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PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

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ANALYSIS OF LOAD CHANGES IN THE CHAIN DRIVE DURING THE DRYING PROCESS OF COTTON FALLING FROM THE LONGITUDINAL SHELVES OF THE DRUM

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Abstract:

Objective. The results of a theoretical study of the load change in the developed chain drive with uneven rise and fall of dried raw cotton by longitudinal shelves inside the 2SB-10 drum during the drying process.

Methods. In the process of research, the principles of higher mathematics and theoretical mechanics, special and modern methods of measurement, evaluation, comparison, methods of mathematical statistics and computational mathematics, computer software were used to assess the differential equations.

Results. Differential equations are derived for determining the torque, the required power of the electric motor and for choosing the brand of the chain.

Conclusion. Based on a theoretical study, it can be concluded that the calculated design scheme of a drum dryer with a chain drive made it possible to derive differential equations for determining the torque, the required power of the electric motor and for choosing the chain brand.

Keywords: dryer drum, raw cotton, load, blades, rolling, torque, process, formula.

Introduction. It is known that when the top point of the dryer drum is reached, the raw cotton captured by its blades begins to fall down [1, 2, 3], while the load on the chain tension of the developed chain drive temporarily drops, and when it falls completely down, such a fluctuation in the chain tension does not preferably, to eliminate this effect, the use of a brake mechanism is proposed.

Suppose there is a load of mass m on the blade. It is located in a uniform layer, after which it rises to a height until the friction angle reaches equilibrium. Then the raw cotton will begin to roll down, and gradually.

Methods. We derive formulas for determining the speed and movement of raw cotton when moving along the blades when lifting. To do this, we compose a differential equation (Fig. 1) [4, 5]:

$$m\frac{dv}{dt} = mg\sin\alpha - fmg\cos\alpha \tag{1}$$

where: m- is the weight of the cargo, kg;

f - is the coefficient of sliding friction of the load along the plane.

Let us integrate equation (1) twice under the initial conditions

t = 0, v = v0, s = 0 we get:

$$v = \frac{g\sin(\alpha-\varphi)}{\cos\varphi} \quad (2)$$

$$l_{пл} = \frac{g\sin(\alpha-\varphi)}{2\cos\varphi}t^2 - v_0 t \quad (3)$$

where: v0 – is the speed of the load at the moment of arrival on the plane, m/s

φ –angle of sliding friction of the load along the plane.

lпл – blade length

Analysis of formulas (2) and (3) reveals the following features in the nature of the movement of cargo particles along an inclined plane:

- if <, then the speed of the load while moving along the blade decreases uniformly and eventually becomes equal to 0 at the beginning of the rise,

- if >, then the speed of the particles of the load when moving along the plane increases evenly, in the case of the end of the ascent.

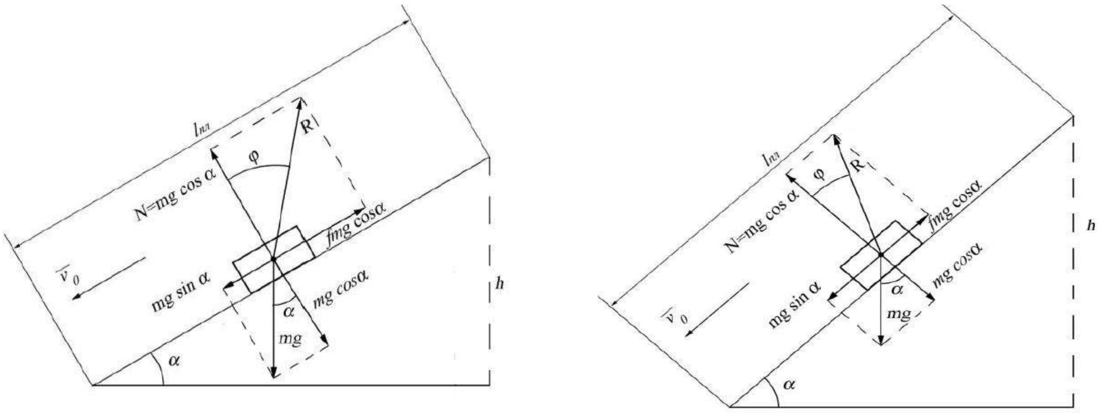

Fig.1. Calculation schemes for determining the speed and movement of raw cotton along the blades of the dryer drum during lifting

Let us denote the speed of the particles of the load at the moment of leaving the plane as *v* out.

