OPTIMIZING THE MAIN STRUCTURAL DIMENSIONS AND OPERATING MODES OF THE DEVICE THAT SEPARATES THE SEEDS OF AGRICULTURAL CROPS FROM THE EARS AND PODS.

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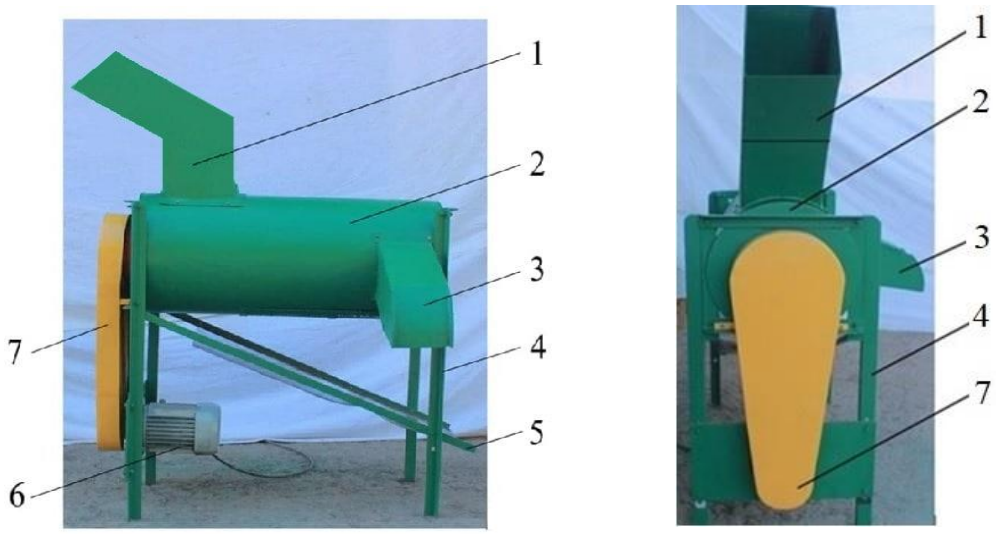
Abstract. The article presents the structure of the device that separates the grain of agricultural crops from the ears and pods, as well as the results of optimization of its main structural dimensions and operating modes. The results of the experimental research showed that the number of revolutions of the shaft when separating grain from the ears and pods of agricultural crops is 400 r/min, the number of rods fixed to the shaft in a screw shape is 18 pieces, and the length of the rods It should be equal to 165 mm.

Keywords. Device, spike, pod, stem, grain, parameter, shaft, number of revolutions, sago, length and grain.

Foreign countries, including Russia, have carried out a certain amount of scientific and research work on the development of devices that separate grains from cobs and pods, as well as on the justification of their design parameters and operating modes [2,3]. However, the structure of the devices developed by them is complex and has not been put into practice.

Based on this, a new construction device was developed that separates the grain of small-sized agricultural crops from the ears and pods. (Fig. 1) [4,5,6,7,8,9,10,11].



a) b)

a) side view; b) front view 1-transmission channel;

2- hollow cylinder; 3-exit hole; 4-frame; 5-set device;

6-electric motor; 7-protective means

Figure 1. General view of the device that separates the grain of agricultural crops from the ears and pods

Multifactorial experimental studies were conducted to study the connections between the factors that affect the technological process of the device that separates grain from ears and pods of these agricultural crops and to determine their optimal values. On the basis of previous scientific and research works, scientific sources, results of theoretical studies and preliminary experimental studies, the number of revolutions of the shaft n, the number of screws fixed to the shaft in the form of a screw Zk and the shaft it was found that the length of the threaded rods had the greatest effect. Based on the results of preliminary experiments and theoretical studies, as well as on the basis of arpior information, the limits and ranges of changes of the factors were determined.

Table 1 lists the main factors, their change limits and intervals.

