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ANALYSIS OF THE MOVEMENT OF COTTON PARTICLES ALONG THE SURFACE OF A VIBRATING SCREEN.

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Objective. *The article deals with issues that are devoted to the study of cotton cleaning using vibration cleaning. An analysis of the results obtained in experimental studies shows that at low vibration frequencies, small trash impurities are intensively released from the total amount of the selected trash. Increasing the frequency leads to a slow decrease in the yield of small weeds, and with a further increase, stabilization of the separation of weeds is observed.*

Methods. Currently, one of the promising non-traditional methods for cleaning raw cotton is the use of a vibration method. Since, the method has been known for a long time, but it is at the stage of theoretical and experimental study.

When developing the cleaning of raw cotton from weed impurities by the vibration method, its natural properties are preserved. To increase the cleaning effect of cotton gins, we offer a design with a vibration drive.

Results. The regularity of the movement of cotton particles along a vibrating mesh surface is proposed. An equation of motion for a mesh surface that performs oscillatory reciprocating motions is obtained.

The movement of the mesh surface in this case is considered complex. A characteristic feature of the mathematical description is the presence of a generalized force of potential forces and a generalized force from the action of resistance forces. A differential equation for the motion of a vibrating mesh surface of a raw cotton cleaner has been obtained.

Conclusion. Analytically and numerically, the differential equation of the movement of the cotton flow over the mesh surface is solved, the results of which show that the speed of the cotton flow and its cleaning from small weeds in the horizontal plane depend on the amplitude and frequency of the movement of the mesh surface over the mesh surface.

Keywords. peg-slatted drum, mesh, removal of weeds, vibration, cleaning of raw cotton from weeds, cleaning action, reciprocating mesh surface, eccentricity, coefficient of sliding friction.

Introduction. The choice of cleaning plans for raw cotton is made depending on its initial weediness, breeding and industrial grade, in conjunction with the subsequent cleaning of cotton fiber. If necessary, the cleaning plan is carried out with the inclusion of technological equipment of the drying and cleaning shop of procurement points [1].

The authors studied the issues of cleaning cotton from small weed impurities [3-4]. Cleaning machines from small weeds are an indispensable element of the production line of cleaning cotton, and when using them, it is necessary to take into account the place of their

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installation, and also in the designs of cotton cleaners from weeds there must be mechanisms to control the performance and cleaning effect.

M.J. Koshakova [5] considered the cleaning process using vibration. This method has an advantage over the traditional ones in terms of preserving the natural qualities of the fiber, but the low cleaning effect did not allow the use of this design in industry.

In the process of processing cotton and cleaning it from weeds, repeated mechanical impact of the working parts of the cleaners causes mechanical damage to cottonseeds [6]. As a result, defects appear in the composition of the fiber. Along with this, the priority operation of technological machines of drying and cleaning shops is disrupted and the physical and mechanical properties of cotton are deteriorating.

One of the promising directions for the modernization of cleaners is the attachment of pegs with the help of elastic elements. With the right choice of fastening rigidity, it is possible to excite vibrations of the pin during the operation of the machine. This will increase the number of impacts of the splitter on the cleaned mass of cotton and thereby increase the cleaning effect [7].

The authors studied the process of cleaning cotton using the vibration method. The movements of seeds along an inclined vibrating surface were studied and various effective results were obtained [8].

Theoretical study. Based on the above theoretical and experimental studies, we conduct a theoretical study

The differential equation of motion in the OXY plane, i.e., as a result of fluctuations in the cotton flow along the mesh surface, has the following form;

$$\left.\begin{aligned} m\ddot{x} &= mA\omega^2 sin\omega t + F \\ m\ddot{y} &= mA\omega^2 sin\omega t + N \end{aligned}\right\} \qquad (1)$$

where m - is the mass of the fly; ω - vibration frequency; A - is the amplitude of oscillations; g - free fall acceleration; H - is the normal pressure force; F - resistance force (fig. 1).

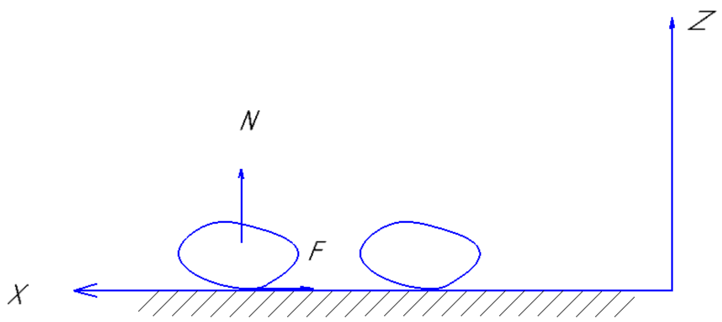

Fig. 1. Pattern of movement of cotton particles on a vibrating mesh surface

$$F = \begin{cases} -fN & \text{when} \quad \dot{x} > 0 \\ fN & \text{when} \quad \dot{x} < 0 \end{cases} \qquad (2)$$

where f - is the coefficient of sliding friction.

