Research on Practical Application of Energy Saving and Consumption Reduction Technology for Boiler in Thermal Power Plant

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Abstract: China is a big fuel country. In recent years, with the concept of economic and environmental protection, energy saving and consumption reduction widely promoted in China, thermal power plants pay more and more attention to the application of energy saving and consumption reduction measures in the production and operation process. As people's living standards have been greatly improved, people's demand and requirements for electricity have also been improved, and thermal power plants mainly obtain power through the burning of coal, so while meeting people's demand for electricity, it is also prominent at the level of energy consumption. At present, the general operating efficiency of power plant boilers is not high, and the low fuel utilization rate has led to the large consumption of non-renewable energy in boiler generator sets. Therefore, it is necessary to conduct in-depth analysis and research on energy-saving and power-reduction technologies for power plant boilers. In this regard, research is conducted on its practical application, and how to take effective energy-saving measures to improve the operation level of thermal power units and reduce energy consumption, and make strategies to improve the economic efficiency of thermal power plants and achieve energy-saving reduction of thermal power units.

1. Introduction

Due to the relative backwardness of electrical equipment, China’s power supply energy consumption has a large gap compared with developed countries[1]. With the continuous development of society and economy and the increasing needs of people’s lives, effective energy conservation and consumption reduction measures have been taken to increase energy use efficiency is a requirement for building a conservation-oriented society. China is a country with large energy consumption and is in the current stage of reform[2]. The concept of energy saving and emission reduction is gradually gaining popularity. Therefore, the implementation of energy saving and consumption reduction measures for thermal power plants is more important. The boiler of power plant uses coal as combustion material. The water in the boiler body is heated by the heat generated by the combustion of coal. When the water temperature reaches the point where water can be converted into high-pressure water vapor, the turbine can be driven to operate, and the generator forms a rotating magnetic field to generate electricity for users[3]. At present, the general operating efficiency of power plant boilers is not high, and the low utilization rate of fuel leads to the large consumption of non-renewable energy by boiler generating units[4]. Therefore, it is very necessary and of great practical significance to conduct in-depth analysis and research on energy saving and consumption reduction technologies of power plant boilers. Energy conservation and consumption reduction work can not only link the conflict between energy supply and demand, but also fundamentally improve environmental protection issues[5]. As a large energy consumer, coal power consumption in thermal power plants is quite large throughout the year. Therefore, how to deepen the energy efficiency and reduce the coal consumption during power generation, especially the energy consumption of boilers in thermal power plants research focus[6].

Increasing the technical and economic indicators of thermal power unit operation and reducing energy consumption are of great significance to the country's achievement of the energy saving and emission reduction targets during the 12th five-year plan period. Thermal power generation will still

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be China's main power generation method. According to the “twelfth five-year plan”, China's unit gdp energy consumption will be reduced by 16% compared with the end of the “11th five-year plan” period. As a resource-intensive industry, coal-fired coal-fired units, which account for 74% of installed power capacity, account for 30% of the country's total coal consumption. How to take effective energy-saving measures to improve the operation level of thermal power units and reduce energy consumption is of great significance for improving the economic benefits of thermal power plants and achieving energy conservation and emission reduction of thermal power units[7].

2. Problems Existing in Energy Consumption of Boilers in Thermal Power Plants

2.1 Boiler Operation and Equipment Problems

In the selection of boiler equipment, many thermal power plants only consider the immediate interests and choose low-cost boiler equipment without considering the use cost of the boiler, resulting in poor quality of the selected boiler equipment, which has great defects in the fuel combustion efficiency and other energy utilization; in addition, the boiler equipment has serious unstable operation, high failure rate and a large number of parts in the later stage The energy waste of the boiler is caused by the problem of replacing. Low load rate of boiler operation is one of the main factors affecting energy consumption. For example, there are many problems with frequent boiler shutdowns. Due to the use of adulterated coal or boiler operation in accordance with regulations, or the coal storage yards of some power plants are open-air coal storage yards, when the rainy season is encountered, the coal has more moisture. As a result, the coal combustion quality cannot meet the requirements of the boiler operation, causing the coal mill's powder pipe to be blocked, reducing the coal mill's output, and even causing the boiler to stall; at the same time, it seriously damages the boiler equipment, resulting in further energy utilization efficiency Reduction makes the energy consumption further increase[8]. The aging of the equipment, especially the severe air leakage in the air pre-heater and the tail flue, greatly increased the output of the suction fan, increased the power consumption rate, and reduced the thermal economy. See Table 1 for main specifications and auxiliary parameter names of most boilers.

