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Screw conveyor

螺旋输送机

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Screw conveyor

1 Scope

This standard specifies the type and basic parameters, basic calculation principles, technical requirements, safety protection, test methods, inspection rules, signs, packaging and storage of screw conveyors (hereinafter referred to as conveyors).

This standard applies to horizontal or slightly inclined (below 20°) conveyors, that continuously transport bulk materials. The temperature of conveyed materials shall not exceed 100 °C.

This standard also applies to the general parts of conveyors, which have special requirements and special types.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 1184-1996 Geometrical tolerancing - Geometrical tolerance for features without individual tolerance indications

GB/T 1348 Spheroidal graphite iron castings

GB/T 3768 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane

GB/T 8923 (all parts) Mapping requirements for the natural disasters remote sensing thematic maps

GB/T 9286-1998 Paints and varnishes - Cross cut test for films

GB/T 9439 Grey iron castings

GB/T 11352 Carbon steel castings for general engineering purpose

GB/T 13306 Plates

- b) Main technical parameters (conveyor length, spindle speed, power, whole-machine weight);
- c) Exit-factory number;
- d) Date of manufacture;
- e) The name and address of the manufacturer.

9.1.2 The pictorial marks for packaging, storage, transportation shall comply with the provisions of GB/T 191.

9.2 Packaging

9.2.1 The packaging of conveyor parts shall comply with the provisions of GB/T 13384 AND be suitable for land and water transport requirements.

9.2.2 The packaging of electrical appliances and motors shall be protected from rain and moisture.

9.2.3 The following documents shall be attached with each conveyor, when shipped:

- a) Product qualification certificate;
- b) Instructions for use and maintenance of the product;
- c) Product installation drawing;
- d) Packing list.

9.3 Storage

9.3.1 The conveyor shall be stored in a well-ventilated and rain-proof warehouse, to avoid corrosion damage.

9.3.2 When the conveyor is stored in the open air, it shall be stored in a place where there is no water accumulation, meanwhile rainproof measures shall be taken.

9.3.3 Electrical equipment shall be stored in a dry and ventilated warehouse.

Appendix A

(Normative)

Basic principles of conveyor calculation

A.1 Scope of application

This Appendix specifies the basic principles for the unified calculation of conveyors. It is applicable to conveyors, that continuously and uniformly transport bulk materials horizontally or slightly inclined (below 20°).

This Appendix does not apply to the following special conveyors, which are used in special occasions:

- a) Unloading screw conveyor;
- b) Batching screw conveyor;
- c) Mixing screw conveyor;
- d) Wet screw conveyor;
- e) Screw conveyors with an inclination angle greater than 20°;
- f) Vertical screw conveyor.

A.2 Concept

Conveyor is used for continuous conveying of bulk materials. It consists of one or more sets of helical blades, which are fixed on the pipe shaft, to form a helix, as well as a fixed trough. The spiral rotates in a fixed trough.

The bulk material, which is fed into the trough, rotates together with the helical blade in the trough. It is prevented by the friction force on the trough wall. During operation, the spiral blade pushes the bulk material to move axially. Bulk materials can fall from a suitable opening, at the bottom of the trough or be output from the end of the tank.

A.3 Rationale and accuracy of calculations

The driving power required by a conveyor is related to the conveying capacity it can achieve; however, it is also related to the working conditions, the nature and structure of the conveyed materials, the most important calculation parameters given in this standard. This standard proposes a relatively simple calculation method, the accuracy of which can meet the requirements in most cases.

A.4 Symbols and units

A: The axial projected area of the spiral, in square meters (m^2);

D: The nominal diameter of the conveyor screw, in meters (m);

F_H : The material running resistance (main resistance), in Newton (N);

F_N : No-load running resistance (additional resistance), in Newton (N);

F_{st} : Tilting resistance, in Newton (N);

g: Acceleration due to gravity, in meters per second squared (m/s^2);

H: Lifting height, in meters (m);

I_m : Mass conveying capacity, in tons per hour (t/h);

I_v : Volume conveying capacity, in cubic meters per hour (m^3/h);

L: Conveyor length, in meters (m);

n: Conveyor speed, in revolution per minute (r/min);

P: The total driving power of the conveyor's shaft end, in kilowatts (kW);

P_H : The power required for the material to run, in kilowatts (kW);

P_N : The driving power of the conveyor when it is running without load, in kilowatts (kW);

P_{st} : Tilting power, in kilowatts (kW);

S: Pitch, in meter (m);

v: The conveying speed of the conveyor, in meters per second (m/s);

λ : Running resistance coefficient;

Φ : Filling factor;

ρ : Bulk density, in tons per cubic meter (t/m^3).

