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An overview of the constructions of conveyors for moving bulk materials, comparison and study of their parameters

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Abstract. The production of concrete mixes, along with their use in the production of building materials and structures, is one of the key processes in the construction industry during the construction, restoration and repair of buildings and structures. Because of this, the need to create modern concrete mixing plants that will meet the requirements of minimum energy consumption and maximum productivity of concrete mixture production is an urgent task. Not only the main operations, which include the dosing of the components of the mixture and their mixing, but also the maintenance operations, namely operations that ensure the timely movement of the components of the concrete mixture from warehouses to the main technological equipment, affect the set rhythm of the concrete mixture production. Conveyors of various types and designs are used to move bulk materials, such as crushed stone and sand.

For the rational selection of such equipment in accordance with the characteristics of the cargo to be transported, knowledge of the types of conveyors, their structures and parameters, understanding of operation issues and methods of parameter calculation are required. In addition, it is worth paying attention to the following parameters: maximum cargo transportation productivity, low energy consumption per unit of moved products, low metal content of the structure.

The work reviewed the most common designs of conveyors used to move bulk materials in concrete mixing plants, analyzed the disadvantages and advantages of conveyors, as well as technical parameters. As a result, the predominant directions for the use of belt and plate conveyors at construction enterprises were determined. The advantages of belt conveyors, which contribute to their widespread distribution, are high productivity, simplicity of design, reliability, quiet operation, low specific power consumption.

When choosing a conveyor, it is recommended to choose the equipment with the highest productivity and the lowest power of the drive motors, however, the performance should be clearly related to other technological equipment.

Keywords: bulk materials, concrete mixing plant, moving, technical means, transport equipment, conveyors, speed, productivity

INTRODUCTION

The development of the country's construction industry nowadays requires increasing the efficiency of production, constant updating and improvement of equipment based on the achievements of the scientific and technical process.

At enterprises engaged in the production of concrete mixtures, a wide range of equipment is used to perform main (mixing of concrete mixture, sorting of fillers, etc.), service (transportation of mixture components, loading and unloading of bulk materials, etc.) and auxiliary (maintenance equipment, etc.) operations.

Service operations, along with the main operations, directly affect on the productivity of concrete mix production. Various materials must be moved quickly and on time to the places where they are needed.

The speed of materials movement and its preservation, reduction of time spent and improvement of labor productivity at the enterprise based on the maximum mechanize-tion and automation of all processes and operations related to transportation.

PROBLEM FORMULATION

Conveyor is a machine of continuous action, designed for the transportation of bulk materials and artificial cargo. Belt, plate, chain (namely, bucket) and screw conveyor devices for continuous movement of cargos have become the most common at enterprises and workshops where concrete mixtures are manufactured.

When choosing the type of conveyor, as well as its technical parameters, special attention should be paid to the following aspects: maximum productivity of cargo transportation and low energy consumption per unit, low metal density of the structure of equipment, the presence of drive mechanisms that allow smooth adjustment of the speed of movement of the working body.

In order to rationally choose conveyors in accordance with the characteristics of the cargo to be transported, knowledge of the types of conveyors, their designs and parameters, understanding of operational issues and methods of parameter calculation are required.

GOAL AND PROBLEM STATEMENT

The purpose of the work is to determine the rational design of the conveyor, which is used for supplying bulk materials in the concrete mixing plant.

Achieving the purpose is carried out by reviewing the designs of conveyors for bulk materials, determining their disadvantages and advantages, analyzing technical parameters, as well as comparing conveyors available on the market.

MAIN PART

For the construction of buildings from reinforced concrete structures, monolithic frame and prefabricated technologies are mainly used. During construction using prefab technology, ready-made products and structures manufactured at special factories are assembled on the construction site. During construction using monolithic-frame technology, supporting structures and overlaps of the building are cast from concrete directly on the construction site using special forms. In prefabricated monolithic technology, there are two main technologies combined. The overlaps and part of the structures are manufactured in factory conditions and are used on the construction site in a finished form. Some of the structures are erected from concrete directly on the construction site using special forms [1].

