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Theoretical Study of the Movement Process of Destroyed Seeds and Fiber in the New Construction Saw Gin Working Camera

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Abstract

A theoretical study of the process of movement of a dehydrated seed + fibrous medium in a saw gin working chamber has been carried out. The process representing the motion of a depleted seed + fibrous medium is mathematically constructed, based on which the corresponding differential equations are constructed. The constructed differential equations were solved numerically in the MAPLE-17 program, corresponding graphs were obtained and conclusions were given.

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1 Introduction

In the technology of primary processing of cotton, one of the main issues is the process of separating the seeds from the fibres and removing them from the raw material shaft. This is because more than 30% of the hairy and hairless seeds separated from the fibres are collected in the centre of the raw material roller. This in turn leads to an increase in the density and internal pressure of the raw material roller (Tojimirzayevich, 2021; Umarov et al., 2020; Wisudawati & Maheswari, 2018). As a result, the rotation of the raw material roller is slowed down and in turn, the grinding process has a negative effect. When the gin machine stops the working chamber for a certain time, the placement of the fibrous seeds in the transverse shear of the raw material roller in $h_1 \approx 70 \div 100$ mm thickness will be as in Fig. 1.

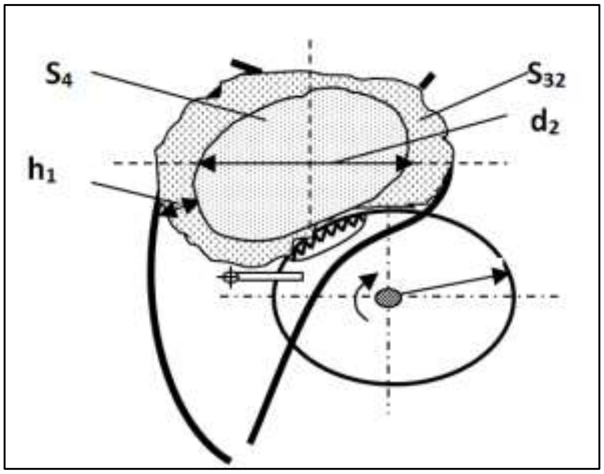

Figure 1. Formation of the raw material shaft

2 Materials and Methods

The main part

Therefore, the authors proposed a new design of the working chamber to increase the efficiency of the ginning process (Fig. 1). Horizontal bars are opened from the left inner surface of the working chamber. In this case, due to the rotational movement of the raw material roller, a certain part of the degreased seeds leaves the seed + fibrous medium through the grids through the working chamber. This in turn increases the intensity of the ginning process. During the movement of a seed + fibre mass of known thickness along the surface of the mesh, a contact force is formed between the mesh surfaces, under the influence of which a flat and spatial motion occurs (Sarimsakov et al., 2012; Sarimsakov et al., 2015; Sarimsakov et al., 2020).

As a result, a certain part of the hairless seeds that are not attached to the fibres protrudes beyond the open areas of the mesh surface. A model was proposed by A.G. Sevostyanov to describe such a mechanism. According to this model, the decrease in the number of seeds on the mesh surface is proportional to the amount of raw material roller and the speed of movement along the surface (Ariputra & Sudiana, 2019; Castellano et al., 2015; Copur, 2010). Based on this model, we theoretically study the process of separation of non-fibrous seeds from the composition of the seed + fibrous medium. Before modelling this process, it is necessary to determine the velocity of the seed + fibrous medium on the mesh surface. Suppose that an elementary seed with an initial mass M + a fibrous medium t+0 is moving on a different surface from the moment of inertia and is equal to its mass M due to the separation of the seeds. Taking the coordinate head at a point 0, we direct the axis OX from right to left along the horizon, and the ordinate axis OY from top to bottom perpendicular to it (Figure 2). Let the cotton piece move one dimension along the curve BC on the surface (Sarimsakov, 2014; Sarimsakov et al., 2020; Sarimsakov et al., 2019). By setting the polar pole at a point O, we assume that the curve BC equation is in the polar coordinate system r=r(f). The particle moves from the point V(f g) of the mesh surface and exits the surface at point C (f,r) (here r=r(f),r= (f,r). Suppose that at the moment t_0 the fraction is at the point A(r(f)f) of the line BC and is at a distance B from the point C. We assume that the mass of the particle is a constant material point, and its equation of motion on the line BC and we write the expression of the normal force by using S.M. Targ's literature.

$$M_0 \frac{d^2 s}{dt^2} = T + M_0 g \sin\psi, \; N = \frac{M_0 \dot{s}^2}{\rho(\phi)} - M_0 g \cos\psi \quad (1)$$

Here the contact must be assumed to be a normal compressive force N O in order to be maintained.

