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Determination of the duration of the service of the forming of the rubber-trouser conveyor belts

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ABSTRACT: This article presents the results of studying the durability of rubber-rubber conveyor belts. As a result of the conducted researches it was revealed that the least reliable places of the closed contour of the conveyor belt are the connecting places, the quality of which mainly depends on the way of joining the tape elements and the experience of the dockers. The authors developed and proposed an alternative method for docking the tape. The article reflects the results of the calculations performed, experiments on the rupture of the connecting points of the proposed and existing options. According to the presented results, the strength characteristics of the developed method significantly exceed the method used. The coefficient of uniformity is calculated to determine the service life of the connecting places.

KEYWORDS: rubber-rubber conveyor belts, docking points, docking methods, cable rope, tensile strength, tape service life.

I.INTRODUCTION

According to statistical data, the cost of tape is on average 50-60% of the cost of the conveyor, and for mine conveyors reaches 67%. Even more operational costs associated with the replacement and repair of tapes. The costs of amortization of tapes in mines account for 70-80% of all costs for the depreciation of conveyors. Therefore, the study of resource issues and tape wear is of current practical importance. The resource of conveyor belts depends on the nature of the loads acting on it and the types of wear. Many factors affect to some extent the wear of the tape. The most interesting are those that are dominant and the degree of influence of which can be effectively changed with a positive effect without damage to the delivery process, the accepted procedure for calculating and selecting equipment, technical and economic indicators, safety rules and working conditions [4].

II. SIGNIFICANCE OF THE SYSTEM

In order to determine the service life of the docking sites of rubber conveyor belts, a large number of factors and conditions must be taken into account. These include, in particular [1,4]:

- Conveyor length and belt speed, which determine the abrasion of the belt by the conveyed load;
- The base material of the tape;
- Thickness and properties of rubber and linings, which must correspond to the nature of the goods being transported;
- the conditions of installation work (the quality of commissioning work, the thoroughness of the installation, the correct connection of the ends of the belt, the device and equipment of loading and reloading points affecting the shock load of the tape, especially for large lump loads, causing its additional wear, etc.);
- operating conditions (qualification of the maintenance personnel, the influence of the aggressive environment, climatic factors, reliability of cleaning the tape from adhering particles to the load, the availability of lubrication in the rollers, the timeliness of inspection and repair of the tape, the correct selection of the lining of the drive drums, etc.).

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III. LITERATURE SURVEY

We express our deep gratitude for the help and support in conducting research and experiments to the Director General of the Navoi Mining Metallurgical Combine. tech. K.S.Sanakulov, employees of the central factory laboratory (Central laboratory of factory) and the forging and pressing shop (CPC) of Navoi mining metallurgical combinat.

IV. METHODOLOGY

Let's consider the expression for determining the service life of 2000St-5400 (in hours) tapes for transportation of ordinary rock mass:

$$\mathrm{T} = \frac{200 * B^2 * \delta * \cos\beta * \sqrt[3]{L}}{(1+\alpha f) * \gamma * h} = 48151{,}93\ hour$$

And this means 48151.93h / 24h / 365days = 5.5 year expiration date of the rubber belt, produced in length of 200 meters.

Here: ***δ***- thickness of the working lining, mm; ***a***- average linear size of pieces m, ***f***- coefficient of strength of transported rock (according to Protodyakonov scale); ***h***- the height of the load falling onto the belt at loading, m.

Additional factors include:

K_1-design of the fabric frame of the tape (for linings from cotton lining K1 = 1,2, with nylon base K1 = 1,4, with cable base K1 = 1,4 ÷ 1,5);

K_2 - the quality of the strip coverings (with the usual rubber coating K2 = 1, with wear-resistant plates K2 = 1,8 ÷ 2);

K_3-elasticity of supports (rigid K3 = 1, elastic K3 = 1,2 ÷ 1,25);

K_4-location and nature of the installation (stationary K4 = 1, mobile K4 = 0.6, stationary K4 = 0.5, mobile K4 = 0.3);

K_5-Presence of preliminary pouring of fines on the tape during transportation of ordinary ore (in the absence of padding K5 = 1, in the presence of a good padding K5 = 2.0 ÷ 2.5).

The following formula, proposed by the Institute "Giproruda", is valid for conditions of transportation of medium and large crushing ores with a strength of ***f>8*** by belt conveyors with rigid roller supports in the absence of sowing of small-sized fractions. An empirical formula is recommended for determining the service life of a tape (in hours):

$$T = \frac{800000 * B * \sqrt[2]{L} * \cos\beta}{Q} \prod_{i=1}^{6} K_i = 53873\ hour$$

This means 53873h / 24h / 365days = 6.1 years expiration date of the rubber belt, produced in length of 200 meters.

Where $K_1 \ldots K_6$- are the coefficients.

This formula is close in structure to the previous formula, but differs from it by the numerical values of some parameters, as well as by additional coefficients.

