American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 29, June - 2024

THEORETICAL ANALYSIS OF DRIVING FORCES OF COTTON PIECES ENTERING THE SEPARATOR WORKING CHAMBER

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Abstract
In this article, a theoretical study of the condition of entering the cotton ball into the separator through the air transport device and hitting the working chamber That is why impact of cotton particles entering the separator working chamber together with the air flow on the elastic plank located at a certain distance from the entrance path and forming an angle with the vertical direction, and the impact process between the cotton particles and the elastic plank is theoretically analyzed. When the cotton raw material sticks to the mesh surface, as a result of air absorption from the mesh surface, the process of cleaning from the small impurities in the cotton raw material in a passive state occurs.The air flow is sucked in through the slits of the mesh surface located after the elastic plank in its direction. The mesh surface is in the form of a conveyor belt, which moves regularly. Graphs of changes in the movement of a piece of cotton from the surface of the entrance to the separator to the elastic plate. Methods of conducting research and tests. A theoretical study of the movement of cotton pieces to an elastic plank. Mathematical model developed graphs are built.

Keywords: Separator, cotton, air flow, working chamber, elastic plate, speed, pressure, movement.

Introduction

Inlet cotton pieces entering the working chamber of the separator together with the air flow hit the elastic plank located at a certain distance from the inlet and forming an angle with the vertical direction (fig. 1). The pieces of cotton move under the influence of their own gravity and air flow to the elastic plank, which is located at a certain distance from the entrance path and forms an angle with the vertical direction. The air flow is sucked in through the slits of the mesh surface located after the elastic plank in its direction. The mesh surface is in the form of a conveyor belt, which moves regularly. The main part of the cotton particles is separated from the air after the shock process and falls into the lower chamber of the separator, a certain part moves along the mesh surface during the process of air separation, sticking to it. [1]

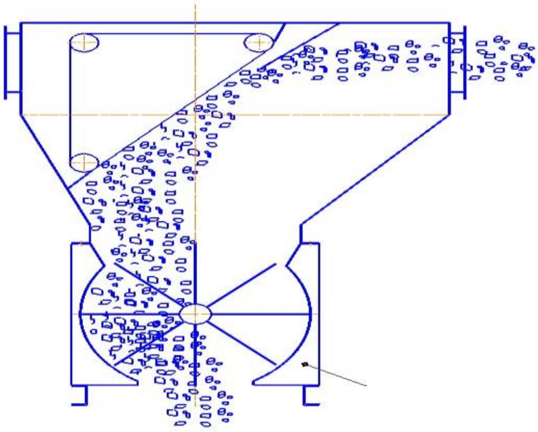


Fig.1. The movement of cotton particles entering the separator working chamber together with the air flow

After the mesh surface and the raw cotton material have traveled a certain distance, the cotton raw material is separated from the mesh surface using a brush drum located at the bottom. The separated cotton raw material is thrown into the bottom of the device and is discharged from there through the vacuum valve. When the cotton raw material sticks to the mesh surface, as a result of air absorption from the mesh surface, the process of cleaning from the small impurities in the cotton raw material in a passive state occurs.
Therefore, it is important to study the process of separation, the laws of movement of cotton particles along the mesh surface. Fig 2. [2]

2.METHODOLOGY & EMPIRICAL ANALYSIS
We will study the theoretical study of the movement of cotton particles in the working chamber of the separator into three parts. [3]
A theoretical study of the movement of cotton pieces to an elastic plank. The forces acting on the cotton particles are as follows (figure 2). A) aerodynamic lifting forces of air flow:

$$P_x = c_x v_0;\ P_y = c_y v_0;$$

B) the force of gravity on a piece of cotton:G=mg;
We consider the piece of cotton entering the working chamber as a material point m. To study its movement, we pass the coordinate axes ax and ou through the center of the entrance surface. By setting the inertial force against the driving force, we construct an equilibrium equation based on dalamber's principle. [4]

