Analysis on Flue Gas Pollution of Coal-fired Boiler and Its Countermeasures

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Abstract. As the main energy in industrial production, coal resources are widely used in the world. However, in the process of coal combustion will produce a certain amount of pollutants, thus causing adverse effects on the air. The analysis of flue gas treatment of coal-fired boiler aims at improving coal utilization rate, reducing flue gas emission and advocating low-carbon concept. This paper deeply analyzes the flue gas problem of coal-fired boiler, explores the effective environmental treatment technology, and makes contribution to the environmental treatment problem.

Keywords: Coal-fired Boiler; The Flue Gas Problem; Environmental Problems; Management Technology.

1. Air Pollution in The Use of Coal-fired Boilers
Among the air pollution problems, the main pollution problems existing in the operation of coal-fired boilers can be divided into two aspects: gas and solid impurities. This paper focuses on the analysis of these two aspects.

1.1. Gas
From the point of view of the constituent elements of coal, it is a kind of mineral resource formed by the long-term evolution of underground ore. It is mainly composed of carbon, oxygen and sulfur. Cost is relatively low, mining difficulty is not high. At the same time, coal has a low flash point and is easy to burn, making it a common resource for industrial production in cities and for heating rural residents. Based on the structural characteristics of coal itself, in the actual combustion process, will generate carbon dioxide, sulfur dioxide and other gases. Sulfur dioxide is the main gas that produces acid rain and causes climate warming. Therefore, at present, technicians are mainly studying how to remove sulfur from coal.

1.2. Impurities
Coal is also divided into many types, different types of quality is not the same, consumption. The economic cost of fee also has certain diversity. This makes many areas in the use of coal to provide heat for the boiler, out of consideration of economic benefits, often choose some cheap coal. This kind of coal is prone to soot particles when burned, which not only pollutes the environment, but also has great harm to human health. Based on this, the relevant technicians should not only solve the problem of high sulfur content in coal, but also focus on how to remove impurities and eliminate soot particles.
2. Countermeasures for Flue Gas Pollution of Coal-fired Boilers

For the two major air pollution problems mentioned above, they are respectively discussed below and more appropriate solutions are proposed.

2.1. Dust Removal Technology of Flue Gas from Coal-fired Boiler

2.1.1. Mechanical. The basic principle of mechanical dust removal is to design a kind of machine according to the different quality and volume of dust particles to achieve the purpose of dust removal. Among them, cyclone dust collector is the most widely used dust removal machinery. Among all dust removal machinery, its advantages are relatively high cost performance, simple operation, low environmental requirements, good corrosion resistance, high dust removal efficiency. The disadvantage is that it can only act on large particle dust, but not on small particle dust. Therefore, the use of cyclone dust remover still has certain limitations [1].

2.1.2. The Filter Type. Another kind of commonly used dust remover is the filter type dust remover, its principle is to use the filter net to prevent the dust in the flue gas from entering the atmosphere, so as to achieve the purpose of dust removal. According to the pollution situation, the filter dust can be selected including air filter, bag dust and particle layer dust three methods. Among them, the highest dust removal efficiency is bag dust collector. Although bag-type dust collector belongs to traditional dust collector, with the development of new technology and new technology, its structure type has been innovated, the filter material and the way of ash removal have been constantly improved, the dust removal performance has been improved, the scope of application has been expanded, and the role it plays has been more and more important.

2.1.3. Electric Dust Removal. When dealing with a large amount of flue gas, electric dust removal method is generally used. The relatively high efficiency of electric dust removal is based on the principle of using dust particles with their own electrostatic power to achieve the purpose of dust removal. Because it directly acts on dust particles, the air flow resistance is relatively small, so the efficiency is higher. The advantage of electric dust removal is that it is not afraid of special environments such as high temperature and high pressure, strong acid and alkali; The disadvantage is that the equipment is expensive and large, that is, it takes up a lot of money and occupies a lot of space, so effective technical improvements are needed in this regard.

