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Theoretical Study Of The Movement Of Single And Systemic Seeds Along The Grate Of A Saw Gin With A Concave Profile

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ABSTRACT

The article examines a practical and theoretical study of the process of separating seeds from saw gin with installed grates with a concave profile proposed by us, in contrast to the existing grates.

Improving the efficiency of the process of separating the fibre from cotton seeds by improving the working chamber of the gin is one of the important issues. The main way to increase the efficiency of sawn gin is to increase the fibre content in the mass of seeds in the working chamber with a uniform decrease in its density. This can be achieved by using grates with a concave working surface, which serves to move the seeds away from the rotating saws and accelerate the release of bare seeds from the working chamber. The article discusses the movement of seeds on the concave surface of the grate and determines the rational parameters of their working part.

KEYWORDS

Cotton fibre, cotton ginning, saw gin, roll box, seed roll, rib, rib with a concave profile, cotton, seeds.

INTRODUCTION

Currently, the quality of the fibre produced at ginning enterprises depends on the efficient operation of machines working directly in the technological process. Each technological process, to one degree or another, is of great importance in the production of high-quality fibre. At the enterprise, the main process influencing the production of fibre is the ginning process (separation of the fibre from the seed). Cotton cleared from small and large litter in the cleaning shops is fed to the saw gin, which is the main machine of the gin shop. The teeth of the rotating saw catch the cotton bites, which are fed into the working chamber of the gin, and are brought to the rib. Cotton flies, hooked on the saw teeth in the working chamber, interacting with other cotton flies, hook them and form a raw roller. The raw roller rotates in the opposite direction of rotation of the saw cylinder and continuously supplies the saw teeth with fibre. The rib is one of the main units of the saw gin working chamber. Through them, the saw blades, freely passing into the working chamber, serve to remove the fibre after separating them from the seed of the saws caught in the teeth. The grate consists of individual grates, together with the front bar they make up the profile of the working chamber. The grates are attached to the upper and lower bars with special screws.

The article explores the proposed grate model, consisting of four geometric shapes, provides an analytical analysis of the geometric types. The dependence of the location of the last rectilinear part of the general contour on the shape of its convexity and concavity is determined.

Cotton seeds move along the contour in the form of a stream. We assume that the thickness of the flow along the contour is constant and equal. We compose a unique equation of the flow in each section of the circuit. To determine the state of the flow, we denote its velocity, density and pressure in each section, respectively. Let us determine the flow motion along the contour with respect to the arc.

Formulation of the problem.

The authors have carried out several studies to improve the working elements of the gin. The purpose of the research is to create the possibility of timely withdrawal of bare seeds from the working chamber of the saw gin by creating a groove, i.e. concavity on the working surface of the grate. In addition, having made a device that performs this process, the definition of effectively working technological dimensions, as well as their introduction into production. The choice of the optimal design and technological parameter of the new grate is a crucial stage in the research work.

Mathematical model of the problem.

1. Mathematical model of the grating profile and its theoretical analysis. Let us consider that the transitions from one to another section AB, BC and CA of the concave grate are expressed by circular arcs (Fig. 1).

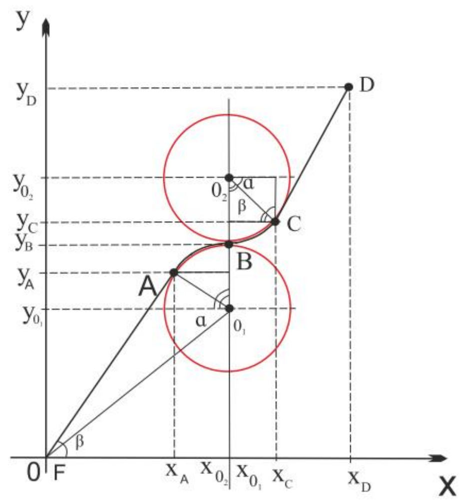

Fig. 1. Schematic diagram of the rib.

a) for the straight line EA - the coordinates of the points E and A are determined in relation to the XFY coordinate system:

$$\left.\begin{aligned} x_F &= 0 \qquad y_F = 0 \\ x_A &= OA\cos\beta = l_1 \cdot \cos\beta \\ y_A &= OA\sin\beta = l_1 \cdot \sin\beta \end{aligned}\right\} \tag{1}$$

b) for a circle centered at point O_1 and radius R:

$$\left.\begin{aligned} x_{O_1} &= x_A + R \cdot \sin\beta \\ y_{O_1} &= y_A - R\cos\beta \end{aligned}\right\} \tag{2}$$