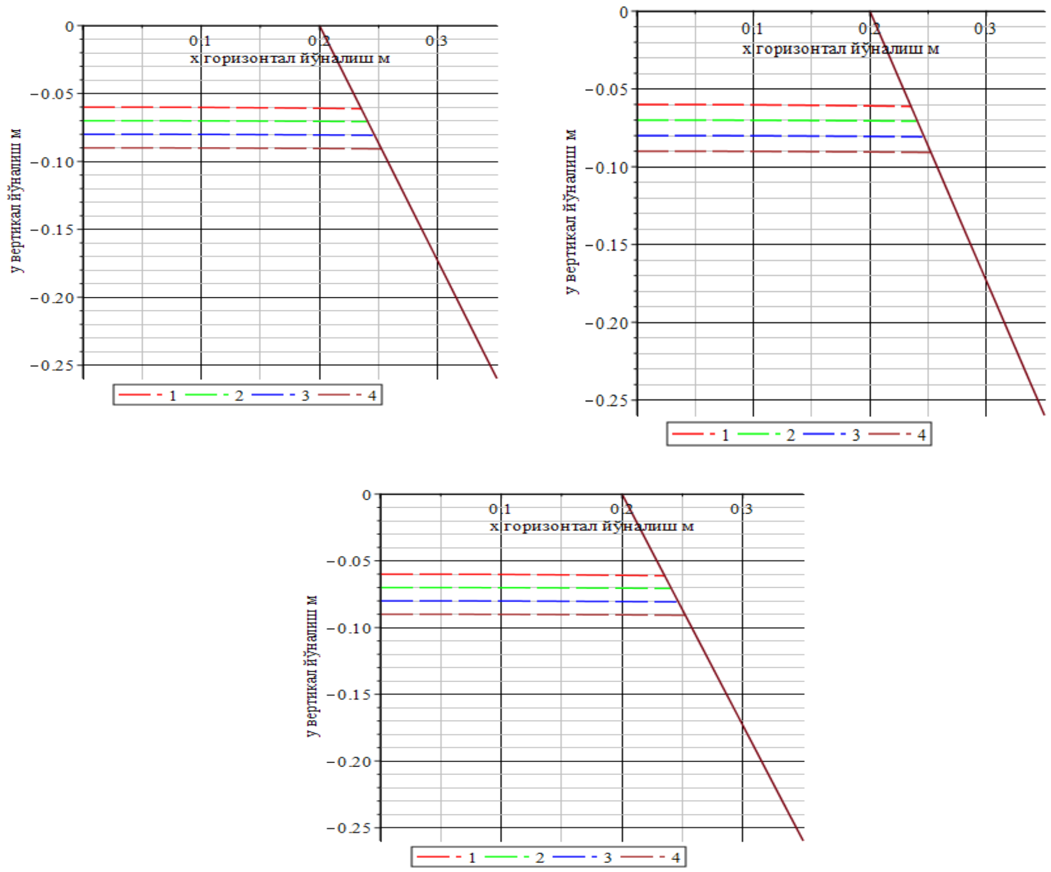
$$\begin{cases} \sum X_i = 0 \\ \sum Y_i = 0 \end{cases} \qquad \begin{cases} m\ddot{x} = c_x v_x \\ m\ddot{y} = -mg \end{cases} \qquad (1)$$

Here: -acceleration, component of the acceleration vector of the cotton ball □(→┬a) with the axis axis; -acceleration, component of the acceleration vector □(→┬a) of the cotton ball along the - axis. . c_x,c_y- -the aerodynamic resistance coefficient of air flow is determined by experiment. M-is the mass of the cotton ball

(1)- initial conditions for the system of differential equations:

$$\boldsymbol{t = 0: x(0) = 0, y(0) = h, \dot{x}(0) = v_0, \dot{y}(0) = 0;}$$

Solving (1) and (2) based on the conditions in the maple-17 program, we obtain the laws of motion of a piece of cotton in the coordinate system at time t.



