IMPROVEMENT OF CONVEYOR DRUM LINING CONSTRUCTION

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Nowadays, there is a need to use belt conveyors more and more in mining enterprises for transporting rock. A simple driving drum without a lining cannot effectively transmit the electric drive power to the conveyor belt. As a result, there is a need to use various linings in driving drums, especially when the driving drum with a diameter of 500 mm and larger works under the influence of friction forces with the conveyor belt [1,2].

Conveyor drums are cylindrical or barrel-shaped and are designed to pull the conveyor belt and create the necessary movement.

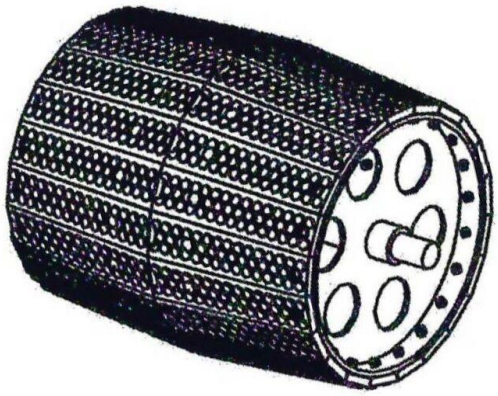
а.  б. 

Figure 1. Cylindrical (a) and barrel-shaped (b) drums

The diameter of the drum is determined depending on the function of the drum, the tension of the belt, its width and the type of traction frame.

The load on the drum due to belt tension is determined by the following formula:

$$\bar{S} = \bar{S}_{nb} + \bar{S}_{cb}; \quad (1)$$

$\bar{S}_{nb}$ - maximum tension of the belt network coming to the driving drum;

$\bar{S}_{cb}$ - the maximum tension of the belt web coming out of the driving drum;

For belt conveyors, the diameters of the moving drums (without taking into account the lining) and the moving drums are determined according to the following formula [2]:

$$D = k_z \cdot k_b \cdot z; \quad (2)$$

Here; k_z - the coefficient of the pad type (Table 1);

k_b - the coefficient of the drum task (Table 2);

z - gasket number.

Table 1

Cushion strength, N/mm	550	1000	2000	3000	4000
k_z	125-140	141-160	171-180	181-190	191-200

Table 2

Drums	Belt drum coverage angle a	k_b - the permissible tension in determining the coefficient of drum duty, % as obtained			
		25 кам	25-50	51-75	76-100
Motivator	180-240	-	0.63	0.8	1
Stressful	180-200	0.50	0.63	0.8	1
Returner	70-100	0.4	0.5	0.63	-
Squeezer	30-69	0.32	0.4	-	-

The diameters of the drums transmitting motion are determined according to the following formula [2]:

$$D = D_б \cdot k_b;$$

here: $D_б$ - driving drum, м;

k_b - drum utilization rate;

For example: 2000St-5400 The drum diameter for branded tape is found as follows.

$$D = k * d = (125 - 150) * 11.2mm = (1400 - 1700)mm;$$

So, for a 2000St-5400 grade belt, the drum diameter can be from 1400 mm to 1700 mm.

The selected diameter of the driving drum should be checked in terms of the pressure, in MPa, exerted by the belt on the drum surface.

$$P = \frac{3600 S_{нб}}{\alpha \pi B D_б} \frac{e^{\mu\alpha} + 1}{e^{\mu\alpha}} \le P_б$$

here: B - drum width, мм;

$D_б$ - drum width, мм;

μ - coupling coefficient;

α - the angle of winding of the belt on the drum, degrees;

$P_б$ =0.2-0.3 МПа rubber fabric for the strap;

$P_б$ =0.35-0.55 МПа for the rubber cable strap;

The lining of conveyor drums ensures the extension of the operational resource of the conveyor and the efficient and uninterrupted operation of the transport system.

Linings are manufactured in the form of special vulcanized coatings with a smooth rubber or grooved working surface. To protect the belt conveyor drums from corrosion and mechanical damage, they are rubberized or lined (coated with rubber). The process involves coating the drum with a special composite material based on rubber or polymer [2,3]. The drum surface is thoroughly polished with a special polishing machine to a depth of not more than 30 μm. The strength of the lining adhesion to the drum depends on the quality of surface preparation (Fig. 2).