2.1.4. Wet Dust Removal. Wet dedusting is also a more common dedusting method. The principle is that water and dust particles in the smoke gas combine to form large dust particles with a diameter of more than 10 μm, and these large dust particles are removed. Under normal circumstances, wet dust removal can also be used to remove sulfur dioxide. Therefore, wet dust removal is the most efficient method at present. Its advantages include low cost, simple operation, easy maintenance, and wide application environment. The disadvantage is that it will produce a large amount of sewage, and the wet dust collector is easily corroded and needs to be modified into the pipeline material[2]. There are two common wet dust precipitators that deal with smoke and dust in large quantities. They are Wencuili dust precipitators and granite water film dust precipitators. According to specific needs, the best dust precipitators are selected or the two wet dust precipitators are combined to use. Give full play to the advantages of each type of dust precipitator. In order to improve the dust removal efficiency, it can also solve the problem of pipe corrosion. The self-excited spray dust collector is suitable for dust removal in small boilers.
2.2. Flue Gas Desulphurization Technology for Coal-fired Boilers

2.2.1. Dry Desulphurization. Dry desulfurization is also called direct desulfurization. Traditional dry desulfurization is to use absorbent or adsorbent material that can be recycled to absorb sulfur dioxide in the flue gas, and then use catalyst to catalyze sulfur dioxide to produce new non-polluting compounds, thus achieving the purpose of desulfurization. With the development of the times, dry desulphurization technology has also made some progress and made considerable progress.

2.2.2. Wet Desulphurization. Wet method is direct desulfurization with salt or alkaline solution that reacts with sulfur dioxide in the flue gas. When the flue gas is passed into the reaction tank containing salt or alkaline solution, the gas sulfur dioxide reacts in the reaction tank at a fast rate and a high desulfurization efficiency. Under the existing technical conditions, when limestone is selected as a desulfurization agent, the desulfurization rate can reach more than 90% under the conditions of similar calcium and sulfur content. Generally, large coal-fired power stations use this method for flue gas desulfurization. However, whether it is wet desulfurization, a large amount of industrial wastewater is generated, and there is a problem of wastewater treatment. Therefore, an industrial wastewater treatment device should also be installed. This increases the cost of equipment input and the latter is equivalent to the operation of two sets of equipment. The operating cost is also extremely high.[3]. In recent years, zero emission requirements have been put forward in industry, which brings new challenges to wet desulphurization technology, and the technology of wet desulphurization technology needs to be improved urgently.

2.2.3. Semi-dry Method. The water is first removed by evaporation, the remaining sulfur-containing material becomes dry powder, and then the dust is removed using a bag-type dust collector. The sulfur-containing material is removed in the form of dry powder particles to achieve effective desulfurization. The traditional dust removal technology is to spray calcium in the furnace. After the technical improvement, the calcium injection in the furnace can be sprayed with some humidifying activators to form an activation reactor, and it can also directly spray water to increase moisture, which is conducive to improving the dust removal efficiency. At the same time, Some desulfurization reactions can also be promoted to achieve the purpose of flue gas desulfurization. Semi-dry and semi-wet desulphurization technology is actually a combination of wet and dry desulphurization technology, retaining the dry and wet methods. The desulphurization agent used is the same as lime or gypsum. When desulfurization is carried out, a desulfurization ash and alkaline matter must be added. When the flue gas enters the flue gas, the flue gas and desulfurization ash are combined with the desulfurization and alkaline substances to achieve effective desulfurization.

3. Technology of Environmental Pollution Control In The Flue Gas Problem Of Coal-fired Boiler

In recent years, smog has become a global environmental governance problem. Many countries attach great importance to the flue gas problem of coal-fired boilers. China has also developed integrated and coordinated technical means. In general, the smoke treatment of coal-fired boilers is roughly divided into two phases: First, for a single pollutant, different equipment coordination work to achieve the purpose of governance; The second is to use a comprehensive environmental protection equipment to treat different pollutants at the same time. At present, China is in the first stage, the first stage mainly has the following technical characteristics.

3.1. Collaborative treatment of wet desulphurization and precipitator

Wet desulphurization is a popular desulphurization method used in boilers of coal-fired power plants in China. Its working principle is to mix a large amount of water with limestone powder or raw stone ash powder to form limestone or cooked lime alkaline emulsion and spray it from the upper part of the desulphurization tower. Under the action of a fan, acid flue gas containing a large amount of sulfur...
dioxide flows upward from the bottom, meets with limestone or cooked lime in alkaline droplets, produces gypsum and other sulfates, falls with the droplets to the bottom of the desulfurization tower, and collects and removes. The joint treatment of wet desulfurization and scrubber can make the flue gas treatment more convenient, thus improving the application effect of desulfurization equipment and increasing the dust removal rate. In addition, the staff can be deployed according to the specific process of wet desulfurization, and through the system management of wet desulfurization and precipitator, the smoke treatment can be truly coordinated [4].

