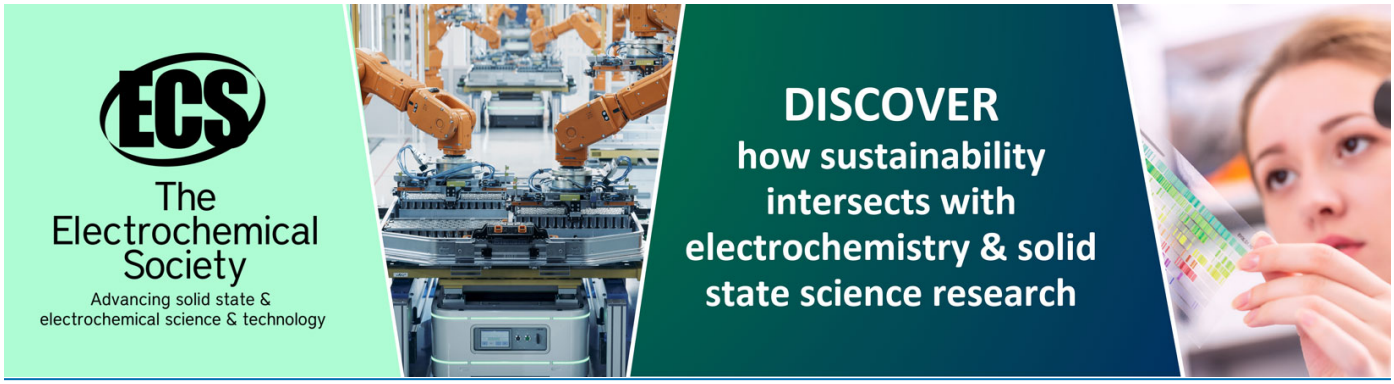
Analysis on the Problem of Blocking of the Storage Pump Caused by Peak Load Regulation of the Unit



Analysis on the Problem of Blocking of the Storage Pump Caused by Peak Load Regulation of the Unit

Ke Liu[1, *], Haichao Wang[1], Jinglong Liu[1], Fuxing Cui[1], Chuanjun Duan[2] and Xudong Zhang[2]

[1]State Grid Shandong Electric Power Research Institute, Jinan 250003, China
[2]Zhong Shi Yi Tong Group, Jinan 250003, China

*Corresponding author e-mail: luliuke@163.com

Abstract. A unit frequently participated in the deep peak load regulation of the power grid. In the process of deep peak load regulation, the time of oil feeding and stabilization of combustion was relatively long, which caused the blocking of the pipeline at the inlet of the ash storage pump at the rear of the electrostatic precipitator. According to the analysis, it was found that it was caused by the spontaneous combustion and coking of mixture of oil and pulverized coal which had not been thoroughly burned in the ash bucket.

1. Course of the event

The ash bucket in the upper part of No. 8306 storage pump of a power plant gave an alarm of high level of material, but the feeding gate of the storage pump was opened and closed normally. After the inspection, it was found that the small ash bucket in the upper part of the short pipe for ash discharge was blocked by a lot of coke substances, as shown in the figure 1.

Figure 1. Blocked short pipe for ash discharge.

By dredging the small ash bucket blocked, it was found that there were a lot of coke substances in it, they were very hard, it was difficult to dredge and there was a high risk of flying dust.

2. On-site inspection and recent operation of the unit

2.1. Access to historical data

After the access to the trend of secondary voltage and current of the electric field in the upper part of the ash bucket, we could know that the secondary voltage and current changed with the load of the unit and had no obvious change.

In addition, before the alarm of the high level of material, an alarm of the high level of material lasted for 6 hours. However, if the ash bucket of Electric Field 3 does not convey ash in the normal conditions, it will take 10 days to fill up the whole ash bucket. It is difficult for the 6-hour alarm of the high level of material to cause the filling up of the ash bucket. The possibility of electric discharge when the ash bucket is full of ash is eliminated.

2.2. Appearance inspection of coke

The appearance inspection was made on the cokes removed. There are basically two kinds of cokes. One type is yellowish red and has a low density. The other type is black fluid sludge with a high density, as shown in figure 2.

Figure 2. Appearance inspection of coke.