From equation (1) we determine the normal pressure of the cotton flow on the surface of the oscillating mesh surface:

$$N = m\ddot{y} - mA\omega^2 sin\omega t \qquad (3)$$

If the movement of cotton particles occurs only along the OX axis, then it is equal to $\ddot{}$=0, then equation (3) will take the form:

$$N = -mA\omega^2 sin\omega t \qquad (4)$$

Equation (4) N=N(t) is the law of the dependence of the normal compressive force on time. The dependence of the force of normal pressure on the flow of cotton moving along the surface of an oscillating grid of small weeds, on the frequency and amplitude of the oscillations is presented.

Let us determine the equation of motion of the cotton jet Y=0 along the mesh surface using equation (1):

$$m\ddot{x} = mA\omega^2 sin\omega t + F$$

Instead of F in equation (2), we substitute $F=fN$:

$$m\ddot{x} - \ mA\omega^2 sin\omega t \pm fN$$
$$m\ddot{x} - mA\omega^2 sin\omega t \pm fN(-mA\omega^2 sin\omega t)$$
$$\ddot{x} = A\omega^2 sin\omega t\ (1 \pm f)$$

Integrating over time

$$\dot{x} = A\omega^2 cos\omega t\ (1 \pm f) + \ C_1 \qquad (5)$$

$$x \ = A\omega^2\ sin\omega t\ (1 + f) + \ C_1\ t\ +\ C_2 \qquad (6)$$

Equation (5) is the flow rate of cotton over an oscillating mesh surface, and we use the following condition to determine the constants C_1 and C_2:

$$x(0) = 0, \qquad \dot{x}(0) = 0$$

Where

$$0 = A\omega\ (1 \pm f) + \ C_1 \ \Rightarrow \ C_1 = \ A\omega\ (1 \pm f)$$
$$C_2 = \ -C_1 t = \ A\omega\ t(1 \pm f)$$

Substituting the constants into equation (6), the equation for the flow of cotton over an oscillating mesh surface is determined.

$$x = Asin\omega\, t\,(1 \pm f) + A\omega\, t\,(1 \mp f) + A\,\omega\, t\,(1 \pm f) \qquad (7)$$

Results. Thus, equation (7) is a model of the oscillatory process of cleaning from small weeds, in which a differential equation for the steady motion of the cotton flow is constructed. According to this equation, the analysis of the movement of cotton particles on the surface of the vibrating screen is built in the form of a graph using the Maple program (Fig.2 and 3.).

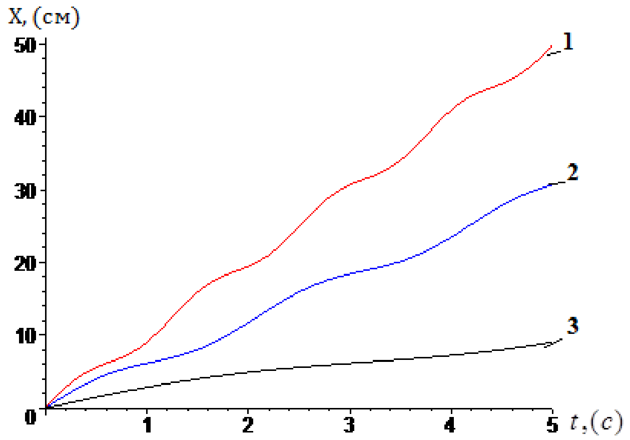

Fig. 2. Graph of change in time at different values of angular velocities when cleaning cotton bats from small weeds on the surface of a vibrating mesh;

$A_1 = 0.2$ м; $A_2 = 0.4$ м; $A = 0.6$ м.

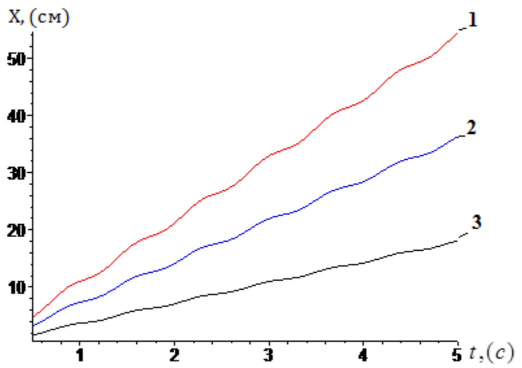

Fig. 3. Graph of changes in time at different values of the amplitude of oscillations when cleaning cotton bats from small weeds on the surface of a vibrating mesh;

Conclusion. Analytically and numerically, the differential equation of the movement of the cotton flow over the mesh surface is solved, the results of which show that the speed of the cotton flow and its cleaning from small weeds in the horizontal plane depend on the amplitude and frequency of the movement of the mesh surface over the mesh surface.

The results obtained show that the cleaning of the cotton flow from small weeds and the surface of the oscillating mesh obeys the parabolic law and the law of harmonic oscillations. With the effective cleaning of the cotton flow from small impurities, the vibration frequency is 400 times per minute, and the vibration amplitude is 0.2 m, which also ensures cotton consumption of 3000 kg/h.

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