SIZE CALCULATIONS AND CHECKING COUPLING OF A CONVEYOR BELT

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ABSTRACT: Conveyor belt is one of the most common types of continuous handling equipment used for moving rocks of various sizes horizontally or inclined. From researches in the exploitation of mineral resources and rocks and from the calculations in this paper is observed above the conveyor sizing and other elements of the transporter requires knowing how belt traction forces (tensions thereof) varies on the conveyor length. In all cases the operation of the conveyor belt must be provided without engaging the slip phenomenon and limiting its displacement (between sets of rollers) so conveyor operating at optimum parameters. Conveyor belt dimensioning calculations and other elements of a conveyor varies depending on its length and the carrier operating situations. Another condition for a good functioning is to use an apropriate coupling which can transmit rotational movement and torque without modifying the value and their meaning. This is why is important to know the speed, the rotation and the torque which appear in the conveyor belt because, this way, we cand do a correct dimensioning of all the components.

KEY WORDS: power, coupling, conveyor belt, torque, dimensioning

1. INTRODUCTION

In this paper we present the problems arising in granite quarry exploitation, from Oltenia area, because of the bad equipment dimensioning like machine pats. It is conveyor belt which caused important losses of processed material because of improper sizing so we need to use an appropriate coupling which can improve the functioning of the conveyor belt. Couplings are machine parts that make the permanent or intermittent connection between two axes with the purpose of transmitting rotational movement and torque without modifying the numbers and their meaning. They can also be used for making the connection between shaft and parts mounted thereon free: gears, pulleys, chain wheels, etc. They can also serve as a safety (limitation of torque, limiting speed or direction). A kind of coupling is also the coupling of a conveyor belt from a mineral career. Here we meet the problem of torque limitation within a transmission of an asynchronous electric motor and a belt conveyor using a safety friction discs coupling with central arc. We know that P = 6 kW transmitted power; coupling speed n = 960 r / min; Ks regime coefficient = 1.6, the minimum diameter of the groove on semi coupling led $d_{i\ min}$ = 40 mm. We need to dimension the coupling and establish the necessary strength coil spring assembly. We have to compare the torque limit in both cases of calculation.

2. TECHNICAL REQUIREMENTS

We follow the production process and found that conveyor belt having an inclination angle and speed of the belt too high and we have to determine the right dimensions of the machine parts which run the conveyor. First of all we have to determine the torques such as:

- Nominal torque
- Calculation torque
- Limit torque

With all these we can do a correct dimensioning of the coupling [1,2]:

- Nominal torque

$$M_{tn} = 9{,}55 \cdot 10^6 \frac{P}{n} = 9{,}55 \cdot 10^6 \frac{6}{960} = 59687\,Nmm \qquad (1)$$

- Calculation torque

$$M_{tc} = K_s M_{tn} = 1{,}7 \cdot 59687 = 101468\,Nmm \quad (2)$$

- Limit torque

$$M_{t\,lim} = (1{,}15...1{,}25)M_{tc} = 1{,}2 \cdot 101468 = 121762\ Nmm \quad (3)$$

In the figure 1 we can see a conveyor belt system which is met in the granite quarry. exploitation. It is compound of a belts system driven by motors and gears like we see below:

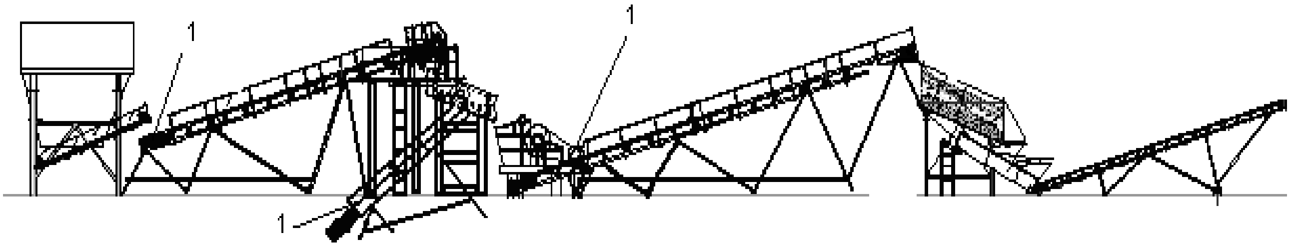

Figure 1. Conveyor belt system (1 – friction discs coupling)

Between motors and gears are placed the friction disc couplings noted with 1 like we see below:
1 - semi coupling one grooved interior, 2 - exterior grooved semi coupling, 3 - friction discs, grooved on the outside and secured to the coupling part 1, 4 - friction discs interior grooved and integral to the semi coupling 2. The discs pressing is done with central arch 5 whose strength can be adjusted using sectioned nut 6 self insured against dissolution by a screw 7 [3,4], like we see in figure 2 from below:

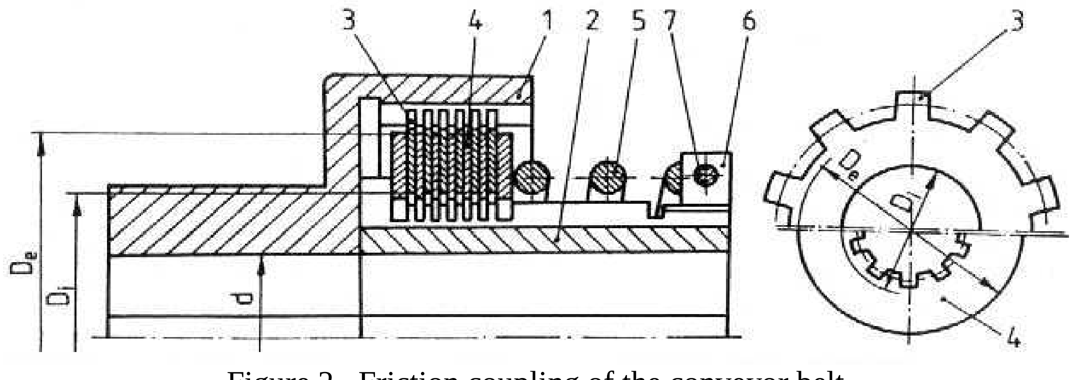

Figure 2. Friction coupling of the conveyor belt

The second step is:
- Determine the dimensions of the friction surfaces for the semi-coupling led we choose splined shaft with 8x42x48 dimension from STAS 1769 with:
-number of groove z=8;
-the inside diameter di = 42 mm;
-outer diameter de= 48 mm.
- The inside diameter of the friction surfaces Di = de + 2...3 = 51 mm (in constructive terms)

- The outer diameter of the friction surfaces for the constructive condition:

$$\frac{D_i}{D_e} = 0{,}5...0{,}6\,mm$$

$$D_e = \frac{D_i}{0{,}577} = \frac{51}{0{,}577} = 88\,mm$$

-The number of pairs of friction surfaces:

Assuming a uniform distribution of pressure on the friction surfaces we have the following result [5,6]:

$$i \geq \frac{12M_{tlim}}{\pi\,\mu\,p_a\left(D_e^3 - D_i^3\right)} = \frac{12 \cdot 121762}{\pi\,0{,}2 \cdot 0{,}8\left(88^3 - 51^3\right)} = 3{,}71 \quad (4)$$

In the event of wear uniforms we can calculate this:

$$i \geq \frac{8M_{t\,lim}}{\pi\,\mu\,p_a D_i\left(D_e^2 - D_i^2\right)} = \frac{8 \cdot 121762}{\pi\,0{,}2 \cdot 0{,}8 \cdot 51\left(88^2 - 51^2\right)} = 4{,}98 \quad (5)$$

For friction material sintered alloy/steel grade we have the following parameters:

μ = 0.1 ... 0.3, μ = 0.2 is adopted;
pa = 0.5 ... 1 MPa, shall be adopted pa = 0.8 MPa.

It is adopted i = 6 pairs of friction surfaces, if worn uniforms.
The numbers of disks on the two couplings have:

- $z_1 = \frac{i}{2} = \frac{6}{2} = 3$ discs on led semi coupling.
- $z_2 = \frac{i}{2} + 1 = \frac{6}{2} + 1 = 4$ discs on led semi coupling.

Pre-stressing force of the spring is given by the next formula:

$$F_{arc} = \frac{4M_{t\,lim}}{\mu i\left(D_e + D_i\right)} = \frac{4 \cdot 121762}{0{,}2 \cdot 6\left(88 + 51\right)} = 2014N \quad (6)$$

Torque limit for uniform distribution of pressure on the friction surfaces has the next value:

$$M_{t\,lim\,prest} = \frac{\mu\,i\,Farc}{3}\,\frac{D_e^3 - D_i^3}{D_e^2 - D_i^2} = \frac{0{,}2 \cdot 6 \cdot 2014}{3} \cdot \frac{88^3 - 51^3}{88^2 - 51^2} = 125671Nmm \quad (7)$$

3. CONCLUSIONS

Calculation assuming uniform wear leads to an excess of coupling than if uniform pressure distribution. If uniform pressure distribution, pressure is reduced relative to the actual allowable pressure, resulting in a lower wear; Torque occurs slippage is greater if uniform pressure distribution:

$$M_{t\,lim\,prestconst} = 125671\,N \cdot mm >$$
$$M_{t\,limuzuraconst} = 121762\,N \cdot mm$$

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