Figure 2. Grinding the surface of the drum

A special primer is applied to the drum surface, the drying time of which depends on the type of primer. A special glue is applied to cover the surface with rubber, and the most difficult stage begins with gluing the rubber to the drum (Fig. 3a). There is a corresponding primer for each glue. First, the primer is thoroughly mixed for 1-2 minutes before application, then it is applied in one thin layer to the drum surface with a smooth bristle brush. The average primer consumption per 1 m2 of surface is 180-200 ml. After applying the primer to the metal, it must be dried for at least 60 minutes at a temperature of >20 0C [10]. The temperature of the drum surface and the temperature of the primer, glue, and lining rubber must be the same.

When gluing the lining, the ambient temperature should be 20..+ 25 ^{0}C.

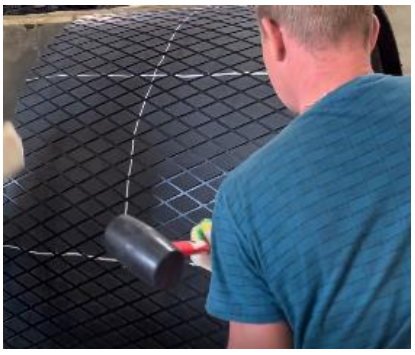
а.  б. 

Figure 3. Gluing and hammering the lining to the drum

In Figure 3b, when gluing the lining to the drum, it is necessary to glue the lining rubber every 400-600 mm in length and then tap the lining with a special rubber hammer, because when tapped with a hammer, it leads to a strong adhesion between the rubber and the drum surface without air. Linings are mainly effective in dry conditions. In operating conditions with high

humidity, the conveyor belt and the drum lining have a very low adhesion coefficient, which leads to the conveyor belt slipping on the drum or the inability to operate the conveyor.

Table 3.

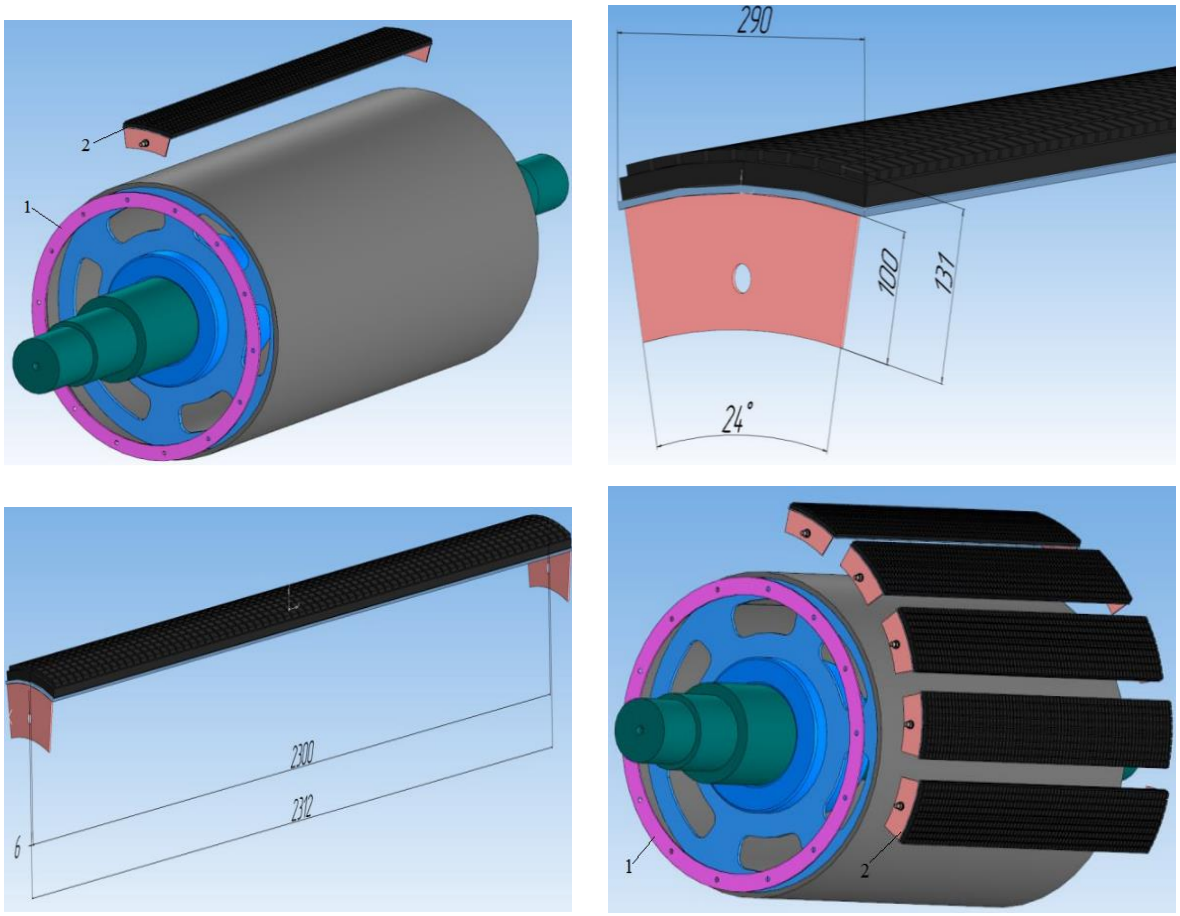
Conditions of use	Steel iron	Rubber	Ceramics
Dry	0,35-0,40	0,40-0,45	0,75-0,85
Wet	0,10-0,15	0,33-0,38	0,50-0,80
Wet and dirty	0,05-0,10	0,22-0,30	0,45-0,55