Let us determine the coordinates of the point β related to the given circle:

$$\left.\begin{aligned} x_\beta &= x_{O_1} \\ y_\beta &= y_{O_1} + R \end{aligned}\right\} \tag{3}$$

c) for a circle centered at point O_2 and radius R

$$\begin{aligned} x_{O_2} &= x_{O_1} \\ y_\beta &= R + y_\beta \end{aligned} \tag{4}$$

for point $(x_c; y_c)$

$$\left.\begin{aligned} x_c &= x_{O_2} + R \cdot \sin\beta \\ y_c &= y_{O_2} - R \cdot \cos\beta \end{aligned}\right\} \tag{5}$$

for direct CD:

$$\left.\begin{aligned} x_D &= x_C + l_1 \cdot \cos\beta \\ y_D &= y_C + l_1 \cdot \sin\beta \end{aligned}\right\} \quad (6)$$

In this case, the analytical equations of the grate profile will be in the form:

$$\text{OA: } \begin{cases} y_1 = K_1 x(1.4), \quad K_1 = tg\beta \\ 0 \le x \le x_A \end{cases} \quad (7)$$

For a circle with center O_1

$$\begin{cases} y_2(x) = y_{0_1} + \sqrt{R^2 - (x - x_{O_1})^2} \\ x_A \le x \le x_B \end{cases} \quad (8)$$

for a circle with center O_2

$$\begin{cases} y_3(x) = y_{0_2} + \sqrt{R^2 - (x - x_{O_1})^2} \\ x_B \le x \le x_C \end{cases} \quad (9)$$

for direct CD

$$\begin{cases} y_4(x) = K_2(x - x_C) + y_C \\ K_2 = \dfrac{y_0 - y_C}{x_D - x_C} \\ x_C = x \le x_D \end{cases} \quad (10)$$

Using separate functions of the grating profile, based on the above equations, the view on the XOY coordinate system obtained with the MAPLE-17 program is shown in Fig. 2.

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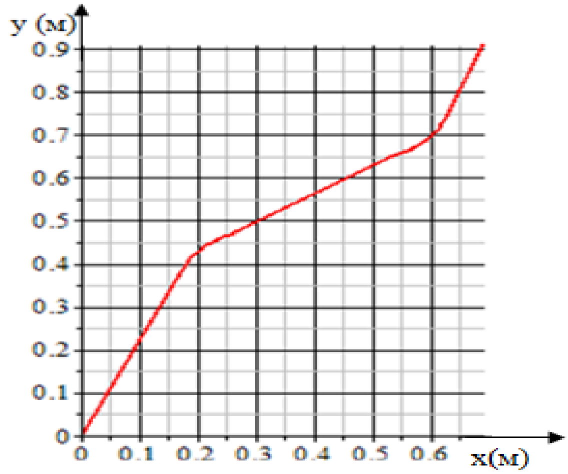

Fig. 2. View of the grating profile in the XOY coordinate system.

2. Theoretical study of the movement of single and systemic seeds on a grate with a concave profile.

Let us compose the differential equations of the movement of seeds along the main sections of the grate BC, CD and DE.

Differential equation of seed movement along with the profile of the BC curve:

$$R_1 m\ddot{\varphi}_1(t) = mg\left[(\sin(\varphi_1(t)+\varphi_0) - f\cos(\varphi_1(t)+\varphi_0)\right] - R_1 m(\dot{\varphi}_1(t))^2 \quad 0 \le t \le t_1 \qquad (11)$$

Differential equation of seed movement along with the profile of the straight line CD:

$$m\ddot{x}(t) = mg(\sin\varphi_0 - f\cos\varphi_0) \qquad t_1 \le t \le t_2 \qquad (12)$$

Differential equation of seed movement along with the profile of the DE curve:

$$R_2 m\ddot{\varphi}_2(t) = mg\left[(\sin(\varphi_2(t)+\varphi_{20}) - f\cos(\varphi_2(t)+\varphi_{20})\right] - R_2 m(\dot{\varphi}_2(t))^2 \qquad t_2 \le t \le t_3 \qquad (13)$$

Initial conditions:

$$t = 0 \quad \begin{Bmatrix} \varphi_1(0) = \varphi_0; \\ v_1(0) = R_1\omega_1(0) \end{Bmatrix}$$

$$t = t_1 \begin{cases} x(t_1) = R_1\varphi_1(t_1) \\ v(t_1) = v_1(t_1) \end{cases} \qquad (14)$$

$$t = t_2 \quad \begin{cases} \varphi_2(t_2) = \varphi_{10} \\ v_2(t_2) = v(t_2) \end{cases}$$

The above differential equations, with appropriate initial conditions, were solved numerically using the MAPLE-17 program.

