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Theoretical Analysis of the Movement of Wool Fiber along the Surface of the Raw Material Bunker, Which is Located Obliquely

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A B S T R A C T
The number of rotations is reduced due to the increase in the diameter of the supply roller, the fiber carrying surface is expanded, as a result of which the wool fiber is wrapped in the shaft is expected to be obtained. The roller and 12 teeth are mounted and a process of removing fiber from the bunker, without interruption to the equipment is provided.

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INTRODUCTION

We analyze the movement of the wool traction cleaning equipment in the transmission from point A to point B when cleaning down wool content light dirt impurities through the vibrating grill surface. At point A, the wool will continue its flow over the surface of the sloping grating and fall into the raw material bunker when it comes to point B.

Light dirt is present in the cleaning of impurities and from point a known V_∂^ it must reach Point B without oscillating motion in the inclined plane with initial velocity, and then be transmitted to the feedstock bunker. A grid made of steel list separates the fine impurities in the wool by vibrating. As a result of this, we determine the increased efficiency of cleaning from small impurities in the wool, the laws of movement influenced by external forces acting on the wool being harmed along the sloping plane. Their scheme is shown in Figure 1.

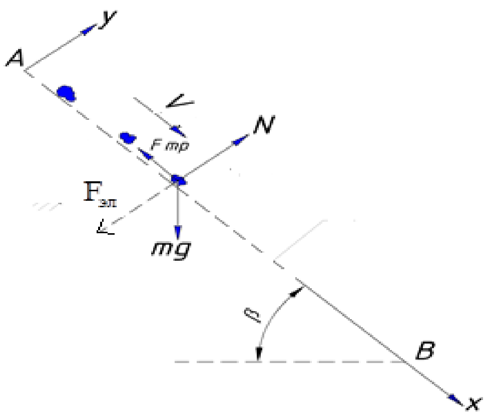

Figure 1 scheme of forces acting on wool and dirty impurities moving along the sloping surface

EXPERIMENTAL RESEARCH

To do this, let's consider the forces acting on them. Since the excitation velocity of the masses of wool and light dirt mixtures is different, we define them the initial velocities V_0^if V_0^js at the boundary of the transition to the oblique plane at Point A. Then we determine them the trajectory of the law of motion in the inclined plane. We will consider the conditions under which the wool will continue to Harakat on the surface of the inclined plane, and light impurities without hanging in the air.

As a result, we determine the speed of air by connecting it to the angle of the inclined plane. Next, we determine the trajectory of wool and light dirty mixtures at Point B. The light dirt is separated from the wool by vibration and transmitted to the bunker. We determine the initial movement of wool and light dirt along the sloping plane. We construct the differential equations of motion of woolly dirty mixtures on OXY axes. I) the differential equation of Motion of wool and impurities at distance AB With respect to the moon's axis is constructed as follows. $m\ddot{y} = N - k_1 \cdot \vartheta_y - c \cdot y$ (3.1)

$N = m \cdot g \cdot \cos\beta$ from the equivalence of

$m\ddot{y} + k_1\dot{y} + cy = 0$ (3.2)

we obtain $\ddot{y} + \frac{k_1}{m}\dot{y} + \frac{c}{m}y = 0$

$\frac{k_1}{m} = 2n, \quad \frac{c}{m} = k^2$ let's enter the designations where k_1 is the coefficient of resistance; -the mass of the wool Slice; s is the coefficient of unity in vibration.

$\ddot{y} + 2n\dot{y} + k^2y = 0$

$y = e^{\lambda t}; \dot{y} = \lambda e^{\lambda t}; \ddot{y} = \lambda^2 e^{\lambda t}$

as a result $\lambda^2 + 2n\lambda + k^2 = 0$

$\lambda_{1/2} - n \pm \sqrt{n^2 - k^2}$

we express the general solution as $y = e^{-nt}\left(c_1 \cos\sqrt{k^2 - n^2} \cdot t + c_2 \sin\sqrt{k^2 - n^2} \cdot z\right)$ (3.3)

(3.3) from the equation we use the initial and boundary values to determine the constant values S_1 and S_2

$$\dot{y} = e^{-nt}\left(-c_1\sqrt{k^2 - n^2} \sin\sqrt{k^2 - n^2} \cdot t + c_2\sqrt{k^2 - n^2} \cos\sqrt{k^2 - n^2} \cdot t\right) -$$

$$-ne^{-nt}\left(-c_1 \cos\sqrt{k^2 - n^2} \cdot t + c_2 \sin\sqrt{k^2 - n^2} \cdot t\right) \quad (3.4)$$

