# THEORETICAL ANALYSIS OF FIBER MOVEMENT IN ROCK PILES

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***Abstract:*** *This article presents theoretical analyses of the movement of fibers in inclined piles in a local wool fiber combing and cleaning equipment, and presents graphical representations and theoretical equations using the Maple program.*

***Keywords:*** *Mesh surface, wool, fiber, dirt, drum with pegs, stationary, cleaning.*

**Introduction.** Let us assume that the fiber flow moves along the mesh surface and the process of separating impurities from the fiber bundles occurs under the impact of the impact of the transfer of the movement through the inclined slots. The efficiency of cleaning small and large impurities from the fiber flow passing through the mesh surface due to the rotational movement in the inclined slots does not change when the flow velocity and density are increased by the same percentage. The flow parameters from the drums are the speed, density and pressure, respectively υ, $\rho$, R we define with. As a result of the interaction of the flow with the piles on the mesh surface, a certain amount of pressure R acts on the flow. In this case, the flow moving along the mesh surface ds=Rdα It is possible to write the following Euler equation for the element.

$$v\rho\frac{dv}{d\alpha} = -\frac{dP}{d\alpha} + \rho gS\sin\alpha - SNf \qquad (2.29)$$

where α-is the pole angle, S-is the arc length of the inclined pile, f-is the coefficient of friction between the mesh surface and the fiber flow, and N-is the normal force generated on the mesh surface.

$$N = \frac{\rho v^2}{S} + \rho g S \cos\alpha \qquad (2.30)$$

If we substitute the normal force expression in formulas (2.30) into (1),

$$v\rho \frac{dv}{d\alpha} = -\frac{dP}{d\alpha} + \rho g S \sin\alpha - S\left(\frac{\rho v^2}{S} + \rho g \cos\alpha\right) \cdot f \qquad (2.31)$$

Equation (2.31) is given by additional conditions

I) The equation assumes a linear relationship between density and pressure.

$$\rho = \rho_0(1+\mu(P-P_0)) \qquad (2.32)$$

where ρ0,R0-is the density and pressure of the cotton raw material before entering the cleaning zone, μ-is an experimentally determined coefficient, which is the inverse of the bulk compressibility modulus of the raw material k. (2.32) is considered valid in all zones of the pore flow.

II) In a stationary flow, the mass does not change per unit of time, which determines the law of conservation of mass.

$$Q_0 = \rho_0 v_0 z_0 L = \rho v z L \qquad (2.33)$$

where z0-is the thickness of the fiber stream, ρ, v, z-are the density, velocity and thickness of the wool fiber stream in the inclined pile arc of the cleaning zone; L1-is the shaft length.

In the calculation process, we assume that the thickness of the fiber stream z is constant, since the fiber flowing through the inclined pile drum is distributed in a uniform plane. Assuming z=z0, we express the density and pressure velocity v using equation (2.33).

$$\rho = \frac{v_0\rho_0}{v}, \quad P = P_0 - \frac{1}{\mu}\left(\frac{v_0}{v} - 1\right) \qquad (2.34)$$

Substituting equation (2.34) into expression (2.31), we obtain the following equation for the velocity

$$v\rho\frac{dv}{d\alpha}=-\frac{1}{A\cdot v_0}\cdot\frac{dv}{d\alpha}=\rho gS(\sin\alpha-f\cos\alpha)-\rho v^2 f \qquad (2.35)$$

$$\left(1-\frac{1}{v_0^2 A\rho}\right)\frac{dv}{d\alpha}=\frac{gS}{v}+(\sin\alpha-f\cos\alpha)-v\cdot f$$

Multiplying (2.35) by the velocity v, we obtain a linear equation for the function y = v2(x). $T=\frac{v_0}{c_0}$ $c_0=\sqrt{\frac{1}{A\cdot\rho_0}}$ - speed.

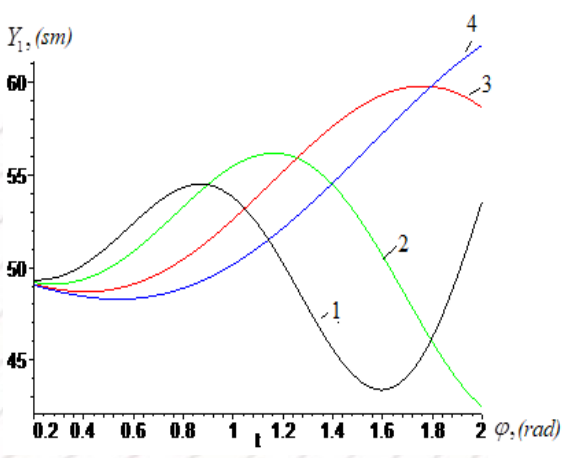
$$\left(1-\frac{1}{T^2}\right)\frac{dv}{d\alpha}\cdot v=gS(\sin\alpha-f\cos\alpha)-v^2\cdot f \Rightarrow \frac{dy}{d\alpha}+k_1Sy=k_2(\sin\alpha-f\cos\alpha) \qquad (2.36)$$

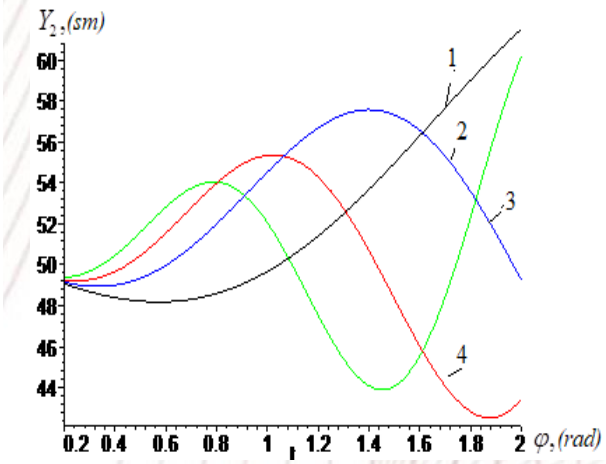
here: $k_1=\frac{2T^2 f}{T^2-1}$, $k_2=\frac{2gT^2}{T^2-1}$

