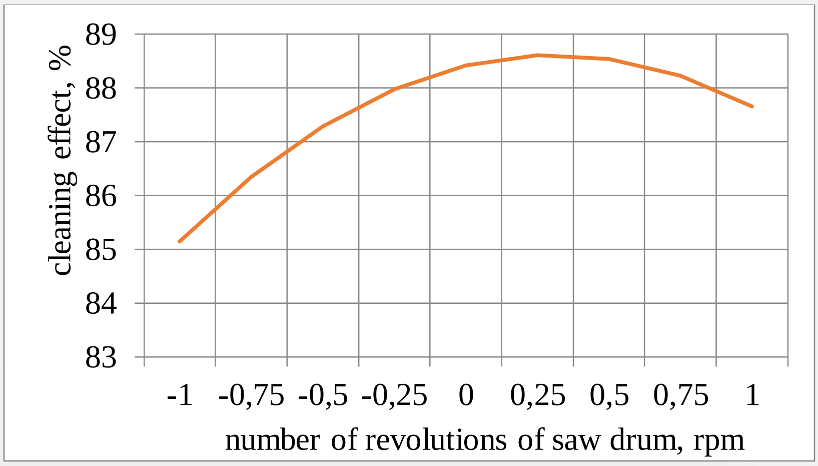
Graphs were constructed showing the effect of each input factor on the process in the regression equation that adequately describes the cleaning efficiency U1 of the cotton regenerator (Figure 1).




(a)




(b)

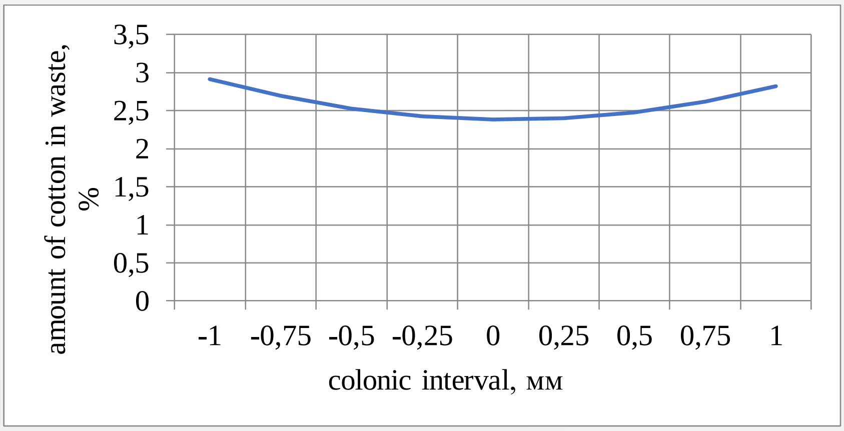



(v)

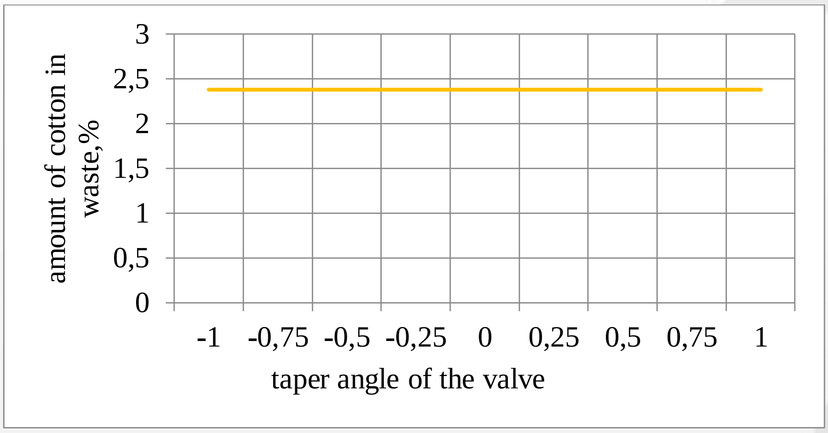
Figure 1. Influence of unwanted factors on cleaning efficiency.

