EMJ MS
EUROPEAN MULTIDISCIPLINARY JOURNAL OF MODERN SCIENCE
ISSN 2750-6274 https://emjms.academicjournal.io Volume: 9 | August-2022

Theoretical Study of the Process of Transferring Cotton from the Long Pile Drum to the Saw Drum in a Cotton Raw Material Cleaner

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Abstract: The article presents a theoretical analysis of the movement of cotton from the improved working parts of the machine for cleaning cotton from large impurities. rational values can be determined.

Keywords: Machine picker, cleaner, long pile, drum, dirt, large impurity.

In recent years, the issues of picking cotton by machine have become one of the major issues in our Republic, and great attention is being paid to reducing cotton-picking by hand and accelerating the mechanization of cotton-picking process. If we take into account that the amount of large impurities in machine-picked cotton increases up to 30-40% [1] compared to total impurities, ensuring the quality indicators in the cleaning of actual cotton from large impurities at the level of standard requirements remains an actual problem today.

A scientific solution was proposed by the scientists of JSC "Cotton Industry Research Center" and the author in order to improve the PT-10 machine for cleaning raw cotton picked by machine from large impurities [2].

The developed scientific solution is to divide the cotton into two parts after it has been threshed by only one pile drum and to install two saw cylinders in the cleaning section of the cleaner. [3]. After the cotton is well separated in the drum with a long pile, the separation of the cleaner into the upper and lower drums is improved, so we will theoretically analyze the movement of the cotton flow in the cleaner under the influence of the drums with piles, passing through two supply rollers.

It is aimed at increasing the efficiency of cleaning by reducing cotton jams in the initial cleaning process by ensuring that a part of the flow passes through the diverter under the influence of the pile drum to the cleaning saw drum, and the rest falls into the second cleaning saw drum through the slot between the saw drum columns and the cleaning drum housing.

First, the cotton stream moves along a curved line (Fig. 1). Let's look at the equation along the curve from the polar coordinate system. That is, the flow of cotton consists of a rotational movement under the influence of the pile, so the dependence on the angle of rotation of the pile is given as variable parameters $h = h(\varphi)$.

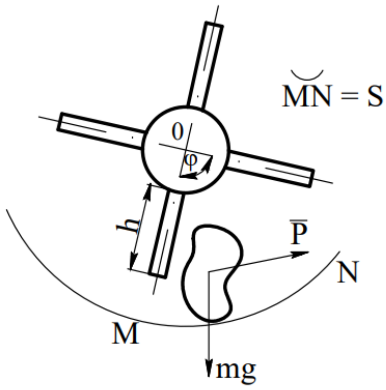

Figure 1. The movement of a piece of cotton along the contour

We assume that the mass of a piece of cotton is constant and we use the equation of its movement on a curve and the equation of S.M.Torg to express the normal [4, 5]:

$$\frac{d^2S}{dt^2} = P + m \cdot g \cdot \sin\alpha \quad (1)$$

The force of gravity acting on the piece of cotton in the direction of the test, the impact force acts on the falling force. A piece of cotton partially dampens the force of the impact.

Therefore, we can make this force proportional to the difference between the speeds of the cotton ball and the pile.

$$P = -f \cdot N + k \cdot (\vartheta_0 \cdot t - S) + \eta \cdot (\vartheta_0 - \dot{S}) \quad (2)$$

where: f – coefficient of friction; v0 is the linear speed of the pile; k, η - coefficient of elasticity and viscosity.

Putting equation (2) into equation (1), we construct the differential equation of motion of the cotton flow along the curve MN.

$$m \cdot \ddot{S} = -f \cdot N + k \cdot (\vartheta_0 \cdot t - S) + \eta \cdot (\vartheta_0 - \dot{S}) \cdot m \cdot g \cdot \sin\alpha \quad (3)$$

From equation (3), we express the differential relationship between the distance S and the polar angle φ

$$\dot{S} = \dot{\varphi} \cdot \sqrt{h^2 + \dot{h}^2} \quad (4)$$

From equations (3) and (4), we use the bound conditions to determine the movement of cotton particles on the surface of the pile S=S(t) and the angle φ = φ (t)

$$S(0) = 0 \quad \dot{S} = \vartheta_n \quad \varphi(0) = 0$$

here: ϑ_n – cotton speed.

Cotton is located between the mesh surface and the pile, and its movement is complicated.

Parameters from equation (3). $f = 0.3, v_0 = 10\,м/c,\ \varphi = 100^0,\ \ \omega = 15\,рад/c$ For the prices, the cotton flow angle speed is different at different values of vp $\dot{\varphi}(t)$ is calculated and the finite solution of equation (3) is determined in the Maple program. Figures 3 and $4MN = \check{S}$ graphs of cotton flow along the year at various values of vp are presented.

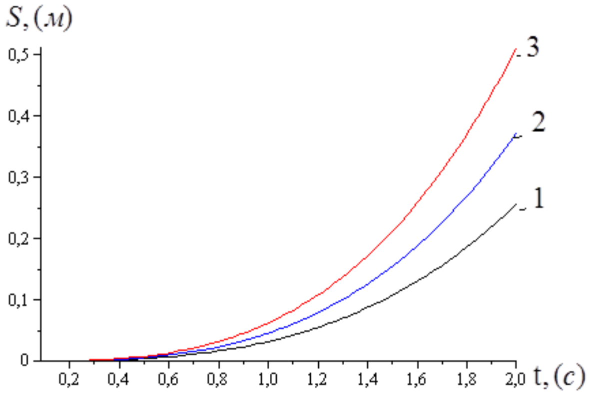

Figure 3. A plot of the cotton stream as a function of the rotation speed of the pile drum and the change of the distance of the cotton stream discharge at different values. $\vartheta_{n1} = 12$ м/с $\vartheta_{n2} = 15$ м/с $\vartheta_{n3} = 18$ м/с.

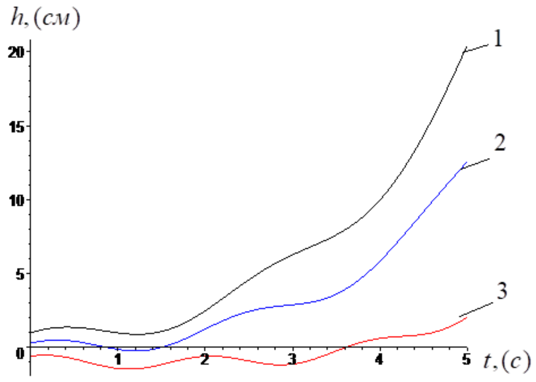

Figure 4. Variation of the speed of rotation of the drum with a pile of cotton along the surface of the pile depending on the productivity of work on cotton $\omega_1 = 600\,мин^{-1}$ $\omega_2 = 500\,мин^{-1}$ $\omega_3 = 400\,мин^{-1}$ **productivity of cotton at different values.**

From the analysis of the graphs in Figures 3 and 4, it is possible to determine the rational values of the pile length of the pile drum and the angular speed of the pile drum depending on the performance of the machine.

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