

Discussion on Design Method of Belt Conveyor with Variable Slope

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Abstract: The situation of the carboniferous coal seam floor is complex and changeable, most of them are wavy and have large variations in roughness, which brings new challenges to the design of belt conveyors that take on the task of transporting coal underground. In order to adapt the complex and variable transmission lines, the transmission system must be considered and designed scientifically and rationally. In this paper, the problems are put forward which paid attention should be to when designing such conveyors, and some reference is proposed for it.

Keywords: concave -convex variable slope, belt conveyor, working-condition analysis.

1. INTRODUCTION

The problems when designing the conveyor with variable slope are as follows: calculation of the turning radius, selection of the driving mode, selection of the starting and braking scheme, and the balance of motor power in multi-drum drive. The design scheme is discussed in light of above problems.

2. DETERMINATION OF THE DRIVE SCHEME

2.1 Comprehensive analysis of multiple working conditions

There may be a variety of working conditions for belt conveyor with variable slope during the work: full-load, maximum power, maximum power generation and no-load.

The full load is the normal working condition, which takes up the most of the conveyor's running time; The maximum power only exists in the condition that loads only exit on the horizontal and upward transport section, but nothing added on the downward; On the contrary, the maximum power generation exists in the condition that loads only exit on the downward but not the horizontal and upward; The no-load running state generally exists at the start-up and debugging stage of the conveyor [1].

During the process of designing the belt conveyor with variable slope, attentions shall be paid to discussing the conditions existing in each working condition. The power parameters of the

motor and other components must be selected rationally, the safety factors and spare coefficients of key components comprehensively. Thus, the safe and efficient production of the mine could be ensured.

2.2 Balance of motor power in multi-drum drive

In the design process of long-distance and large-capacity belt conveyors, the forms of multi-drum and multi-driving are used commonly. Multi-motor drive could reduce belt tension and save the costs. However, this type of driving may cause unequal belt tension at the conveyor driving drum due to various errors, and it will cause a power imbalance, if serious, the motor will burn. The tension of conveyor belt must meet two conditions: one is the friction drive condition, and the other is the sag condition. The former requires that the tension of belt must ensure that the conveyor cannot be slipped under any conditions; The latter requires that the sag of belt between two rollers does not exceed the specified value.

When using multi-driving drums for driving, we cannot consider the total friction conditions simply. Each drive roller must be individually checked for friction conditions to ensure that each one does not exist slip on the basis of the conveyor belt tension meeting the total friction conditions[2].

3. LAYOUT OF THE DRIVE FORM

The traditional belt conveyor generally adopts the arrangement: electric motor + hydraulic coupler+gearbox+ driving drum. This kind of the drive is complex and it has a disadvantage of wasting energy seriously; With the development of motor and control technology, the belt conveyor has adopted the new type driving mode: the permanent magnet synchronous motor+drive roller, which reduces the intermediate transmission mechanism, improves the transmission efficiency, and it is consistent with the concept of sustainable development.

3.1 Start mode selection

In order to reduce the impact of starting moments on the electromechanical systems, soft starting mode is usually adopted. This kind of start mode can control the starting current of the motor, can achieve no-load start, shorten the start-up time, and provide adjustable and smooth torque; When the conveyor is driven by multiple motors, this start mode can also be used for adjusting the power balance. Some devices frequently be used for soft starting, such as speed-controlled fluid couplings, liquid viscosity soft start, CST soft start and other methods. However, with the optimization of driving form, a new type of soft starting method—Variable-frequency Drive (VFD) has also developed rapidly and it has become the most ideal soft-starting device currently. When the soft-starting device is implemented with VFD, the harder motor characteristics and the larger starting torque we get, with a more significant energy saving effect.

3.2 Selection of braking scheme

The soft braking can realize the safe, reliable and accurate braking and stopping of the conveyor, and can also reduce the impact on the mechanical system. At present, the self-cooled hydraulic control disc brake has gradually replaced the hydraulic brakes, has become the first

choice for soft braking devices at present. They have the advantages of large braking torque, adjustable control, sensitive movement, better heat dissipation performance, easier use and so on[3].

4. TURN RADIUS SELECTION

In the design process of belt conveyor with variable slope, the radius of curvature of the arc section is also very important considerations. When the radius of the concave segment is not reasonable, it is easy to affect the tension of the belt, which may lead to serious accidents such as scattering and running deviation. And if the convex radius turning radius is not reasonable, wrinkling and scattering of the conveyor belt is easily to be caused; Thus, concave arc section can be arranged with a larger groove angle of the roller group to improve the groove characteristics of belt; When designing the convex arc, selecting a radius of curvature sufficient to make the belt tension and the carrying capacity of drums are kept within permitted range.

5. SUMMARY

According to the problems existing in the process of designing the belt conveyor with variable slope, especially the long-distance and large-capacity conveyors, solutions and its superiority are proposed, which provides experience for the design of complex conveyors.

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