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Clean the cotton from small impurities and establish optimal parameters

R.G. Rakhimov
Namangan Institute of Engineering and Technology

Annotation: In the article, the effective cleaner of cotton raw materials from small impurities is fully obtained on the basis of experimental studies, its optimal parameters are determined according to the analysis of connection graphs, and it is recommended for use.

Key words: cleaner, small impurities, pile drum, mesh surface, concave radius, spacing, rows, rubber, bushing, efficiency, roughness.

As the main factors for the development of the field of cotton cleaning, the preservation of the initial quality indicators of fiber and seed in the process of separating cotton fiber from the seed, compact technologies that can reduce the energy consumption of the process, control the quality of the product, simple, low-material equipment for separating cotton fiber from the seed and providing the process with cotton raw materials and it is necessary to create energy-consuming constructions.

Analysis of mesh surface parameters in the new construction

of the cotton cleaner allows to significantly increase the cleaning effect due to the additional shaking of the cotton skin by vibrating the different surface. Vibrations of the mesh surface with rubber bushing occur due to the impact of cotton pieces on it. The frequency and amplitude of vibration of different surface mainly depends on the following: the mass of the cotton seed, the rotation speed of the drum; the gap between the piles and the mesh surface, the geometric parameters of the mesh surface with rubber bushing (Fig. 2), the mesh surface material, etc.

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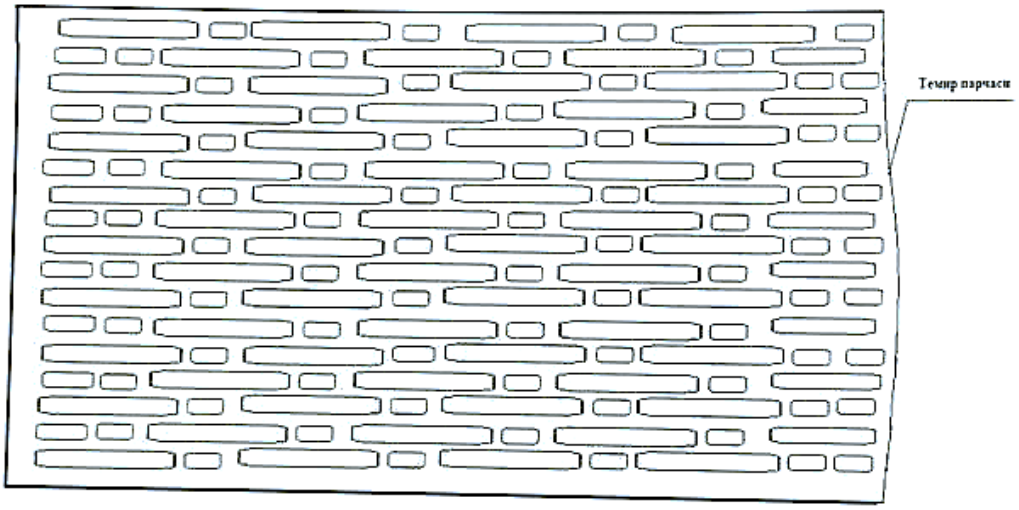

2 - picture. An overview of the various surfaces in the new construction

Cotton pieces are moved at an angle on a smooth surface . Therefore, the vertical component of the impact force, which causes vibrations of the flat surface in the vertical direction :

It can be said that after the cotton particles leave the mesh surface, the air flow velocity and the small difference value of the cotton at a distance equal to the hole, the change of the velocity is insignificant.

As the mass of the cotton pieces increases, the amplitude of the vibrations of the disturbing force of the mesh surface of the cleaner with rubber bushing increases. The numerical solution of the problem is carried out at the following parameter values:

Based on the results of the calculations, graphical dependences of the change in the breaking force on the change in the mass of the cotton pieces, the radius of the pile drum and its frequency of rotation are constructed.

Acceptable values for the amplitude oscillations of the mesh surface in the range of (1.4-1.6) 10-3 m required for effective cleaning of cotton are the mass of the mesh surface (0.35-0.45) 10-3 kg and the radius of the pile drum 0.20- 0.25 m. The vibration process of the mesh surface and based on them, the necessary parameters of the cleaner were selected (Fig. 3).