а) $v_0 = 10\frac{m}{c}$; б) $v_0 = 14\frac{m}{c}$; с) $v_0 = 20\frac{m}{c}$;

Fig. 2. Graphs of changes in the movement of a piece of cotton from the surface of the entrance to the separator to the elastic plate. 1-m=0.004kg; 2-m=0.006kg; 3-m=0.008kg; 4-m=0.010kg; [6]

Research Results

After hitting the elastic plank, the cotton balls continue to move, changing their speed depending on the value of the masses. It is known from the experiments that changing the angle of deflection of the elastic plank leads to a change in the impact force. The distance of the cotton particles entering the separator working chamber to the elastic plate is very short. For this reason, we can consider the movement of cotton pieces to the elastic plank as straight line. [7]

After the pieces of cotton hit the elastic plank, let them turn in the vertical direction under the angle b and continue their movement. In this case, we write the differential equations of motion of cotton balls as follows:

$$\frac{dv_x}{dt} = -k_0(v_{10} - \frac{dx}{dt})^2 \sin\beta, \qquad (3)$$

$$\frac{dv_y}{dt} = -g - k_0(v_{10} - \frac{dy}{dt})^2 cos\beta$$

Initial conditions $t = 0: x(0) = 0, y(0) = h, \dot{x}(0) = v_{x0}, \dot{y}(0) = v_{y0};$ (4)

Here: m is the mass of a piece of cotton; c_k- coefficient of aerodynamic resistance of air flow; ; $k_0 = \frac{c_k}{m}$; v_{10}, v_{x0}, v_{y0}- air flow, the speed of a piece of cotton after hitting the elastic plate;

In the known theory of mutual oblique impact of two bodies, conventionally known as follows: I-sticky friction and II-dry friction hypotheses are used. [8]

a) according to the hypothesis of viscous friction, the angle b is determined by the angle of inclination of the elastic plank by the formula in the well:

$$\tan\beta = \frac{1-\lambda}{\mathrm{R}}\tan\alpha$$

Here: l- instantaneous friction coefficient in the impact process; R-speed recovery coefficient after impact;

b) according to the hypothesis of dry friction, the angle b is determined by the formula in the well through the angle of inclination of the mesh surface:

$$\tan\beta = \frac{1}{\mathrm{R}}\tan\alpha - f(1+R)/R$$

Here: f is the coefficient of dry friction in the impact process;

(2) - the solutions of the system of nonlinear differential equations, according to the above two hypotheses, are integrated in the following initial conditions (4) and are presented in the corresponding graphs in Figure 3 based on the MAPLE-17 program.

