EFFICIENCY MANAGEMENT STUDY OF BUNKER TYPE RECEIVER

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ABSTRACT

It was studied that the effective operation of cotton receiving and transmitting devices depends on the average density of transported cotton with the filling factor. It was found that an increase in the density of transported cotton by 1 m3 will increase labor productivity by 0.8-0.9 t / s, and an increase in the filling factor by 10% will increase labor productivity by 3.7-4.0 t / s. It was studied that the installation of a bunker on a receiving-transmitting device is purposeful and that the control of bunker work efficiency is gravitational, force-acting and combined. It was found that in the gravitational control of the work, the cotton is transferred from the receiving bunker to the conveyor by its own movement, and under the influence of force by means of blade drums, and the combined control involves two methods. The equations were obtained taking into account the forces acting on the distortion of the cotton shear on the control of work productivity by gravity, force and combined method. Theoretical studies have shown that for a conveyor with a width of 800 mm to operate at a working capacity of 30 t / s, its minimum speed must be 1.8 m / s. Research has shown that it is necessary to use pile drums to break the cotton uniformly and transfer the required amount to the conveyor belt. It was found that in order for pile drums to work effectively as dosing devices, it is necessary to theoretically and practically study the operation of pile drums in the form of dosing devices.

KEYWORDS: conveyor, bunker, truck, gravity, power, shear, pile drum, dispenser, volume, cotton, work productivity.

The efficiency of complex mechanization depends on the interdependence of the mechanisms and the state of the process of spinning cotton in the system, ie the state of operation of the cart-receiver-transmission device-belt conveyors. The productivity of the casting is determined by the performance of the belt conveyor, which is the last chain link in the cotton receiving mechanization. The performance of the conveyor is determined using the following formula [1].

$$Q = Q_v \varphi \rho \quad (1)$$

Q_v - volumetric productivity of the conveyor;

φ - Coefficient of filling of the conveyor belt;

ρ - bulk density of cotton.

We can see from the formula that the efficiency of transporters in the reception and transmission of cotton depends on the average density of cotton transported by the coefficient of filling of cotton. The payout ratio is related to the change in work productivity and the ratio of the actual material volume in the transport to the calculated payload volume of the tarn. The increase in work productivity at the same parameters is due to the high uniformity of the cotton in the stream and the maintenance of density.

As an example, the theoretical performance of the TLX-18 conveyor is shown in Figure 1. The theoretical calculation of the productivity of the TLX-18 conveyor showed that the working productivity of the unloaded cotton at a density of 40 kg / m3 and the height of the scraper reaches 37 t / s. An increase in the density of transported cotton by 1 m3 will increase labor productivity by 0.8-0.9 t / s, and a 10% increase in the filling factor will increase labor productivity by 3.7-4.0 t / s. The design parameters of the TLX-18 can ensure that the working productivity is 35-40 t / s and more at high uniformity and density of cotton flow. All this is achieved through the choice of means and methods of performance management of receiving and transmitting devices.

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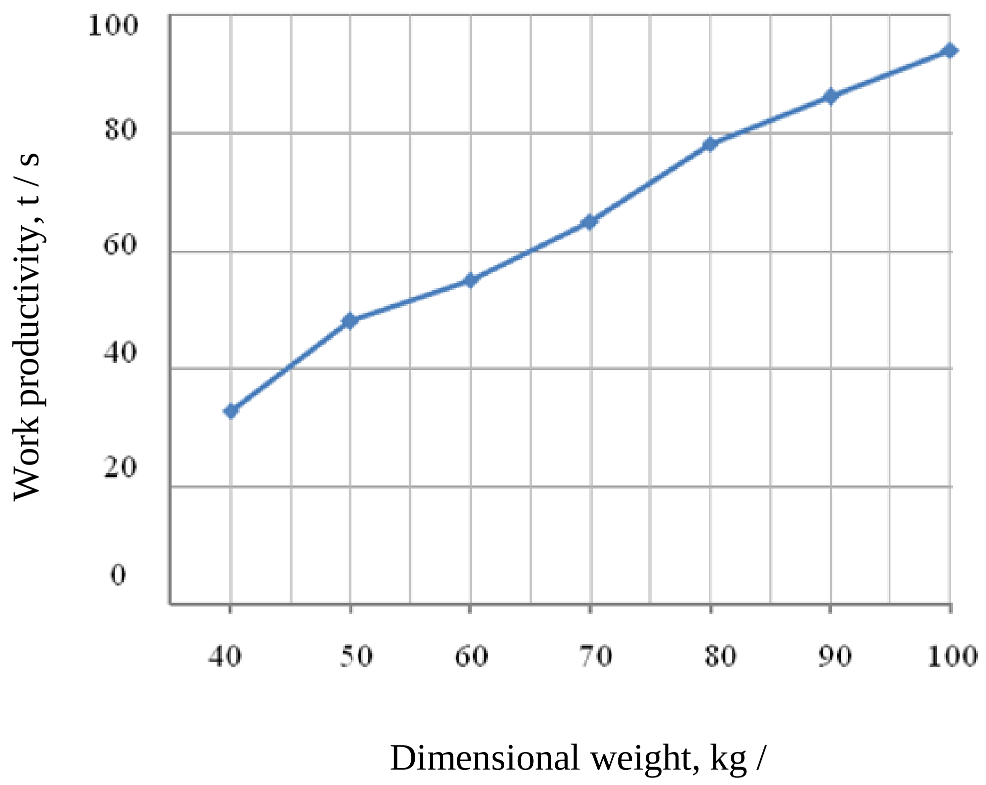

