THE TENSION FORCES ACTING ON THE BELT CONVEYOR ROLLERS

Atakulov Lazizjon[1],
Haydarov Shoxid[2],
Gaffarov Azamat [3].
[1] Doctor of Technical Sciences Navoi state university of mining and technologie, Navoi city,
Republic of Uzbekistan.
[2]Docent, Department of mining electromechanics,
Navoi state university of mining and technologie, Navoi city, Republic of Uzbekistan., Navoi city, Republic of Uzbekistan.
[3] Assistant, Department of mining electromechanics,
Navoi state university of mining and technologie, Navoi city, Republic of Uzbekistan., Navoi city, Republic of Uzbekistan.

ABSTRACT

This article determines the distribution of the forces applied to the cross-sectional surface of the belt, when rocks are transported by belt conveyors, the effect of dynamic forces on the bending of the belt and middle roller length rocks on the basis forces the roller supports.

Keywords: *Belt conveyor, belt, roller, roller base, damper, power.*

АННОТАЦИЯ

В данной статье определяется распределение усилий, приложенных к поверхности поперечного сечения ленты при транспортировании горных пород ленточными конвейерами, влияние динамических сил на изгиб ленты и средней длины ролика горных пород на основание сил роликовых опор. .

Ключевые слова: *Ленточный конвейер, лента, ролик, роликовая основа, демпфер, мощность.*

INTRODUCTION

Roller is one of the main and most numerous element of belt conveyors. Guaranteed (90%) service life of bearings in the mining industry is usually set at 40000-44000 hours or more.

In operation, the guaranteed service life of conveyor roller bearings is determined by the formula:

$$T_{pod} = \pi D_p \left(C_0 / P_e\right)^3 / 3{,}6\vartheta_l,\ ч \qquad (1)$$

where T_{pod} the operating time at which no more than 10% of the bearings fail, h

D_p - roller diameter, mm;

ϑ_l -belt speed, m/s;

P_e - equivalent dynamic load on the most loaded roller bearing, N;

P_e - coefficient of dynamic load capacity of this type of bearings, N

C_0 - The equivalent dynamic load roller bearing is calculated by the formula, N

The equivalent dynamic load on the roller bearing is calculated by the formula

$P_e = 1{,}2 K_d F_p,\ H.$

F_p -There is the radial component of the load on the bearing, N

K_d - dynamic load factor.

It is shown that the static load capacity condition allows for a radial load value of at least 5.5 greater than the sufficient dynamic load capacity condition, therefore, in the work roller bearings were not checked for static load capacity.

In addition, it was estimated how much the reduction in the maximum actual load on the bearings of the roller support compensates for the decrease in the allowable load according to the condition of the rigidity of the axis of the side rollers with an increase in their relative length, taking into account the fact that the remaining design parameters of the roller are unchanged.

The equivalence two versions' roller support in terms of rigidity roller axis is reduced to the equality angles rotation inner ring of bearing relative to the outer ring in the places where the roller bearings are installed. It is shown that when length of side rollers is doubled compared to the traditional design (with the same belt width), load on a lower side roller bearing should be 1.7 times less than the load on the middle roller bearing, which is quite feasible. At the same time, it was concluded that it is necessary to switch to lighter series of bearings with a slight. by reducing the diameter of their landing size or without reducing it at all.

Next, an analysis of the efficiency achieved by balancing the loads on the bearings of the middle and side rollers is carried out.

As an efficiency criterion, the ratio calculated load on the most loaded bearing to the weight F_p of load located in one span between roller bearings is used G_r :

$$\psi_p = \frac{F_p}{G_r} \quad (2)$$

To analyze the dependence of the adopted performance indicator on various factors ψ_p , formula (2) is written as:

$$\psi_p = \psi_r\left[1 + \left(K_{pol} + K_l\right)K_0\right], \quad (3)$$

Where $$\psi_r = \frac{1}{2 + 3\cos\beta_p}; \quad (4)$$

$$K_l = \frac{q_l B_n l'_p}{G_r} = \frac{G_l}{G_r}, \quad K_{pol} = \frac{G_{po}}{G_r},$$

$$K_0 = \frac{1}{2}\left[\cos\beta_p + 0{,}9\theta_p\left(1 - \cos\beta_p\right)\right]; \quad (5)$$

G_l - the weight of the belt located in the span between the roller supports

At the maximum possible value of the value K_o, the value θ_p is equal to the value θ of the coefficient for the traditional design of roller bearings: $\theta \cong \frac{1}{2}$ At angles of inclination of the side rollers equal to 30° and 45°, the maximum possible values are 0.45 and 0.40, respectively.

The performed analysis of the influence' various factors on the value of the coefficient showed that this coefficient practically does not depend on the angle of repose of the bulk cargo in motion (within the real limits of this angle) and is only a function of angle inclination of side rollers. A reliable estimate of this coefficient can be obtained by taking in formula (6) equal to 1/3:

$$K_0 = \frac{1}{2}\left[\cos\beta_p + 0{,}33\left(1 - \cos\beta_p\right)\right] = 0{,}17 + 0{,}33\cos\beta_p. \quad (6)$$

In this case, expression (8) takes the form

$$\psi_n \approx \psi_r\left[1 + \left(0{,}17 + 0{,}33\cos\beta_p\right)\left(K_l + K_{pol}\right)\right]. \quad (7)$$

Taking into account the expression (7) for the proposed design of elongated side idlers, the following formula was obtained:

$$F_p = \psi_r\left[q_p + K_0\left(q'_p + q'_l\right)\right] = \frac{1}{2 + 3\cos\beta_p}\left[q_r + \left(0{,}17 + 0{,}33\cos\beta_p\right)\left(q'_p + q'_l\right)\right] \quad (8)$$

When calculating the load on the most loaded bearing of the middle roller for a roller bearing of a traditional design, the well-known formula was used:

$$F_p = \frac{1}{2}\left(0{,}65 \div 0{,}70\right)\left(q_r + q'_p + q_l\right)l'_p,$$

where $q_r; q'_p; q_l$ - respectively linear weight of the cargo on the tape; linear weight of the rotating parts of the roller bearings of the cargo branch and linear weight of the belt, N/m

The values of the coefficients ψ_r and K_0 are given in Table. 1.

