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Experimental Research of Constructive Parameters of Drum Pile of Shovel Type Pile

Kuliev Takhir Mamarajabovich,
Ph.D., professor,
Rayimkulov Jakhongir Qulmurodovich,
candidate, "Cotton Industry Scientific Center" JSC
Rosulov Rozimurad Khasanovich, Ph.D.,
associate professor, TTESI, jahogirrayimqulov@mail.ru

Abstract: The article discusses the modeling of an elastic bond in the process of cleaning weed impurities from two or more raw cotton flies. Graphs of the dependence on time are plotted at different angles of inclination over the surface of the mesh surface of raw cotton bats, as well as changes in the efficiency coefficient when cleaning raw cotton at two different angular velocities of each bat of raw cotton over time. From the analysis of the obtained graphs according to the theoretical study, it is possible to achieve the effective use of the mesh surfaces of the raw cotton cleaner from small weeds to increase the cleaning efficiency.

Keywords: modeling, elastic bond, cleaning efficiency, viscosity, mesh surface, tilt angle.

The Republic of Uzbekistan occupies one of the leading positions in cotton cultivation and export. Therefore, cotton farming occupies an important place in the country's economy. Obtaining high-quality fiber and seeds while preserving the natural properties of cotton is an important task of the cotton ginning industry. Cotton ginning machines consist of piles and saw drums. As a result of the mechanical impact of pile and saw drums on cotton, the cotton is cleaned of various impurities, and the cleaned cotton goes to the next process through pneumatic transport.

One of the main technological parameters of cotton cleaning machines is cleaning efficiency [1]. During the experimental research, the performance of the cleaner, the rotation frequency of the drum, the turning angle of the shovel-type pile relative to the axis of the pile drum, the performance of the cleaner, etc., were studied. The above indicators directly affect the technological parameters of the purifier [2]. Experiments were carried out in order to study the effect of the rotation angle of the plate of the proposed piled drum relative to the axis of the piled drum on the cleaning efficiency of the cleaner [3; 4].

As a result of conducting experimental-laboratory and theoretical studies, the following main factors were determined: frequency of rotation of the drum (min-1). the angle of rotation of the shovel pile relative to the pile drum axis (degrees), the working efficiency of the cleaner (tons/hour). Total factorial experiment (TOT) 23 were selected for research. All fixed main factors were on two levels (+1) and (-1), and the number of experiments was 23=8 [5]. After selecting the main factors and their levels, it is possible to optimize the technological and structural parameters of the shovel-type piles of the cleaner pile drum, as well as about the work of the cleaner, which parameter is the main one.

In accordance with the research task, it is necessary to evaluate the influence of three independent input factors (the rotation frequency of the drum n, the rotation angle of the shovel-type pile relative to the axis of the pile drum, φ, the performance of the cleaner P) on the output parameter (cleaning efficiency of the cleaner). The appearance of the mathematical model at the initial stage of approximation is as follows will look like:

$$\bar{\bar{y}} = b_0x_0 + b_1x_1 + b_2x_2 + b_3x_3 \quad (1)$$

It is known that only two possible changes (variations) from each input parameter - lower and higher, the number of experiments will be N = 8:

N =23= 8

We conduct three parallel experiments at each plot point to determine the experimental processing variance. In the center of the plan - the main level - we accept the initial quantities of the factors under investigation.

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The mentioned parameters are listed in Table 1. To construct the model in formula (1), we encode the input parameters, construct the planning matrix of TOT in the form of 23, and conduct 24 experiments after randomization using the mathematical model of cleaning efficiency.

Table 1

№	Омиллар номланиши	Ўлчов бир-лиги	Ном-лани-ши	Омиллар миқдори			Ўзга-риш дара-жаси
				-1	0	+1	
1	Барабаннинг айланиш частотаси	мин$^{-1}$	X_1	280	300	320	20
2	Пластинани қозиқли барабан ўқига нисбатан бурилиш бурчаги	град.	X_2	15	30	45	15
3	Тозалагичнинг иш унумдорлиги	т/соат	X_3	6	7	8	1

Planning matrix and calculated experimental results
given in table 2.

