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THEORETICAL STUDIES OF THE NATURE OF THE INTERACTION OF COTTON SEEDS IN THE GAP BETWEEN THE AGITATOR BLADE AND THE SAW CYLINDER

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https://doi.org/10.5281/zenodo.7218857

ARTICLE INFO

Received: 27th September 2022
Accepted: 10th October 2022
Online: 18TH October 2022

KEY WORDS

Linter, cottonseed, fluffy seed, removing lint, trash, thickness, seed-roll box,

ABSTRACT

To carry out each test, it is necessary to use instruments capable of measuring with the necessary accuracy. A TCh 10-R tachometer was used to measure the number of revolutions of the eccentric shaft. In our experiments, the number of revolutions of the shafts was changed by changing the diameter of the pulleys and using an electric motor. The performance of the device was determined by the formula presented in the work. 100 kg of seed was transferred from the supply hopper in the set number of rotations. Each test was repeated five times. It was found in the tests that the number and time of rotations were selected correctly for production efficiency. The slope angle of the sorting surface was measured using a protractor. Experiments were conducted in a randomized order. After each test, each fraction of the sorted seeds was weighed using a scale and the level of dirtiness and hairiness was checked. After the experiment, the samples taken from the sorter were checked for stringiness, dirtiness, sorting efficiency, and mechanical damage according to the rules established in the laboratories of cotton ginning enterprises. On general grounds, we pass from the natural values of the factors to their coded values. The results of the total factor experiment (TOT) revealed that the studied process is represented by a higher-order equation. Therefore, to obtain a second-order regression mathematical model, the central non-composite experiment (MNKT), which is somewhat simpler and more convenient than other methods, and widely used in the research of the technological processes of the cotton ginning enterprise, was selected and implemented.

Introduction. In clause research, the angular motion of particles of a granular medium (seed layer) was studied. In this case, the feed rate of the product to the

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zone of interaction of the agitator blade with the saw cylinder is indicated by V_1. It is assumed in the calculations that the granular medium has a finite thickness along and contains a sufficient number of grains (seeds). Under this assumption, the contact interaction of the layer with two moving surfaces was studied. In practice, the thickness of the layer is chosen to ensure the contact of a single seed with both surfaces, to implement an effective removal of lint from the surface of the seeds. [1] Therefore, the layer has a thickness less than the maximum size of the seeds. In this case, consider the movement of a system of single seeds lying between the agitator blade and the surface of the cylinder. Since the process is continuous, it can be assumed that in the zone of the gap between the blades and the cylinder, seeds enter, performing the rotational movement in the seed-roll box of the linter, the speed of which, according to the adopted model and the calculation scheme in Section 2.2, is distributed along the radius of the seed-roll box according to the law

$$v_2 = \omega r + r\frac{\mu\rho\omega^2 r_0^2}{2\eta}\left[\bar{p}_0(\xi^2\frac{r^2-r_o^2}{r^2} - 2\ln\frac{r}{r_0}) - \xi^2\ln\xi\frac{r^2-r_0^2}{r^2} + \ln^2\frac{r}{r_o}\right]$$

Introducing the characteristic frequency $\omega_* = 2\eta/\rho r_0^2$ and ratio $z = r/r_0$, we write the last formula in the form

