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ANALYSIS OF RELATIONSHIPS OF ANGULAR VELOCITIES OF BELT CONVEYOR DRUMS OF DRIVER LOAD ON TECHNOLOGICAL RESISTANCE AND FRICTION FORCE OF RESISTANCE MOMENT

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Abstract. Taking into account the performance of belt conveyors in mining enterprises, the study of the influence of the parameters of deep pits on the selection of technological schemes for the operation of technological transport and the transportation of ore mass, and the optimal technological scheme in terms of plan and depth for the transportation of ore mass in the development of deep quarries comments on the importance of development are given. The laws of change of the angular speed of the belt conveyor drums and the torque on the conveyor shaft at different rotational speeds of the belt, and the recommended values of the analysis of the graphs of the dependence of the angular speed of the drums on the vibration range and the load on the conveyor are given.

Keywords. Conveyor, drum. belt element, deformation, loading, transportation, amplitude, vibration, technology.

Today, a lot of research work is being carried out on the issues of transport of minerals by means of vehicles in mining enterprises. In particular, with the increasingly complicated mining and technical conditions of operation of belt conveyors, it was determined that it is necessary to improve them in the following directions: implementation of continuous supply of minerals, maximum reduction of fuel costs, smooth operation of belt conveyors on high slopes by developing optimal structural schemes provide.

Taking into account the performance of belt conveyors at mining enterprises, the study of the influence of the parameters of deep pits on the selection of technological schemes for the transportation of mining mass, as well as the optimal technological scheme in terms of plan and depth for the transportation of mining mass in the development of deep quarries development is gaining importance.

In order to implement these important tasks, improving the equipment, taking into account the performance of belt conveyors with a length of several kilometers, studying the influence of the parameters of underground and open quarries on the choice of technological schemes for the transportation of mine mass, developing effective methods of workplace management the need to carry out scientific research on the development of energy evaluation capacity of conveyor systems is of great importance [1, 2].

Figure 1 shows the kinematic scheme of the belt conveyor. This belt conveyor works in the following order: the motion is transmitted from the 5AM250M4 electric drive 1 through the clutch 2 to the reducer 3. After that, the movement is transmitted from the reducer 3 through the coupling 4 to the leading drum 5 using the belt 7 to the leading drum 6. During the transportation of minerals, rollers 8 are used to provide support and tension in the belt [1-4].

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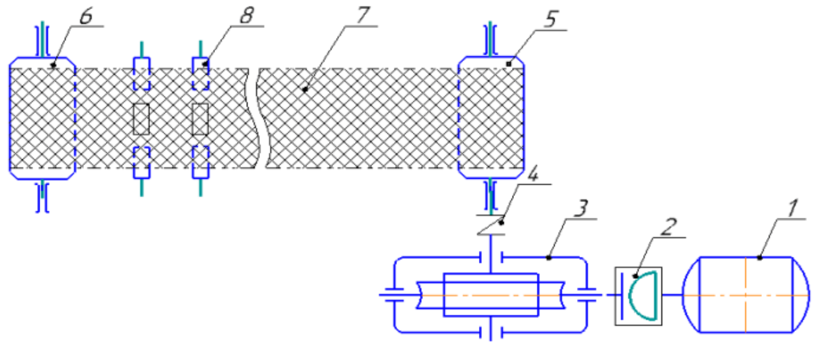
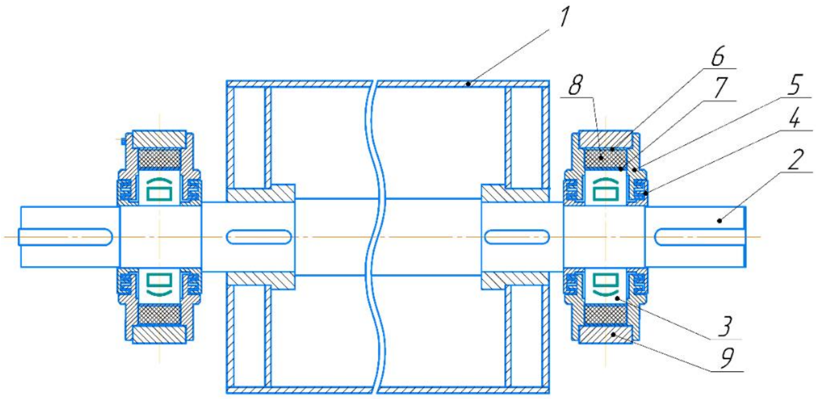


1- engine, 2, 4- coupling, 3- reducer (with worm), 5- leading drum, 6-drive drum, 7-belt, 8-roller.