From equation (2), assuming v = v out, we determine the time of particle motion along the inclined plane [6]:

$$t_в = \frac{(v_{вых} - v_0)\cos\varphi}{g\sin(\alpha-\varphi)} \quad (4)$$

Considering that the movement is in the drum, the initial speed will be equal to zero, then (4) will take the following form:

$$t_в = \frac{v_{вых}\cos\varphi}{g\sin(\alpha-\varphi)} \quad (5)$$

Using equation (2), we find the time of passage of raw cotton if it is at the base of the blade:

$$t_в = \sqrt{\frac{2l_{пл}\cos\varphi}{g\sin(\alpha-\varphi)}} \quad (6)$$

Results. At what we will change the time, since the angle will change taking into account the rotation of the drum.

Knowing the angular ω velocity of the drum, we can write (6) in the following form.

$$t_{в}=\sqrt{\frac{2l_{пл}\cos\varphi}{g\sin(\omega t-\varphi)}} \qquad (7)$$

And since a change in angle leads to a change in time, so the speed will change.

$$v=\frac{g\sin(\omega t-\varphi)}{\cos\varphi} \qquad (8)$$

The slipping of the total mass of raw cotton from the blade will occur in the time:

$$t_{в}=\sqrt{\frac{2dx\cos\varphi}{g\sin(\omega t_{в}-\varphi)}} \qquad (9)$$

$$dt_{в}^{2}\sin(\omega dt_{в}-\varphi)=\frac{2dx\cos\varphi}{g}$$

We integrate both parts of the equation and get the following:

$$\frac{\cos(\varphi-\omega t)(\omega^2t^2-2+2\omega t)}{\omega^3}=\frac{2l_{лп}\cos\varphi}{g} \qquad (10)$$

So for $\varphi-\omega t$ the boundary conditions is comparable to 0, $\cos(\varphi-\omega t)$ then we equate the values to 1 in this case, equation (10) can be represented as:

$$\omega^2t^2+2\omega t-\frac{2l_{лп}\cos\varphi\omega^3}{g}-2=0 \qquad (11)$$

Solving equation (11) we obtain the following

$$t_{1,2}=\frac{-\omega\pm\omega\sqrt{g+4l_{лп}\cos\varphi\omega^3}}{\omega^2\sqrt{g}}$$

Since the angular velocity cannot be negative, and the time cannot be less than zero, we leave only one root of the equation

$$t=\frac{-\omega+\omega\sqrt{g+4l_{лп}\cos\varphi\omega^3}}{\omega^2\sqrt{g}} \qquad (12)$$

Having the time of slipping of raw cotton from the blade and its finished speed during the tearing, one can find the regularity of the dynamics of the chain tension

The tension of the chain at full load until the cotton falls off will be equal to

$$F_{натя}=\frac{2M_{кр}}{D_{цепи}} \qquad (13)$$

When raw cotton falls, the tension will change according to the following formula

$$F_{натяж}=F_{натяж}-F(t) \qquad (14)$$

where: $F(t)$ - changes in force depending on the rolling of the load

And, in turn, from the torque, which is also expressed through the function

$$M_{кр}=M_{кр}-M(t) \qquad (15)$$

find the function of changing the moment in time. As already mentioned, it will change from a change in the mass on the blades.

Let us assume that the blades are completely filled and a layer of raw cotton lies on them in an even layer.

Then the total mass x / s will be equal to

$$m=L*h*L_{бараб}*\rho \qquad (16)$$

Then the moment affected by the rise of raw cotton will be equal to

$$M_0 = \left(R - \frac{L}{2}\right) * m * g \qquad (17)$$

Let's select a small section along the width of the blade, which moves depending on the angle that the bar occupies during the rise (8).

Let us now introduce the initial position at which the raw cotton begins to mix, let this be the angle, then equation (8) can be written in the following form for the selected area:

$$v(t) = \frac{g\cos(\alpha + \omega t - \varphi)}{\omega \cos\varphi} \qquad (18)$$

The mass will change as the raw cotton increases according to the following relationship

$$L(t) = L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega \cos\varphi} t \qquad (19)$$

Substituting formula (19) into (16) we obtain the following

$$m = \left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega \cos\varphi} t\right) t * h * L_{бараб} * \rho \qquad (20)$$

To calculate the torque, it must be taken into account that the point of application of the force will also change according to the following law [6,7]:

$$L(t) = \left(R - \frac{(L - v(t)t)}{2}\right) \qquad (21)$$

Discussions. We substitute the obtained data into formula (15) and obtain the following dependence

$$M_{кр} = M_{кр} - \left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega \cos\varphi} t\right) t * h * L_{бараб} * \rho * \left(R - \frac{\left(L - \frac{g\cos(\alpha + \omega t - \varphi)}{\omega \cos\varphi}\right) t}{2}\right) \qquad (22)$$

Let us substitute the numerical data, and take the time data from equation (12). Take the drum diameter 3.2 m, drum length 10 m, blade height 0.5 m, raw cotton bulk thickness 0.2 m, raw cotton density ρ = 45 kg/m^3, angular velocity 1 rad/s, friction coefficient 0.3.