A.5 Calculation of conveyor capacity

The initial data for calculating the volumetric conveying capacity and mass conveying capacity of the conveyor are the spiral axial projected area A of the conveyor, the conveying speed v, the filling factor Φ of the conveyor trough.

From $A=D^2\frac{\pi}{4}$ and $v=S\frac{n}{60}$, it can obtain the formulas (A.1) ~ formula (A.2):

$$I_v=60\times\frac{\pi}{4}\Phi D^2Sn \dots\dots\dots (A.1)$$

$$I_m=\rho I_v=60\times\frac{\pi}{4}\rho\Phi D^2Sn=47\rho\Phi D^2Sn \dots\dots\dots (A.2)$$

Among them, the mass conveying capacity I_m is the maximum mass throughput, which is completed by the conveyor, under rated working conditions. The throughput depends on the magnitude in the filling factor Φ . This value is not allowed to be too large, because when the filling is too full, there will be a non-negligible difference between the theoretical conveying speed used and the actual conveying speed. In addition, when the filling factor is large, the intermediate suspension bearing of the long screw conveyor prone to clogging.

The filling factor depends on the friction of the material being conveyed and its adhesion, the pitch, the inclination of the conveyor axis.

The filling factor is generally taken as:

- a) For materials that are easy to flow and have almost no abrasiveness (such as flour, cereals), take $\Phi = 0.45$;
- b) For mildly abrasive bulk materials (such as salt, sand, coal), that are granular to small lumps, take $\Phi = 0.33$;
- c) For bulk materials (such as slag, gravel, ore), that are highly abrasive and erosive and have a high bulk density, $\Phi = 0.15$.

The Φ value shall be lowered in the following cases:

- a) When the pitch is particularly large, the Φ value is reduced by 10%;
- b) For every 1° inclination of the conveyor axis, the value of Φ decreases by about 2%;
- c) If it is necessary to charge the material at the intermediate support, the value of Φ is reduced by 10%.

The peripheral speed of the conveyor is not allowed to be too large, otherwise the conveyed material will be affected by the centrifugal force AND the conveying process will be affected. The maximum rotational speed $n_{\max}$ therefore depends on the nominal diameter D of the screw. Table A.1 includes the recommended screw pitch S , which is matched with each screw nominal diameter D , as well as the recommended values of multi-speed rotation speed, where the first column is the maximum rotation speed $n_{\max}$.

Appendix B

(Normative)

Safety protection of conveyor

B.1 General

This Appendix specifies the safety requirements for conveyor design, manufacture, installation, use, maintenance.

B.2 Basic requirements

B.2.1 The safety protection of the conveyor shall comply with the provisions of GB/T 23580.

B.2.2 Safety precautions for conveyors shall be carried out, in accordance with the following requirements:

- a) Due to the rotation of the spirals, workers who are careless near the conveyor may be injured by physical contact with the spirals. The safety rules are intended to maximize the protection of personnel, using the conveyor in a safe environment.
- b) Due to the rotation of the spirals, hard foreign objects and large pieces of material falling into the trough can damage the spirals as well as the conveyor itself. The safety rules are intended to guarantee the safe use of the equipment.

B.3 Safety rules

B.3.1 Design and manufacture phase

B.3.1.1 Protective cover

B.3.1.1.1 The U-shaped trough of the conveyor shall be provided with a protective cover.

B.3.1.1.2 When opening observation holes on the cover plate or side, there shall be protective grids on the holes.

B.3.1.1.3 A grid plate shall be set on the opening feeding area.

B.3.1.1.4 For the protective cover that may be accessed by people, after it bears a static pressure of 1500 N in an area of 0.2 m x 0.2 m, the permanent deformation of the reference dimension shall not exceed 1%, meanwhile it shall not contact with any moving parts.

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