$t = 0 \quad y = y_0$ from the condition (3.2) equation we define the S_1 constants

$u_0 = s_1$

$t = 0\dot{u} = \dot{y}_0$ from the condition (3.3), we define the S_2 constants from the equation

$$\dot{u}_0 = s_2\sqrt{k^2 - n^2} - ny_0 \Rightarrow$$

$$\Rightarrow c_2 = \frac{v_0 + ny_0}{\sqrt{k^2 - n^2}}$$

we put the fixed values S_1 and S_2 (3.3) in the equation

$$y = e^{-nt}\left(y_0 \cos\sqrt{k^2 - n^2} \cdot t + \frac{v_0 + n \cdot y_0}{\sqrt{k^2 - n^2}} \sin\sqrt{k^2 - n^2} \cdot t\right) \quad (3.5)$$

$$y_0 = A \sin\beta, \frac{\dot{y}_0 + ny_0}{\sqrt{k^2 - n^2}} = A \cos\beta$$

we enter the designation-initial distance, - initial speed, - slope angle of the steel list.

$$A^2 \sin^2 \beta + A^2 \cos^2 \beta = y_0^2 + \frac{(\dot{y}_0 + n y_0)^2}{k^2 - n^2}$$

$$A = \sqrt{y_0^2 + \frac{(\dot{y}_0+ny_0)^2}{k^2-n^2}} \quad (3.6)$$

$$tg\beta = \frac{y_0\sqrt{k^2 - n^2}}{\dot{y}_0 + n y_0}$$

$$\beta = arctg\frac{y_0\sqrt{k^2-n^2}}{\dot{y}_0+ny_0} \quad (3.7)$$

then equation (3.7) yields the following

$$y = Ae^{nt}\, sin\left(\sqrt{k^2 - n^2} + \beta\right) \quad (3.8)$$

(3.8) the equation is based on the fact that a grid made of list in the proposed device vibrates and separates small impurities in the wool, and in addition to cleaning from small impurities, a theoretical analysis was carried out in increasing the efficiency of cleaning as a result of hitting list [1].

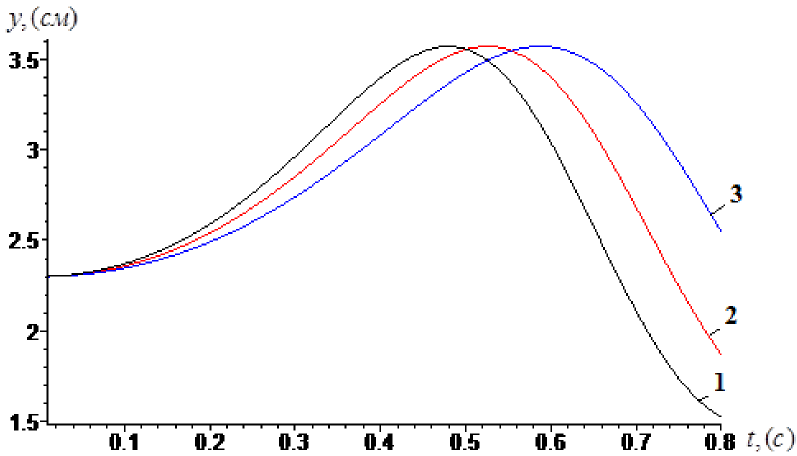

Figure 2. The amplitude of the movement of the wool flow in vibration along the axis of the moon in the oblique list is different $A_1 = 0{,}9$ $A_2 = 0{,}7$ $A_3 = 0{,}5$ time dependence graph in values

