Discussion on Starting Way of Belt Conveyor

Hanzheng Dong [a], Wei Zheng and Baofei Ren

College of Mechanical and Electronic Engineering, Shandong University of Science and Technology, Qingdao 266590, China.

[a]252201844@qq.com

Abstract

Belt conveyors used in coal mines are rapidly developing in the direction of high speed, large capacity, long distance, large dip angle and high power. Belt conveyor performance, reliability, economy and service life depends largely on the performance of the drive. In order to reduce the tension of the conveyor belt during start-up and emergency braking, reduce the dynamic load of each load-bearing component during start-stop and extend the service life of key components such as tapes, rollers, racks and drives. Belt conveyor drive and start-up mode should be analyzed.

Keywords

Belt conveyor, start mode, soft start.

1. Introduction

Belt conveyor belonged to the large-capacity electric machinery, if starts directly under the labor frequency, the starting current possibly reaches the current 4 ~ 8 times of the rated current, the starting torque also greatly surpasses the rated torque, if has the start belt conveyor also has not to unload Coal, the situation will deteriorate further. Starting the current over the General Assembly caused by fluctuations in the power grid, the voltage drop, resulting in insufficient motor output, and the starting torque is very large, forming a vicious circle, so often there will be a conveyor belt start directly failed phenomenon. And the large starting torque on the motor itself is also considerable loss, coupled with the often need to restart the failure to start, greatly affecting the working life of the motor. And direct start mode belt acceleration is very large, which in turn caused an extra loss of the belt, affecting the working life of the belt.

2. Comparison of Starting Methods

Soft start refers to the motor belt in a period of time during startup, belt conveyor belt speed in accordance with a certain range of acceleration increase gently, and in the process to ensure that the motor current, starting torque within the allowable range. This method not only protects the power grid from impact, but also avoids the adverse impact of the direct start mode on the belt conveyor, so it is widely used in the belt conveyor system.

The realization of soft-start at this stage mainly consists of three applications: hydraulic speed control mode, differential gear fluid viscosity speed mode, frequency control mode.

Hydraulic speed control mainly by the hydraulic coupler, electric actuators, fuel tanks and other components, of which the most important is the speed control components are fluid coupling. It consists of pump impeller, turbine, closed box composition, in airtight box filled with a certain amount of working fluid. Its working principle is driven by the motor impeller rotation, due to the centrifugal force, the impeller pump will push some of the working fluid into the turbine hitting the turbine blades, so that the turbine-driven mechanical rotation. In order to achieve a smooth starting of the machine, initially no working fluid is present in the hydrodynamic coupling and the pump wheel runs idle. The working fluid is injected into the hydrodynamic coupling at a certain speed, so the more working fluid enters, the more work the pump wheel does to the working fluid and the more energy is transferred to the turbine. Therefore, adjusting the working fluid injected into the fluid

coupling speed, you can achieve a smooth motor start. This speed control device costs less to achieve easier. However, its response is slow, inefficient, and requires some air-conditioning, it is rarely used in the belt conveyor.

Differential gear fluid viscosity speed, also known as CST. Mainly by the controllable fluid viscosity clutch and planetary gear reducer. Its working principle is that the motor drives the central reducer to rotate. The middle shaft transmits the rotation to the sun gear through the intermediate gear, and the sun gear drives the three planetary gears to rotate. Planetary wheel has a freely rotating inner ring and the controllable fluid viscosity clutch friction plate is connected within the controllable fluid viscosity clutch without ring gear is not rotating, and gradually increase the controllable fluid viscosity clutch Within the hydraulic pressure, there will be more and more energy transmitted to the ring gear through the oil film, so that you can achieve the motor soft-start. This adjustment method to adjust the high precision, the reaction sensitivity is not bad, controllable performance is very good. However, this method is expensive, covers an area of large, for many of China's coal mines are not appropriate.

Frequency control method, frequency control method is the core inverter. According to motor theory, the speed of induction motor is proportional to the frequency of three-phase symmetrical current, and the number of motor poles Inversely proportional to the difference between 1 and the slip is proportional to:

n——Synchronous speed;