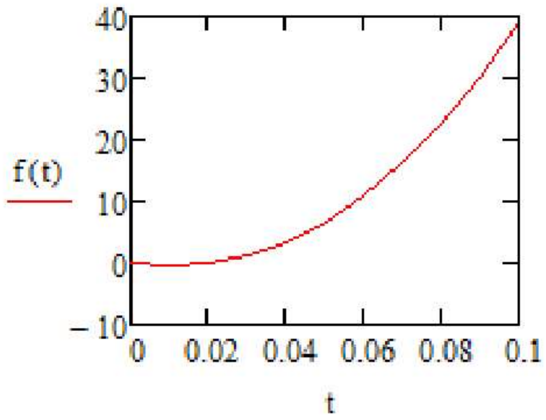

Fig.2. Torque release when raw cotton slides

In Fig.2. the dependence is presented, how the torque changes in time when the raw cotton slides from the slats. Moreover, the torque decreases, this can cause unwanted jerks, which will be transferred to the chain drive and then to the drives of the mechanisms. Given the dynamics of the process, it is possible to plot the change in torque over time and affect the dynamic factor. As mentioned above, to eliminate these jerks, a brake latch is provided in the mechanism. He takes over jerks and extinguishes.

We find the jerk force using the following formula:

$$F_{рыв} = \frac{2M_{осв}}{D} \tag{23}$$

This force will act on the brake latch. In this case, the brake latch axle diameter can be calculated using the following formula:

$$d = \sqrt{\frac{4\left(\mathrm{L}-\frac{g\cos(\alpha+\omega t-\varphi)}{\omega\cos\varphi}t\right)t*h*L_{бараб}*\rho*\left(R-\frac{\left(L-\frac{g\cos(\alpha+\omega t-\varphi)}{\omega\cos\varphi}\right)\mathrm{t}}{2}\right)}{\pi\left[\tau_{срез}\right]}} \tag{24}$$

Additionally, this effect affects the oscillations of the system.

$$\omega = \sqrt{\frac{\pi G D^4}{32 Jl}} \tag{25}$$

where: J - moment of inertia of the drum

Conclusion. Based on a theoretical study, it can be concluded that the calculated design scheme of a drum dryer with a chain drive made it possible to derive differential equations for determining the torque, the required power of the electric motor and for choosing the chain brand. From formula (25), we can conclude that the natural frequency of the drum oscillations is half as much for a drum with a drive in the middle than for a drive of a standard design dryer drum.

The derived dependencies show how the torque changes in time when raw cotton slides from the longitudinal shelves. Moreover, the torque decreases, this can cause unwanted jerks that will be transmitted to the chain drive and further to the mechanism drives. Taking into account the dynamics of the process, a graph of the change in torque over time was obtained, which can affect the dynamic factor. To eliminate these jerks, a brake latch is provided in the drive mechanism. He takes over jerks and extinguishes.

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INFLUENCE AND CHARACTERISTICS OF DRYING MECHANISMS IN LEATHER PRODUCTION ON THE DERMA LAYER

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Abstract:
Objective. The article is devoted to the description of the drying method of liquid liquid vehicles produced on the basis of a joint solution of heat generated by the authors. The number of leather layers, thermophiles properties and sizes. The content of the dried product is focused on the appearance of dried structures with the emergence of communication. The influence of structures that appear on the surface of thermopam of dry drying is noted. When studying the drying processes of various products, the understanding of the physical essence of the process and the possibility of its mathematical dispersion of products and the quality indicators of the finished product are mainly determined by specific structural and rheological changes. For example, in the process of drying heat-resistant materials, chemical and structural deformation changes determine the quality indicators of a dry product [18].

Any phenomena that occur during drying (for example, the formation of structure on the surface, chemical reactions, changes in the shape and size of the dried material, the formation of mass flows in the main part of the material, etc.) will lead to the appearance of some "non-classical" points or areas on drying thermogram (for example, turning points or the fate of a monotonic asymptotic increase or decrease in temperature) [2]. As a result, the shape of the drying thermogram changes significantly.

The kinetics of material heating during drying is often more important than the kinetics of moisture loss for determining the properties of the process and describing its mechanism [1, 6]. Therefore, the type of thermogram is often the most informative in terms of understanding the physics of the process.

When liquid-dispersed systems are dried, a certain structure (for example, a film) is formed on the surface, which leads to a change in the thermophysical properties of the surface of the drying material and, as a result, has a limiting effect. evaporation process, which is clearly reflected in the nature of the thermogram.

Sheep and cattle skins were chosen as the studied leather materials for drying on substrates [2, 3]. The main thermophysical properties of the studied materials are identified.

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