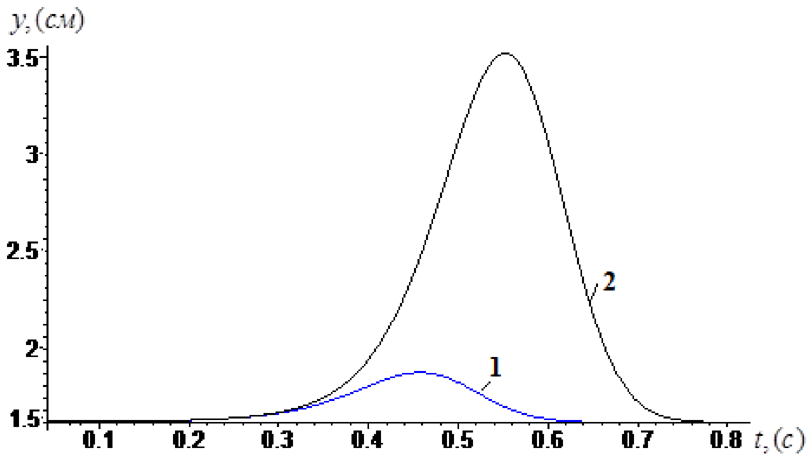

Figure 3. In the motion of the wool flow in the oblique list along the lunar axis in vibration, the amplitude of the various $A_1 = 0{,}9$ $A_2 = 0{,}7$ $A_3 = 0{,}5$ time **dependence graph in values (1-jun, 2-Light impurity)**

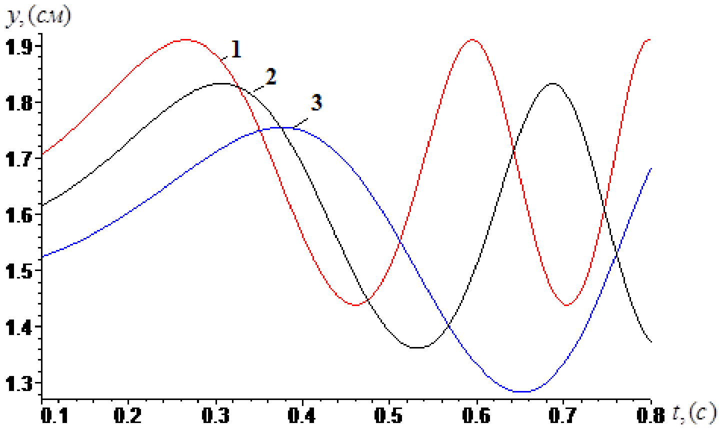

Figure 4. In the motion of the wool flow in vibration along the axis of the moon in the oblique list, the angle of the slope is different $\beta_1 = 25^0$ $\beta_2 = 35^0$ $\beta_3 = 45^0$ time dependence graph in values

From the analysis of the graphs in Figures 2, 3 and 4 above, the trajectories of the motion of the wool over the inclined lattice surface are given by external forces acting on the wool. When separating the grid from small impurities in the wool by vibrating motion, we can see that light impurities separate from the wool at the mm value of the amplitude of the vibration as well as at the graded values of the slope angle. One can see the separation of the mass of light dirt from the mass of the wool from the motion of the wool in the inclined plane as a graph affected by the amplitude of the mass in vibration is important in the angle of slope and amplitude of separation of very small light impurities from the wool.

When transmitting the flow of wool, we construct the differential equation of motion along the OX axis $F_{ish} = f \cdot N = f \cdot m \cdot g \cdot \sin\beta$

$m\ddot{x} = -k \cdot \vartheta_x - F_{ish}$

$m\ddot{x} + k\dot{x} = f \cdot m \cdot g \cdot \sin\beta$ (3.9)

(3.9) the equation consists of summing the X_2-private solutions with the X_1-general solution of the second order non-homogeneous differential equation.

$x = x_1 + x_2$

We look for a general solution as follows

$x_1 = c_1 e^{\lambda_1 t} + c_2 e^{\lambda_2 t}$ (3.10)

$x = e^{\lambda t} \dot{x} = \lambda e^{\lambda t} \ddot{x} = \lambda^2 e^{\lambda t}$

$m\lambda^2 + k\lambda = 0$ bundan

$\lambda_1 = 0; \lambda_2 = -\frac{k}{m}$ we put the defined values (3.9) in the equation

$x_1 = c_1 + c_2 e^{-\frac{k}{m}t}$

The specific solution is then followed by

$x_2 = M \sin\beta + N \cos\beta$ (3.11)

(3.11) we define the values of M and N by putting the equation (3.8) at parity

$\dot{x}_2 = M \cdot \cos\beta - N \cdot \sin\beta\,; \ddot{x} = -M \cdot \sin\beta - N \cdot \cos\beta$