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The calculation was carried out for the proposed grate with a concave profile and the following parameters were taken $R_1 =\ 0{,}14$, $R_2 =\ 0{,}14$, $f = 0{,}3$, $\varphi_{10} = 30^0$, $\varphi_0 = 10^0$, $\varphi_{20} = 10^0$

The graphs of the path and movement of the seed on the sections of the grate BC, CD and DE were obtained.

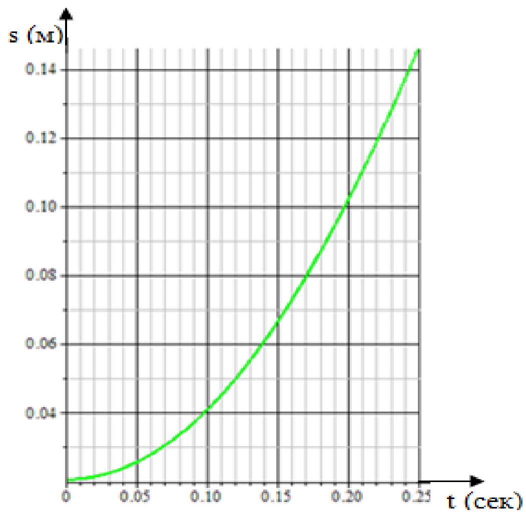

Fig. 3. The law of movement of seeds along the section of the grate of the aircraft during the course of time.

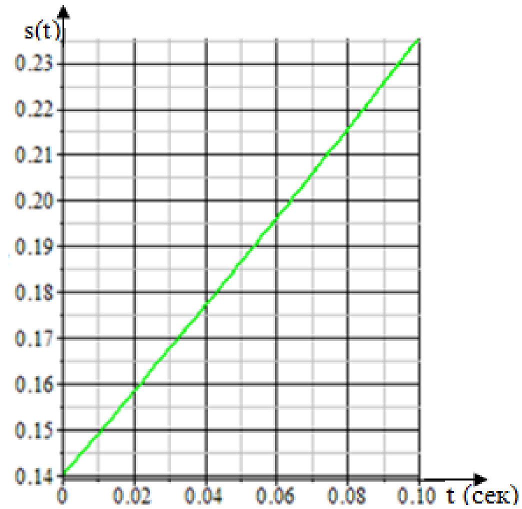

Fig. 4. The law of movement of seeds along the section of the grate of the SD in the course of time.

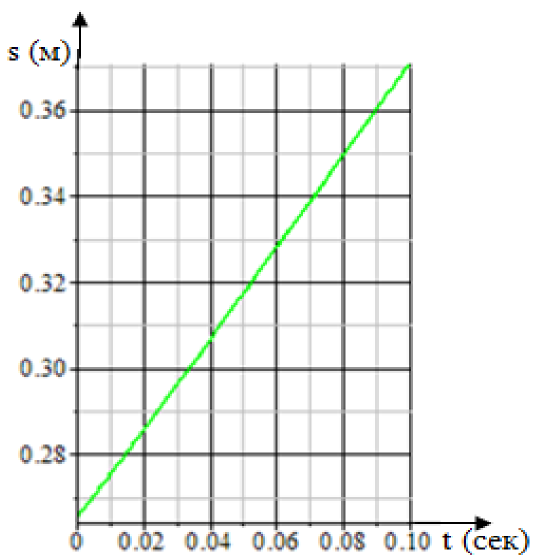

Fig. 5. The law of movement of seeds along the section of the DE grate in the course of time.