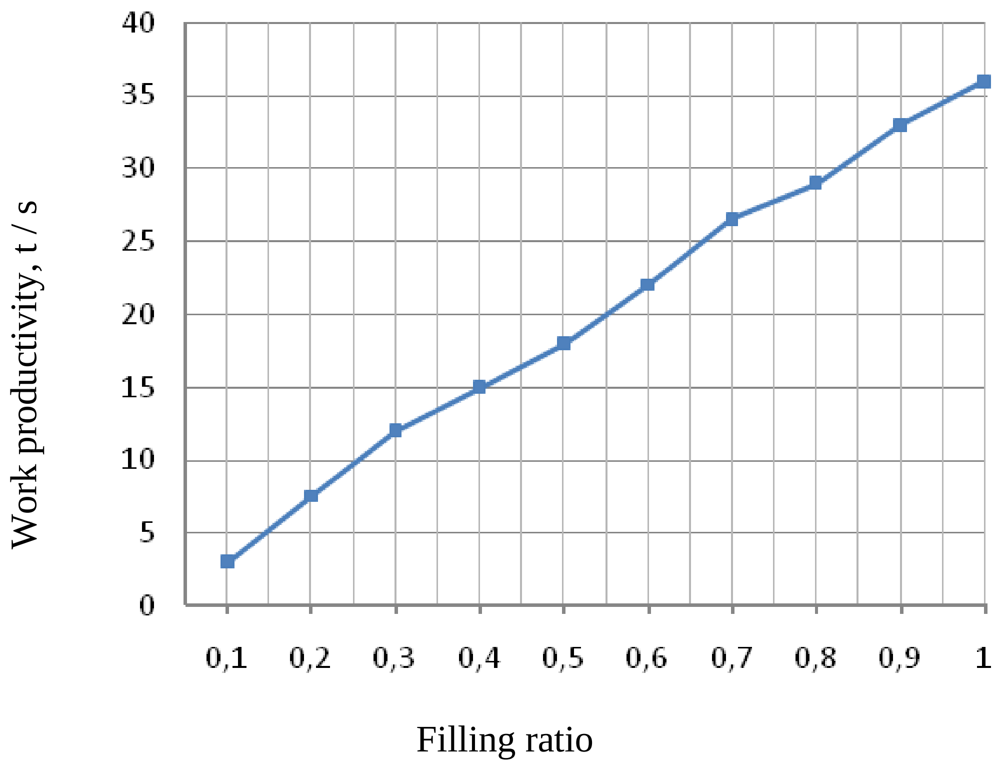

Figure 1. Dependence of TLX-18 conveyor productivity on cotton density and filling factor

To date, little attention has been paid to productivity management tools in the development of new types of transceivers. The application of an existing local constructive technical solution in work productivity management does not yield significantly positive results. Therefore, there is a need to develop and conduct research on a new way to manage work productivity [2].

The solution developed for mechanized collection of cotton from the transport cart shows that the bunker should be installed on the receiving-unloading device. In general, the performance management of a receiving-unloading device with a bunker can be done in the following two different options:

- management of the cost of productivity of the receiving bunker;
- Simultaneous management of conveyor work efficiency and receiving bunker work efficiency.

Bunker work productivity management can be gravitational, force-driven, and combined.

