THEORETICAL ANALYSIS OF SEPARATION OF GINNING SEEDS

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ABSTRACT. By carrying out theoretical and practical research, a sorting device with the ability to improve the efficiency of sorting, maximally clean the small impurities in the seed, reduce the mechanical damage of the seeds and the jamming of the seeds on the mesh surface, and increase the output of fiber suitable for spinning was studied.

KEYWORDS. cotton, seed, fiber, sorter, mesh surface, fine dirt, lint, fraction, damage, productivity.

INTRODUCTION. Taking into account the importance of quality indicators in the next technological process for the processing of ginned hairy seeds, in addition, taking into account the introduction of new cotton varieties with specific physical and mechanical properties into production in recent years, research was conducted to study the fractional composition of hairy seeds under production conditions.

From these, it can be seen that the ginned fractions contain fully purified seeds. They can make up 2-5% of the total mass of seeds, depending on the type of production and the productivity of the gin. In addition, seeds with 12% fiber content are 45-50%, and the amount of impurities in the seed mass is 1-3% [1].

At present, in many cotton ginning plants, the seed is removed from the technological processes due to the low productivity of the sorting devices and the low sorting efficiency. As a result, valuable raw materials are being wasted due to fiber getting mixed with fluff and other waste. In addition, the seed is sent to the linter machines without being cleaned of various impurities, and thus the quality of fluff is significantly damaged.

A more complete approach to the problem of seed processing is necessary. That is, their physical and mechanical properties, technology should be thoroughly studied. In addition, it is desirable to pay attention to the selection of the technology of sorting, taking into account the fractional content of cotton seeds, and the creation of high-efficiency machine structures.

THE MAIN PART. Kh.T. Akhmedkhodzhaev [2-3] developed a seed sorter that works in a new way. The size of the holes of the sorting surface of this device 2 mm increases along the length of the device in increments of 5. 17 mm. The holes of each section are arranged in a checkerboard pattern, and the diameter of the holes of the next row 0,7 mm differs from the holes of the previous row.

The seed sorting device works as follows (Fig. 1) . The seeds coming from the gin come to the feeder hopper by means of an elevator. This feeder transfers the seeds evenly to the bar. And the movement is carried out with the help of an eccentric shaft and a connecting rod. The trough moves towards the wedges. The oscillating mesh rod works as follows. The seeds coming out of the gin come to the feeder's hopper with the help of an elevator, and the feeder conveys them to the hopper at once. In this case, the movement is carried out with the help of an eccentric shaft and a connecting rod. The seeds are sent from the hopper to the mesh surface of the sorter with a single-layer movement under the influence of vibrations generated by the shaft and connecting rod.

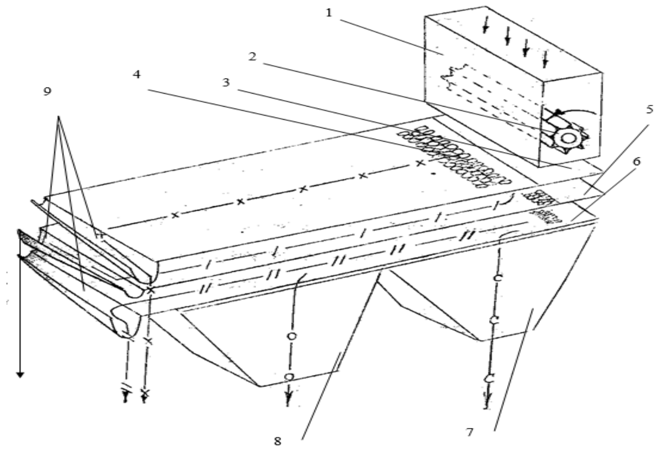

Figure 1. Scheme of a vibration type sorter

Here, fibrous and poorly germinated seeds fall from the main mass. Seeds with a fiber content of 12% passing through holes with a diameter of the main mass 10 mm of 5 are separated. In the next tier, the holes have a diameter of 5 mm and 8 mm, where the seeds are separated from impurities and clean seeds.

In the study, a device for sorting seeds by passing them through the holes of the inclined grid of the vibrating sorter was proposed. First of all, the shape and size of the seeds are of great importance in this process. A special tool and methodology was created to determine the size of seeds with different hairiness. Measurements were carried out by taking 200 pieces of medium and fine fiber cotton seeds and repeating them multiple times. [4-7] (Table 1).

Studies have been conducted on the position of the centers of gravity based on the size and shape of the seeds, for example, for seeds with fibers in the head or in the triceps, and for seeds without fibers. Two forms were proposed for calculations - two semicircles on the sides, and a rectangle in the middle. Using the laws of mechanics, the centers of gravity of seeds were determined by their constituents.

Table 1.