$-m \cdot M \cdot \sin\beta - m \cdot N \cdot \cos\beta + k \cdot M \cdot \cos\beta - k \cdot N \cdot \sin\beta = f \cdot g \cdot \sin\beta$

$$\begin{cases} -m \cdot M - k \cdot n = f \cdot g \\ -m \cdot N + k \cdot M = 0 \end{cases}$$

$$\Delta = \begin{vmatrix} -m - k \\ -k - m \end{vmatrix} = m^2 + k^2$$

$$\Delta_M = \begin{vmatrix} f \cdot g & -k \\ k & 0 \end{vmatrix} = k^2$$

$$\Delta_N = \begin{vmatrix} -m & -f \cdot g \\ k & 0 \end{vmatrix} = -k \cdot f \cdot g$$

$$M = \frac{\Delta_M}{\Delta} = \frac{k^2}{m^2 + k^2}; N = \frac{\Delta_N}{\Delta} = \frac{-k \cdot f \cdot g}{m^2 + k^2}$$

We put the values of M and N (3.10) in the equation

$$x_2 = \frac{k^2}{m^2 + k^2} \cdot \sin\beta - \frac{k \cdot f \cdot g}{m^2 + k^2} \cos\beta$$

general solution

$$x = x_1 + x_2 =$$

$$x = c_1 + c_2 e^{-\frac{k}{m}t} + \frac{k^2}{m^2 + k^2} \cdot \sin\beta - \frac{k \cdot f \cdot g}{m^2 + k^2} \cdot \cos\beta \quad (3.12)$$

(3.12) we find the constant values of S_1 and S_2 in the equation using the initial cordinate.

$t = 0 x = 0, \dot{x} = 0$ from this

$$\begin{cases} 0 = c_1 + c_2 - \dfrac{k \cdot f \cdot g}{m^2 + k^2} \\ 0 = -\dfrac{k}{m} c_2 + \dfrac{k^2}{m^2 + k^2} = 0 \end{cases}$$

$$c_2 = \frac{k \cdot m}{m^2 + k^2}$$

$$c_1 = \frac{k \cdot f \cdot g}{m^2 + k^2} - \frac{k \cdot m}{m^2 + k^2} = \frac{k(f \cdot g - m)}{m^2 + k^2}$$

We put the defined values S1 and S2 (3.11) in the equation.

$$x = \frac{k(f \cdot g - m)}{m^2 + k^2} + \frac{k \cdot m}{m^2 + k^2} \cdot e^{-\frac{k}{m}t} + \frac{k^2}{m^2 + k^2} \cdot \sin\beta - \frac{k \cdot f \cdot g}{m^2 + k^2} \cos\beta \quad (3.13)$$

(3.13) the equation represents the movement of the wool fiber in a tube mounted on an elastic element. We analyze this equation in graphs using the Maple Program [2].

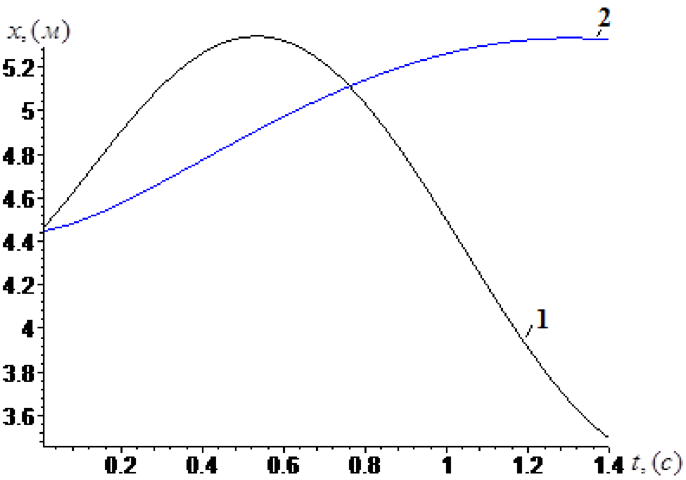

Figure 5. In the motion of the wool flow in vibration along the axis of OX in the oblique list, the amplitude of different $A_1 = 0{,}9$ $A_2 = 0{,}7$ $A_3 = 0{,}5$ time dependence graph in values (1-Light impurity, 2-jun)