Table 1

Recommended coefficient values ψ_r and K_0

$\beta_{p,град}$	20^0	30^0	36^0	45^0
ψ_r	0,205	0,216	0,225	0,240
K_0	0,475	0,452	0,429	0,410
$\psi_r \cdot K_0$	0,0978	0,0976	0,0965	0,0984

In sum, the coefficients K_l and K_{pol} according to various estimates, can take values from 0.1 to 0.3. Since the spread is quite large, the efficiency of balancing the loads on the middle and side rollers was evaluated for different values of the sum $K_l + K_{pol}$, depending on the angle of inclination of the side rollers β_p.

For traditional design of roller bearings, the indicator of relative load on the bearings is equal to

$$\psi_{nt} \approx 0,325\left(1 + K_l + K_{pol}\right)$$

For a design with elongated side rollers, the indicator ψ_{nt} is expressed by formula (7) and then the ratio of these indicators is equal to

$$\frac{\psi_{nh}}{\psi_{nt}} = \frac{1 + \left(0,17 + 0,35\cos\beta'\right)\left(K_l + K_{pol}\right)}{\left(2 + 3\cos\beta'\right)\cdot 0,325\left(1 + K_l + K_{pol}\right)}. \qquad (9)$$

The results of calculations performed by the formula (9) at values $(K_l + K_{pol})$ =0,1; 0,15; 0,20; 0,25; and 0.30 and for various angles' inclination of the side rollers are given in Table. 2.

From Table. 2 it follows that with an increase in relative weight of the belt and rollers, effect of using idlers with a shortened middle roller is more significant, it is advisable to use such rollers on powerful belt conveyors with a belt width of. $B \succ 1600$ мм

A significant reduction in the design loads on the roller bearings (by 1.40-1.75 times) also occurs at the angles of inclination of the side rollers $\beta_p = 30^0 \div 45^0$

Table 2

Bearing relative load reduction factor

Relative weight of belt and rollers	Angle of inclination of side rollers, β_p rad			
	20^0	30^0	36^0	45^0

$(K_l + K_{pol})$				
0,10	0,610	0,635	0,660	0,708
0,15	0,600	0,621	0,645	0,690
0,20	0,585	0,608	0,631	0,660

RESULTS

The analysis of possibility for using the reserve of dynamic load capacity of roller bearings performed in the work showed that with a decrease in the calculated load on the bearings of conveyor rollers, when the estimated service life of bearings remains unchanged, their required dynamic load capacity decreases. But when switching to bearings with a lower dynamic load capacity, other parameters of the bearing and, consequently, the roller also change. The required dynamic load rating is usually reduced by not one, but two steps in the corresponding bearing diameter series. This means that a 10 mm decrease in the inner diameter of the bearing can lead to a decrease in the outer diameter by 18-20 mm, which in turn will lead to an unacceptable decrease in the rigidity rollers' axis, misalignment of the rings in the bearings of the elongated side rollers and possibly, an increase in resistance tape movement.

REFERENCES

1. Atakulov LN, Khaidarov Sh.B., Istablaev F.F., Narzullaev B.Sh. Investigation of an alternative method of connecting rubber cord belts. Achievements, problems and modern trends in the development of the mining and metallurgical complex IX International Scientific and Technical Conference. 2017
2. Atakulov LN, Khaidarov Sh.B., Istablaev F.F., Narzullaev B.Sh. Determination of the method of connecting rubber cord belts. Achievements, problems and modern trends in the development of the mining and metallurgical complex IX International Scientific and Technical Conference. 2017
3. Kharchenko V.I. Rationalization of geometric parameters of linear roller bearings of general-purpose belt conveyors at the design stage. / V.I. Kharchenko. - M., 1994 - 248 p.
4. Galkin V.I. Modern theory of belt conveyors for mining enterprises. V.I. Galkin, V.G. Dmitriev, V.P. Dyachenko et al. - Moscow: MSGU Publishing House, 2005. - 543 p.
5. Lodewijks G. Energy Consumption of Pipe Belt Conveyors: Indentation Rolling Resistance / G. Lodewijks, M. Zamiralova // FME Transactions. - 2012. Vol. 40. - P. 171 - 176.

6. Kiriya R.V. Determination of the coefficient of resistance to the movement of the belt along the roller supports of the conveyor, due to the bending of the belt / Kiriya R.V., Maksyutenko V.Yu., Mishchenko T.F.//Geotechnical mechanics: Interdepartmental. Sat. scientific. tr. / IGTM NASU. - Dnepropetrovsk, 2012. - Issue. 106. - S. 140-146.

7. Atakulov L.N., Haydarov Sh.B., Ochilov Kh.B., Gaffarov A.A. Application of the scheme of effective conveyor transport in the conditions of Daugiztau quarry. Technical science and innovation. 2021. No. 2. -b. 74-86.

8. Atakulov L.N., Kakharov S.K., Haydarov Sh.B. Selection of the optimal method for joining rubber-cord conveyor belts. Scientific, technical and production journal "Gorniy jurnal". – Rossiya, Moscow, 2018, # 9 (2254), 97-100 p

9. Shakhodjaev L.Sh. Calculation of mine conveyor transport: methodological instruction, Tashkent: 2012