2.3. Analysis on the operation of the unit before the arising of the problem

After access to the running log, it was found that the unit started at 3:50 on March 7th, and the oil was cut off at 16:50 on March 7th. The oil and coal were burned together for a long time. The unit was stopped on March 21st and March 31st. On March 26th, March 31st and April 5th, the deep peak load regulation at the load lower than 50% of the rated load was made. After referring to the Report of Analysis on Combustibles in the Flying Ash, the abnormally high content was not found.

3. Analysis on the reasons

The unit operated at a low load for a long time and oil and coal were burned together, so that the content of combustibles in the ash was relatively high. When oil and coal were burned together, there was the problem of tacking for fan by the fuel. When a different type of coal is used, especially when the volatile matters are quite different, the coal difficult to burn may be burned partly, so that the content of combustibles in the flying ash is relatively high and the volatile matter cannot completely precipitate. (With the conventional sampling method in the conventional sampling period the low load period and the content of combustibles in the flying ash when oil and coal are burned together may not be collected.) And the fume temperature is relatively low during operation at a low load and oil and coal are burned together, so that it is easy for them to adhere to the internal wall of the ash bucket and gradually precipitate or accumulate. Over time, the ash with high carbon content and a few volatile matters may cause spontaneous combustion when the fluidization fan supplies air, form the slag block in the shape of fluid sludge, transfer heat to other ash, cause the smoldering of other ash, and form the yellowish red slag block.

The combustion of the unit was not stable and the time of oil feeding was too long. The mixture of oil and pulverized coal was accumulated in the ash bucket of the electric precipitator. The spontaneous combustion and coking occurred. The unstable combustion of the unit was mostly caused by poor coal quality, many impurities in the coal, high ash content, low calorific value and low volatile content. The spontaneous combustion and coking of most mixture of oil and pulverized coal which had not been thoroughly burned occurred in the ash bucket.

The fine ash was accumulated in the ash bucket for a long time and the low temperature sintering occurred. There are cokes in the ash bucket of Electric Fields 3, 4 and 5 of the electrostatic precipitator, while there is no coke in that of Electric Fields 1 and 2. The reasons are as follows. Electric Fields 1 and 2 have a lot of coarse ash, and the pulverized coal and ash which have not burnt out will not be accumulated for a long time in the ash bucket. Electric Fields 3, 4 and 5 have little fine ash, and the ash and powder deposits may easily accumulate on the wall of the ash bucket and may not easily fall down.

According to the above inspection, combined with the recent operation of the unit, including deep peak load regulation, load reduction and frequent starting and stopping, during the stabilization of combustion (oil feeding) at a low load, starting and stopping of the unit, a lot of mixture of oil and pulverized coal which was not thoroughly burned was produced and accumulated on the internal wall of the ash bucket of the electrostatic precipitator. It is believed that it was caused by the deposition and spontaneous combustion of ash with a high content of combustibles in the ash bucket.

4. Treatment measures

During the deep peak load regulation or stopping of the unit, to ensure the sufficient burning, the coal with good combustion characteristic should be used, the rotation speed of the rotary separator of the coal mill should be increased, and the fineness of pulverized coal should be ensured. At the same time, when the safety of the coal mill is ensured, the air temperature at the outlet of the coal mill should be increased, and the air speed should be reduced properly.

After the unit starts normally and the oil is fed when the combustion of the unit is unstable, the ash bucket of the electrostatic precipitator should be knocked on, so as to prevent the pulverized coal and ash which has not been thoroughly burned from accumulating on the wall of the ash bucket of the electrostatic precipitator.

8 hours before the unit starts, the ash bucket should be installed for heating and the fluidization fan should be installed at the right time.

The adjustment of the ash conveying parameters should be strengthened, and the high level of material should be avoided. In the normal operation, the inspection on the blanking of the ash bucket of the electrostatic precipitator should be strengthened (There is a negative pressure after the access hole is opened). The operation with an empty ash bucket should be kept. Once it is found that there is no negative pressure and the ash bucket has a high level of material, it should be dealt with in a timely manner.

References

[1] Zhao Zhijun, Feng Weizhong and Zhang Ling 2009 J Journal of Power Engineering 29 (11) 994 - 997.
[2] Lu Wanpeng, Sun Fengzhong and Shi Yuetao 2011 J Proceedings of the CSEE 31 (11) 6 - 10.
[3] Huang Xinyuan, Sun Fengzhong and Shi Yuetao 2008 J Thermal Power Generation 37 (3) 56 - 58.