Fault analysis and optimization technology of HP bowl type medium speed coal mill

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Abstract: HP type medium speed coal pulverizer produced by Shanghai heavy machinery works has been widely used in recent years, with common faults in operation, short maintenance cycle and heavy task. In order to facilitate the staff to complete the maintenance task more quickly and with higher quality, this paper introduces the common faults in HP type bowl type medium speed coal pulverizer in detail from the reality, and analyzes the causes. At the same time, part of the performance optimization scheme of this type of coal mill is introduced.

1. Introduction
In recent years, various types of medium speed coal mills are used more and more in coal pulverizing system of thermal power plant, and there is a trend to gradually replace ball mills and other forms of coal mills. However, the faults of medium speed coal mill in power plant operation are also more prominent, which directly affect the boiler operation stability, furnace combustion economy, and seriously affect the unit output. HP medium speed coal pulverizer was manufactured by Shanghai heavy machinery works in the early 1980s by introducing the manufacturing technology of bowl type coal pulverizer from CE company of the United States[1]. It embodies the advanced coal pulverizing technology in the late 1980s in the world. On the basis of introducing the technology of CE company, HP coal pulverizer has made a lot of technical improvement and innovation, using more advanced wear-resistant materials and sealing materials, the application scope of HP coal mill is expanded, which makes it more suitable for grinding domestic coal quality, with more outstanding performance, longer service life and more convenient maintenance. Hp1103 coal mill is a kind of HP coal mill. Compared with similar coal mills, it has stronger adaptability to raw coal and is more suitable for large unit thermal power plants.

Taking hp1103 medium speed roller disc coal mill as the carrier, this paper mainly describes the common faults in the normal operation of this type of coal mill, and analyzes and judges each type of faults, optimizes the performance, and describes the maintenance skills in detail.

2. Equipment introduction
The boiler pulverizing system is of positive pressure direct blowing type. The cold primary air output by primary fan is heated by air preheater to become a hot primary air with temperature of about 300 °C, and the hot primary air is mixed with the cold primary air and then it becomes a mixed air and enters the coal mill. HP coal mill is mainly composed of motor, lubricating oil station, planetary gearbox, side body and its liner plate device, bowl impeller device, spring loading device, grinding roller, separator body, separator head device, Wenqiu Li device, multi outlet discharge valve device
and gas sealing system. In recent years, in order to improve the fineness of pulverized coal, most HP coal mills have transformed the outlet separator from static separator to dynamic rotary separator. Compared with static separator, the separation efficiency of dynamic separator has been significantly improved, and the result is that the internal cycle load of dynamic separator is smaller under the same output condition. Because the coal mill can achieve the maximum internal circulation load by increasing the load, that is, the maximum capacity of the pulverizer is improved, in particular, it can be a higher coal output; The smaller harzburgical grindability and fineness of pulverized coal are selected, and the uniformity of pulverized coal is improved (the uniformity coefficient of pulverized coal $n \geq 1.2$)\(^2\).

3. **Common fault analysis and processing technology optimization**

The carrier coal is lignite with low degree of coalification, which is characterized by high moisture, small specific gravity, high volatile matter and poor thermal stability. The overall quality of coal is poor, so the wear of each part of coal mill is large, and the planned maintenance cycle is about 8000h. The common faults of this type of coal mill are analyzed as follows:

3.1 **The output of the coal mill is unstable and fluctuates greatly, and the motor current and the differential pressure of the grinding bowl fluctuate greatly**

Cause analysis: (1) serious shortage of air volume. (2) The baffle of multi outlet discharge valve falls off. (3) The pulverized coal pipe is blocked by pulverized coal accumulation.

Troubleshooting and improvement and Optimization: (1) check the operation condition of the primary air fan. If the fan operates normally, contact the operator to adjust the primary air valve and increase the primary air volume. (2) Check the valve plate of multi outlet discharge valve, if it falls off, restore and reinforce it. (3) Clean up the accumulated powder in the pulverized coal pipeline.

3.2 **Insufficient output of coal mill**

Cause analysis: (1) the primary air volume was insufficient. (2) The clearance of each part of the coal mill is increased due to the wear of parts. (3) The roller is not flexible, so it is necessary to check the oil quality and bearing condition of the roller. The sealing of the grinding roller is damaged, and the pulverized coal entering the grinding roller causes the roller to rotate flexibly, the oil quality is poor and the bearing is damaged. (4) The pressure of spring loading device is too low, and the general pressure is not less than 28Mpa. (5) Low quality coal causes insufficient output of coal mill.