In gravity control of work, cotton is transferred from the receiving bunker to the conveyor by its own movement. Under the influence of force, it is transmitted by means of drum drums. Combined management involves two methods.

Gravity control of work efficiency is carried out on conveyors, elevators or other mechanisms in which the cotton flow is inclined.

Bunker is a simple gravity method of productivity management. The size of the moving mass is determined by the physico-mechanical properties of the cotton, the conditions of pouring and the parameters of the receiving bunker.

The process of spontaneous decomposition of mass cotton takes place in a fragmented state. The mass of cotton coming out of the receiving bunker is affected by its own gravity (Fig. 2). The general distortion of the cotton is determined by the shear deformation and the shear stress.

$$G_i = \tau S + t_n v S \rho \text{, н} \qquad (2)$$

here ρ - density of cotton, n / m3;

τ - shear stress, Pa;

S - cross-sectional area of cotton in the bunker, m2;

t_n - time of crawling, s .;

v - conveyor speed, m / s.

The technological robustness of the gravitational process occurs when the mass of cotton moves freely in the bunker in the control of work productivity and its internal distortion during the unloading process is fully realized.

The minimum height of motion in gravity is expressed using the following equation:

$$\Upsilon_t = \Upsilon h_0 \qquad (3)$$

here Υ - relative deformation in shear;

h_0 - the maximum internal height of the drive, m.

Accounting h_0 smaller than the height does not ensure complete excitation of the internal structure of the cotton. This in turn causes congestion on the conveyor belt and you have to use manual labor to clear the congestion. The smallest in terms of theoretical research h_0 height should not be less than 200 mm.

The speed mode of the conveyor depends on the driving mass of the cotton. The loading process on the conveyor must be continuous. After passing the loading end point of the conveyor conveyor, the next movement occurs at the end point of the receiving bunker. For continuous operation of the conveyor, the time spent on the mass of cotton passing through the conveyor must be equal to the time spent on moving the mass of cotton collected in the bunker.

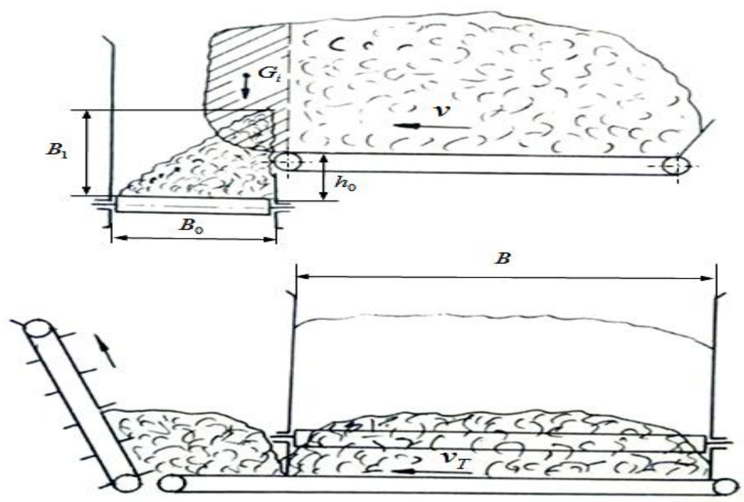

Figure 2. Scheme of gravity transfer of cotton

$$t_k = t_б \qquad (4)$$

The time taken to move the harvested mass of cotton depends on the productivity of the bunker, which is in the form of the following equation.

$$t_б = \frac{G_i}{Q} \text{ , c} \quad (5)$$

here Q - technical performance of the bunker, kg / h;

G_i - drive mass, kg.

Taking into account the efficiency of the bunker, we express the mass of the movement by the following equation:

$$G_i = Sv\rho t_б \quad (6)$$

From equations 2 and 6 we find the time taken to excite the mass of cotton

$$t_б = \frac{\tau}{v\rho} + t_п \text{ , c} \quad (7)$$

For continuous operation of the conveyor, its speed is determined by the following equation, taking into account the width of the bunker

$$v_к = \frac{B}{t_б} \text{ , м/c} \quad (8)$$

here B - bunker width, m.