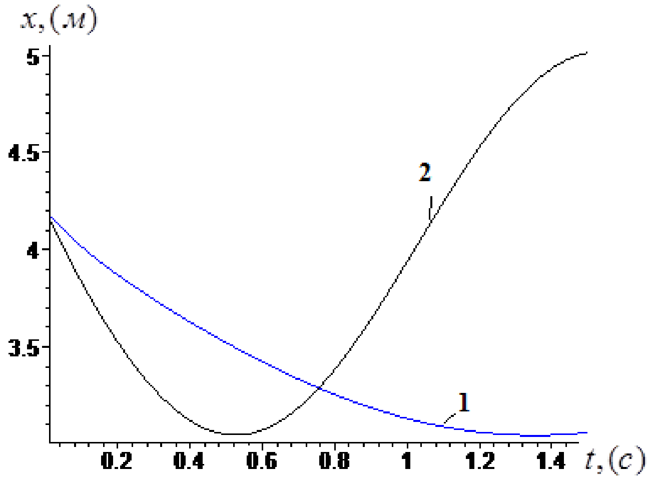

Figure 6. In the motion of the wool flow in vibration along the axis of the OX in the oblique list, the angle of the slope is different $\beta_1 = 25^0$ $\beta_2 = 35^0$ $\beta_3 = 45^0$ time-dependent graph in values (1-jun, 2-Light impurity)

In the graphs in Figures 5 and 6 above, the trajectories of the motion of the wool along the axis over the sloping grid surface are given. When separating from small impurities in the wool, we can see the trajectory of the downward separation of light impurities from the wool at the value of the amplitude of the vibration as well as at the values of the slope angle. One can see the separation of the mass of light dirt from the mass of the wool from the movement of the wool on the axis of the inclined plane under the influence of the amplitude in vibration, the mass is important in the separation of very small light impurities from the wool at the angle of slope and amplitude.

RESEARCH RESULTS

Slant-toothed supply valves with a diameter of 200 mm are 0-14 r/min depending on each other. spinning at speed, the wool in the bunker gets tangled and carried away. The number of rotations is reduced due to the increase in the diameter of the supply roller, the fiber carrying surface is expanded, as a result of which the wool fiber is wrapped in the shaft is expected to be obtained. 12 teeth are mounted on the VA at a slope of 70° degrees, and a process of removing fiber from the bunker, without interruption to the equipment, is provided.

The supply rollers take the wool fiber out of the bunker and transfer it to the smooth-surface pressing roller and small roller [3].

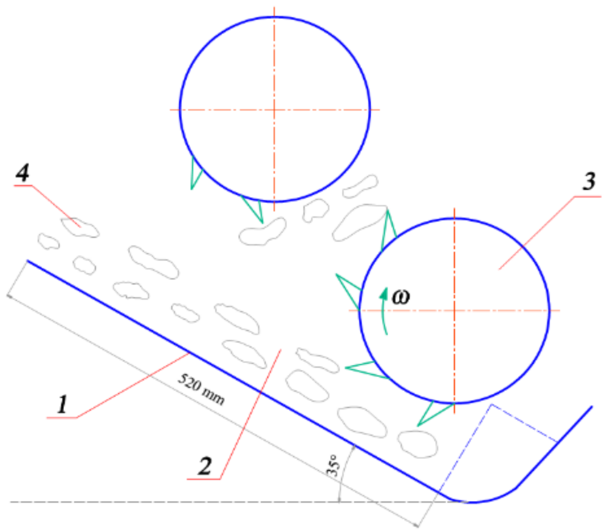

Figure 7. Scheme of the proposed supply mechanism

1-vibrating grille; 2-raw material Bunker; 3-supply valve; 4-wool;

These rollers normalize the tangle of the fiber and throw it into a dense working chamber. In the working chamber, the woolen fiber is titib-cleaned using a pile drum and a colosnik grid. The shaken and cleaned wool fiber falls into the brushed drum through the exit novi is transmitted to the next washing process.We cite the movement of the wool flow transmitted to the bunker in ensuring the transmission process without interruption in the supply rollers. We first bring up the equation of motion of the deformable wool in the bunker:

We define the differential equation of motion of a time-varying wool flow. In this case, we construct the differential equation in the result of the strength of elasticity and the force of gravity acting on the flow of wool falling into the bunker.

$$m \cdot \ddot{y}_1 + C \cdot y_2 = C \cdot h - G \qquad (3.14)$$

Where: s is the biker coefficient of wool, G is the weight force of wool, h is the height of the bunker, m is the mass of wool falling into the bunker. This divides the differential equation by mass and yields the following expression. $\ddot{y}_2 + \frac{c}{m} \cdot y_2 = \frac{c}{m} \cdot h - \frac{G}{m}$ (3.15)

(3.15) the general solution to the differential equation is

$$A \cdot \cos\sqrt{\frac{c}{m}}t + \mathrm{B} \cdot \sin\sqrt{\frac{c}{m}} + \frac{c \cdot h}{m\omega^2 - c} \cdot \cos\omega t + (\frac{G}{m} + h) \qquad (3.16)$$