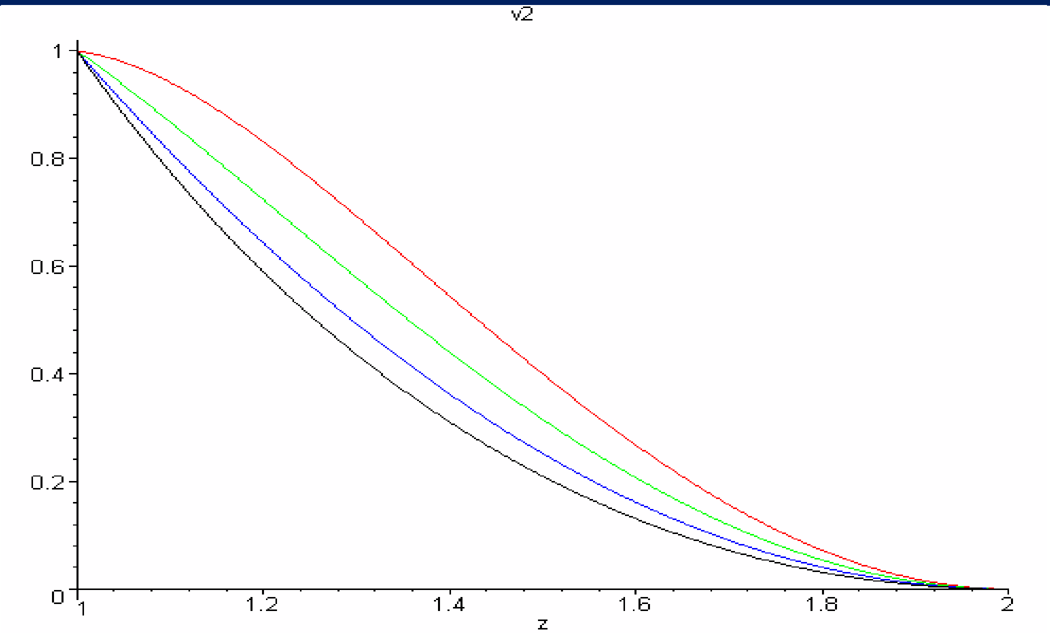
$$v_2 = \omega r + r\frac{\mu\omega}{\omega_0}\left[\bar{p}_0(\frac{z^2-1}{z^2}\xi^2 - 2\ln z) - \xi^2\frac{z^2-1}{z^2}\ln\xi + \ln^2 z\right]$$

Velocity distribution along the working seed-roll box radius for $\omega_* = 3.12$;
different values of the dimensionless parameters μ $\bar{\omega} = \omega/\omega_0$ $\xi = r_*/r_0$ are shown in experiments

Materials and Methods. From the obtained curves, it can be seen that with an increase in the compression parameter μ, which corresponds to a more packed medium, the linear velocity of the granular medium increases, and, as the calculation results shown graphically in linear speed at some distance from the axis of the cylinder may even increase. So, for example, at a distance $r = 1.2r_0$ from the center of the drum, the linear speed is $v_2 \approx 1.2\omega r_0$.[2,3]

Let us now consider the movement of seeds in the zone of the gap between the agitator blade and the surface of the saw cylinder. The speed of $r_2 = r_0 + h$ entry of seeds into this zone is determined $r_2 > r_*$ by h the formula $V_1 = v_2(r_2)$ Let $t = 0$ the interaction of the seeds with the surface of the cylinder begin at the moment, moving with a linear speed V_2. Let us direct the axis Oy in the direction of the axis of the cylinder perpendicular to the plane of the drawing, and the axis Ox perpendicular to it in the direction of rotation of the saw cylinder. We will assume that the seeds