There are manufacturers of rubber linings for drums: HUAO rubber lining, China, drum rubber lining, Ukraine, TREX economy class rubber lining, Netherlands, CORREX premium class rubber lining, Germany, CERA rubber-ceramic lining, Netherlands, quick-change SLIDE-LAG lining, France.

The lining of belt conveyor drums consists of coating the drum shell using special materials, such as tread rubber lining, ceramic lining, rubber-ceramic mixture, polyurethane and other similar materials. These coatings improve the adhesion of the drum to the conveyor belt [11].The method of fastening the removable lining to the drum plays a key role in ensuring the durability and protective efficiency of conveyor drums. In Figure 5a, the drum consists of a shaft 1, a ring 2, a hub 3, a cylindrical shell 4, a removable plate 5 (a metal sheet with a rubber lining), special fastening elements - bolts or 6 clamping stop plates, which provide a strong and reliable connection between the lining and the drum surface. This approach ensures the stability of the lining even under high loads and facilitates the installation and replacement of linings.

Due to the wear of the bolt heads installed in the drive drums during operation, the replacement times of the linings are lengthening and causing great difficulties. Therefore, one of the main issues is to prevent the bolting of the drum linings and to introduce a constructive modification to them so that they can be quickly removed. Lining plates are easy and quick to remove and

reinstall, making them ideal for drums installed in locations where it is difficult to remove (dismantle) the drums from the conveyor due to obstacles or height. The profile is made of steel sheet with a thickness of 6 mm, with a rubber lining, the thickness can be 18-34 mm, the maximum lengtRRh can be 1600 mm or more, and the width can be 100 - 300 mm.



a-drum lining assembly view, 1st ring; 2-rubber plate;

Figure 4. Constructively improved lining plate

In order to precisely fit the plank to the diameter of the driving drum, each plate of the liner is bent to its diameter. It also makes it easier to slide and lay under the guides. The stop plates are also made of steel, so the built-in rollers are firmly fixed on the surface of the drum. Detachable linings are in the form of a diamond pattern. When replacing the lining, disassembly of the drum is not required: installation is carried out on site (Fig. 4).

In Figure 6, in order to increase the strength, 1 ring (rod) is installed on the cylindrical drum shell (body), to which 2 special removable lining plates

made of special rubber resistant to abrasion are attached on a steel frame bent to the diameter of the drum, and 1 ring is bolted with a nut. This neutralizes the internal stresses in the lining and ensures maximum adhesion of the rubber to the metal. The use of high-density rubber ensures long-term operation. When replacing the lining, the drum does not require dismantling, that is, it is carried out at the installation site.

In short, the improved drum linings, due to the fact that the bolt nut, that is, the connecting elements, are located on the sides of the drum, allow for easy and convenient replacement of the plates without friction with the belt and during removal. This, in turn, leads to an increase in the conveyor utilization factor and increases efficiency.

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