Table 1 Main Parameters Of Boiler

Serial number	Parameter name	Unit
1	Superheater evaporation	t/h
2	Main steam pressure	MPa
3	Main steam temperature	℃
4	Reheater outlet pressure	t/h
5	Reheater inlet pressure	MPa
6	Reheater outlet temperature	℃
7	Reheater inlet temperature	℃
8	Actual coal consumption of boiler	t/h
9	Boiler exhaust gas temperature	℃

2.2 Fuel Problem

Most of the fuel used in thermal power plants is coal, and the substances produced by raw coal after combustion will cause greater pollution to the air and environment. In addition, raw coal should be treated with corresponding technologies before use. Only in this way can the energy utilization efficiency be maximized and the pollution to the environment be reduced. On the other hand. If there is a problem in the quality of coal, it will also directly affect the combustion efficiency of coal, resulting in the output of heat sites can not achieve the desired effect. The combustion efficiency of many coal-fired power plants is generally not high, about 70%. There are still some problems that need to be solved when energy saving and consumption reduction are performed on boilers. Because most of the energy required for domestic boiler combustion uses coal as the main material. The quality of coal itself is also the main factor limiting the improvement of boiler operation efficiency.

3. Countermeasures for Improving Energy Saving and Consumption Reduction of Boilers in Thermal Power Plants

3.1 Renovation of Boiler Equipment

The transformation and upgrading objects of the boiler plant mainly include the optimization of the heating mode of the dedusting hopper, the transformation of the burners and the air powder mixing equipment, the improvement of the heating pressure and the optimization of the air induction and supply facilities. Boiler equipment transformation is one of the most direct means to achieve boiler energy saving and consumption reduction, mainly through minor repair, replacement and other ways to provide boiler operation efficiency, and then achieve the goal of energy saving and consumption reduction. The main methods are to reasonably transform the forced draft fan and induced draft fan of the boiler, reduce the power consumption of the fan, and provide the conveying capacity of the fan; secondly, transform the low nitrogen burner of the boiler, replace the burner with low combustion efficiency, air powder mixer, etc., greatly reduce the emission concentration of nitrogen oxide at the outlet of the economizer, thus improving the operation efficiency of the boiler and reducing the combustion of the boiler Third, improve the heating mode, use the ash bucket steam heating mode to replace the original ash bucket heating mode, avoid ash accumulation in the ash bucket, and improve the operation efficiency of the boiler. The implementation of the measures for energy saving and consumption reduction of boilers in thermal power plants must be implemented in various aspects. First, the combustion system of the boiler must be adjusted in combination with the actual situation, the air volume ratio must be well controlled, and the coefficient of excess air must be designed. It is effectively improved, and the coal combustion adequacy of the boiler is effectively guaranteed. In order to fully ensure the effective operation of the unit, Wei can control the operating state of the boiler at the optimal level to do a good job from the adjustment of the entire system.

3.2 Controlling Heat Loss in Boiler Operation

It is necessary to deal with the air leakage of the boiler in time. In the process of implementing the specific measures, it is necessary to conduct a comprehensive investigation on the system performance of the boiler in the operation of the boiler in the thermal power plant, and find out the causes of the air leakage to ensure the tightness of the boiler. In addition, the means of supervision should be effectively strengthened, the supervisors should be able to arrange reasonably, the operation of the boiler should be able to supervise and check in time and effectively, and effective measures should be taken immediately to improve if problems are found. In addition, the maintenance and protection of the boiler should be strengthened effectively. Only when the air leakage problem of the boiler is effectively solved can the combustion efficiency of the energy be effectively improved. In the aspect of the improvement and optimization of the boiler induced and forced air device, the key is to change the single air distribution method previously used to the frequency conversion air distribution method, so as to reduce the power loss caused by the high frequency of the transformation of the distribution mode of the boiler induced and forced air device. To make the ratio of wind coal to scientific, for the non-volatile and poor quality coal, the air distribution measures should be selected in a centralized form to ensure the balance of the powder from the burner; The status of the fine powder separation equipment is always in good condition, and the fineness of the fine coal is adjusted in time according to different coal types. Control the waste of energy through measures of stable combustion. For example, in the state of boiler operation, the primary air must ensure the stability of its wind pressure, which is controlled at three thousand Pa. The main content of the machine is not full of coal. The negative pressure in the furnace should be controlled at about 30 Pa, and the oxygen content of the furnace mouth should be controlled to 4%. At the same time, pay attention to controlling the ratio of primary and secondary air, not only can the pulverized coal be burned in advance, but also can follow the basic concept of coal blending and blending. New and old coals are mixed together, and good and bad coals are mixed together. This can prevent the boiler from stalling, reduce combustion-supporting oil consumption, and further ensure the reliability of combustion. As shown in Figure 1, the related

literature describes the effect of wall temperature changes on sulfuric acid concentration.