Figure 1. Belt conveyor kinematic scheme

The proposed belt conveyor operates at high loads, the transported ore is not uniformly distributed along the width and length of the belt. Therefore, the load on the leading and leading drums is affected by varying values in a certain range. In order to adequately absorb these loads, rubber bushings are used on the outer side of the bearings that provide the basic rotational movement of the drums. Absorption of vibrations also reduces the amplitude of vibrations of the conveyor belt. This, in turn, partially saves the power consumption for turning the tape [5, 6].



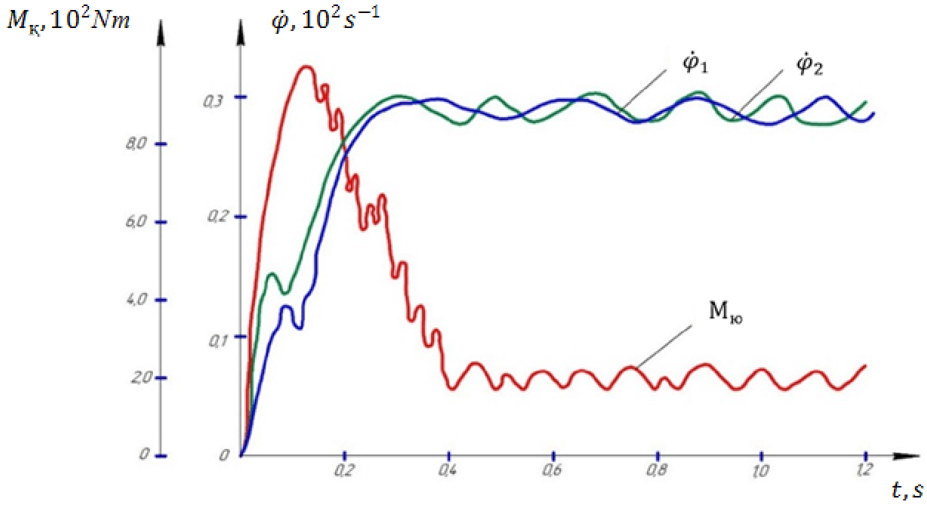
1 – bearing, 2 – axle, 3 – bearing, 4 – labyrinth cover 1, 5 – labyrinth cover 2, 6 – outer ring, 7 – inner ring, 8 – elastic element (rubber)

Figure 1. Drum construction (Belt conveyor)

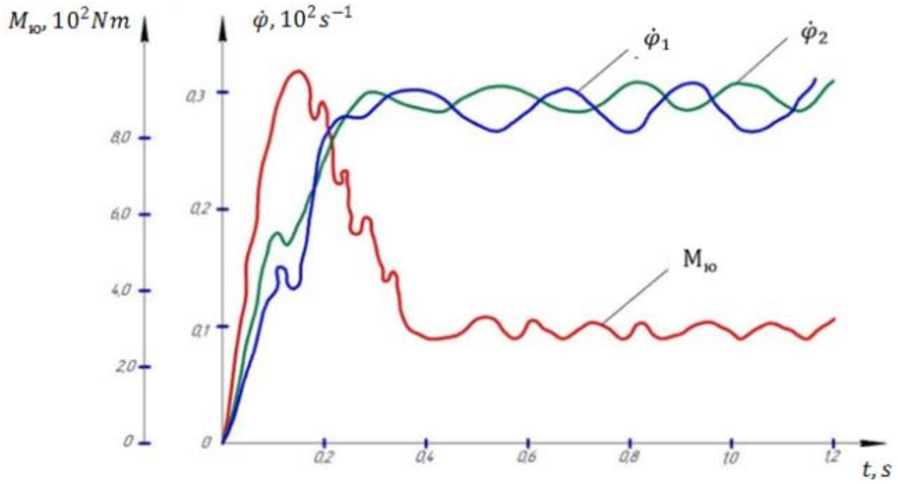
In theoretical studies, it is important to study the law of motion of the conveyor drums, determine the limits of the change of angular speeds, recommend the optimal values as a result of studying the effects of loading and changing the parameters of technological resistance and inertia on the dissipative-cohesion properties of the belt.

Figure 3 shows the laws of change of the angular speeds of the belt conveyor drums and the torque on the drive shaft at different rotational speeds of the belt. As a result of processing these changes in the laws of motion, the corresponding connection graphs were generated. As mentioned, the content roller damper helps to reduce belt vibrations, and the ore distribution on it is stabilized. Therefore, the effect of the shock absorber was taken into account when expressing the rotational speed of the belt. In this case, the values of the range of angular velocities of the leading and driven drums are slightly larger when the stiffness of the roller damper is 1.5□10^4 *N/m* and the dissipation coefficient is 4.5 *Ns/m* (Figure 4, Graphs 2, 4).