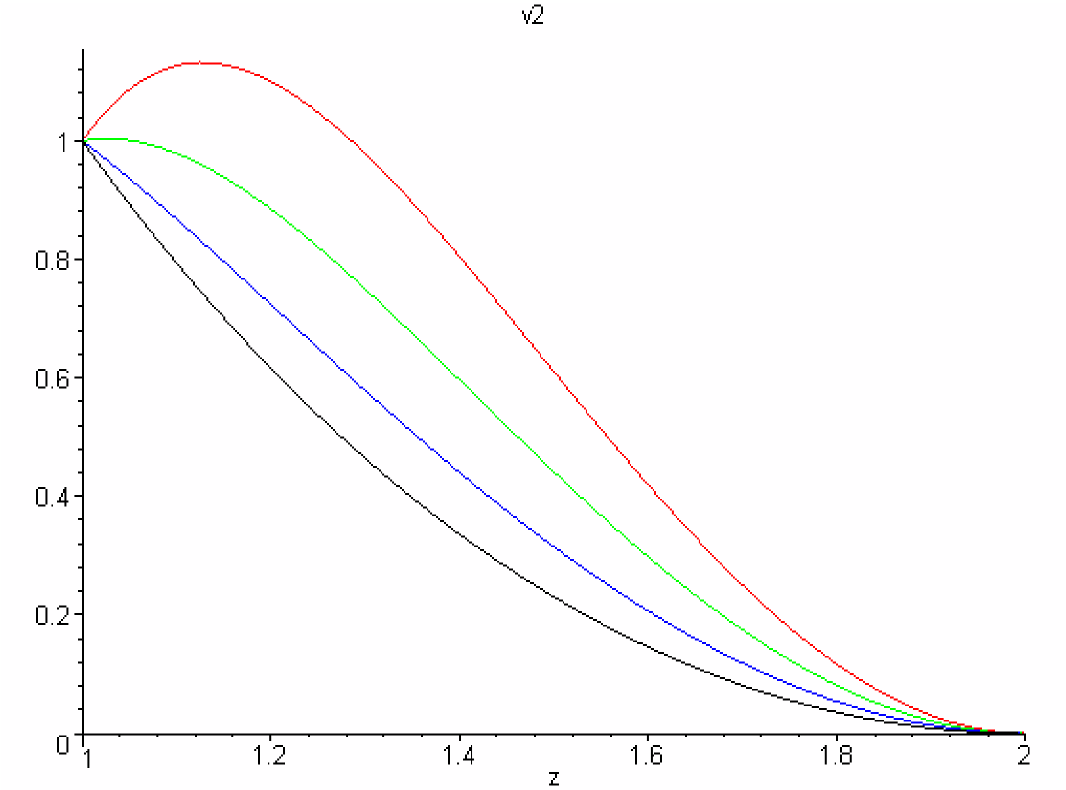
The distribution of the linear velocity of particles of a granular medium (referred to as the value ωr_0) along the radius $z = r/r_0$ of the working seed-roll box of the linter at $\xi = r_*/r_0 = 2$, $\varpi = 2\omega_*$ and different values of the parameter μ



1- μ =0.1; 2- μ =0.3; 3- μ =0.6; 4- μ =1

Figure 1

The distribution of the linear velocity of particles of a granular medium (referred to as the value ωr_0) along the radius $z = r / r_0$ of the working seed-roll box of the linter at $\xi = r_* / r_0 = 2$, $\varpi = 4\omega_*$ and different values of the parameter μ



1- μ =0.1; 2- μ =0.3; 3- μ =0.6; 4- μ =1

Figure 2

perform a two-dimensional movement in the zone: in a circle and parallel to the axis of the cylinder, the movement of which will be denoted by u_x and u_z (Fig. 13). We believe that the length of the interaction zone is a small with the radius of the cylinder, and the dry friction force acts on the seeds, which is constant in modulus and oppositely directed to the seed velocity relative to the rotating cylinder. Denote by $\vec{U}\{U_x, U_y\}$ and $\vec{V}\{V_x, V_y\}$ - the vectors of displacement and speed of the seeds, and write the equation of motion of the seeds in the interaction zone in vector form

$m\frac{d^2\vec{U}}{dt^2} = -F_{mp}(i\cos\alpha + j\sin\alpha)$, (2.41) where m is the mass of seeds, F_{mp} is the absolute value of the friction force, $\cos\alpha = \frac{V_2 - V_x}{\sqrt{(V_2 - V_x)^2 + V_y^2}}$ and $\sin\alpha = \frac{V_y}{\sqrt{(V_2 - V_x^=)^2 + V_y^2}}$, α is the angle between the friction force and the axis Ox. We introduce dimensionless variables and parameters using the formulas

