THEORETICAL STUDY OF RAW COTTON TRANSPORTATION PROCESS ON THE SUBMISSION AND DISTRIBUTION DEVICE

XAYRIDIN RAKHMONOV, PH.D.,
ADYL SAFAROV, PH.D.

Bukhara Technology Institute
of Food and Light Industry, Uzbekistan

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Abstract: The transportation of raw cotton in many respects is carried out through rotating screws or moving tapes. The study considers influence of raw cotton humidity on increase of friction factor during transportation process using submission and distribution device. It is shown that increase of humidity of raw cotton within the limits of 11 up to 38% is accompanied by surge of static and kinetic frictions. The research is executed by experimental methods on the special stand with use of strain measurement.

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Improving of technology of transportation, drying and distribution of a cotton, as well as validating geometrical and kinematical parameters of raw cotton transportation device requires studying of respective theoretical issues.

The process of transportation of raw cotton is carried out through rotating screws or moving tape. Much studies are devoted to examination of raw cotton internal friction on various surfaces

The size of resistance to shift of raw cotton defines size of internal friction and cohesion (Figure 1) and it is described by the following equation:

$$\tau = \tau_0 + q_n \cdot tg\varphi_c \text{, n/m}^2 \qquad (1)$$

where, τ_0 - internal friction of raw cotton; q_n - normal pressure of raw cotton. We know that the dependence between resistance to shift of raw cotton and normal pressure is expressed by the following empirical equation:

$$\tau = q_n \cdot tg\varphi + \text{c},$$

Where c - structural texture of raw cotton. The resistance to shift of raw cotton, depending on density, is experimentally determined by the following equation (Rakhmonov, 2009):

$$\tau = m_\lambda \cdot e^{n_4} \cdot \rho,$$

m_λ and n_4 - constant dependent from humidity of raw cotton.

We shall consider a general case of transportation of raw cotton (simulated as visco-elastic mechanical system) by load-transporting machine (Figure 1) making movement directed under corner β to load imposed under a corner α to horizon of cargo bearing organ.

General energy expenses connected with process of machine transportation of raw cotton will be:

$$W = \frac{1}{\Delta}\left[\int_{\delta_n}^{\delta_0} T^+ ydt + \int_{\delta_H}^{\delta_k} F^{\pm} xdt + \int_{\delta_{n_o}}^{\delta_{r_o}} F_o ydt\right] \qquad (2)$$

where, Δ - duration of a motion cycle; T^+, $F^{\pm}$, F_o - working and normal shift forces; δ_0, δ_k, δ_n, δ_{r_0}, δ_{n_0} and δ_H - top and bottom intensities of working force duration.

With the help Lagrange equation of second kind we can write down the equations of raw cotton movement on a site of elastic deformation on mobile axes XY:

$$m\ddot{y} = -m\ddot{y} - mg\cos\alpha - c_y\dot{y} - k_y y + \Phi_y$$

$$m\ddot{x} = -m\ddot{x} - mg\sin\alpha - c_y\dot{x} - k_x x - c_x(\ddot{x} + \dot{x}) + \Phi_x \qquad (3)$$

$$\ddot{y} = d^2y/dt^2; \quad \ddot{x} = d^2x/dt^2; \quad \dot{x} = dx/dt; \quad \dot{y} = dy/dt.$$

where, m - weight of raw cotton; k_y, k_x - rigidity factor of elastic elements; c_y, c_x - factors of friction; Φ_y and Φ_x – occurring external kinematical influences.

The examination allowed to establish that the increase of humidity of raw cotton in bounds from 11% up to 38% is accompanied by increase of friction coefficients - both static and kinetic. With increase of specific loading on raw cotton, the size of factor of friction reduces, and with increase of speed of sliding of a surface from 0 up to 0.54 m/s, factor of friction reduces rather sharply.

The further increase of speed is accompanied by insignificant decrease of factor of friction which approaches to some constant size. Systems of the differential equation are solved numerically by method of Rung-Kut. Dependence ΔP (pressure) from speed υ is given in a Figure 2. From the figure it is clear, that ΔP strongly depends on internal friction of raw cotton (humidity, contamination, etc.).