Table 2.
Planning matrix and calculated experimental results

Т/р	Кирувчи параметрларнинг кодланиши				Чиқувчи параметр		
	x_0	x_1	x_2	x_3	y_1	y_1	y_1
1	+	-	-	-	89,7	90,1	91,2
2	+	+	-	-	88,3	88,9	89,5
3	+	-	+	-	84,8	85,3	85,8
4	+	+	+	-	80,1	80,7	81,3
5	+	-	-	+	86,4	87,8	88,2
6	+	+	-	+	82,2	82,5	82,8
7	+	-	+	+	81,6	81,0	81,4
8	+	+	+	+	76,4	76,9	77,4

In Table 2, the following designations are adopted:
x_0-хаёлий ўзгарувчан;
x_1- n - омилнинг кодланган кўриниши;
x_2- φ - омилнинг кодланган кўриниши;
x_3- П - омилнинг кодланган кўриниши. y_{ij}. бу ерда i-1.8; j-1,3 – ij W - чиқувчи параметрлар қиймати, %.

As incoming uncontrollable random factors, random effects of the external environment are given, for example, meteomills, corresponding to constant and random elements.
We check the possibility of processing the results of the experiment with the method of multiple regression analysis.
With all the above data processing, the regression equation will look like this:

$$\bar{y} = 84{,}18 - 1{,}93x_1 - 3{,}12x_2 - 2{,}13x_3 - 0{,}33x_1x_2 - 0{,}42x_1x_3 + 0{,}46_1x_2x_3$$

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Checking the significance of the regression equation based on the results of the experiment

$$F_{\text{воспр}} = \frac{S^2_{\text{ад}}}{S^2_{\text{воспр}}} S^2_{\text{ад}} = 15{,}52;\ S^2_{\text{воспр}} = 16$$

$$S^2_{\text{ад}} = \frac{3\sum_{j=1}^{l}(\bar{y}_{jэ} - \bar{y}_{э})^2}{8-6} = \frac{3}{2}\sum_{j=-}^{8}(\bar{y}_{jэ} - \bar{y}_{э})^2$$

$\bar{y}_1 = -3{,}21;\ \bar{y}_2 = 0{,}09; \bar{y}_3 = -2{,}39; \bar{y}_4 = 0{,}95; \bar{y}_5 = -2{,}37; \bar{y}_6 = 0{,}93; \bar{y}_7 = 1{,}69;\ \bar{y}_8 = 4{,}31.$

$S^2_{\text{ад}} = 1{,}9$ $\quad F_{\text{расч}} = \frac{1{,}9}{0{,}3} = 3{,}66$

$F_{\text{табл}}(0{,}05/2;\ f=2;\ f=16)=4{,}68$ $\quad F_{\text{расч}}=3{,}66 < F_{\text{табл}}=4{,}68$

Thus, the mathematical model is consistent with the experimental results.

Interpretation of the regression equation.

After processing the TOT results, we got the regression equation (first degree polynomial).

$$\bar{y} = 84{,}18 - 1{,}93x_1 - 3{,}12x_2 - 2{,}13x_3 - 0{,}33x_1x_2 - 0{,}42x_1x_3 + 0{,}46_1x_2x_3$$

The cleaning efficiency of the cleaner leads to an increase in the amount of factors, the reduction of the cleaning efficiency depends on the interaction of the x_1 x_2 factors (x_1–drum rotation frequency, x_2–rotation angle of the plate relative to the pile drum axis).

Mathematical calculations based on the obtained regression formula showed the compatibility of the experimental results and the model. The amount of regression coefficients in the model characterizes the corresponding factor of the amount of the output parameter in the transition of the main factor to the main higher or lower level. The larger the regression coefficient, the higher the effect of this factor, that is, the stronger the factor's influence on the output parameter.

We will consider the influence of the incoming factors on the investigated factor, that is, on the cleaning efficiency. The analysis of regression equations shows that the influence of u on the cleaning efficiency is the rotation frequency of the drum (x1), the angle of rotation of the shovel-type pile relative to the pile drum axis (x2) and the efficiency of the cleaner (x3) and the interaction of the factors (x1x2, x1x3, x2x3, x1x2 x3) is represented by. In order to check these relationships, numerical calculations of the curves on the regression equations of different sizes of the main factors were carried out. The results of the calculations are displayed graphically after processing. Figure 1 shows the effect of cleaning efficiency on the angle of rotation of the shovel type pile relative to the pile drum axis, where three curves of y=y(x) are presented.