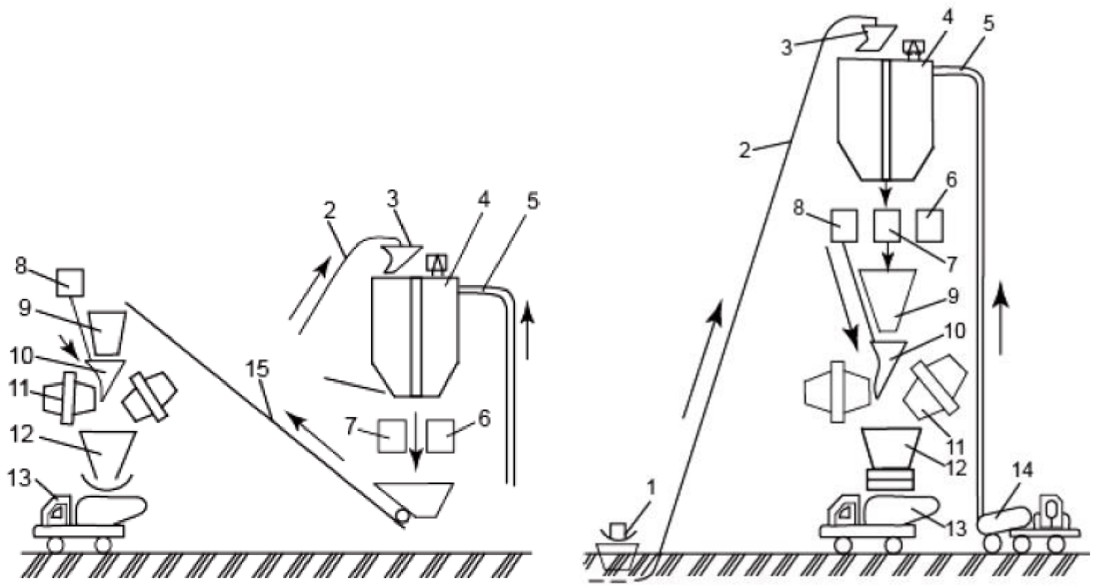
For the production of concrete structures, it is necessary to produce a sufficient amount of concrete mixtures - these are mixtures of mixed components, namely binder, water, fillers (coarse and fine) and additives to improve the properties of the mixture or the final product - concrete. Concrete mixtures are made at concrete factories, stationary or mobile plants.

According to their design, plants and installations are divided into stationary and inventory, prefabricated-dismantled and mobile. According to the layout of the equipment - on the parterre (Fig. 1, *a*) and high-rise (Fig. 1, *b*) [5].

The equipment included in concrete mixing plants is as follows: 1 – conveyor for supplying fillers from the warehouse; 2 – the conveyor for supplying aggregates to expendable hoppers; 3, 10 – rotary distribution guides of mixture components; 4 – expendable hoppers of mixture components; 5 – pneumatic section of cement supply; 6, 7, 8 – dispensers of mixture components (cement, fillers, water); 9 – collective hopper of components; 11 – concrete mixer; 12 – hopper for delivery of concrete mixture; 13 – vehicle for transporting the mixture; 14 – cement truck; 15 – skip lift.

As you can see, machines for transporting bulk components are an integral part of the modern technological process of concrete mixture production.

Transporting machines are divided by the principle of operation into two groups: periodic (cyclic) and continuous operation.



a *b*

Fig. 1. Layout schemes of equipment of concrete mixing factories, plants and installations

Periodic operation machines include railed and non-railed ground intra-production transport: carts, manipulator industrial robots, suspended cableways and rail roads of periodic operation, skip lifts and other similar machines in terms of cyclicity.

Continuous operation transport machines, as they are often called - continuous transport machines are machines in which the load moves in a continuous flow along a linear route with the help of a load-carrying element that does not stop for loading or unloading operations.

The working (with load) and reverse (without load) movement of the load-carrying element occur at the same time, which allows such machines to achieve high productivity of transportation, which is important for modern enterprises with large cargo flows. Such machines are divided into two large subspecies.

The first subspecies includes machines in which the load-carrying and traction element is a belt (Fig. 2, *a*), chain (Fig. 2, *b*) or rope (Fig. 2, *c*). The load is moved in a continuous flow on the traction element or on the devices attached to it. Such machines include belt, plate and chain conveyors, suspended conveyors, elevators, cableways, etc. The second subspecies includes machines that do not have a traction element, namely gravity transport (Fig. 3, *a*), roller (Fig. 3, *b*), screw conveyors (Fig. 3, *c*), vibrating and inertial conveyors , as well as pneumatic and hydraulic transport devices.

a *b* *c*

Fig. 2. Transporting machines with a load-carrying and traction element

a *b* *c*

Fig. 3. Transporting machines without a traction element

Continuous operation transport machines have become the most widespread in construction enterprises engaged in the production of concrete products, and especially in concrete mixing shops of such enterprises. Fine and coarse filler of the concrete mixture is moved using belt and plate conveyors, cement and additives are transported by screw conveyors or pneumatic transport. Such transport devices ensure the mechanization and automation of the processes of moving and feeding the components of the mixture into the expendable hoppers, allow to increase labor productivity and therefore have become an important part of the technological equipment of the concrete mixing plant.

Next, we will consider the design and parameters of belt and plate conveyors in more detail.