The angle W-BC formed by the axis A of the experiment passing through the point of the line Oy , using the links and the equation, we obtain the following expression. ψ is the angle formed by the axis 0x from the point A on the line BC. If we use the relations x = r (ϕ) cosϕ, y = r (ϕ) sinϕ and the equation tgΨ = y ^ '(x) = (dy/dϕ)/(dx/dϕ), we get the following expression

tgψ = (r ^ 'sinϕ + r cosϕ)/(r ^' cosϕ-r sinϕ). (r ^ 'sinϕ + r cosϕ)/√ (r ^ 2 + r ^' 2), cosψ = 1/√ (1 + tg ^ 2 ψ) = (r ^ 'cosϕ- r sinϕ)/√ (r ^ 2 + r ^ '2), ρ = ((r ^ 2 + r ^' 2) ^ (3/2))/(r ^ 2 + 2r ^ '2-rr ^ ')

Equation (1) defines the sum of the forces exerted on the subdivision by T. In this direction, the Coulomb force is affected by the projection of the gravitational force (Abrão et al., 2007; Agblevor et al., 2006; Akramjon et al., 2018). In this case, the force of the applied force is proportional to the normal force of force -N: T = -fN, where f is the resulting coefficient of friction, (for its calculation the formula in the formula is recommended f = S_0_) f = S_0_ the coefficient of friction between the coarse and non-coherent surfaces, the surface of S_0, the surface of various surfaces of the coarse surface.), and the velocity of the raw material v_0. It should be borne in mind that the normal pressure force affecting the depleted seed + fibre subdivision is zero at the time of crossing the surface. We can count these cases with the help of the function in Hevisa.

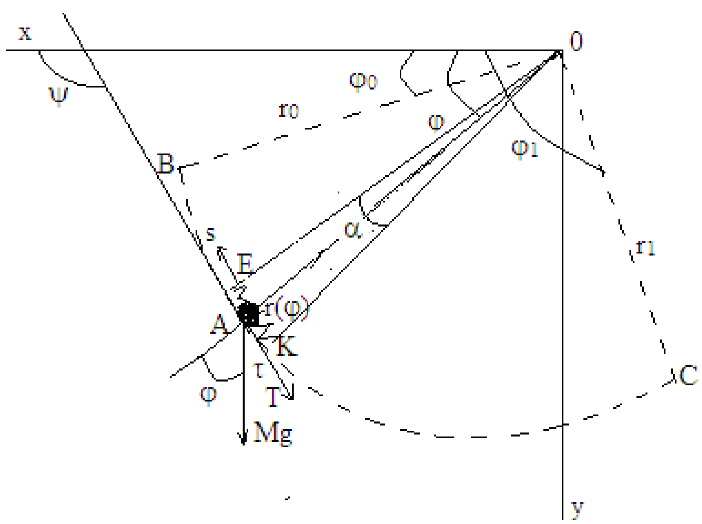

Figure 2. Schematic of the movement of the particle on different surfaces

Considering the above expressions, equations (1) take the following form:

$$m_0 \ddot{s} = T + m_0 g\cos\varphi + F_0, \quad (2)$$

Here: $N = \frac{m_0 (\dot{s})^2}{r} + m_0 g \sin\varphi, \quad (3)$

$$\dot{s} = r\dot{\varphi}, \ddot{s} = r\ddot{\varphi} \quad (4)$$

Substituting (3), and (4) into (2), we obtain the following differential equation of motion.

$$\ddot{s} = -f\{\sum_{k=0}^{30}[\eta(t - kT_0) - \eta(t - t_0 - kT_0)]\}\left(\frac{(\dot{s})^2}{r} + g\sin\varphi\right) + g\cos\varphi + \frac{F_0}{m_0} \; (5)$$