As can be seen from the graphs in Figure 1 above, the increase in the distance between the first grid columns in the X1 regeneration drum to the baseline has a positive effect on the cleaning efficiency, and we can see that the cleaning efficiency decreases as it passes from the baseline (a), in which the increase in the column spacing leads to a decrease in the number of columns and the cotton is hit by cleaning. decreases, as well as X2 – valve taper angle (b) and X3 – sawing drum rotation number change in the graphs (v) we see an increase in the cleaning efficiency up to the base values, and decrease as it passes from the base. A large increase in the angle of the valve causes the air to be drawn back when the valve cover is opened due to the incompleteness of the upper part of the cone, while the increase in the speed of the saw drum also has a negative effect on the cleaning effect.

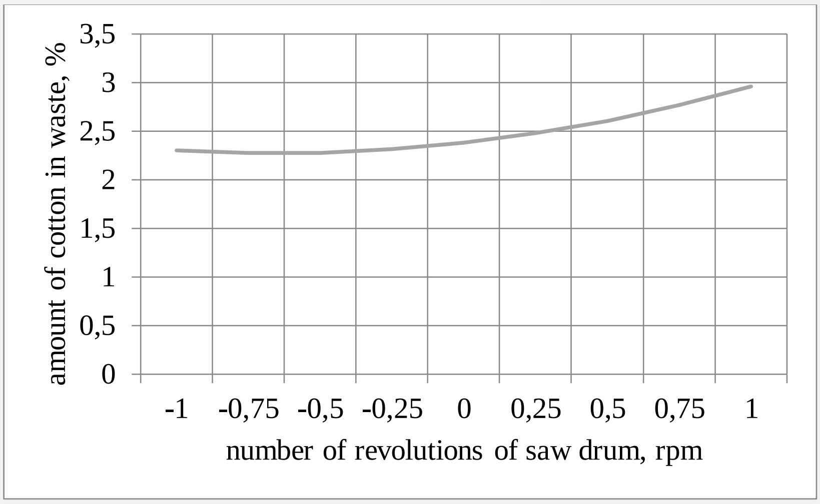
Graphs were constructed showing the effect of each input factor on the process in the regression equation that adequately describes the amount of cotton particles in the effluent leaving the regenerator U2 (Figure 2).




(a)




(b)




(v)

Figure 2. Effect of unwanted factors on the amount of cotton pieces in waste.

From the graph in Figure 2 (a), we can see that the distance between the first grid columns in the regeneration drum decreases to the base amount of cotton in the waste, and passing the base amount leads to an increase in the amount of cotton in the waste. The change in the taper angle of the valve (b) does not show any effect on the change in the amount of cotton in the waste. The increase in the number of revolutions (v) of the sawed drums leads to the increase in the linear speed of pushing the cotton between the colosniks, and the waste and cotton also pass through the colosniks.

In order to confirm the results of the multi-factor experiment, we consider the optimization problem of determining the optimal values of the cotton regenerator. Boundary conditions:

Y1 ---> max

Y2≤ 3 %

The resulting optimization problem was solved using the random search method and modern computer application programs, and the following optimal solutions were obtained (Table 2):

Table 2

Results of mathematical model optimization

| factors | $X_1$ | $X_2$ | $X_3$ |
|---|---|---|---|
| Encoded | 0,184507 | 0,296613 | 0,283806 |
| Natural | 45,923 | 22,966 | 314,190 |
| rounded up | 45 | 22 | 300 |

Therefore, according to the results of the conducted experiments, X1 – the distance between the first grating columns in the regeneration drum, 45 mm, X2 – the taper angle of the valve, $22^0$, X3 – the number of revolutions of saw drums, 300 revolutions/minute were accepted.

Effective operation of the cotton regenerator with newly constructed working parts was observed at the value of the given factors, that is, the cleaning efficiency was 88.7%, the amount of seeded cotton in the waste was reduced to 2.5%.