According to the nature of the drive, mechanical transport machines are divided into machines with a frictional and rigid kinematic connection of a flexible traction element with a drive link. In machines with a friction kinematic connection, the flexible traction element moves due to the friction forces that are formed between them and the driving pulley (drum). Such machines include a belt conveyor. With a rigid kinematic connection, the transmission of motion to the traction element occurs due to the engagement of it and the drive sprocket. Such machines include a plate conveyor.

According to the location of the traction element, they are divided into planar and spatial, which include both horizontal and inclined or vertical sections. In the case of a plate conveyor, it may also have sections of the track with a turn.

Conveyors are divided by mode of operation depending on their operating conditions, loads and hours of operation per year [2] are shown in Table. 1. Where P_f and P_{max} are, respectively, the actual and maximum productivity of the conveyor, m^3/s; Q_f and Q_{max} – actual and maximum load capacity, kg; S_f and S_{per} - actual and permissible tension, N.

Table 1. Modes of operation of conveyors

Modes of operation	Conveyor usage class			
	By time per year, hour/year	By productivity $P_0=P_f/P_{max}$	By load capacity $H=Q_f/Q_{max}$	By the tension of the traction element $C=S_f/S_{per}$
Very easy	< 1600	< 0,63	< 0,63	< 0,63
Easy	< 1600 < 2500	< 1,00 < 0,63	< 1,00 < 0,63	< 0,80 < 0,80
Average	< 4000	< 0,63	< 0,63	< 0,80
Heavy	< 6000 < 8000	< 0,63 < 0,25	< 0,63 < 0,50	< 0,80 < 0,63
Very heavy	< 8000	< 1,00	< 0,63	< 1,00

In addition, temperature and air humidity are taken into account to assess the operating mode. At a temperature from 5 to 20 °C with air humidity of 10...50% - easy mode of operation; from 0 to 30 °C with a humidity of 50...65% - average; from -20 to 30°C and humidity 65...90% - heavy; from -40 to +40 °C and humidity over 90% - a very heavy mode.

Belt conveyors. The design of the belt conveyor is consists of a frame 12 on which the drive 8 and tension drums 5 are placed, as well as the upper 7 and lower 11 supporting and guiding rollers 10, which form the post of the conveyor. The endless conveyor belt 6 covers the tension and drive drums. Between these two drums, two branches of the conveyor belt are formed, namely the working (carrying) and idle, which rest on the support rollers in order to avoid their sagging. The torque from the electric motor is transmitted through the gearbox to the drive drum, which in turn drives the conveyor belt. In order to increase the force of friction between the belt and the drive drum, a special deflecting drum 9 is additionally installed, which allows to increase the angle of coverage of the drum by the belt. A tensioning device is used to prevent the belt from sagging and to keep it pressed against the drive drum. The weight of the suspended load 1 with the help of the rope 3 and deflecting blocks 2 pulls the cart 4, on which the tensioning drum 5 is installed and ensures a constant tension of the belt. Belt conveyors are classified [3]:

1. According to the design of the drive and the number of drive drums:
- with one drive drum;
- with several drive drums.

2. According to the location of the working branch of the belt:
- with the upper working branch;
- with the lower working branch.

3. By unloading method:
- with unloading on the final drum;
- with intermediate unloading;

4. By type of cargo:
- for bulk;
- for artificial ones.

5. According to the shape of the cross section:
- with a flat belt;
- with a belt in the form of a trough.

The drive mechanism of the belt conveyor (Fig. 5) simply consisting of a bearing frame 1 on which the deflection 3, unloading 4 and drive drums 2 are installed. The torque from the

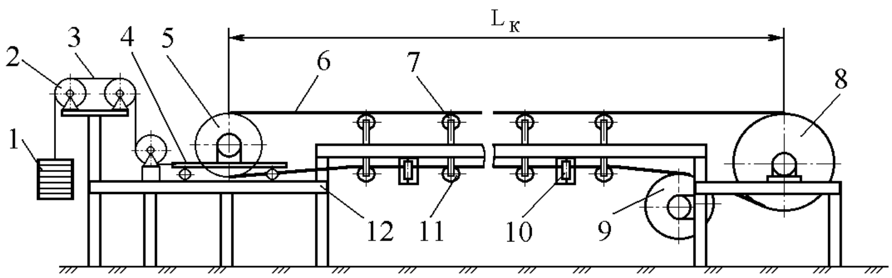


Fig. 4. The basic scheme of the belt conveyor mechanism

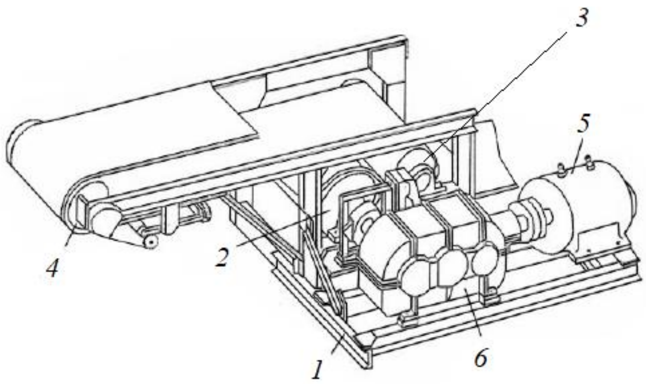


Fig. 5. Construction of the belt conveyor drive station

engine 5 is transmitted to the drive drum 2 through the gearbox 6.