If we take into account (4), we can write (5) as follows

$$\ddot{\varphi} = -f\{\sum_{k=0}^{30}[\eta(t-kT_0)-\eta(t-t_0-kT_0)]\}\left((\dot{\varphi})^2+\frac{gsin\varphi}{r}\right)+\frac{g}{r}cos\varphi+\frac{F_0}{rm_0} \quad (6)$$

Here: η (t) is a function of Hevisis, k is the number of holes on the surface, t_0 is the time for the line to pass through the grid, T_0 is the time for the line to pass through the grid. The following initial conditions are accepted for the solution of equations (5) and (6) $s_0 = 0$, $\dot{s}_0 = v_k - v_0$, $\phi(0) =$

ϕ_0, $\dot{\phi}(0) = v_k/\sqrt{r_0^2 + r'^2(\phi_0)}$

Especially if the BC curve is circular $r = r_0 = r_1$, $r' = 0$
Parameters $f = 0.3$, $\bar{v}_0 = 1$, $\phi_0 = 30^0$, $\phi_1 = 120^0$.
Equations (5) and (6) are solved numerically in the Maple-17 program by the Runge-Kutta method.

3 Results and Discussions

Outcome analysis

Figure 3 shows a time-varying change in the law of motion corresponding to different coefficients of friction in the natural coordinate system along the entire internal and lattice surface of the working chamber of the seedbed. The analysis of graphs is closely related to the coefficients of friction of the surface of the law of motion (Rasulov & Rahmonov, 2011; Rejabboev et al., 2021; Rejabboev et al., 2021). If the velocity of the working chamber along the inner full + lattice surface obeys the law of parabola to the inner part of the lattice, then the growth of the inner part of the lattice changes according to the hyperbolic law. This situation can be explained by the process of removing a certain part of the seeds from the cracks in the grid + fibre (Fig. 4). As can be seen in Figures 4 and 5, the speed of rotation of the raw material shaft increases due to the fact that the cracks in the grille in the working chamber protrude from the seamless seams (Haque et al., 2020; Jensen et al., 2011; Matji et al., 2017). This accelerates the process of insanity. From Figure 6 we can see that the normal pressure force oscillates during the passage of the fibre through the cracks in the grid. As a result, the part of the fertilized seeds separated from the fibre medium comes out of the working chamber. At the same time, it maintains the internal pressure, reducing the accumulation of dehydrated seeds in the middle of the raw material shaft. As can be seen from the graphs, the working chamber must be as smooth as possible on the inside + the outside of the grille. Otherwise, the increase in internal friction has a negative effect on the process of insanity.

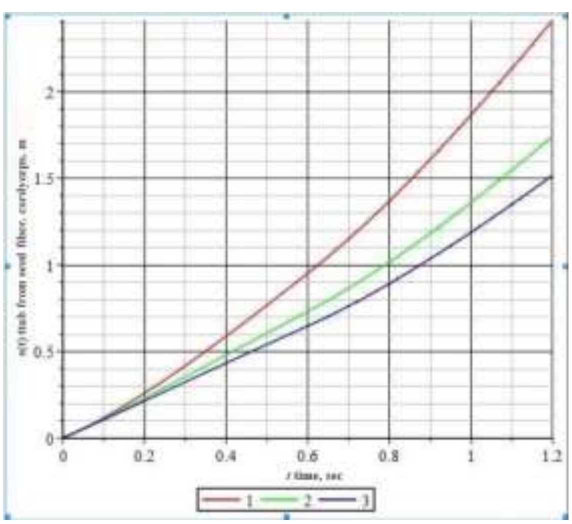

Figure 3. The law of temporal change of the law of motion along the inner and lattice surface of the working chamber of the seedbed.1-f = 0.2; 2-f = 0.5; 3-f = 0.7.