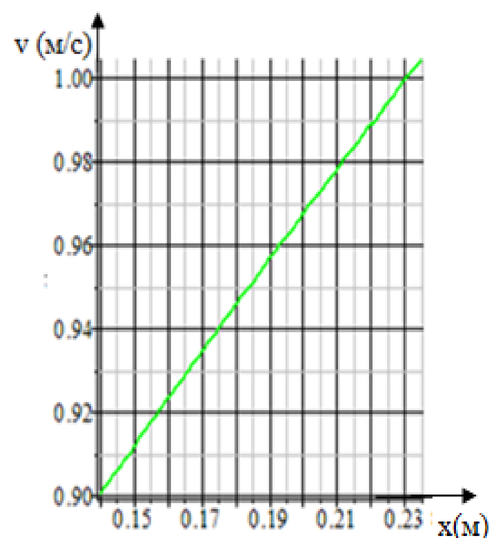

Fig. 6. The law of movement of seeds along the section of the DE grate in the course of time.

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Let us compose the differential equations for the movement of seeds along the grate for each section. Differential equations for the movement of seeds along a rectilinear DC profile:

$$m\ddot{x}_1(t) = mg(\cos\beta_1 - f\sin\beta_1 \qquad 0 \le t \le t_1$$

Differential equations for the movement of seeds along the curvilinear profile of the CB:

$$Rm\ddot{\varphi}_1(t) = \frac{mg}{R}\left[(cos\varphi(t) - f\sin\varphi(t)\right] \; t_1 \le t \le t_2$$

Differential equations for the movement of seeds along the curvilinear profile of BA:

$$Rm\ddot{\varphi}_2(t) = mg(\cos\varphi(t) - f\sin\varphi(t) \quad t_2 \le t \le t_3 \qquad (1.11)$$

Differential equations for the movement of seeds along a rectilinear profile AE:

$$m\ddot{x}_2(t) = mg(\cos\beta_2 - f\sin\beta_2) \qquad t_3 \le t \le t_4$$

The above differential equations, with appropriate initial conditions, were solved numerically using the MAPLE-17 program, and the corresponding graphs of the distance travelled and the speed of the seed were obtained. Initial conditions:

$$\left.\begin{array}{ll} t = 0; & x(0) = 0 \qquad v_1(0) = 0 \\ t = t_1 & \begin{cases} \varphi_1(t_1) = 0; \quad \varphi_1(t_2) = \beta \\ v_2(t_1) = v_1(t_1) \end{cases} \\ t = t_2 & \begin{cases} \varphi_2(t_2) = 0 \\ v_3(t_2) = v_2(t_2) \end{cases} \end{array}\right\} \qquad (1.12)$$

$$t = t_3 \quad \begin{cases} x_4(t_3) = l_1 + l_2 + l_3 \\ v_4(t_3) = v_3(t_3) \end{cases}$$

FINDINGS

1. An opportunity is created to improve - accelerate the state of the withdrawal of bare seeds from the working chamber of the gin, with known movements and speeds of seeds along concave grates.
2. The concavity of the grate profile, during the withdrawal of seeds, reduces their interaction with the saw teeth, as a result, reduces the time for seeds to leave the working chamber.
3. Analytical equations are given for the sections of the concave grate transition, the profiles of which are expressed by circular arcs, and graphs

are obtained using a computer program.

4. The graphs of changes in the laws of motion with respect to the time t of displacement and the speed of the seed along the concave profile of the grate were obtained.