The above cases are true in the continuous movement of mass cotton. In practice, gravitational motion depends on several factors that can be taken into account and not taken into account. It is known that cotton delivered to cotton processing plants has different physical and mechanical properties [3]. The main ones are its moisture and density. The change in the shear characteristics of cotton can vary by 3 times, and by 1.6 times in terms of moisture. According to these figures, the process of moving the mass of cotton on the conveyor belt changes. Therefore, high intermittent performance can be seen in receiving-transmitting devices. Theoretically, it is possible to determine the required performance of receiving-transmitting devices. The expected maximum operating capacity of the conveyor per second is determined by the weight of the drive, and its non-uniformity is determined in the following intervals:

$$0 \le Q \le G_i \quad (9)$$

As mentioned above, the rational means that perform the best dosing function include pile drums. Bunker flow control depends on the number of drums and their location, which is carried out in the combined-gravity-forced method. Assume that when the cotton layer is broken evenly with the pile drum, the layered cotton between the bottom of the bunker and the drums falls under its own weight (Figure 3). In this case, the maximum productivity in the mandatory and combined methods can be expressed by the following equation:

$$Q_{\max} = H_0 v\rho + \delta H_0 v\rho$$

(10)

$$Q_{\max} = nD_{кб} vB\rho + \sum_{1}^{n+1} \tau S_i$$

(11)

here $D_{кб}$ - pile drum diameter;

S_i - cross-sectional area of layered cotton between drums;

n - number of drums.

The fact that the bunker has the same working capacity is due to the change in the height of the cotton layer in the bunker [4]. Theoretically, the expected change in productivity in the mandatory and combined method will be in the following rang

$$H_0 v\rho \le Q \le H_0 v\rho + \sum_{1}^{n+1} \tau S_i + \delta H_0 v\rho \qquad (12)$$

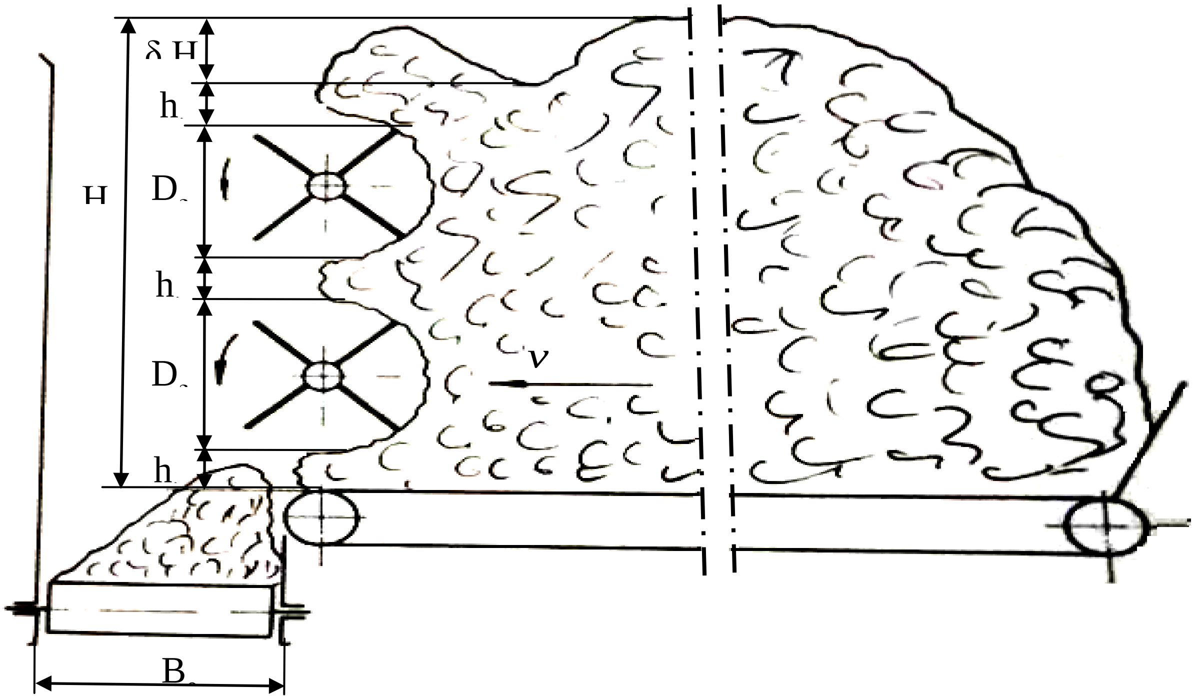

Figure 3. The required amount of cotton with pile drums

homogeneous transmission scheme

According to this equation, the parameters of the conveyor are found.