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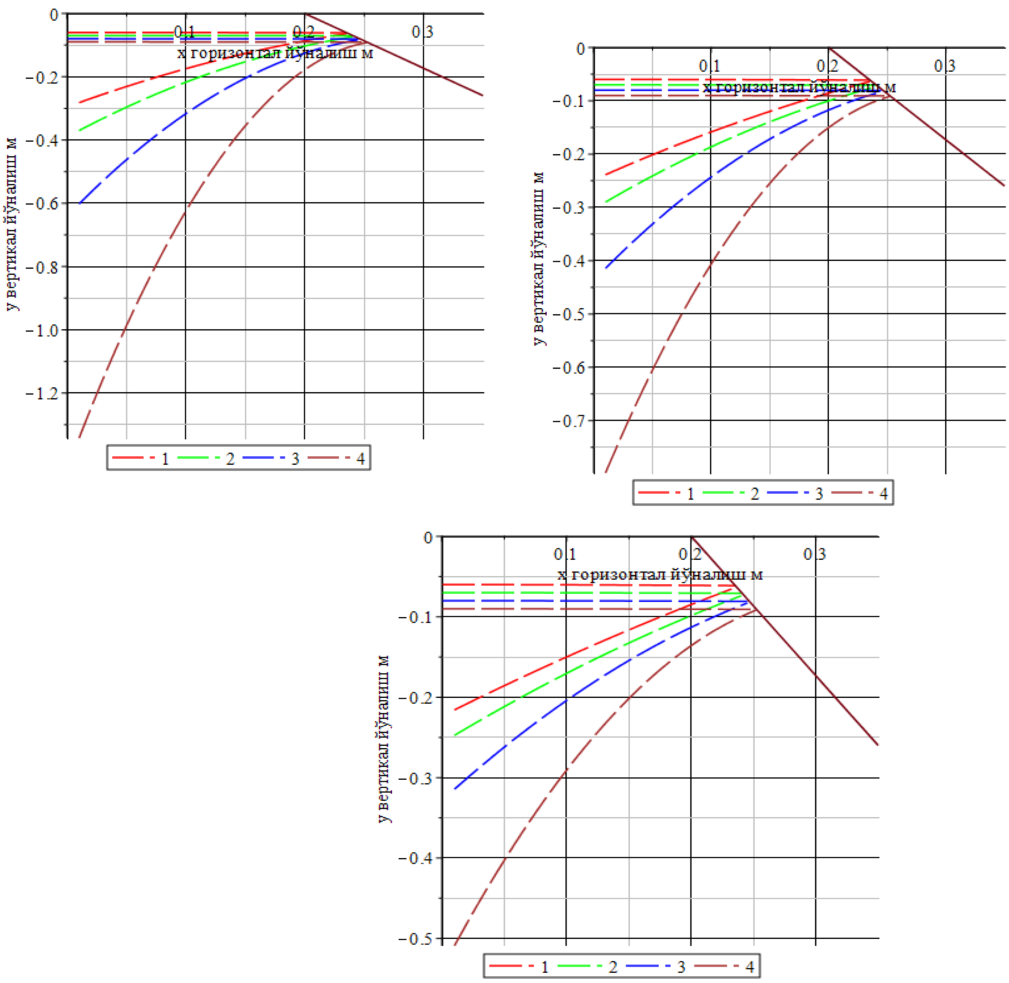

а) $v_0 = 10\frac{m}{c}$; б) $v_0 = 14\frac{m}{c}$; c) $v_0 = 20\frac{m}{c}$;

Fig, 3. Graphs of changes in the movement of the cotton ball from the entrance to the separator to the elastic plate and after impact. 1-m=0.004kg; 2-m=0.006kg; 3-m=0.008kg; 4-m=0.010kg; [9]

The analysis of the results of the processing experiments shows that the increase in the speed of movement of raw cotton during the processing has a negative effect on the quality of fiber and linter. On average, the amount of fibrous shells from the total amount of defects is 1.48 (37%) at increased speed, 0.88 (22%) at normal speed. Lint pollution in the transportation of cotton raw materials in a longer pipeline is on average more than in a shorter pipeline - 6.8 and 5.6%, respectively.

Based on the above indicators, the separator device of a new construction, which is being introduced into the pneumatic transport system, prevents damage to the seed and the increase of defects in the composition of the fiber, and preserves the original natural properties of the seed and fiber. [10]

CONCLUSION

The graphs in Fig. 2 show the graphs of changes in the movement of cotton particles of different mass from the entrance surface to the elastic plate. Since the distance from the entrance surface to the separator to the elastic plate is short, the movement of the cotton particles is mainly linear and depends on the masses. The graphs in Figure 3 show the graphs of changes in the movement of cotton pieces with different masses after impact with an elastic plate. The speed of cotton pieces after hitting an elastic plate changes depending on the coefficient of recovery during impact. As can be seen from the graphs, we can observe that heavy cotton pieces move to the next part of the working chamber faster than light weight cotton pieces. In this process, the movement of cotton pieces changes according to the law of parabola. But the cotton particles mixed with small impurities pass through the plank and hit the mesh surface of the conveyor. It continues to move along its surface.

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