Using the initial conditions we define the values of the invariant A and B

$$t = 0;\ y_2 = 0; \ddot{y}_2 = 0 \quad ; \qquad (3.17)$$

$$A = \left(-\frac{c \cdot h}{m \cdot \omega^2 - c} + h + \frac{G}{m}\right) \qquad B = 0 \qquad (3.18)$$

by putting the fixed values (3.14) at parity, we define the expression of the change in the wool layer in the bunker.

$$y_2 = -\left(\frac{c \cdot h}{m \cdot \omega^2 - c} + h + \frac{G}{c}\right) \cdot cos\sqrt{\frac{c}{m}}t + \frac{c \cdot h}{m \cdot \omega^2 - c} \cdot cos\,\omega\, t + h + \frac{G}{c} \qquad (3.19)$$

(3.19) from the equation of motion, the saw was analyzed in graphs using the Maple program for its motion in the hook using gear shafts. Parameters given: h=10 mm, S=0.05, m=15 kg, $\omega = 0{,}14ayl/min$

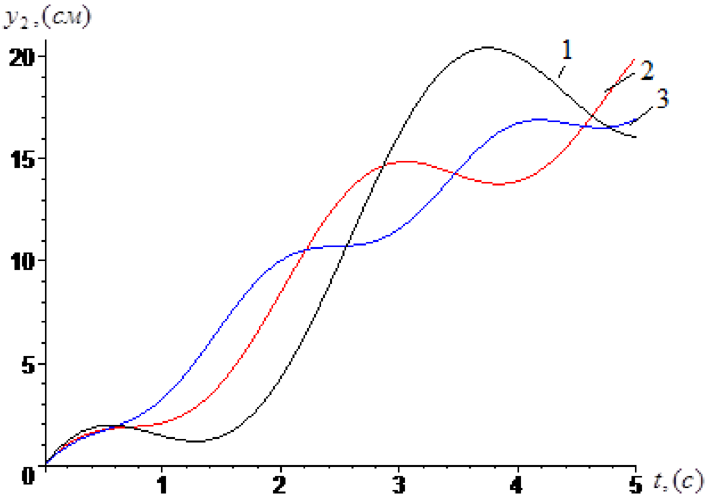

Figure 8. When transmitting wool fibers using rollers supplying them from the bunker, the angular velocities of the shafts are varied $\omega_1 = 22ayl/min$ $\omega_2 = 18 айл/мин$ $\omega_3 = \frac{14ayl}{min}$ time dependence graph in values

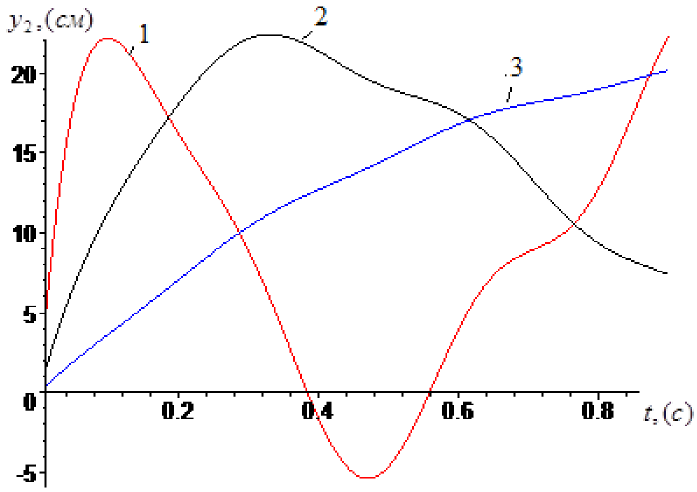

Figure 9. In the transfer of wool fibers from the bunker with the help of the supply rollers, the mass of the bunker is varied $m_1 = 15gr m_2 = 25gr\ m_3 = 35\ gr$ time dependence graph in values

CONCLUSIONS

From the analysis of the graphs in Figures 8 and 9 above, we can see that in providing continuous transmission to smooth-surface suppressing Rollers by means of rollers providing the flow of wool falling into the bunker, the angular velocities of the shafts are ω_3=14ayl/min and the wool fibers in the bunker are provided in sufficient moderation at equal masses m_3=35gr. In this we can see the uniform transmission from the graphs. In other cases, however, it can be observed that the rollers wrap the fibers in the rollers, through which congestion can occur.

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