The main factors, their change limits and ranges

№	Factors naming	Designation	Limit of change	Range of changes

		Real	Real	–1	0	+1	
1	Number of shaft revolutions, rpm	n	X_1	300	400	500	100
2	Number of fasteners to the shaft, pcs	Z_k	X_2	12	15	18	3
3	Length of fasteners to the shaft, mm	l_k	X_3	155	160	165	5

The relationship between the factors affecting the technological process and the obtained results is expressed in the form of the following regression equation [12].

$$y = b_0 + \sum_{i}^{k} b_i x_i + \sum_{i>y}^{k} b_{ij} x_{ij} + \sum_{i=1}^{k} b_{ic} x_i^2, \quad (1)$$

In this case, y is the optimized criterion of the researched process;

b_o, b_{ij}, b_{ii} – constant regression coefficients;

x_i, x_{ij} – changing factors.

To facilitate the calculations, the factors were coded with the following expression

$$X_i = \frac{X_i - X_{oi}}{\varepsilon}, \quad (2)$$

Here, X_i – conditional value of factors;

X_i – actual value of factors;

X_{oi} – true value of factors at zero level;

ε – the actual value of the range of factors.

The Cochrane test was used to test the assumption of homogeneity of variances in the return of the same number of experiments, and the Student's test at the 0.05 level was used to determine the significance of the regression coefficients.

Adequacy to the process model was checked by Fisher's test.

If

$$F_{\max} < F_{жад(0,05)}, \quad (3)$$

if there is, the model of the technological process is considered adequate.

Multifactorial experimental studies were conducted on a pilot copy of the device that separates grain of agricultural crops from cobs and pods. Three observations were obtained for each experiment. A table of random numbers was used to determine the sequence of conducting experimental studies. Regression equations were obtained according to the completeness of the separation of grain from the ears and pods of agricultural crops and the degree of their damage, and the optimal values of the main factors affecting the technological process were determined.

The results obtained in the multi-factorial experimental studies on the separation of grain from the ears and pods of agricultural crops were processed using the programs available on modern computers, and the significance of the coefficients was evaluated. and the following regression equations were obtained, which adequately represent the completeness of extraction and the degree of their damage from pods:

- on the completeness of separating the grains from the ears and pods

$$Y_1 = 96{,}563 + 5{,}967\,X_1 + 4{,}8X_2 + 1{,}467X_3 - 2{,}563X_1^2 + \\ + 1{,}792X_1X_2 - 0{,}708X_1X_3 - 1{,}729X_2^2 - 2{,}79X_3^2, \%; \quad (4)$$

- according to the degree of grain damage

$$Y_2 = 1{,}431 + 0{,}863X_1 - 0{,}510X_2 - 0{,}387X_3 + 0{,}562X_1^2 + \\ + 0{,}317X_1X_3 + 0{,}462X_2^2 + 0{,}275\,X_2X_3 + 0{,}113X_3^2, \% \quad (5)$$

Solving regression equations (4) and (5) under the condition that the completeness of grain separation from ears and pods is Y1max≥ 98 percent and their damage level is Y2<2, it is possible to determine the optimal values of the main factors affecting the technological process gave

Table 2 shows the results of determining the optimal values of the main factors.

Table 2

Optimal value of the main factors

Indicators	Factors and their meanings		
	n, r/min	Z_k, dona	l_k, mm
Conditional	+0,0147	+1	+1
Real	401,47	18	165
Rounded off	400	18	165

As can be seen from the results presented in Table 2, in the proposed device, the completeness of grain separation from the heads and pods is high and the degree of their damage is low. The number of revolutions of the shaft is 400 r/min. it is provided when the length of pieces and swags is equal to 165 mm. At these noted optimal values of the factors, the completeness of separation of grains from ears and pods is 98.3 percent and the level of damage is 1.4 percent.

Summary. 1. The optimal values of the main structural dimensions and operating modes of the device that separates the grain of agricultural crops from the ears and pods can be achieved by conducting multi-factor experimental studies.

2. In order to ensure the completeness of grain separation from heads and pods in the device and to reduce their damage, the number of revolutions of the shaft is 400 r/min, the number of rods fixed to the shaft in the form of a screw is 18 pieces, and the length of the rods is 165 mm. should be chosen around

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