The diameter of the drive drum depends on the length of the conveyor, the number of spacers in the belt and the type of fabric. The width of the drum is taken to be 150-200 mm more than the width of the belt that this drum sets in motion. The number of drive drums in the conveyor design is different and ranges from 1 to 3 units. The magnitude of the friction force transmitted to the traction element depends on such parameters as: belt tension, the friction coefficient of the belt and drum material, the scheme and drive drum girth angle. Deflecting drums are used in the structure to maximize the transmission of friction force. Depending on the number of drive drums, different circuits of the drive drums are used (see Fig. 6). a, b - with one drive drum; c, d - with two drive drums; e, f - with three drive drums.

According to the type of belt, conveyors are divided into those that use a rubberized, steel or wire belt. Conveyors with a rubberized belt were the most widely used in the construction industry. The frame of rubberized belts is made on the basis of cotton and synthetic fabrics, as well as with a cable base [3]. The frame receives longitudinal and transverse loads from the load, and the protective coating, which is rubber, protects the frame from mechanical damage.

Since conveyors are divided according to the shape of the cross-section of the belt in the process of transporting the material, the volume of cargo that can be moved per unit of belt width is determined according to different schemes [2]:

Diagrams for determining the cross-section of the material transported on a flat belt (Fig. 7, *a*) and a trough-shaped belt (Fig. 7, *b*) are shown below.

The cross-sectional area of the cargo on a flat belt determined by the formula, m^2:

$$F_1 = \frac{bh_1}{2}C = 0{,}16 \cdot B^2 \cdot C \cdot tg\psi, \qquad (1)$$

where B – belt web width, m; C – coefficient that depends on the angle of inclination of the conveyor; ψ - the angle at the base of the material, which is equal to 35% of the angle of the natural slope of the material φ at rest ($\psi = 0{,}35 \cdot \varphi$); $b=0{,}8B$ – the base of the material layer triangle, m; $h_1=0{,}4 \cdot B \cdot tg\varphi$ - height of the material layer triangle, m.

Depending on the angle of inclination of the conveyor β, the coefficient C takes the

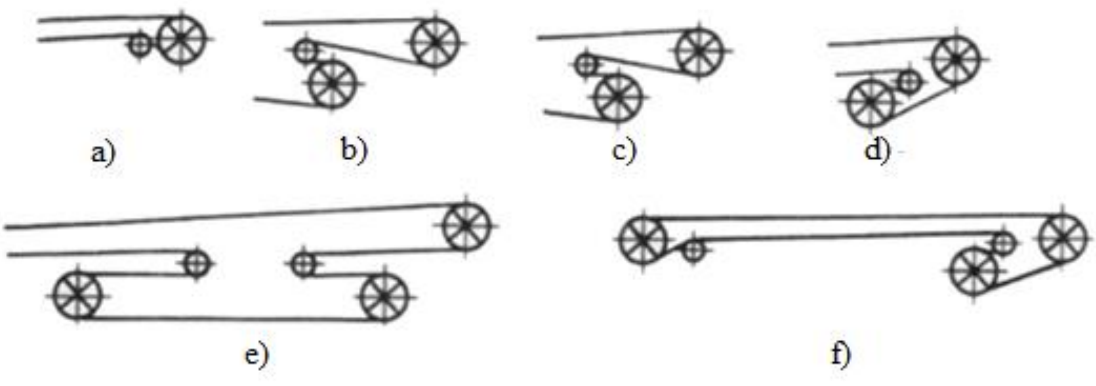
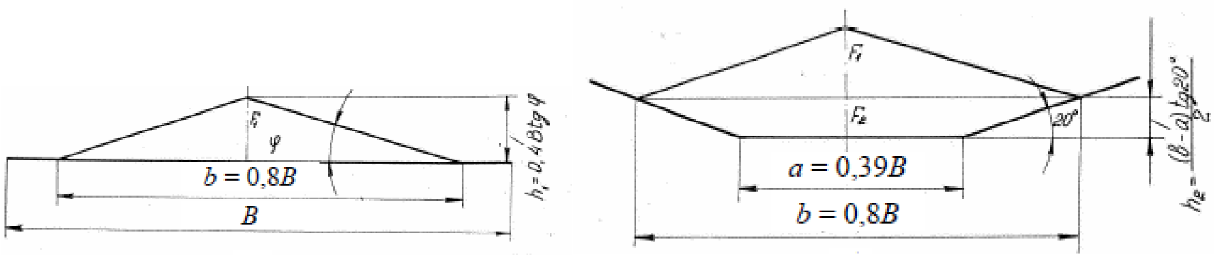