When the coefficient of influence is equal to 1.15 ($c_2 \leq 2.5□10^4$ *N/m*, *в* = *Ns/m*) the rotational torque coefficient of the belt increases from 0.264□10^3 *Nm/rad* to 0.40□10^3 *Nm/rad* $\Delta\dot{\varphi}_1$ values decrease from 1.7 s^{-1} to 1.42 s^{-1} in a non-linear pattern, it was found that the angular velocity of the driving drum decreases from 2.49 s^{-1} to 1.75 s^{-1}. It was also found that when M_{fric} and technological resistance is 1.0□10^2 Nm, the torque on the electric drive shaft increases from 0.13□10^2 *Nm* to 0.54□10^2 *Nm*. It can be seen that M_{ener} values reach 1.1□10^2 *Nm* when M_{fric} and the technological resistance increase to 1.5 102 Nm and the belt uniformity to 0.4□10^3 *Nm/rad* (Fig. 4, graphs 5, 6).

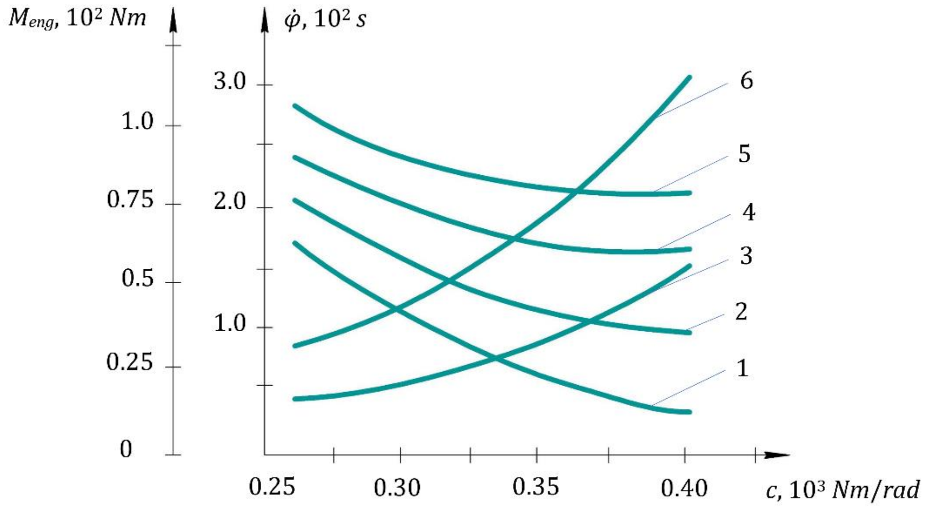


$c_2 = 390\ Nm/rad$; $M_{rev} + M_{fric} = 1.2 \cdot 10^2\ Nm$



$c_2 = 260\ Nm/rad$; $M_{rev} + M_{fric} = 1.5 \cdot 10^2\ Nm$

Figure 3. Belt conveyor drums angular velocities and torque on the drive shaft, different rotational speeds of the belt, laws of change



1, 3 – $\dot{\varphi}_1 = f(c)$ – $k = 1.15$; 2, 4 – $\dot{\varphi}_2 = f(c)$ – $k = 1.15$
5 – $M_{eng} = f(c)$; $M_{rev} + M_{fric} = 1.0 \cdot 10^2\ Nm$; 6 – $M_{eng} = f(c)$; $M_{rev} + M_{fric} = 1.5 \cdot 10^2\ Nm$;

Figure 4. Graphs of the dependence of the angular speed of the belt conveyor drums on the variation of the vibration range and the load on the conveyor on the variation of the coefficient of friction of the belt

Therefore, the following values of the parameters are recommended to bring the angular velocities of the leading and leading drums closer to each other, and to ensure that the vibration ranges are in the range of $\Delta\dot{\varphi}_2 \leq (0.21 \div 0.25)\ s^{-1}$. $c_2 = (0.32 \div 0.38)\ 10^3\ Nm/rad$; $в_2 = (9.0 \div 10)\ 10^3\ Nm/rad$; $k = 1.15$; $M_{fric} \leq 40\ Nm$.

Summary. Graphs of the dependence of the angular speed of the belt conveyor drums on the variation of the vibration range and the load on the conveyor on the variation of the coefficient of friction of the belt were constructed. The following values of the parameters are recommended to bring the angular velocities of the leading and leading drums closer to each other, and to ensure that the vibration ranges are in the range $\Delta\dot{\varphi}_2 \leq (0.21 \div 0.25)\ s^{-1}$ $c_2 = (0.32 \div 0.38)$□$10^3\ Nm/rad$; $в_2 = (9.0 \div 10)$□$10^3\ Nm/rad$; $k = 1.15$; $M_{fric} \leq 40\ Nm$. The graphs of dependence of the angular speed of the belt conveyor drums on the range of vibration and the change in load on the conveyor on the change in the moment of inertia of the drums were obtained.

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