Sizes of the most common varieties of cotton

Selective variety	**Seed size after germination**			
	Length (D 1), mm	**Diameter (D), mm**	**Mass of 1000 seeds, g**	**Fiber content, %**
S-6524	8.0-12.25	5.5-8.75	138.2	14.2
S-6530	8.2-12.22	5.4-8.84	136.9	14.0
Namangan-77	7.25-12.3	5.6-9.0	125.8	14.9
S-9070	8.1-12.2	5.8-9.8	128.3	13.8
9871-I	8.1-10,2	5.1-6.8	117.3	-
An-60	8.1-9.8	4.5-5.3	108.1	-
9853-I	8.2-9.8	5.2-5.8	125.25	-

First of all, the research was conducted on the effect of friction force. In this case, a single-mass system consisting of fibrous bodies (seed, airfoil) with the same degree of freedom and striking a surface without friction is determined by the following equation:

$$m\frac{d^2y}{dt^2} + k \pm F = 0 \qquad (1)$$

where $k = cy$, *s* is the coefficient of unity; *m* is the mass of the piece; *F* - friction force or $F = N \cdot sign\dot{y}$; *N* is the normal force.

The expediency of using this model was confirmed by R. Z. Burnashev.

Equation (1) can be written in the following form:

$$M\frac{d^2y}{dt^2} = -cy \pm F \text{ or } \frac{d^2y}{dt^2} + p^2y = \pm F \qquad (2)$$

Equation (2) can be written in the following form after some substitutions:

$$\frac{d^2y}{dt^2} + P^2y = \theta(t) \qquad (3)$$

In general, the force of friction changes its direction during the movement. The graph will look like this (Figure 2):

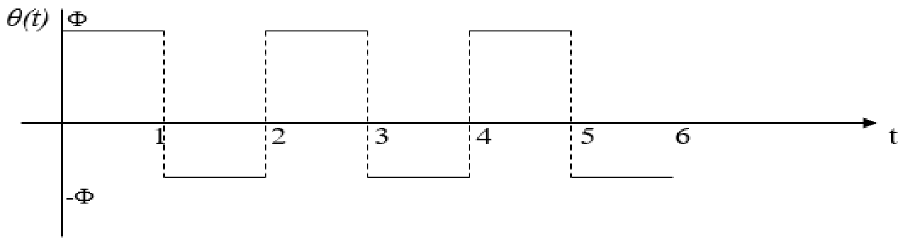

Figure 2. Variation of the magnitude of friction by *θ (t)*.

The solution of the equation of motion (3) is solved using integral Laplace transforms

$$y = V_0 \cos pt + \frac{y_0}{p^2} \sum_{n=1}^{\infty} \{\varepsilon^n (1 - \cos(pt - n\pi))\} \qquad (4)$$

$$\varepsilon^n = \begin{cases} 1 & агар \quad n = 1 \\ 2 & агар \quad n \geq 2 \end{cases}$$

where *r* is the angular frequency of specific vibrations; V_0 – initial speed; *it is* $_0$ - initial deformation.

A second type of model of a piece of cotton is a linear segmented model, the equation of motion of which is expressed as:

$$m\frac{d^2y}{dt^2} + cy = \pm\eta \cdot (\frac{dy}{dt})^2 \qquad (5)$$

This equation can be written in canonical form as:

$$\frac{d^2y}{dt^2} - \Delta\left(\frac{dy}{dt}\right) + P^2 y = 0 \qquad (6)$$

here $P^2 = c/m, \qquad \Delta = \eta/m \qquad (7)$

To solve this equation (7), the solution was sought in series form:

$$y = y_0(t) + \Delta y_1(t) + \Delta^2 y_2(t)... = \sum_{n=0}^{\infty} \Delta^n y_n(t) \qquad (8)$$

and the solution can be written as:

$$y = \xi \cos\omega_\Delta t + \frac{\Delta\xi^2}{6}(3 - 4\cos\omega_\Delta t + \cos 2\omega_\Delta t) - \frac{\Delta^2\xi^3}{72}(48 - 61\cos\omega_\Delta t + \\ + 16\cos 2\omega_\Delta t - 3\cos 3\omega_\Delta t) \qquad (9)$$

here

$$\omega_\Delta = \frac{p}{\left[1 + (\Delta^2\xi^2)/3\right]^{1/2}} \qquad (10)$$

In finding the solution of (9), Δ^3 we discarded the extremes as infinitesimally small.

Derivative with respect to time was taken from (9) to find the speed of movement of the piece of cotton under the influence of friction force. If the initial conditions are used, then

$$V = V_0\omega_\Delta \sin\omega_\Delta t + \frac{\Delta V_0^2}{6}\omega_\Delta(4\sin\omega_\Delta t - 2\sin 2\omega_\Delta t) - \frac{\Delta^2 V_0^3}{72}\omega_\Delta(61\sin\omega_\Delta t - \\ - 32\sin 2\omega_\Delta t + 9\sin 3\omega_\Delta t) \qquad (11)$$

The differential equation of mass movement in a system with several degrees of freedom in nonlinear viscosity is derived from Lagrange's type II equations, and the recovery coefficient depends on the shock and jump speed. Energy consumption is determined by the interdependence of these speeds.

CONCLUSION. The more mature seeds, the higher the recovery rate. This natural factor is taken into account in the selection of seeds by vibration, and with the help of this it is possible to see that cotton seeds of the same variety differ from each other by their physical and mechanical properties.

In the above study, vibration type sorting devices with different shapes of slits have low efficiency due to the insufficient useful surface for effective cleaning and sorting of seeds, and the phenomenon of seeds getting stuck in the holes of the nets is observed. For this, it is necessary to add additional cleaning devices to the structure. This increases the material size of the device and causes various other complications.

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