$\tau = V_1 t / a$ $U_1 = U_x / a$ $U_2 = U_y / a$ $W_1 = V_x / V_1$ $W_2 = V_y / V_1$ $\beta = F_{mp} a / mV_1^2$ $\lambda = V_2 / V_1$

and write equation (1) in projections along the axes Ox and Oy:

$$\frac{d^2U_1}{d\tau^2} = \frac{dW_1}{d\tau} = \beta\frac{(\lambda - W_1)sign(\lambda - W_1)}{\sqrt{(\lambda - W_1)^2 + W_2^2}}, \frac{d^2U_2}{d\tau^2} = \frac{dW_2}{d\tau} = -\beta\frac{W_2}{\sqrt{(\lambda - W_1)^2 + W_2^2}}$$

where $sign(z) = 1$ at $z > 0$, $sign(z) = -1$ at, $z < 0$ and $-1 < sign(z) < 1$ at $z = 0$

System (2) is integrated under the following initial conditions

$$U_1 = 0.\ U_2 = 0.\ \frac{dU_1}{d\tau} = W_1 = \cos\alpha_0.\ \frac{dU_2}{d\tau} = W_2 = \sin\alpha_0$$

The system has an integral, which, taking into account the initial conditions, can $W_1 < \lambda$ be written as

$$\frac{\lambda - W_1}{\lambda - \cos\alpha_0} = \frac{W_2}{\sin\alpha_0}$$

Using (2.44), we exclude the function from the system W_2, then we obtain one equation for W_1

$$\frac{dW_1}{d\tau} = \beta\frac{\lambda - \cos\alpha_0}{\sqrt{(\lambda - \cos\alpha_0)^2 + \sin^2\alpha_0}}$$

We integrate (2.45) over τ provided $W_1 = \cos\alpha_0$, and we get

$$W_1 = \beta\frac{(\lambda - \cos\alpha_0)\tau}{\sqrt{(\lambda - \cos\alpha_0)^2 + \sin^2\alpha_0}} + \cos\alpha_0$$

$$W_2 = \frac{(\lambda - W_1)\sin\alpha_0}{\lambda - \cos\alpha_0}$$

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At the moment, the $\tau = \tau_0 = \dfrac{\sqrt{(\lambda - \cos\alpha_0)^2 + \sin\alpha_0^2}}{\beta}$ dimensionless velocity W_1 reaches the value, λ and then the dimensionless velocity W_2 vanishes, and in this case, the system (2.42) $\tau > \tau_0$ will have the trivial solution $W_1 = \lambda\ W_2 = 0$, If denoted by τ_c time to remove the lint from the surface of the seed, then the complete removal is carried out when the inequality is fulfilled $\tau_0 > \tau_c$, from which we obtain the condition for the implementation of the complete removal of the lint.

$$\frac{\sqrt{(\lambda - \cos\alpha_0)^2 + \sin\alpha_0^2}}{\beta} > \tau_c$$

We solve the last inequality for the parameter λ

On fig. 2.14 shows curves $V_2/V_1 = \cos\alpha_0 + \sqrt{V_*/V_1 - \sin^2\alpha_0}$ in the plane $(x,, V_2/V_1)$ for different angles of the screw, which separate the values of the parameters at which the complete removal of the lint is realized.

Results. It can be seen from the obtained curves that the angle of the screw mainly affects the limiting value of the speed V_1,

$$\lambda > \cos\alpha_0 + \sqrt{\beta\tau_c - \sin^2\alpha_0} \quad (2.47)$$

To implement inequality (2.47), it is necessary to require

$$\beta\tau_c > \sin^2\alpha_0 \,(2.48)$$

We write inequalities (2.47) and (2.48) in dimensional form

$$V_2 > V_1\cos\alpha_0 + \sqrt{\frac{F_{mp}V_1t_c - mV_1^2\sin^2\alpha_0}{m}},$$

$$V_1 < \frac{1}{\sin^2\alpha_0}\frac{F_{mp}t_c}{m}$$

The ratio $\dfrac{F_{mp}t_c}{m}$ is the characteristic speed, and we denote it by V_* and write the inequalities and as