The Institute of UkrNIIproekt proposed a formula for calculating the service life of belts transporting loose overburden (in hours):

$$T = (1130 - 230\mathrm{B})\sqrt{L} \prod_{i=1}^{6} K_i = 49596\ hour$$

So this will accordingly be equal to ***49596h / 24h / 365days = 5.6*** year, the expiration date of the rubber belt, produced in length of 200 meters.

V. EXPERIMENTAL RESULTS

With such a large number of formulas for calculating the service life of conveyor belts, it is possible to recommend a calculation using two or three formulas that most fully take into account the parameters and operating conditions of a particular conveyor. If the values obtained as a result of calculations are fairly close, then it means that the initial calculation formulas are suitable for these conditions. Then the lifetime of the tape is defined as the weighted average

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value. Normalizes the average service life of conveyor belts depending on the type of belt, operating conditions, type of transported cargo, belt length and speed, and other factors for general purpose conveyors

$T=(T_1+T_2+T_3)/3=(5,5+6,1+5,6)=17,2/3=5,7$ ***year,***

It can be rounded within 5 to 6 years.

An experimental study was carried out. A new method of docking rubber-rubber belts with wire rope is suggested. The spiral consists of several operations: the cable is released from the rubber, unwound on strands, chopped in certain places, (Figure 1, a) and the elements of the cables located opposite each other are intertwined. Then, the rope is straightened along the length of the joint and vulcanized.

When carrying out the docking operation with the proposed method in the conditions of the "**MURUNTAU"** quarry with the experts of the Mining Equipment Repair Facility (URGO) of the central limit theorem (Fig. 1, b), it turned out that, in spite of the fears, the cables in the coupling points turned out without bumps and grooves, and The diameters are identical with the factory settings.

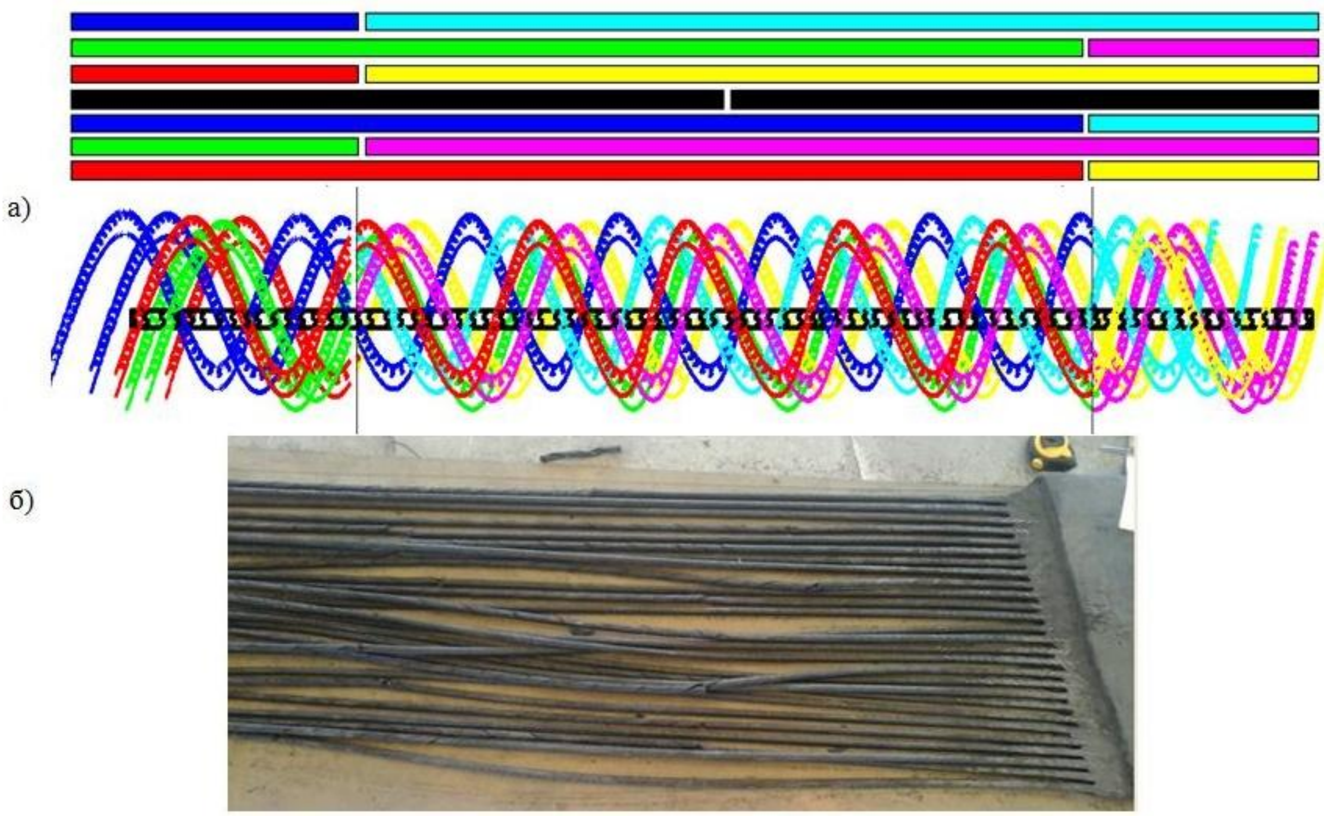

Fig. 1. The rope of cables in the places of joining the belts:
a) The wire rope of one cable; b) the rope of the ropes at the joints of the tape.