If we define the angles at which the inclined piles are installed from equation (2.36) as φ = φi-1 (i=1,2…n) and assume that the flow has a velocity v=vn at φ = φi-1 as a result of the inclined pile impacts, the equation for the fiber flow passing through the drum becomes as follows:

$$y=e^{-k_1S(\varphi-\varphi_{i-1})}\cdot(v_k^2+k_2(\sin\alpha-f\cos\alpha)) \qquad (2.37)$$

The equation of dependence of fiber flow velocity on the length and angle of the inclined pile and the coverage was determined. It was analyzed graphically using the Maple program.



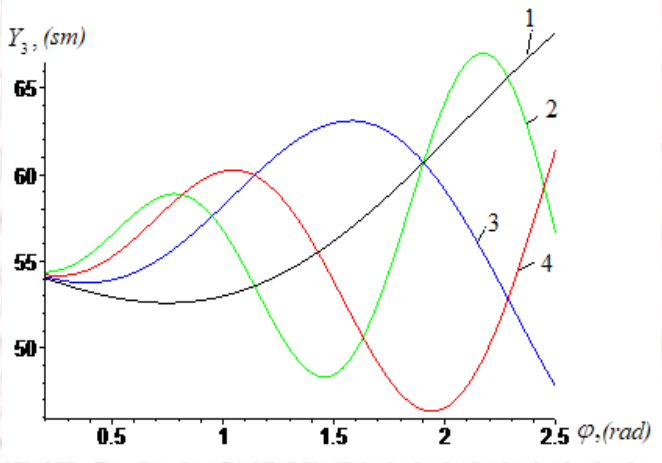



**Figure 2.14.** Different bevel gear angles in separating impurities from a wool fiber stream $\beta_1 = 15^0$ $\beta_2 = 20^0$ $\beta_3 = 25^0$ graph of values

According to the A.T. Sevostyanov model, the decrease in mass of impurities as a result of their separation is determined by the following law: differential dm.

$$\frac{dm}{m} = \lambda \frac{dP}{P} \qquad (2.38)$$

where λ is an experimental coefficient. We integrate equation (2.11) under the condition ρ(α)=ρ0. This experimental coefficient λ is a coefficient related to the impurities released from the fiber due to the fact that the working zone of the mesh surface of the drum with different sizes of inclined piles is in the same layer.

$$m = m_0 \left( \frac{\rho}{\rho_0} \right)^{\lambda} \qquad (2.39)$$

where m0-is the mass of the fiber bundle not cleaned of impurities in the cleaning zone.

We apply formula (2.39) for a drum with inclined piles. That is, the decreasing mass is obtained by (2.12) for the interval α0<α<α1.

$\varepsilon_1 = 1 - \frac{m_1(\alpha)}{m_0}$ We assume that the expression is the cleaning efficiency of the fiber flow.

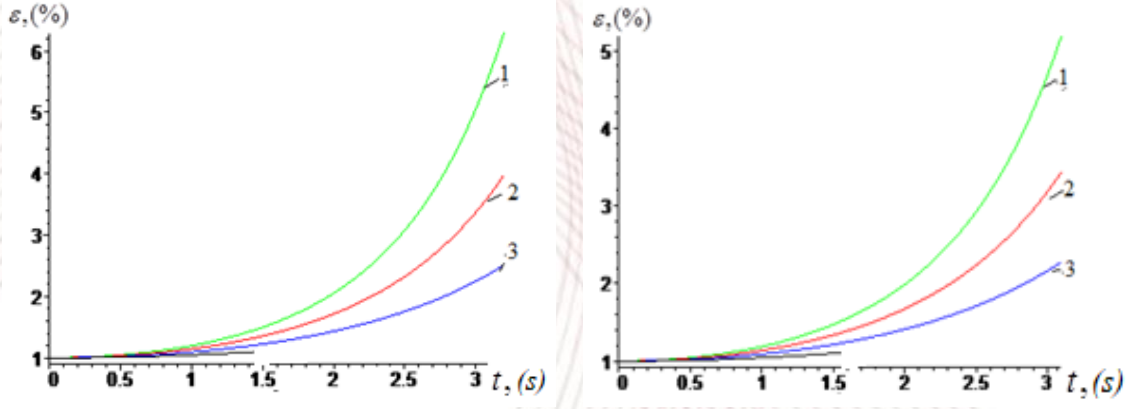
This difference is the ratio of Δm1=m0-m1(α1)

$$\frac{\Delta m_1}{m_0} = 1 - \varepsilon_1(\alpha_1)$$

The relative amount of impurities separated from the fiber stream in the interval (α0<α<α1) in the inclined pile drum is

(Using equation (2.39), graphs of the dependence of the efficiency coefficient on the friction coefficient and the mass of the fiber flowing through the inclined pile drums were analyzed using the Maple-6 program.

$f = 0.2$ $f = 0.4$




$$\lambda_1 = 0.1, \lambda_2 = 0.2$$

**Figure 2.15.** Graphs of the change in the efficiency coefficient over time for two values of the friction coefficient.

**Conclusion:** The graphs above show the dependence of the efficiency coefficient, friction coefficient, and slope angle of the inclined pile on the separation of impurities from the fiber stream.

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