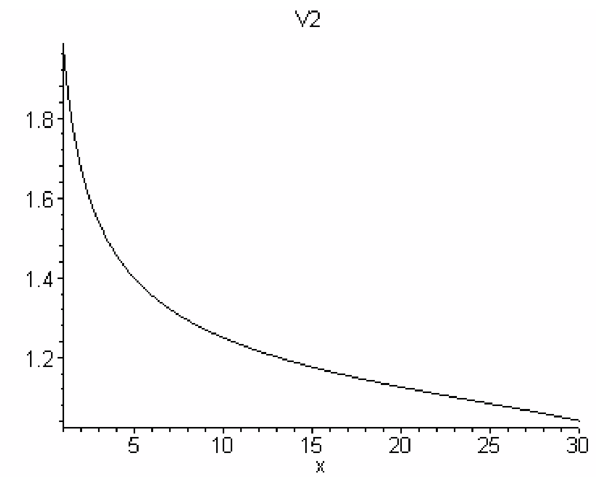
$$V_2/V_1 > \cos\alpha_0 + \sqrt{V_*/V_1 - \sin^2\alpha_0},$$

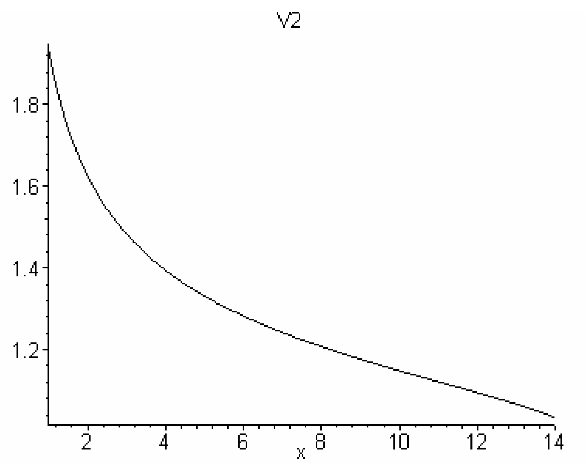
$$V_1 < V_*/\sin^2\alpha_0$$

and it practically does not affect the nature of the curves separating the zones of complete removal from partial.

Curved boundaries $V_2/V_1 = f(x)$ ($x = V_1/V_*$) of the implementation of complete removal

lint from the surface of the seeds at different angles α_0





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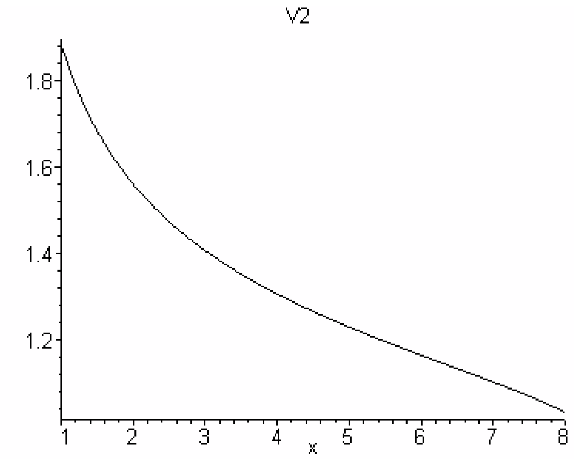
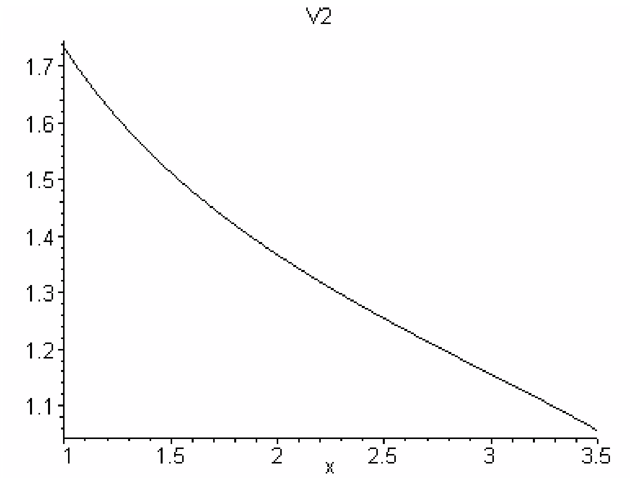
$\alpha_0 = 10^0$ $\alpha_0 = 15^0$





$\alpha_0 = 20^0$ $\alpha_0 = 30^0$

Figure 3

Conclusions

1. To describe the movement of the seed roller inside the working seed-roll box of the linter, a model of a granular medium was used. As a result of analytical studies, it was found that the movement of seed layers in the seed roller relative to each other causes additional compaction of the roller and leads to a change in the kinetics of its movement.