Fig. 6. Schemes of belt routing along the drive drums of belt conveyors



a *b*

Fig. 7. Schemes for determining the cross-sectional area of the material along the width of the belt

following values: at the value *β=0…10°* - *C=1;* at *β=10…15°* - *C=0,95;* at *β=15…18°* - *C=0,95.*

Productivity of the conveyor with a flat belt, t/s:

$$Q_f = F_1 \cdot V_с \cdot \rho_в = \\ = 0{,}16 \cdot B^2 \cdot C \cdot tg\psi \cdot V_с \cdot \rho_в, \qquad (2)$$

where $\rho_в$ – cargo density, t/m^3; $V_с$ – speed of movement of the conveyor belt, m/s.

Hence the width of the flat belt, m:

$$B = \sqrt{\frac{Q_f}{0{,}16 \cdot C \cdot tg\psi \cdot V_с \cdot \rho_в}}. \qquad (3)$$

When transporting material on a trough-shaped belt, the cross-sectional area of the cargo is determined as the sum of the areas of the trapezoid F_2 and the triangle F_1, m^2:

$$S_{пп} = F_1 + F_2. \qquad (4)$$

In the calculation of the area of the trapezoidal part of the cross-section of the cargo, the standard angle of inclination of the rollers is taken 20°, m^2:

$$F_2 = \frac{a+b}{2} h_2 = 0{,}045 \cdot B^2, \qquad (5)$$

where $h_2 = \frac{b-a}{2} tg20°$ - trapezium height, m; *a=0,39B* – length of the lower roller, m.

Productivity of the conveyor with a trough-shaped belt, t/s:

$$Q_t = (F_1 + F_2) \cdot V_с \cdot \rho_в = \\ = 0{,}045 \cdot B^2 \cdot V_с \cdot \rho_в (3{,}6 \cdot C \cdot tg\psi + 1) \quad (6)$$

Hence the width of the trough-shaped belt, m:

$$B = \sqrt{\frac{Q_t}{0{,}045 \cdot V_с \cdot \rho_в (3{,}6 \cdot C \cdot tg\psi + 1)}}. \qquad (7)$$

The speed of movement of the belt is chosen most often from the following row, m/s: 0.25; 0.315; 0.4; 0.5; 0.63; 0.8; 1.0; 1.25; 1.6; 2.0; 3.15 [2]. Moreover, the selection of the speed of the belt depends on the characteristics of the cargo, the angle of inclination of the conveyor, the type of unloading device, etc. For example, when transporting medium and small-sized cargo such as crushed stone, sand or earth on horizontal conveyors, a speed of 1.5...2.5 m/s is assumed, and when transporting large-sized cargo, such as coal, the speed is assumed to be within 1...2 m/s.

In inclined conveyors, the speed of the belt is reduced, because when the belt runs into the rollers, the material is dumped, because the angle of inclination of the belt when running into the roller increases due to slack.

Belt conveyors have become widely used due to operational qualities, such as high productivity, simplicity of design and reliability, quiet operation, low specific power consumption and the possibility of automation.

Disadvantages include the short service life of the belt and restrictions on the inclination of material transportation.

The areas of application of belt conveyors are limited by the following parameters:

- restrictions on temperature, size and abrasiveness of transported materials;
- limitation of the lifting angle when using a smooth belt(from 16 to 18 degrees);
- the need to install the conveyor in a straight line in the plan, which makes it impossible to use it in curved areas.

Plate conveyors. The design of the plate conveyor (Fig. 8) is a frame 5, at the ends of which two stars are installed, one of which is a drive 2, and the other is a tensioning 7 with a tensioning device 8. An endless deck consisting of separate plates 3, which are attached to the chassis , consisting of a traction chain 4, which go around the end stars and are engaged with their teeth. In some cases, both sprockets may have a drive to transmit torque from the engine and drive the plate chain. The number of traction chains also varies. Closed traction chains move together with the flooring along the frame guides along the longitudinal axis of the conveyor. The conveyor is loaded through funnel 6 at any point along the route, and unloaded into funnel 1.