The first curve corresponds to the minimum, the second to the intermediate, and the third to the largest of the sum of the factors x2 and x3. It can be seen from the curves that when the rotation angle of the shovel-type pile increases from 150 to 300 with respect to the axis of the pile drum, the cleaning efficiency is from 89.1% to 90.37% at x2=150, x3=6 t/h. , in the largest amount, that is, from 86.47% to 88.37% when x2=300, x3=6 t/h, in the second curve from 83.09% to 85 when x2=450, x3=7 t/h, increases to 71%.

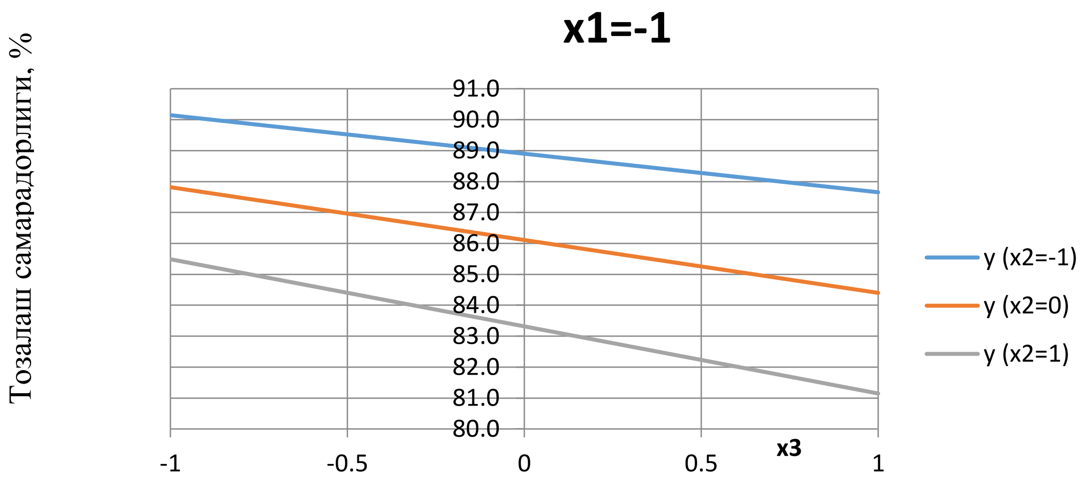

Figure 1. The graph of the dependence of the frequency of rotation of the drum on the efficiency of cleaning