2. An analytical relationship between the radius of mobility of the seed medium and the frequency of rotation of the agitator blade has been obtained. It is determined that the radius of mobility largely depends on the characteristic frequency of the granular medium.

3. It is determined that at high values of the ratio of the rotation frequency of the agitator blade to the characteristic frequency of the granular medium (more than 2.5) the radius of mobility of the medium practically remains constant.

4. It has been established that the nature of the mobility of the seed medium depends on the ratio of the coefficient of friction between the surface of the seed roller and the coefficient of compaction of the granular medium. The conditions that determine the rotation of only the surface layer and the entire seed roller are determined.

5. To describe the process of removing lint from the surface of seeds in the gap between the agitator blade and the surface of the saw cylinder, a two-dimensional model of the movement of seeds parallel to the axis of the cylinder and along the process was used.

6. The conditions for the time the seeds stay in the linting zone during which the lint is completely removed from the surface of the seeds are analytically determined.

7. Analytical dependences between the speeds of the saw cylinder and the approach of seeds to the linting zone were obtained, in the presence of axial

displacement of seeds, which determine the zones of complete and partial removal of lint from seeds.

8. The results of theoretical studies make it possible to determine a rational and efficient technology for linting cotton seeds, as well as structural elements of the working seed-roll box of the linter machine.

References:

1. Jurayev Yuldashhon Yunusxon, Yuldashev Khasanboy, Tuhktaev Sherzod, "Investigation Of Fiber Loss In Impurities From The Ss-15a Separator" Eurasian Journal Of Academic Research 425-431 pages https://doi.org/10.5281/zenodo.7193675

2. Sarimsakov Olimjon Sharipjanovich, Yo'ldashev Xasanboy Sulaymon O'gli, Sharapova Xayrullo Numonjonovich , "Investigation Of Separation Of Usable Fibers Added To Contaminants During Cleaning Cotton" Ijodkor o'qituvchi ilmiy-uslubiy jurnal, 448-pages

3. Yoldashev Hasanboy Sulaymon o'gli, Xoshimov O 'tkirbek Xakimjon o'g'li, O 'rinboyev Bekzod Baxtiyor o'g'li, " STUDY OF CLEANING PROCESSING OF SEED COTTON" 209-213 pages

4. GJJabbarov, T.U.Otametov, A.Xamidov"Technology of initial processing of seed cotton" Toshkent O 'qtuvchi-1987

5. Muhsinov Ibroxim, Isayev Shaxboz, Yuldashev Xasanboy" Theoretical Analysis Of

6. The Motion Of Raw Cotton With Uniform Feeder In A Cotton Cleaner" The American Journal of Engineering and Technology (ISSN - 2689-0984) (2021)

7. Yuldashev Xasanboy, Dusmatov Azamjon " Theoretical Analysis of storing, cleaning, processing of seed cotton" Scientific Journal Impact Factor

8. W .S. Anthony and William D. Mayfield, Managing Editors " Cotton Ginners Handbook"

9. Jurayev, X .T. Axmexodjayev, A Bomatov, "Improvement of designs and development of methods for calculating the working organs of cleaning cotton from fine litter " Namangan-2016

10. X.T. Axmedxojayev, M.A.Tojiboyev, X.N.Sharipov "Improving the fiber separation process" "Istedod ziyo press" Namangan-2021

11. O.Sh.Sarimsakov "Theoretical bases of cotton transfer and pneumatic transport processes" Toshkent-2021