REFERENCES

1. Sarimsakov, A. I. Karimov R. Murodov. (2012). Static calculation of processes in the roll box of the saw gin. Problems of Mechanics, No. 2.
2. Kh. T. Akhmedkhodjaev, A.I. Karimov, M. Tojiboyev, H. Sharipov. (2013). Determination of the static balance of forces affecting seeds moving along grates with a convex profile. Scientific and technical journal of the Ferghana Polytechnic Institute. No. 2.
3. Kh. T. Akhmedkhodjaev, A.I. Karimov, M. Tojiboyev, H. Sharipov. Theoretical analysis of the movement of seeds along the grate with a convex profile. Scientific and technical journal of the Ferghana Polytechnic Institute. 2018, No. 3.
4. Abdusamat, K., Mamatovich, A. S., & Muhammadziyo, I. (2014). Mathematical Modeling of the Technological Processes Original Processing of Cotton. International Journal of Innovation and Applied Studies, 6(1), 28.
5. Akramjon, S., Rustam, M., Akmal, U., & Dilmurat, K. (2018). Movement Differential Equation of Seed Roller which Has Been Installed Stake Accelerator on the Roll Box of Gin Machine. Engineering, 10(8), 521-529. https://doi.org/10.4236/eng.2018.108038.
6. Akmal, U., Khamit, A., Akramjon, S., & Muazzam, K. (2018). The Saw Gin Stand with Adjustable Movement of the Roll Box. Engineering, 10(08), 486. https://doi.org/10.4236/eng.2018.108034.
7. Axmedxodjayev, K., Umarov, A., & Ortiqova, K. (2019). Investigation of the Ginning Process on ДП Series Saw Gin Stands. Engineering, 11(08), 523. https://www.scirp.org/journal/eng.
8. Khayrullo Sharipov, Khamit Akhmetxodjayev, Botir Mardonov. (2019). Theoretical studies of the movement of a single sustem along grates with a conceve gin profile. The problemes of mexanical. 4, 55-58.
9. Botir Mardonov, Khayrullo Sharipov, Khamit Akhmetxodjayev. (2019). Study of the law of motion of a single seed on the rib. The problemes of textile. 4, 42-50.
10. Khayrullo Sharipov, Khamit Akhmetxodjayev, Mukhammadjon Tadjibayev. (2019). The mathematical model of seed movement on a concave profile rib of saw jin stand. Scientific and technical journal of Namangan institute of engineering and technology. 4, 19-29.
11. Khayrullo Sharipov, Khamit Akhmetxodjayev, Mukhammadjon Tadjibayev. (2019). Practical and theoretical study of the process of separating seeds from advanced gin. Scientific and technical journal of Namangan institute of engineering and technology. 3, 14-19.

12. Sharipov, K., Akhmedxodjayev, K., Tojiboyev, M., & Sarimsakov, O. (2020). The Mathematical Model of Seed Movement on a Concave Profile Rib. Engineering, 12(03), 216.
13. Akramjon, S., Rustam, M., Akmal, U., & Dilmurat, K. (2018). Movement Differential Equation of Seed Roller which Has Been Installed Stake Accelerator on the Roll Box of Gin Machine. Engineering, 10(8), 521-529.
14. Akmal, U., Khamit, A., Akramjon, S., & Muazzam, K. (2018). The Saw Gin Stand with Adjustable Movement of the Roll Box. Engineering, 10(08), 486. https://doi.org/10.4236/eng.2018.108034.
15. Axmedxodjayev, K., Umarov, A., & Ortiqova, K. (2019). Investigation of the Ginning Process on ДП Series Saw Gin Stands. Engineering, 11(08), 523.
16. Umarov, A. A. (2018). A saw gin with a system for controlling the density of a seed roll. Scientific-technical journal, 22(1), 52-57.
17. Abduvakhidov, M.A., & Umarov, A.A. (2008). Research of speed regulation of electric drives of gin feeders. Natural and technical sciences, (2), 328-329.
18. Akramjon, S., Rustam, M., Akmal, U., & Dilmurat, K. (2018). Movement Differential Equation of Seed Roller which Has Been Installed Stake Accelerator on the Roll Box of Gin Machine. Engineering, 10(8), 521-529. https://doi.org/10.4236/eng.2018.108038.
19. Umarov, A., Ortikova, K., & Sarimsakov, A. (2020). Analysis of Speeds of Cylinders of Saw Gins and Linters and Determination of Critical Frequencies for them. Engineering, 12(10), 715. https://doi.org/10.4236/eng.2020.1210050.
20. Sarimsakov, A., Muradov, R., & Mardonov, B. (2020). Modeling Of the Process of Interaction of the Saw Cylinder with the Raw Material In The Process Of Ginning. TEST Engineering and Management (Scopus) May-June, 27386-27391.
21. Sarimsakov, A. U., Ahmedov, B., & Abdullajanov, B. (2020). To Study Circling Of The Seed Roller At Ginning Process With Practical Method. The American Journal of Engineering and Technology, 2(11), 142-148. https://doi.org/10.37547/tajet/Volume02Issue11-22.
22. Sarimsakov, A. U., & Ergashev, J. F. (2020). Modelling the motion of a mixture with weighty particles in a stationary flow of liquid. SAARJ Journal on Banking & Insurance Research, 9(6), 20-24. https:// doi: 10.5958/2319-1422.2020.00035.1