The cotton thread is a prism with a certain size and cut. The size of the prism is calculated by the following formula:

$$W = Sv_{TK} \tag{13}$$

$$W = \frac{Q}{\rho} \tag{14}$$

The cross-section geometry is related to the option of unloading the cotton on the conveyor belt (Figure 4). The options differ in form. Cotton loaded flat on the conveyor corresponds to a) cut, loaded in the center b), c) cut, loaded sideways - d), d) cut. In most cases, the flat and side loading option can be seen on the receiving-transmitting device. The geometry of the cotton flow section on the conveyor depends on the rotational speeds of the pile drums. At high speed rotation of the drums, the cotton is scattered along the width of the conveyor and the cut shape is close to the rectangular appearance. In the rotation of the drums at low speed - in the form of a triangle or trapezoid. With this in mind, the following equation is recommended to calculate the conveyor parameters of the receiving device:

$$v_{TK} = \frac{Q}{\left(\frac{B_0^2}{2} + B_0 B_1\right)\rho}, \quad \text{м/с} \tag{15}$$

Where B_0 - conveyor width, m;

B_1 - tarnov height, m;

ρ - density of cotton, kg / m3;

Q - bunker capacity, kg / h;

v_{TK} - conveyor speed, m / s.

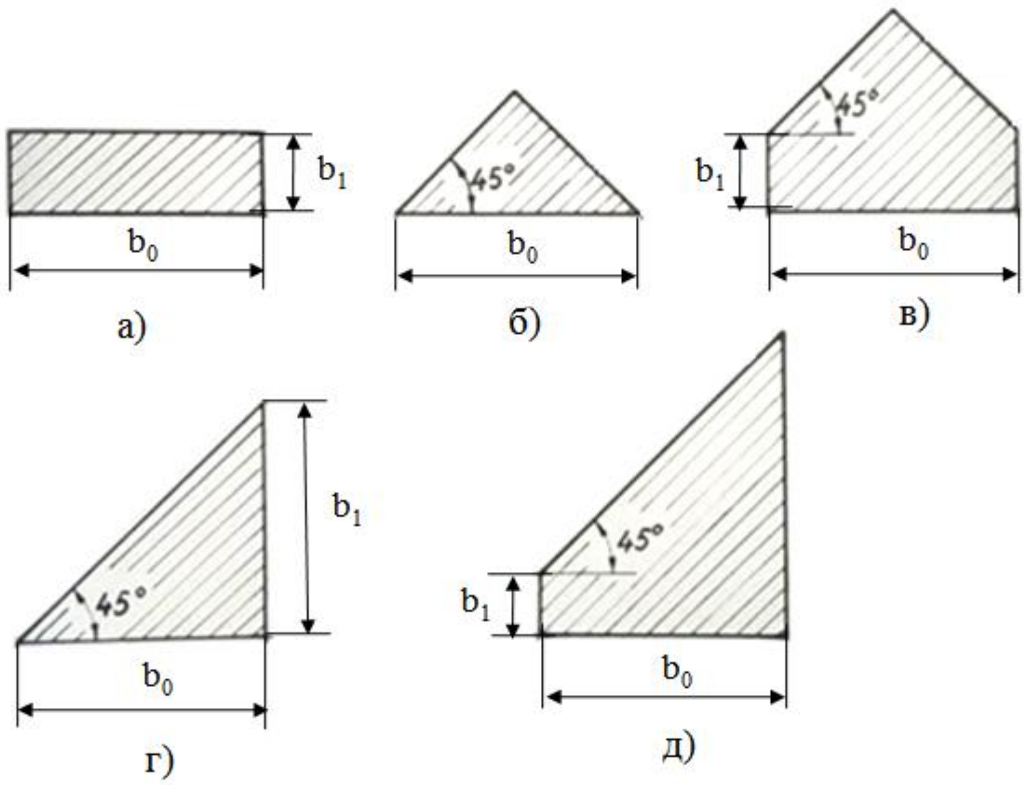

Figure 4 Cutting forms of cotton flow on the conveyor

The results of theoretical studies show that a conveyor with a width of 800 mm has a minimum speed of 1.8 m / s to operate at a working capacity of 30 t / s.

Research shows that pile drums are capable of uniformly breaking down massive cotton. However, the technological robustness and uniformity of production depends on the design of the drums and the efficiency of the work. In this case, pile drums should act as dosing devices. This, in turn, requires first a theoretical study, and then a practical study of how pile drums work in the form of dispensers.

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