Frequency Conversion Control Technology and Energy-saving Analysis for Coal Mine Electromechanical equipment

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Abstract

Our country has vast land and abundant resources, but energy-consuming is also large, so the development of the coal industry has always been attached great importance. Various types of coal mine electromechanical equipment are inseparable in coal mine production operations, but coal mine electromechanical equipment generally consumes large amounts of energy, and the production efficiency is not high, which greatly affects the comprehensive benefits of coal mines. Later, in order to solve this problem, frequency conversion control technology is applied to coal mine electromechanical equipment, which not only effectively reduced coal mine production energy consumption, but also greatly improved the comprehensive benefits.

Keywords

Coal mine electromechanical equipment; frequency conversion control technology; energy saving.

1. Introduction

The frequency conversion control technology is a process that realizes the frequency conversion through the application of the frequency conversion power supply. However, the coal mines in our country is relatively large, and the number of frequency converters used is also increasing. To a certain extent, it has effectively promoted the application of frequency conversion control technology in coal mine electromechanical equipment, and promoted the development of frequency conversion control technology. Under the current situation, with the rapid development of information technology and digital technology, frequency converters are developed very quickly. Aiming at the practical application of frequency conversion control technology, it effectively improves the basic performance of coal mine electromechanical equipment, and promotes the efficiency of coal mine enterprises, and effectively improves social and economic benefits while reducing enterprise production costs.

2. Problems existing in coal mine electromechanical equipment

2.1. Problems in lifting equipment

Coal mining enterprises have the characteristics of complex environment, heavy workload, and high work intensity. Coal production is highly dependent on electromechanical equipment. In the process of coal mine production, lifting equipment is one of the main electromechanical equipment. The hoist mainly plays the function of transporting coal and coal mine workers safely and reliably. The traditional coal mine lifting equipment mainly connects the metal resistance in the internal circuit of the rotor of the motor, and cuts off the resistance through the electrical control system or contactor, so to realize the adjustment and control of the hoisting equipment. Although this control method is relatively simple, there are major drawbacks in actual production applications, which are mainly reflected in the excessive dependence on electrical energy and excessive electrical energy consumption; in addition, the heat dissipation performance of this control method is not ideal, and it is easy to cause Heat...
increase and causes other accidents; at the same time, because the resistance is used to control the lifting equipment, the effective control range is limited, and the speed and accuracy of the lifting equipment cannot be guaranteed during the operation of the lifting equipment, especially when the lifting equipment needs to slow down or descend. It is often necessary to use brake power supply or low-frequency power supply for control, which increases the probability of equipment damage and reduces the efficiency of the equipment.

2.2. The excessive current during belt start process

In the process of coal mining process, the belt conveyor equipment plays an important role, and the motor power of the belt conveyor equipment is relatively large. The belt conveyor equipment realizes frequency operation through the step-down start of the windings of the electromechanical equipment, and the hydraulic coupler is used to drive the belt conveyor to operate. When the belt conveyor starts, there will often be a large current, which can easily cause voltage fluctuations and form a huge mechanical impact on the inside of the motor. Under this impact, the motor will generate a lot of heat and make the motor temperature in a short time rise, so to bring greater damage to the motor. In addition, the motor can be started in a short period, which causes the belt tension of the belt conveyor to increase, which increases the damage to the belt. Besides that, the oil temperature will rise at the moment of startup of the hydraulic coupling, which will cause greater damage to the equipment, which will not only affect safety, but also increase the repair and maintenance costs of electromechanical equipment in coal mine enterprises, resulting in low production efficiency and increase production and operating costs.

2.3. Problems in ventilation equipment

The production environment of coal mine enterprises is relatively complex, and there are often a lot of smoke and harmful gases in the working environment. Ventilation equipment is one of the most important electromechanical equipment of coal mine enterprises. The ventilation equipment usually needs to operate for a long time. In the long-term work, with the development of coal mining progress, the air pressure under the mine will also change. It is necessary to continuously increase the power of the ventilation equipment to ensure good ventilation effects. Traditional ventilation equipment has great shortcomings in speed adjustment and cannot be adjusted according to actual needs, which will affect the stability and reliability of the ventilation equipment.