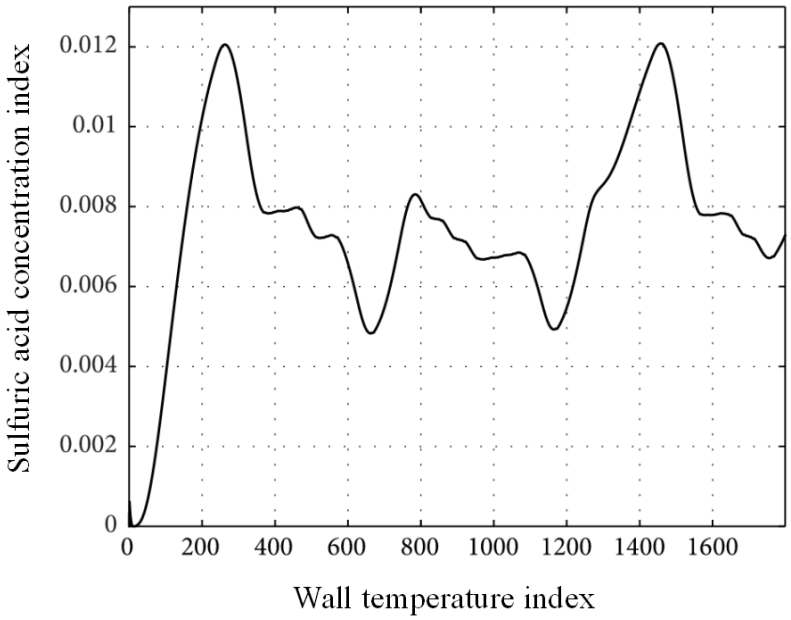

Fig.1 Effect of Wall Temperature Changes on Sulfuric Acid Concentration

3.3 Control Fuel and Save Energy

Several key points should be paid attention to for energy saving and consumption reduction of boilers in thermal power plants. First, the combustion rate of boilers should be controlled stably, which is closely related to the quality of coal. If the coal with low quality is selected, the energy consumed by boiler operation will be increased and the operation efficiency of units will be greatly affected. In addition, the problem of coal ash exceeding the standard will occur in the operation, thus reducing the operation efficiency of the system. Therefore, the combustion rate of the boiler should be stably controlled and the quality control of coal should be strengthened. Furthermore, in order to effectively control the uniformity of pulverized coal, the quality of fuel is a factor that determines the energy use efficiency. when controlling the fuel, the coal mine should be treated accordingly to improve the overall quality of the fuel. specifically, the following methods can be used:(1) First, the stones contained in coal and low-quality coal mines are screened out by coarse screening to improve the combustion performance of coal mines, achieve energy savings, and reduce production costs. (2) Select different types of coal mines for combustion. This method can save fuel cost to a large extent, and has less impact on the combustion performance of fuel. (3) Optimization of the ratio of wind coal, because the combustion of coal mines will rely on oxygen in the air, and the oxygen content will affect the combustion performance of coal. Through the corresponding analysis, the optimal ratio of wind coal can be determined. Significantly reduce costs. In addition, coal blending is used. According to the load situation of the unit, the coal with high calorific value and low calorific value is blended with the coal with high volatile content and low volatile content, and the new coal is blended with the old coal, thus greatly reducing the number of boiler flameouts caused by sudden changes in coal quality and reducing the amount of fuel aid needed to be put into operation due to the burning of inferior coal. The coal used in the boiler combustion is controlled, and rocks, raw coal with low carbon content and the like contained in the coal are selected through a sorting device, so that the quality of the boiler coal combustion is improved, the operation stability of the boiler can be effectively improved, and the full combustion of the fuel is realized; In order to reduce the cost of fuel for boiler combustion, reasonable blending combustion of different coals is carried out.

4. Conclusion

Under the background of the increasingly fierce market economy competition and the

construction of an energy-saving society, in order to improve the efficiency of energy utilization, it is an inevitable choice to save energy and reduce consumption for thermal power plants. In a word, the boiler energy saving and consumption reduction of thermal power plant should be considered from many aspects, and the practical problems should be solved according to the operation of thermal power plant. The operation efficiency of boiler is an important foundation to achieve the goal of energy saving and consumption reduction, so we should pay full attention to the quality of this equipment and the operation efficiency of the unit, so as to achieve the expected goal. Energy saving and consumption reduction of boilers in thermal power plants is still an important policy under the theme of low carbon economy. Due to the huge consumption of dry energy in our country, but the related technology level is relatively low. Aiming at the problems existing in boiler energy consumption, scientific and reasonable energy conservation of boilers is carried out through measures such as technological transformation of boiler equipment, fuel control and operation management Consumption reduction plays an important role in reducing the cost of thermal power plants and improving the economic benefits of their operation.

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