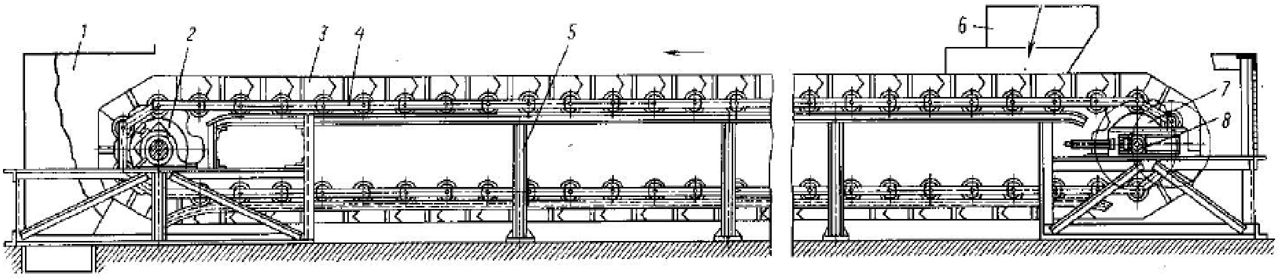


Fig. 8. The basic scheme of the plate conveyor mechanism

Plate conveyors are classified [3]:

1. By application:
- underground;
- general purpose;

2. According to design features:
- spatial;
- rectilinear.

3. By the number of reasons:
- single-star drive;
- multi-star drive.

4. By the number of chains:
- single chain;
- double chain.

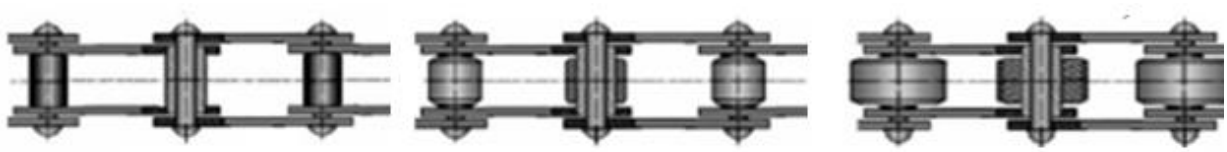
5. By type of cargo:
- for bulk;
- for artificial ones.

6. According to the shape of the cross section:
- with a edgeless flat open floor;
- with a edgeless flat closed floor;
- with edgeless or edged wavy floor;
- with a box floor;
- with a flat loop floor.

The design of the supporting elements of the conveyor also depends on the type of conveyor traction chain [4]. For the hub (Fig. 9, a) and roller (Fig. 9, b) designs of the traction chain, stationary roller supports fixed on the conveyor bed serve as supporting elements for the floor. The supporting elements in conveyors with rink chains (Fig. 9, c) are the running rink of the chain, which transfer the load from the floor with the load to the guide frames of the conveyor.

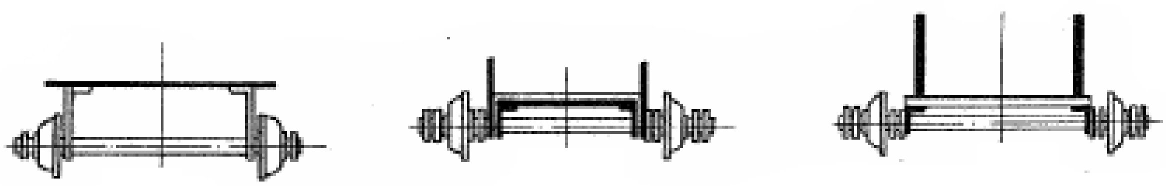
In conveyors with flat flooring of plate (Fig. 10, a), the cross-sectional area of the load is limited by the width of the plate and the angle of the natural slope of the material. To increase the cross-section of the load and thereby the productivity of the conveyor, they are equipped with sides. There are floors with movable (Fig. 10, b) and fixed (Fig. 10, c) sides.

Since plate conveyors are divided by the presence or absence of floor sides, the volume of cargo that can be moved per unit of plate width is determined according to different schemes[2]:



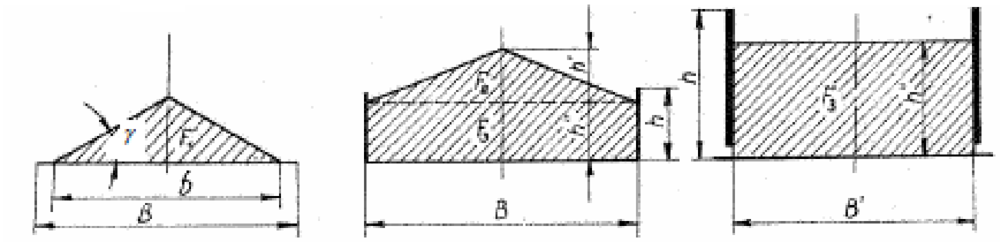
a *b* *c*

Fig. 9. Structures of the traction chain



a *b* *c*

Fig. 10. Types of floor of plate conveyors



a *b* *c*

Fig. 11. Schemes for determining the cross-sectional area of the material across the width of the plate

Fig. 11 shows schemes for determining the cross-section of the material transported on a flat floor(Fig. 11, a), a floor with movable sides (Fig. 11, b) and a floor with fixed sides (Fig. 11, c).