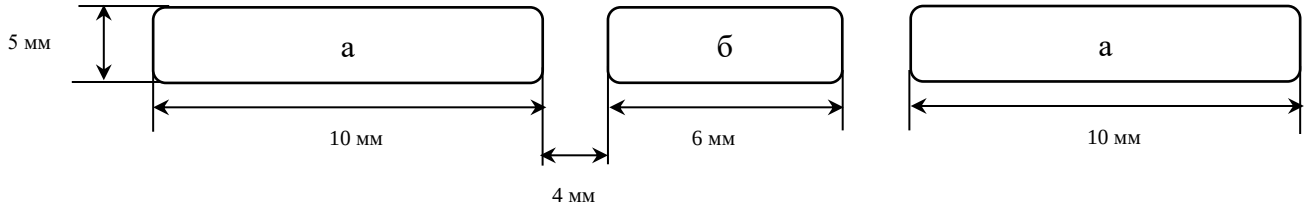

Figure 3. Mesh Surface Apertures and Sizes

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The optimal size parameters of the recommended mesh surface were obtained as follows (Table 1).

a) Holes are 10 mm long and 5 mm wide;
b) Holes length 6 mm, width 5 mm;
c) the distance between holes a and b is 4 mm;
g) The distance between the rows is 5 mm.

Parameters of the optimal dimensions of the mesh surface

Table 1

Factors and their definition	**Encoded symbol**	**Recommended mesh surface sizes**	**Available mesh surface sizes**	**A preferred mesh surface is recommended**
Concave radius	X_1	2 mm	0	Small impurities are separated well
Hole length	X_2	10 mm	12 mm	Cotton balls do not end up in the waste bin
The width of the hole	X_3	5 mm	6 mm	
The distance between two holes	X_4	4 mm	8 mm	Small impurities fall off quickly
Distance between rows	X_5	5 mm	6 mm	

Optimizing the parameters and working modes of the developed working body

Acceptable values of operating modes and parameters were determined using the method of mathematical planning of multifactorial experiments .

the research , the eccentricity of the tension roller of the input and output belt drive and the work output were selected as factors affecting the quality of cotton cleaning and the uneven rotation coefficient [5,6].

Based on theoretical studies and one-factor experiments, the values of the level of the determined factors and the intervals of change were determined (Table 2).

Table of factors and intervals of their change

Table 2

Factors and their definition	**Unit of measure**	**Factors**				
		Encoded symbol	**A sign of change**	**Levels**		
				Lower (-1)	**Main (0)**	**High (+1)**
Is it work?	Tons/hour	X_1	1	5	6	7

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Coefficient of uniformity of bearing on solid surface with rubber bushing	10^3 n/m	X_2	2	0.5	1.5	2.5
Radius of grooves in mesh surface with rubber bushing	10^{-3} m	X_3	3	10	13	16

the evaluation criteria is considered to fully illuminate the second level and is carried out according to the plan of experiments.

In conducting multi-factor experiments, the degree of cleaning of cotton (Y_1 %) and the coefficient of uneven rotation (Y_2) were taken as evaluation criteria.

conducting multifactorial experiments and their results are presented in Appendix 1.

" PLFNEX " developed for personal computers by the Scientific-Research Institute of Agricultural Mechanization to the data obtained from the experiments. was processed according to the program, and the following regression equations representing the adequacy of the evaluation criteria were obtained.

- Cotton cleaning degree (100%):

$$Y_1 = +94.684 - 1.884X_1 + 0.854X_2 + 0.784X_3 - 0.867X_1^2 - 1.009X_1X_2 - 0.859X_1X_3 - 0.684X_2^2 - 0.388X_2X_3 - 0.672X_3^2 \quad (1)$$

- Uneven rotation coefficient:

$$Y_1 = +0,017 - 0,049X_1 + 0,0046X_2 + 0,0016X_3 + 0,0037X_1^2 + 0,0005X_1X_2 + 0,0005X_1X_3 + 0.0022X_2^2 + 0.0005X_2X_3 + 0.0013X_3^2 \quad (2)$$

The following results were obtained from the statistical analysis conducted with 95% confidence probability and the adequacy tests of the derived equations.

(1) for the equation $F_x = 0.18 < F_j = 2.49$;

(2) for the equation $F_x = 1,63 < F_j = 2.65$;

where F_x and F_j are calculated and tabulated values of Fisher's criterion.

As can be seen from these obtained results, the calculated value of Fisher's criterion for both equations is smaller than its value given in the table. It means that they represent the adequacy of the considered process [7,8].

The obtained results are presented in Table 3.

Optimal values of the parameters of the combined argegate working bodies

Table 3

X_1		X_2		X_3	
Encoding-resurrected	Natural	Encoding-resurrected	Natural	Encoding-resurrected	Natural
-0.32185	6.356294	0.106513	2.606513	0.4145	1.207238

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So, in order for high cleanliness and the uneven rotation coefficient not to increase to the required level, the productivity should be 6.35 t/h, the eccentricity of the pulls of the outgoing belt drive should be 2.6 mm, and the eccentricity of the pulls of the incoming belt drive should be 1.2 mm. At these values of the factors, the degree of cleaning of cotton is 96.75 and the coefficient of uneven rotation is 0.015.

Summary. On the basis of experimental full- factor studies, the optimal values of the parameters of the cleaner have been determined. The estimated value of Fisher's criterion is determined.

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