THE RESEARCH OF ELASTICITY AND STRENGTH OF SEEDS

Obidov Avazbek,
Vohidov Mukhiddin
Namangan Institute of Engineering and Technology

ANNOTATION
This article puts forward the idea of isolating seeds with residual fiber from the composition of ginned seeds using a special technology. In the course of the study, the properties of seeds were studied and rational solutions for seed treatment using this technology were found.

Keywords. Cotton, cotton seeds, fibrous seeds, specific gravity, bulk density, sowing seeds, ginning, load, friction force

The elastic properties of cotton seeds have been studied in many studies [1]. The compaction coefficient describes the degree of change in the initial volume after the compaction load is applied to the germinated seeds.

$$k_z = \frac{V_1}{V_2} \quad (1)$$

Here:
v_1 and v_2 are the volume of seeds before and after compaction, respectively.
The density coefficient depends on the complete fibrousness of the seeds, and it ranges from 1.4 to 1.7 [2].
The volume recovery coefficient, which varies from 1.02 to 1.5, indicates the degree of change in seed volume after removal of the compaction load.

$$k_t = \frac{V_k}{V_2} \quad (2)$$

Here:
V_k – the size of the seeds after receiving the load.
Also, the uniformity of seeds is characterized by the recovery factor, which determines the size and direction of connecting bodies. Taking into account the importance of these properties in the selection and purification of denatured seeds, we conducted several theoretical studies.
Let's consider the problem in three cases. In the first case, we do not consider the effect of frictional forces. In this case, the absence of friction (conservative system) is characterized by the following equation, as a single mass system that can affect a surface (absolutely rigid) with one whole degree of freedom and one elastic element, without large errors, fibrous particles (seeds, cotton balls) [3]:

$$m\frac{d^2y}{dt^2} + Cy = 0 \quad (3)$$

The constant coefficient of this model is linear, the correctness of its use has been proven in work [4], in which fiber seeds and flaps are considered a system with weak linearity (the coefficient of nonlinearity is 1.1-1.2, leading to an error of no more than 20% in numerical calculations allowed).

Equation (3) can be expressed as:

$$\frac{d^2y}{dt^2} + P^2 \cdot y = 0 \qquad (4)$$

$$P = \sqrt{\frac{c}{m}} \qquad (5)$$

Such a model represents a conservative model in which, without any energy consumption, the shock velocity is equal to the reflection velocity, i.e. K=1 in Nytonian shock theory.

We try to find a more accurate solution to the problem, taking into account the effect of friction forces, which are linearly related to the displacements, such a system is written as follows:

$$m\frac{d^2Y}{dt^2} + C_B\frac{dy}{dt} + cy = 0 \qquad (6)$$

We accept the initial conditions: $t=0, y=y_0=0, \quad V_a = \frac{dy}{dt}$

Then equation (6) becomes:

$$y = e^{-nt}\frac{V_a}{\sqrt{p^2-n^2}} sin\sqrt{p^2-n^2} \cdot t \qquad (7)$$

From this, we determine the movement of the fibrous particle:

$$\frac{dy}{dt} = -ne^{-nt}\frac{V_a}{\sqrt{p^2-n^2}} \sin\sqrt{p^2-n^2}\, t + e^{-nt}V_0 \cos\sqrt{p^2-n^2}\, t \qquad (8)$$

In a non-linear viscosity system with several degrees of freedom, the differential equation of mass motion is different, but the recovery coefficient K_B is always determined by the ratio of shock and bounce speeds, the relationship between which is determined by energy loss.

The higher the seed, the greater the recovery coefficient K_B. With the help of this natural factor, seeds of the same variety are distinguished by their individual physical and mechanical properties during vibrating sorting. It can be seen from the formula (8) that the larger the mass, the smaller the losses and the larger the recovery coefficient K_B.

The recovery coefficient for the issue under consideration is determined as follows:

$$tg\varphi_n/tg\varphi_К = К_B \qquad (9)$$

In the case under consideration, when $V_{ck} = const$, the recovery coefficient K_B, depending on the incidence and return angles in the formula (9), determines the state. The smaller K_B, the larger the return angle.

Two important facts have been established from the above:

- a coefficient widely used in the analysis of dynamic processes, depending on the amount of the function model of energy loss during impact and the level of viscosity of this material, with the following formula for the linear model: $C_B = 2\sqrt{c \cdot m}$, and for the case of more complex nonlinear relationships in general is found from the energy loss function. It can be seen that this coefficient depends on the ratio of mass, hardness and viscosity properties, which differ from each other according to the degree of fibrousness and flexibility of cotton seeds. Therefore, it can be concluded that there is a possibility of sorting them according to the level of bounce after the impact.

- and in the second, it was found that the angle of return of seeds depends on their angle. In addition, this condition also depends on the recovery coefficient, which is calculated as a function of the above-mentioned seed properties (mass, hardness, viscosity). This creates new opportunities for sorting them.

To verify the results of theoretical studies, we conducted experimental studies to determine the recovery coefficient of seeds of new varieties of raw cotton. A new special device was installed for this purpose. This device is equipped with a tripod and a built-in mirror ruler and a steel plate to deflect free-falling seeds.

The coefficient of recovery K_B was determined by the known formula [5-6]:

$$K_{\text{B}} = \frac{V_2}{V_1} = \sqrt{{h_2}/{h_1}} \qquad (10)$$

Here:

V_2, V_1 – speed of falling and returning seeds;

h_2, h_1 are the height of falling and returning seeds.

The results of the studies are given in Table 1.

Table 1 The results of determining the coefficient of recovery depending on the fibrousness and moisture content of the seeds

Cotton breeding variety	Fiber content of seeds, %						Unripe seeds
	7,0	10,0	14,0	7,0	10,0	14,0	
	Humidity: 8.0%			Humidity: 12.0 %			
S-6524	0,41	0,40	0,37	0,40	0,39	0,35	0,21
S-6530	0,40	0,39	0,36	0,39	0,37	0,35	0,22
Nam-77	0,41	0,39	0,37	0,39	0,37	0,36	0,22
Bukhara-6	0,43	0,40	0,39	0,42	0,39	0,38	0,22
6037-S	0,42	0,40	0,37	0,41	0,38	0,36	0,25
Parlak-1	0,41	0,40	0,37	0,40	0,38	0,37	0,23
Omad	0,42	0,41	0,36	0,39	0,38	0,36	0,25

As you can see, the recovery coefficient allows you to distinguish between differentiated and immature seeds. Ripe seeds have a stronger shell and a fuller kernel, which resists external loads better than immature ones, for which the seeds of wild cotton species, known as "Rock seed", are particularly strong. The strength of the seeds depends mainly on the moisture content and processing temperature, the seed coat does not contain moisture. They are brittle and break easily, at high humidity the core and shell become sticky and easily deformed. Exposure to high (above 1000) temperature in cases such as long-term storage leads to a decrease in the strength of seeds and worsens their mechanical properties.

Microhardness of seed coat is one of the most important physical and mechanical properties. In the process of processing, under the influence of mechanical loads, the seed coat is damaged, while forming a mixture with fibers and broken seeds. The degree of damage largely depends on the strength of the seed coat, which in turn is related to its moisture content. In this regard, in order to determine the influence of these factors on the quality indicators of seeds, experimental studies were conducted on cotton seeds in different varieties of cotton with a moisture content of 7 to 15%. The results showed that the seed coat microhardness decreased to 73.3 N/cm^2 when moisture content increased from 7% to 12%, and only decreased to 14 N/mm^2 when moisture content increased from 12 to 15%.

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