3. Frequency conversion control technology and key points of energy saving

3.1. Frequency Conversion Control Technology application in Ventilator and Energy Saving analysis

Ventilators are one kind of the most important equipment in coal mine production operations. However, in the past, a problem of ventilators is that the ventilators themselves cannot perform random frequency conversion, so a lot of energy is often wasted. It is not conducive to energy saving and efficiency improvement. Later, with the emergence and development of frequency conversion control technology, this problem was solved. After applying the frequency conversion control technology in the ventilator, the electric frequency can be flexibly adjusted according to the actual needs, thereby effectively reducing the energy consumption during the operation of the ventilator and improving its operating efficiency. Take the production operation of a coal mine as an example: a coal mine needs ventilator to meet the air volume requirement of 2100m³/min in the production operation process, but the actual air volume of the BDK40-6-No7 far exceeds this figure. The total air volume of the ventilator is about 2970m³/min, and the operation power is about 154kW, which means that a lot of useless
power will be wasted; but if 2000kW frequency converter is installed in the operation, and the frequency conversion output is set to 39Hz and the input voltage is set to 400V, it only needs to consume 110A current if it wants to achieve the air volume requirement of 2100m³/min in actual production operations, and the power during operation is only about 75kW. Compared with the situation which didn’t apply frequency conversion control technology, it can save about 43% of the electric energy.

3.2. Frequency conversion control technology applied to mine hoist

In the mine hoist, when the frequency conversion control technology is applied to the drive system, it can effectively solve many shortcomings. In addition to enhancing the protection of the equipment, it can also improve the system performance of the equipment. In terms of application, it is mainly reflected in the following aspects.

Combination with programmer. In the electronic control system, the relay can be fully controlled after the instruction is changed. On this basis, the ladder diagram and the circuit diagram can be flexibly converted;

In the aspect of relay control. There is no need for more external circuits, not only the number of relay is significantly reduced, but also the fault is effectively improved, and the problem of insufficient space is further solved;

When the system fault is solved, the programmer and the touch screen are used. The use of, can provide a lot of convenience for troubleshooting, simplify the processing process, and can understand electrical and mechanical failures at any time.

3.3. Application in belt conveyor

The start-up process of the belt conveyor in coal mine electromechanical equipment is short. Once the toughness of the belt is not enough, the belt will break after the system is started, which will affect the normal coal mining work. In addition, the current generated is relatively large after the belt conveyor is started, and for a long time it will have a very negative impact on the power grid. This process has caused serious safety hazards. The use of frequency conversion technology in the belt conveyor can not only improve its original operation mode, but also greatly reduce the start current, which guarantees the personal safety of the operators.

Here we use frequency conversion control technology, which can make the belt conveyor start slowly. Combined with the belt conveyor modified with frequency conversion technology, the belt transportation frequency can be adjusted when the coal mine is transported with no load and less load, so energy consumption will be reduced and performance of the belt conveyor will be more stable. In this way, the electromechanical belt conveyor can make full use of energy, and basically does not waste the efficiency of the motor; at the same time, the high-voltage inverter can effectively feedback the energy, which more thoroughly saves resources, and makes coal mine excavation work create higher economic benefits while being environmentally friendly, which is in line with our country’s strategic policy of sustainable development; the equipment operation is also more stable, and also save maintenance costs.

3.4. Frequency conversion control technology applied to underground water pump

In the entire mine, the underground water pump is mainly used for drainage. In the process of mine construction and production, due to the different water-rich areas and the different seasons, there will be certain differences in the amount of water inflow. It can be seen that the drainage operation should be adjusted regularly according to the specific water output situation. And we should correctly understand the relationship between pump type and water inflow. In the water pump, through the application of frequency conversion control technology, the equipment can be modified and upgraded. According to the drainage volume of the mine, the operating power and operating speed of the motor can be adjusted reasonably to meet the
actual drainage demand. Not only does the energy consumption get effective reduced, the working period of the equipment has also been effectively extended.

4. Conclusion

In summary, the application of various coal mine electromechanical equipment is inseparable in coal mine production operations. However, most of the traditional coal mine electromechanical equipment consumes a lot of energy, which leads to a greater energy consumption in coal mine production enterprise. However, since the emergence and application of coal mine electromechanical frequency conversion control technology, the operation energy consumption of coal mine electromechanical equipment has been greatly reduced, and some problems in the past have been effectively solved. Therefore, in the future development of the coal mine industry, we should continue to actively apply frequency conversion control technology to achieve the purpose of energy saving.

References