3.2. Collaborative Treatment of Flue Gas Denitrification and Low Carbon Combustion
The flue gas denitrification technology generally refers to denitrification of exhaust gas from combustion emissions, IE, denitrification of the rear end, mainly by selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and oxidation denitrification. With the improvement of environmental protection standards in our country, some traditional flue gas denitrification processes are difficult to meet the strict emission reduction requirements. Ozone oxidation denitrification technology has become a better choice. Advanced ozone oxidation technology not only has a good removal effect on nitrogen oxides, but also can remove other harmful pollutants in the flue gas, such as heavy metal Mercury. It has been proved that ozone oxygenation and denitrification technology can meet the new flue gas emission standards, and the localization of large-scale ozone equipment has greatly reduced the initial investment [5] Currently, The denitrification technology has been applied in many thermal power plants in China. It has achieved excellent denitrification effect and will gradually become one of the denitrification technologies of thermal power plants. Cooperative treatment of multi-pollutant in sintered tobacco gas means that through the combination of one technology or several technical groups, the unit link or unit environmental protection equipment is linked and matched to achieve the purpose of comprehensive removal of multiple pollutants.

Different coal combustion produces different pollutants, people should pay close attention to the combustion efficiency of different coal combustion. In general, people should give priority to the use of low-carbon combustion coal combustion, reduce the emission of pollutants from the root causes, and use flue gas denitrification to further optimize the overall design of combustion, and finally achieve coordinated management of coal-fired flue gas.

3.3. Coordinated Management of Smoke Pollution Clearance and Coal Control
The amount of flue gas in sintering process is large, there are many kinds of pollutants, the content fluctuates greatly, and the flue gas temperature is low. In the process of flue gas treatment, if we want to achieve the harmonization of pollution removal and coal control, the relevant staff must analyze the data and obtain the relationship between the cost of controlling the amount of coal combustion and the price of environmental protection equipment and the operating cost of the public company. In this way, the quantity of coal combustion can be effectively controlled so as to achieve the purpose of collaborative governance. People should choose a technological route that is technically reliable, coordinated between economic and environmental benefits, and reduce the burden on enterprises.

3.4. Efficient Desulfurization System Is Adopted.
According to the current desulfurization technology, the method of universal application is mainly sodium calcium dialkali method wet desulfurization. For sodium calcium dialkali desulfurization system, it mainly includes flue gas desulfurization system, desulfurization liquid ring system and desulfurization agent preparation system. In the process of actual operation, the boiler flue gas needs to be purified by a cloth bag dust collector, and then through the boiler fan, the flue gas is entered into the rotating plate tower in the pipeline. In the cyclone tower, a variety of desulfurization dusts need to be combined. At this time, after the sodium base absorber and the flue gas come into contact, a chemical reaction will occur to effectively remove the flue gas in the boiler. When the smoke gas is processed, it needs to be discharged through the chimney. For the desulfurization liquid, the main way through the closed loop is mainly divided into two ways: the main cycle and the regeneration cycle. In addition, for the main cycle
in the tower, mainly according to the main cycle pump, gradually the self-circulation of the desulfide liquid in the tower is gradually circulated, and then the overflow part of the bottom of the tower is separated and then circulated through the circular pump. Finally, the desulphurization products are guaranteed to be removed, piled and delivered in the sedimentation tank. In addition, for lime powder, it is necessary to use a feeder to add a Humanized ash, make it into a lime slurry, and then flow into the regeneration pool.

4. Conclusion
Environmental issues are a topic of common concern to people all over the world, and the atmosphere is more closely related to people's lives. It is urgent to solve the gas pollution of coal-fired boilers. Therefore, it is necessary to strictly control the smoke emitted by coal-fired boilers, especially the dust content and sulfur dioxide content. Ensure that the content of dust and sulphur dioxide in the discharged flue gas meets the standards. Through the effective dedusting desulphurization technology improvement, to achieve the effect of coal boiler flue gas treatment, in order to increase the operation efficiency of coal boiler, to ensure that the exhaust flue gas does not cause air environmental pollution, the realization of green, environmental, low-carbon new industrial concept.

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