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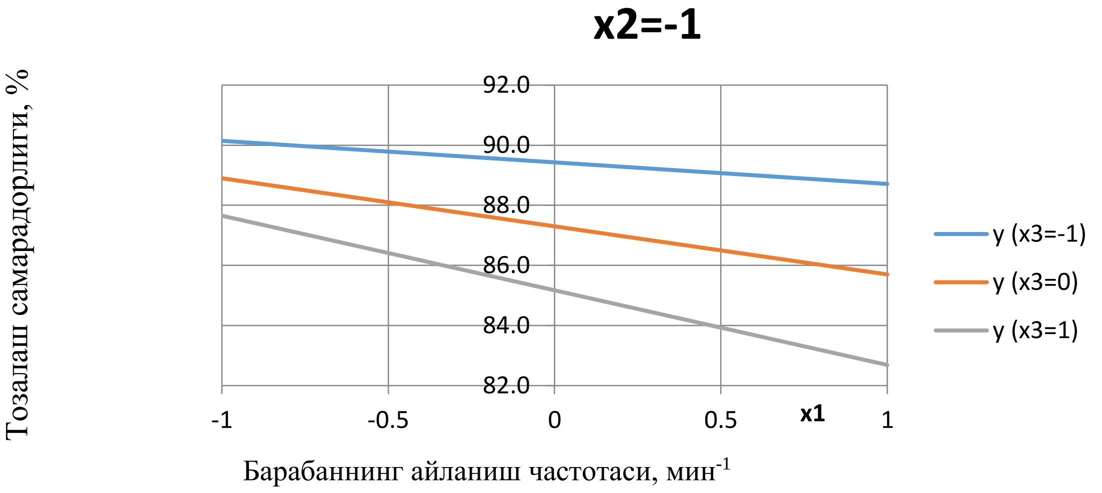
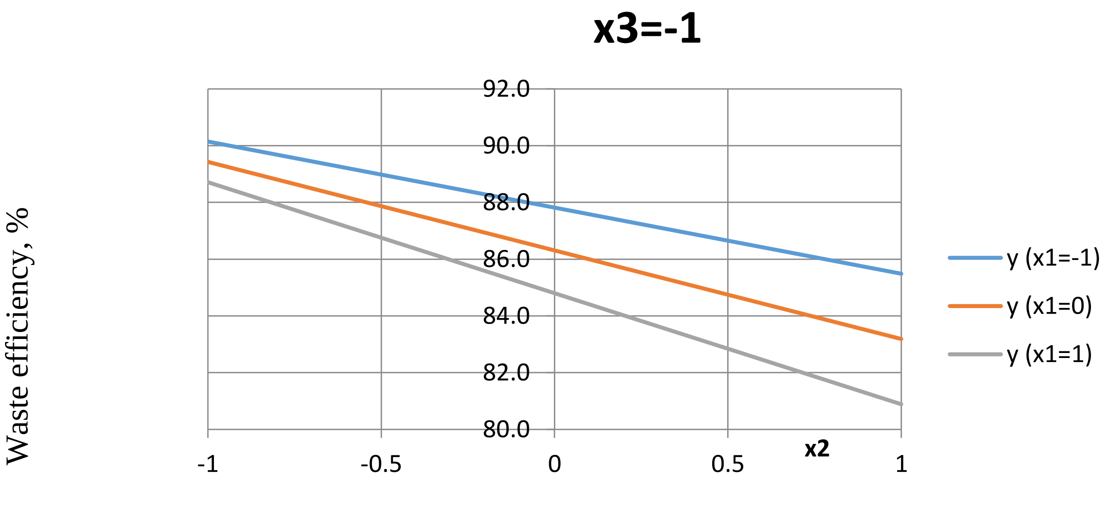
Figure 2 shows the effect of the angle of rotation of the shovel pile relative to the pile drum axis on the cleaning efficiency. The given curves show that the cleaning efficiency increases with the increase of drum rotation frequency from 280 min-1 to 320 min-1 in the given dependence of x1 and x3. In the first curve at x1=280 min-1x3=6 t/h, the cleaning efficiency is from 85.31% to 90.29%, in the second curve from 87.37% at x1=300 min-1, x3=6 t/h up to 89.43%, in the third curve it increases from 85.51% to 87.37% at x1=320 min-1, x3=6 t/h.



Angle of rotation (degrees) of the shovel-type wedge
relative to the wedge-shaped drum

Fig. 2. Dependence graph of the turning angle of the shovel-type pile on the cleaning efficiency compared to the pile drum.

Figure 3 shows the effect of cleaner performance on cleaning efficiency. The given curves show that the cleaning efficiency increases from 88.31% to 92.29% in the first curve when x1=280 min-1 ,x2=7t/hour, in the second curve x1=320 min-1, x2=300 from 86.89% to 89.91%, in the third curve x1=7t/h,x2=450 increases from 85.59% to 88.37%.



Efficiency of the cleaner, tons/hour

Figure 3. The graph of the dependence of the performance of the cleaner on the cleaning efficiency

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The main task of conducting a factorial experiment is to determine the effect of the input factors on the output factors. All the parameters listed above and their ratio affect the cleaning process. It is necessary to choose such a parameter of the input factors, in which the cleaning process should be improved.
The following values are offered for the main factors selected based on the results of the experiment obtained during the full-factor experiment: drum rotation frequency 280 min-1; the angle of rotation of the plate relative to the axis of the pile drum is 150; the working efficiency of the cleaner is 6 t/h. Effective operation of the cotton cleaner was observed at the given values of the factors, that is, the cleaning efficiency was 90.27%.

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