f——Three-phase AC frequency

p——Number of electrode electrodes

s——Slip rate

Slip power

——Electromagnetic power

Therefore, regardless of the speed level, the slip frequency control can be basically the same, the highest speed regulation. And frequency converter speed range, high precision, widely used in industrial automation practice. Inverter generally consists of rectifier, filter, inverter three parts, according to the FM voltage regulator function of the original can be divided into three kinds: 1.The rectifier part of the controllable rectifier is responsible for voltage regulation, inverter FM function. 2.The rectifier part of the diode, regulator function by the chopper to achieve, the inverter voltage regulator function. 3.The rectifier part of the diode, FM voltage regulator function by the inverter through PWM (pulse width modulation) technology. As the use of PWM technology has little effect on the power grid, high power factor, most of the frequency converter uses a third mode. In the practical application of frequency conversion technology, and can not simply adjust the frequency, because: from shows that the voltage is constant, the frequency *f* and flux inversely proportional to the frequency increases or decreases will lead toreduce or increase, reduce the maximum motor torque, or even stalling or flux saturation. So adjust the frequency at the same time have to adjust the voltage simultaneously to ensure that the maximum motor torque is essentially constant.

The frequency changer can change the alternating current frequency and the voltage, thus has realized the controllable electromagnetic torque of the electrical machinery. Speed frequency control method is accurate, responsive, small footprint, and the cost is not high, the usual operation can also achieve the purpose of energy saving, so in many cases have chosen frequency control method to achieve motor soft-start.

In the application of frequency control method to achieve the electrical start-up practice, people realize that for high-capacity motors, the start curve selected as the best S-curve.

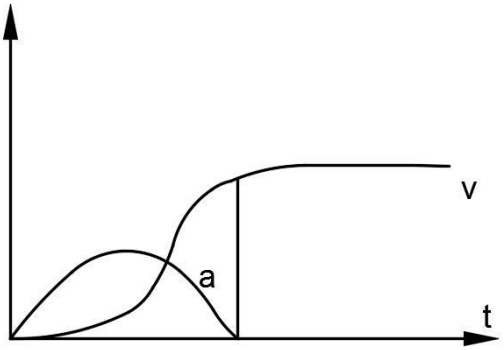

Fig.1.1 S-type speed curve

The corresponding speed equation is:

The acceleration equation is:

——Actual belt speed (function of time t)

——Rated speed

——Kai, braking time

The starting process is as follows: At the beginning of the startup, the acceleration increases steadily and the speed slowly increases. When T / 2 is reached, the acceleration reaches its maximum value and begins to decrease gradually until the speed reaches V / 2. When it reaches the nominal belt speed, the acceleration will be zero.

According to the speed curve can be frequency inverter output curve is:

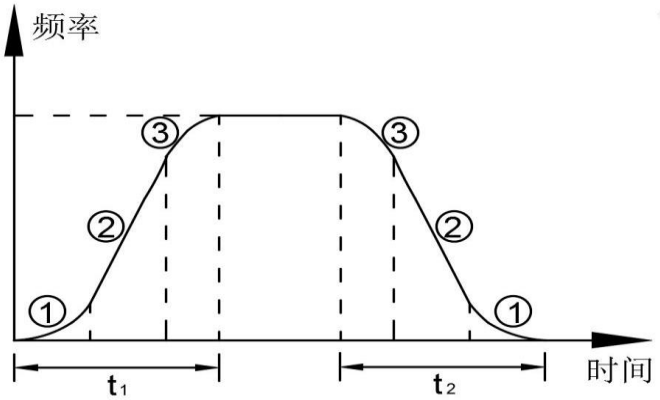

Fig.1.2 S-type frequency curve

The period is the motor start-up period and is divided into three phases. The frequency gradually increases in phase 1, the slope of the curve is> 45 ° and the motor speed is gradually increased with a gradually increasing acceleration. Phase 2 frequency increase rate is constant, curve slope = 45 °, the motor speed increases with a steady acceleration. Stage 3 The frequency increase slows down with a slope of <45 ° and the motor speed also increases with a gradually decreasing acceleration up to the nominal speed.

3. Conclusion

Therefore, the frequency control speed of the highest efficiency, but also a wide range of frequency converter speed, high precision, widely used in industrial automation practices. Therefore, the start of belt conveyor frequency control method is most suitable.

References

[1] Yubin Wang. Motor speed control and energy-saving technologies [M], Beijing: China Electric Power Press, 2008,25-37.

[2] Fangyuan Li. Frequency converter automation engineering practice [M], Beijing: Electronic Industry Press, 2007,55-75.
[3] Huade Li, Bai Jing, etc. AC speed control system [M], Beijing: Electronic Industry Press 2003,22-68.
[4] Chengxun YIN. Development Trend of Mine Belt Conveyor Control Technology Status [J], Journal of Shanxi Institute of Coal Administrators, 2010,11 (7): 6-107.
[5] Jiping Sun. Comprehensive monitoring of coal mine safety production [M], Xuzhou: China University of Mining and Technology Press 2008,7-103.