The cross-sectional area of the cargo on a flat floor is determined by the formula, m^2:

$$F_1 = \frac{bh_1}{2} = 0{,}18 \cdot B^2 tg\psi, \qquad (8)$$

where B – width of floor, m; $b=0{,}85B$ – the base of the triangle of the material layer on the floor, m (Fig.11, a); ψ - the angle at the base of the material, which is equal to 60% of the angle of the natural slope of the material φ at rest ($\psi = 0{,}6 \cdot \varphi$).

In cases of using a conveyor with movable sides of the floor, the cross section of the bulk material consists of areas F_2 and F_3 (Fig. 11, b) and is determined by the formula:

$$F_2 + F_3 = \frac{Bh^{`}}{2} + Bh^{``} = 0{,}25 \cdot B^2 tg\psi + +Bh\chi, \qquad (9)$$

where $\chi = h^{``}/h = 0{,}65 \ldots 0{,}75$ – filling factor of the cross-section of the floor along the height of the sides $h$; $h^{`}$ and $h^{``}$ - the height of the cross-section of the material, respectively, in the area of areas F_2 and F_3, m.

For a conveyor with fixed sides, the cross-section of the material is taken per layer in the shape of a rectangle with an area of F_3 (Fig. 11, c):

$$F_3 = Bh^{``} = Bh\chi, \qquad (10)$$

where $h=0{,}5\ldots0{,}6B$ – height of sides, m.

The productivity of a plate conveyor, which is installed in a horizontal position, is determined by the formula, depending on the type of floor, t/s:

- for flat floor:

$$Q_{ff} = F_1 \cdot V_с \cdot \rho_в = = 0{,}18 \cdot B^2 \cdot tg\psi \cdot V_с \cdot \rho_в; \qquad (11)$$

- for floor with movable sides:

$$Q_m = (F_2 + F_3) \cdot V_с \cdot \rho_в = = 0{,}25 \cdot B \cdot V_с \cdot\cdot \rho_в (Btg\psi + 4h\chi); \qquad (12)$$

- for floor with fixed sides:

$$Q_{fs} = F_3 \cdot V_с \cdot \rho_в = Bh\chi \cdot V_с \cdot \rho_в, \qquad (13)$$

Productivity for inclined conveyors is determined by the formulas:

- at the angle of inclination of the conveyor $\beta \leq 20°$

$$Q_{in} = Q_p \cdot cos^2\beta; \qquad (14)$$

- at the angle of inclination of the conveyor $\beta > 20°$

$$Q_{in} = Q_p \cdot cos^3\beta \quad , \qquad (15)$$

where Q_p – plate conveyor productivity, t/s.

The width of the floor of the plate conveyor is determined by the formulas, m:

- for flat floor

$$B = \sqrt{\frac{Q_{ff}}{0{,}18 \cdot tg\psi \cdot V_с \cdot \rho_в}}; \qquad (16)$$

- for floor with fixed sides

$$B = \sqrt{\frac{Q_{fs}}{h\chi \cdot V_с \cdot \rho_в}}. \qquad (17)$$

Unlike belt conveyors, plate conveyors have higher productivity, capable of transporting cargo with high temperature, large size cargo and highly abrasive cargo.

Their design allows to make long routes with complex spatial trajectories, which have both inclined sections and turns, which allows to ensure transportation without overloading, the possibility of their use in technological processes and flow lines at high and low temperatures.

The maximum angle of inclination of the plate conveyor floor can reach values of 35...60° and depends on the characteristics of the cargo and the type of floor. If there are transverse load-bearing bars on the floor, the angle of inclination can be increased.

Plate conveyors, however, have disadvantages, such as bulkiness and high weight, high cost of production and operation, the presence of a large number of friction pairs that require regular lubrication, high resistance to movement of the web, low speed of movement of cargo (up to 1.25 m/s) .

The speed of movement of the plates is accepted within the range of 0.3...1.25 m/s.

In a simplified way, the productivity of various types of conveyors (belt or plate) is determined by the formula, t/s:

$$Q_k = 3600 \cdot S_{cs} \cdot V_c \cdot \rho_в \cdot K_1 \cdot K_2, \quad (18)$$

where S_{cs} – cross-sectional area of the cargo on the conveyor web, m^2; K_1 – coefficient of the angle of inclination of the inclined section of the conveyor (at angles of inclination up to 6° K_1=1, at angles of inclination from 6° to 18° K_1=0.95); K_2 is a coefficient that takes into account the mobility of the conveyor (for stationary installations K_2=1; for mobile K_2=0.9).