Fault treatment and improvement and Optimization: (1) check the operation status of primary fan, if the fan is in normal operation, contact the operator to adjust the primary air valve to increase the primary air volume. (2) Adjust the clearance between the internal parts of the coal mill. The gap between the roller and the lining plate of the bowl can be kept between 8mm and 10mm. If it is too small, the vibration of the pulverizer will increase, the wear of the roller sleeve is faster and the overhaul period is shortened; the clearance between the grinding roller and spring loading device shall be about 1.5mm. (3) Remove the inner grinding roller of the coal mill for disassembly, check the seal parts such as the skeleton oil seal and the roller bearing, etc. and replace if damaged. At the same time, check the sealing air pipe inside the grinding roller for air leakage. (4) Use special spring pressurizer to calibrate the loading spring. (5) The medium speed mill has strong sensitivity to the three pieces (iron, wood and stone) brought into the raw coal, and has high requirements on the moisture of coal. When the moisture of coal is high, the coal and pulverized coal on the mill bowl will be pressed into cake shape, which affects the output of the mill \(^3\). Therefore, it is an important means of operation adjustment to adopt the appropriate coal type for Blended Combustion.

3.3 **Automatic alarm when the differential pressure of coal mill bowl is too high**

Cause analysis: (1) Insufficient primary mixed air volume. (2) Phenomenon of coal blockage in coal mill. (3) Dynamic separator speed too high. (5) Improper adjustment of air throttle ring. (6) Coal has high water content, high viscosity, poor abrasiveness and fine coal powder.
Fault handling and improvement and optimization: The above faults can be optimized and improved by increasing the air volume, adjusting the component gap, repairing the grinding roller and recalibrating the spring loading force. If the air throttle ring is not properly adjusted, it can be adjusted by removing one air throttle ring. If the fineness of pulverized coal is too low, it is necessary to adjust the opening of the deflector baffle and the rotating speed of the dynamic separator. The fineness of pulverized coal has a direct impact on the combustion of pulverized coal and the operation cost of coal mill. It is very important to choose a reasonable fineness of pulverized coal for boiler combustion technology. The economic fineness of pulverized coal can be calculated according to the empirical formula: \( R_{ij} = 4 + 0.8n \times V_{daf} \), among \( V_{daf} \) is the volatile matter of coal combustion, \( n \) is the uniformity index of pulverized coal\(^4\).

3.4 Large vibration of coal mill
Cause analysis: (1) In addition to the impurities falling from the coal feeder, the parts falling off caused by the wear of the coal mill itself will also cause the vibration of the coal mill. The parts easy to fall off are the guide device liner and the air throttle ring. (2) Grinding roller clearance is too small. (3) The grinding roller does not rotate flexibly. (4) Spring loading device failure, spring fracture.

Fault treatment and improvement optimization: If there are difficult to grind foreign matters inside the coal mill, the vibration of the coal mill body will be large. At this time, the foreign matters can only be taken out after stopping the mill. Other troubleshooting methods are described above.

3.5 Grinding roller device feeding powder or rotating inflexibly
Cause analysis: (1) The roller bearing is damaged. (2) The framework oil seal is damaged or installed in the wrong direction. This type of coal mill framework oil seal is divided into three layers, two layers of lip facing the roller bearing side, one layer of lip facing the roller head. (3) Lack of lubricating oil. (4) Low sealing air pressure.

Fault treatment and improvement optimization: After stopping grinding, remove the grinding roller and replace the damaged parts after disassembly. Check the sealing air pipe and measure the sealing air pressure.

3.6 Serious oil leakage of bearing oil seal on vertical shaft of coal mill reducer
Cause analysis: (1) The upper bearing oil seal is seriously worn. (2) The wear-resistant sleeve of vertical shaft is seriously worn. (3) Serious air leakage of vertical shaft oil seal and gas seal cover.

Fault treatment and improvement optimization: It is necessary to replace the worn parts and seals after the pulverizer is shut down.

3.7 gravel large amount of coal emission
Cause analysis: (1) The roller has no loading force and the spring is not loaded. (2) Low primary air volume. (3) The gap of each part of the pulverizer is too large. (4) Poor coal quality. (5) Venturi sleeve worn through. (6) The grinding roller itself does not rotate.

Fault treatment and improvement optimization: The clearance between static ring and impeller device of coal mill will affect the discharge of stone coal. The selection of new impeller device and improvement of the existing impeller device are important means to adjust the discharge of stone coal and improve the performance of the pulverizer. Choosing a new impeller device is an important means to improve the existing impeller device, which is an important means to adjust the discharge of stone coal and improve the performance of the coal pulverizer. The new impeller device used in practice uses airfoil blades to control the opening area of primary air ring, reduce the primary air turbulence, and the minimum pressure drop design is adopted for blade spacing and tongue, which can significantly improve primary wind speed and air pressure\(^5\).
3.8 The discharge pipe of stone coal on the side of the pulverizer is blocked, which causes the discharge to be blocked

Cause analysis: (1) The scraper device of coal mill fell off, causing the discharge pipe blocked. (2) Block caused by spontaneous combustion of accumulated coal in side body. (3) The drain pipe of the side body is blocked due to the sundries such as wire and wood block. (4) If the pneumatic valve of the discharge pipe of the side body of the coal mill is closed for a long time, the pneumatic valve should be opened regularly for cleaning.