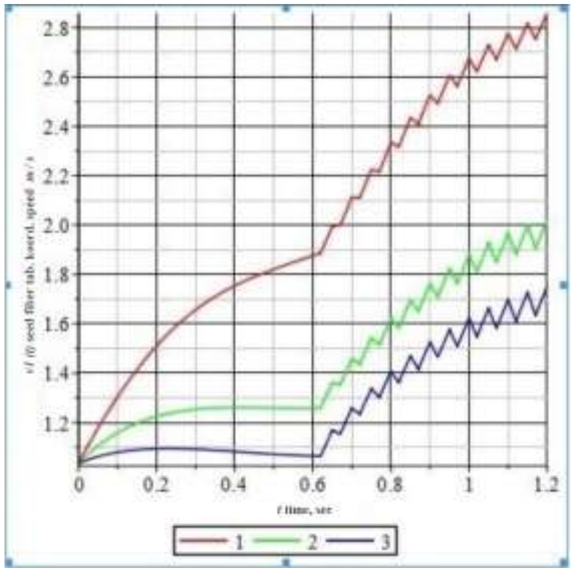

Figure 4. The law of time change the law of velocity along the inner and lattice surfaces of the working chamber of the seedbed.1-f = 0.2; 2-f = 0.5; 3-f = 0.7;

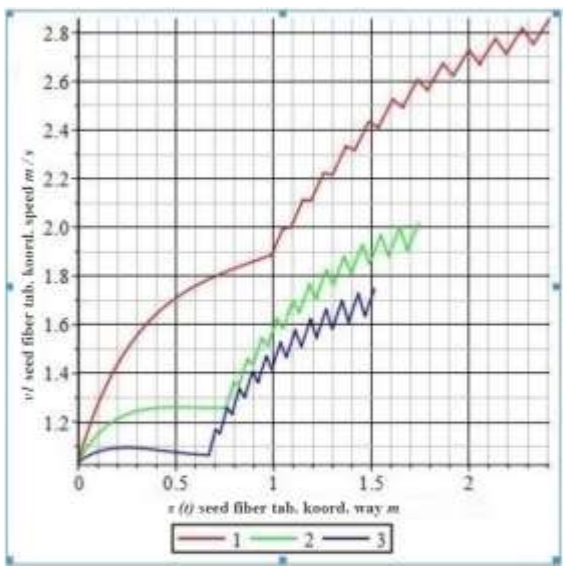

Figure 5. The law of variation on the road, violates the law of velocity along the inner and outer surface of the working chamber of the seedbed.1-f = 0.2; 2-f = 0.5; 3-f = 0.7;

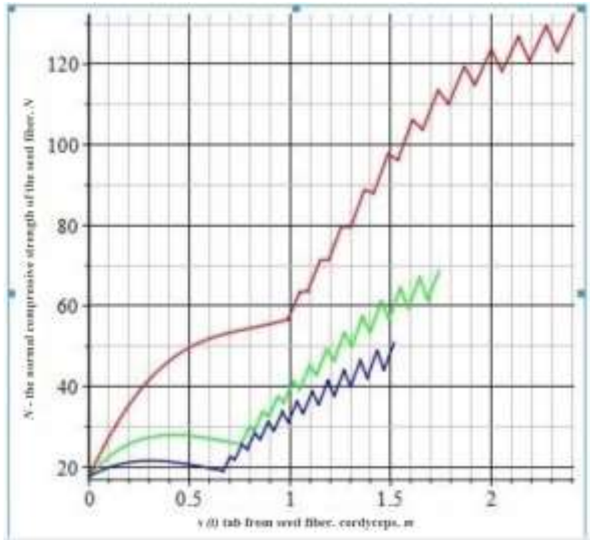

Figure 6. The law of variation of the working pressure of the seedbed along the inner and lattice surfaces of the working chamber along the path of normal pressure.1-f = 0.2; 2-f = 0.5; 3-f = 0.7;

4 Conclusion

A theoretical study of the motion of the fertilized seed + fibre medium in the Arrali gin chamber has been carried out. Mathematically, the process of expressing the process of motion of a dehydrated seed + fibre medium, based on which the corresponding differential equations are formed. The constructed differential equations are solved numerically in the MAPLE-17 program and the corresponding graphs are obtained. The results show that the fact that a certain part of the barbed wire comes out of the lattice cracks in the new structure of the working chamber of the demonic chamber has a positive effect on the process of insanity and increases its efficiency (Fonteyne et al., 2014; Gáspár et al., 2007; Haque et al., 2021).

Conflict of interest statement
The authors declared that they have no competing interest.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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