The most common in concrete mixing plants for moving bulk materials (crushed stone, sand) are belt conveyors, which are widely represented on the market. They differ in the width of the belt, the speed of its movement, the length of the web, productivity, construction and price. Let's consider the models of conveyors available on the market with a belt width of 600 mm and a length of 8 meters. Their parameters are shown in Table 2.

To compare the design excellence of the machines, the specific productivity indicator, t/(kWh) was used:

$$K_{in} = Q_k / N \rightarrow max\,, \quad (19)$$

where N – power of installed engines, kW.

The calculation results are listed in table 2.

Table 2. Characteristics of conveyors for transporting bulk materials with a floor width of 600 mm and a length of 8 meters

Manufacturer and model	Type of belt	Productivity, t/h	Belt speed movement (max), m/s	Power of engine, kW	K_{in}, t/(kWh)
4build LT-8-600	Flat belt	60	1	4	15
4build LT-8-600	Chevron flat belt	30	0,5	2.2	13,63
Hydrolider LT-8-600	Chevron flat belt	30	0,5	2.2	13,63
Budstroi LT-8-600	Flat belt	150	0,8	3	50
Greens-sumy 600-8	Flat belt	30	0,5	3	10
Agrohelix LT-8-600	Trough-shaped belt	150	1	3	50
Zavodslava KL-600	Trough-shaped belt	60	0,57	5,5	10,9
Hydrolider LT-8-600	Flat belt	200	1,5	7,5	26,6

CONCLUSIONS

As a result of the conducted research, an overview of the main designs of conveyors used for transporting bulk materials was performed, the technical parameters of belt and plate conveyors were analyzed, and their disadvantages and advantages were determined.

Belt conveyors are the most widely used in concrete mixing plants because of their high productivity, simple design, reliability, quiet operation, and low specific power consumption.

A comparison of the structural perfection of the machines was made based on the specific productivity indicator. The highest value of the indicator was recorded at conveyors with the highest productivity and speed of belt movement. Therefore, when choosing conveyors, it is worth choosing machines that have the highest productivity and the lowest power of drive motors. At the same time, the productivity of the machines must be clearly related to other technological equipment used in the process of manufacturing building material. So, if the conveyor is used to supply bulk material to the expendable hoppers of the concrete mixing plant, its performance should be selected in accordance with the performance of the supply of the components of the concrete mixture. Therefore, in the process of calculating and selecting the equipment, it is necessary to determine the maximum, actual and reserve productivity of the shop for the key equipment involved in the work processes.

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Огляд конструкцій конвеєрів для переміщення сипких матеріалів, порівняння і дослідження їх параметрів

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Анотація. Виробництво бетонних сумішей на ряду з їх використанням при виробництві будівельних матеріалів і конструкції є одним із ключових процесів у будівельній галузі при зведенні, відновленні і ремонті будівель і споруд. Через це потреба у створенні сучасних бетонозмішувальних установок, які будуть задовольняти вимогам мінімальної енергоємності і максимальної продуктивності виготовлення бетонної суміші є задачею актуальною. Вплив на заданий ритм виготовлення бетонної суміші чинять не тільки основні операції, до яких відноситься дозування компонентів суміші і їх змішування, а і обслуговуючі операції, а саме операції, які забезпечують вчасне переміщення складових бетонної суміші зі складів до основного технологічного устаткування. Для переміщення сипучих матеріалів, таких як щебінь та пісок, використовують конвеєри різних видів і конструкцій.

Для раціонального вибору подібного обладнання відповідно до характеристик вантажу, що підлягає перевезенню, потрібні знання видів конвеєрів, їх конструкцій і параметрів, розуміння на питаннях експлуатації і методів розрахунку параметрів.

Крім того варто приділяти увагу наступним параметрам: максимальна продуктивність транспортування вантажу, низькі витрати енергії на одиницю переміщеної продукції, низька металоємність конструкції.

У роботі здійснено огляд найбільш поширених конструкцій конвеєрів, які використовуються для переміщення сипучих матеріалів у бетонозмішувальних цехах, виконано аналіз недоліків і переваг конвеєрів, а також технічних параметрів, У результаті визначені переважаючі напрямки використання стрічкових і пластинчастих конвеєрів на будівельних підприємствах. Перевагами стрічкових конвеєрів, що сприяє їх широкому розповсюдженню є висока продуктивність, простота конструкції, надійність, безшумність у роботі, невелика питома витрата електроенергії.

При виборі конвеєра рекомендовано обирати обладнання з найбільшою продуктивністю і найменшою потужністю привідних двигунів, однак при цьому продуктивність має бути чітко ув'язана з іншим технологічним устаткуванням.

Ключові слова: сипкі матеріали, бетонозмішувальний цех, переміщення, технічні засоби, транспортне обладнання, конвеєри, швидкість, продуктивність.