Fault treatment and improvement optimization: The scraper device of the coal mill is in the side machine body, the normal working condition is poor, and it is easy to fall off after a long time of operation. The improvement of the original scraper device greatly alleviates the falling off of the scraper.

Figure 1. Old scraper device
Figure 2. New scraper device

3.9 Serious abrasion of multi outlet valve of coal mill results in powder leakage

Cause analysis: (1) The air powder mixture in the pulverized coal pipeline has a high flow rate. When it flows through the multi outlet valve, due to the centrifugal force, the pulverized coal concentration outside the valve body and valve seat of the multi outlet valve is large, and the particles are coarse. Due to continuous erosion, the valve body and valve seat are easy to wear. (2) The larger the deflection of the valve seat is, the higher the wind speed is, and the faster the wear speed is.

Fault treatment and improvement optimization: The valve body and valve seat are made of special wear-resistant steel, and wear-resistant ceramics are pasted on the inner wall.

3.10 The low lubricating oil pressure of the coal mill caused the trip of the coal mill

Cause analysis: (1) Insufficient output of oil pump. (2) The filter screen is seriously blocked, the filter screen of the oil station needs to be cleaned frequently, and the switch is carried out through the steering valve. (3) The oil quality does not meet the requirements of standard viscosity (viscosity is too small), and the viscosity grade of lubricating oil used in reducer is 320. (4) The oil pump coupling is damaged, and the oil pump and motor are connected by elastic quincunx gasket, so the wear is fast. (5) There is air leakage at the pump inlet. (6) The oil pipeline is damaged and there is oil leakage. (7) Small cooling water, resulting in higher oil temperature, lower viscosity, lower oil pressure.

Fault treatment and improvement optimization: The oil pressure of the lubricating oil station decreases, and the most common fault is that the filter screen is blocked, so the maintenance personnel are required to clean the filter screen regularly, filter the lubricating oil regularly, check the oil sample, and test its particle size; in addition, the damage of oil pump or oil leakage of oil pipeline is also the common fault of low lubricating oil pressure. The elastic plum blossom pad connecting the raw oil pump and motor is made of rubber material with poor quality, so it is replaced with high-strength polyurethane material.
3.11 The hot air baffle door of coal mill cannot be opened or the switch is not in place
Cause analysis: (1) Hot air valve pin cylinder not released. (2) Air leakage of hot air valve cylinder is serious. (3) The cylinder of hot air valve is not running synchronously. (4) The door shaft may be rusted or bent. (5) There is a lot of ash at the bottom of the hot air door, causing jam.

Fault treatment and improvement optimization: Because the hot air at the inlet of the coal mill is the hot primary air heated by the air preheater, it carries some ash in the flue gas, and often accumulates on the track at the bottom of the hot air baffle door after reaching the hot air door, which causes the hot air baffle door to jam. Through field research and analysis, a sealing air can be led from the main sealing air pipe of coal mill to the bottom of the hot air baffle door. The switch ball valve can be installed. When there is ash accumulation at the bottom of the baffle valve, the purge can be carried out regularly to prevent the hot air baffle valve from sticking.

3.12 High mill outlet temperature
Cause analysis: (1) Internal ignition of coal mill. (2) Failure of hot air damper. (3) Failure of cold air damper. (4) Failure of coal feeder or blockage of coal feeding pipe.

Fault treatment and improvement optimization: If pulverized coal spontaneous combustion occurs inside the coal mill, it will cause high temperature at the outlet of the coal mill, and the thermal control detection will give an alarm. At this time, the fire steam inside the coal mill can be opened to extinguish the fire. After the fire is eliminated, the manhole door of the coal mill can be opened for inspection.

4. Concluding remarks
Taking hp1103 coal pulverizer used in a power plant in Inner Mongolia as the prototype, this paper mainly introduces the frequent faults of HP coal pulverizer in the process of operation, analyzes the causes of the faults in detail, and puts forward improvement and optimization measures one by one, so as to provide corresponding reference for on-site repair and ensure the safe operation of the unit. The parameters and clearance of the coal mill also change, so the electric power workers need to adjust and improve according to the actual situation, hoping to provide some help for the maintenance workers of the power plant.

References
[1]《Operation and maintenance manual of hp1023-1103 coal mill》, Shanghai heavy machinery works, Shanghai
[2]《Manual of hp1163 coal mill》, Shanghai heavy machinery works, Shanghai
[3]Zhang Li, Z,(2017), 《boiler principles, mechanical industry press》, Beijing
[4]Ye Jiangming, Y,(2010), 《principle and equipment of power plant boiler (Third Edition)》, China Electric Power Press, Beijing
[5]Fang Wei,F, (2018), Performance optimization of hp1003 medium speed pulverizer for 600 MW Unit, 《electromechanical information》, 9,65-66.