The carried out research with composite polymeric coverings of transporting tools has shown that with increase of speed up to the certain size for all normal pressure factor of friction raises, and then lowers a little and accepts gradual meaning. With increase of humidity till 14-16% the factor of friction raises, and then with the further increase of humidity causes its reduction.

FIGURE 1. VISCOELASTIC MODEL OF RAW COTTON, WHERE: O'X'У' - MOBILE SYSTEM OF COORDINATES; OXУ - MOTIONLESS SYSTEM OF COORDINATES

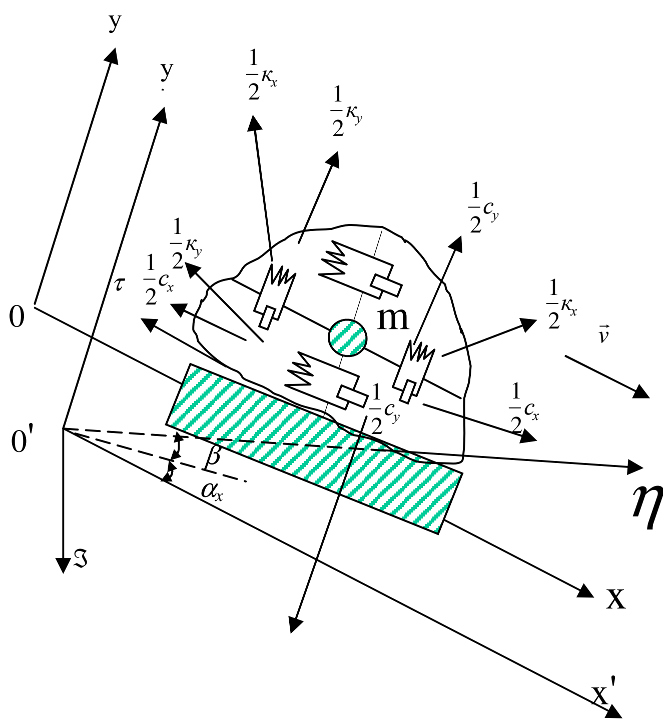
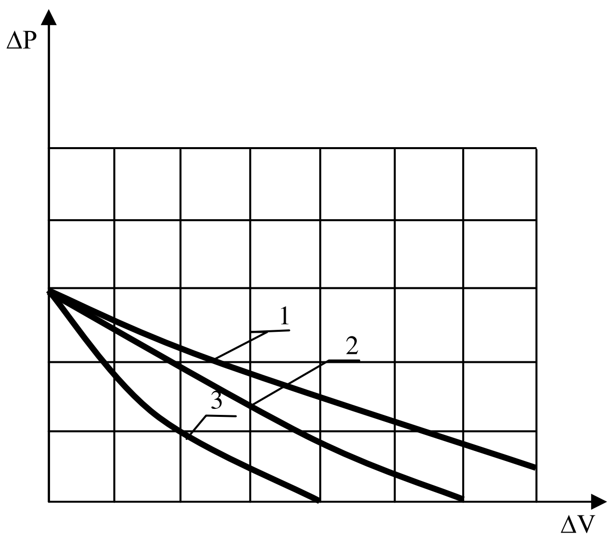


FIGURE 2. DEPENDENCE OF PRESSURE OF RAW COTTON ON SPEED (1- KX=KУ=0.001; 2- KX=KУ=0.01; 3 - KX=KУ=0.1)



References

Endlich ,W., 1982. "Praxisorien Dimensionierungs-methode fur geklebte Welle-Nabe-Verbindungen," Antriebstechnik, No9, pp.434-441.

Maas, H., 1980. "Der Pressverband,"Technica, No21, pp.1829-848.

Niemann, G., Winter, H., 1983. Maschienenelemente. Springer Verlag, Berlin, Heidelberg, New York.

Rakhmonov, X., 2009. "The analysis of compelled fluctuations of lever of chute of the device for distribution of raw cotton," Problems of textile, No2.