The results of the tests, which are presented in [5]. showed that when weaving cables according to the 3x4 scheme, an effect is achieved such that the breaking strength of the cable is 70% of the tensile strength of a single factory cable.

Two samples of the 2000St-5400 tape were delivered to the central factory laboratory of the "Navoi machinebuilding factory". The place of the joint in the first one is made by the method applied at the CPT, in the second - by the method proposed by the teachers of the Navoi state mining instiute. Both are made on a special site of the Muruntau quarry with specialists from the URGO CPT.

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In the sample of the TSC in the places where the tape is joined, the cables are directed towards each other (Figure 2), and these places rest mainly on the rubber force alone. In the Navoi state mining instiute sample, the cables were intertwined and also vulcanized.

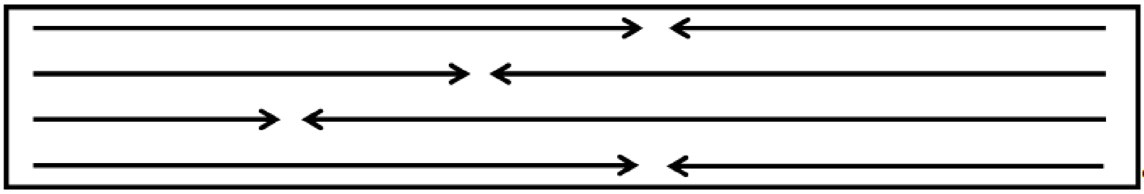

Fig.2. The arrangement of cables in the places of joining the tape

The specimen specimens had the same dimensions. The length and width of the tapes are 7 and 0.5 meters, respectively. The junction point is 3.9 meters. The length is 27 cables with diameters of 11.2 mm each.

For strength tests, a stand with a P-50 tensile machine is used. In cooperation with the workers of the central laboratory of factory and the press-forging workshop (KPTS) of the Navoi machine building factory, special devices were developed - tape holders.

Technical capabilities of the laboratory stand: tension up to 50 tons, the length of the tension - up to 10 meters.

In the course of the experiment, when the sample was stretched, with a load of 24 tons, cracks formed on the tape, and a break in the length of the sample occurred at 27 tons. Since, for the rupture of a tape of a CTP sample with a width of 0.5 m, a load of 24-27 tons is sufficient, then with a full belt width of 2 meters, 96 ÷ 108 tons will be required.

In the tensile testing of the Navoi state mining instiute sample tape, with an indication of the maximum possible value of 50 tons, the P-50 machine, cracks and other defects on the tape were not detected.

As studies have shown, there is no other, more powerful testing equipment for determining exact data on the rupture of the proposed sample of tape joining in the Republic of Uzbekistan.

When comparing the options considered, it can be concluded that the tensile strength of the Navoi state mining instiute specimen is 2 ÷ 2.2 times higher than the sample of the TSP. Then the breaking force of the Navoi state mining instiute sample at a full width of the strip of 2 meters is more than 200 tons.

In addition, if we take into account the data of previous tests, where it is proved that the cable with a 3x4 coupling can withstand a tensile force of up to 70% of the entire factory cable, the total tensile strength of the bands is 200 * 100/70 = 285≈300 tons.
Thus, the breaking force of the junction of the full tape of the TSP sample is (96 ÷ 108) / (285 ÷ 300) ≈35% of the entire factory belt.

Based on the experimental results obtained, it is possible to give recommendations when operating the Circuit conneyor-270 conveyor:
1. For hot vulcanizing, apply Tiptop Solution STL-RF4 glue;

When docking rubber belts use the method developed by the teachers of the Navoi state mining instiute, since in this case the strength of the joint increases in 2-2.2 times. Moreover, the application of the Navoi state mining institute method will allow to reduce the joint length by almost two times, which will reduce the cost of adhesive materials. Then, combining the experimental data obtained with the service life of the tapes, we can determine the rounded service life for the connection points for the 2000St-5400 tape. If one takes into account that the TSP sample yielded up to 35%, and the Navoi state mining instiute sample - up to 70% of the whole tape, then:

For the existing method,

$$T_{st} = 0.35 * T = 0.35 * (5 \div 6) = (1.75 \div 2) \text{ years.}$$

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For the method proposed by the institute

$$Tst = 0.7 * T = 0.7 * (5 \div 6) = (3.5 \div 4) \text{ years.}$$

VI. CONCLUSION AND FUTURE WORK

The obtained results can be used as the coefficient of uniformity of the service life for the jointing points of rubber-rubber bands. For the ribbon joining method used, the uniformity coefficient can be used, as follows:

And for a method with a wire, iron it this way:

$$T=0,35*(T_1+T_2+T_3)/3,$$

Increasing the service life of tapes, depending on many factors, and primarily on reducing belt wear, which is important for improving the economic efficiency of conveyor transport?

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