Research on Petroleum Flue Gas Desulfurization System

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Abstract: The use of alkaline waste liquid discharged from chemical companies to remove SO2 in flue gas not only makes the flue gas discharge meet the environmental protection requirements, saves the investment of sewage neutralization and purification, and some desulfurization products of the desulfurization process can also be recycled and create economic The value makes up for the investment cost of the flue gas desulfurization system. The alkaline wastewater discharged during the production process of a certain company of CNPC contains ammonia or sodium alkali. It is intended to be used as an absorbent in a flue gas desulfurization system.

1. Introduction

China is the world's largest producer and consumer of coal, and is one of the few countries in the world that uses coal as its main energy source. In China's proven primary energy reserves, coal accounts for about 90% of total reserves. In China's primary energy consumption structure, coal accounts for about two-thirds, which is the backbone of China's energy industry. In 2004, China's coal output was close to 1.7 billion tons. In 2005, China's coal output exceeded 2 billion tons. China's economic development requires long-term dependence on coal to provide a reliable energy supply, and the coal-based energy structure will not change for a considerable period of time in the future. Because a large amount of coal is used as the final fuel for direct combustion, a large amount of dust and SO2 and other harmful substances are discharged into the atmosphere, which seriously pollutes the environment and makes China's air pollution situation one of the few most serious countries in the world. China's annual dust emissions are about 20 million tons, and SO2 emissions are about 24 million tons, which has surpassed Europe and the United States and ranks first in the world. The deterioration of the atmospheric environment, especially the large amount of SO2 emissions, has caused great harm to human health, animals and plants, and serious economic losses. According to relevant research, in 1995, China ’s economic losses in crops, forests, and human health caused by acid rain and SO2 pollution amounted to more than 110 billion yuan, which was close to 2% of the gross national product of the year, which became an important constraint on China ’s economic and social development. factor. Sulfur pollution caused by coal-fired boilers has become the primary target of SO2 pollution control in China. Therefore, it is imperative to take effective measures to control SO2 emissions, especially SO2 emissions from pulverized coal furnaces. At present, the percentage of coal consumption in thermal power generation in China's raw coal production has reached about 40%, and with the continuous development of the economy, this proportion will continue to expand. Therefore, reducing SO2 emissions from thermal power plants is to control China's total SO2 emissions. Quantitative focus.

2. Status and Progress of Desulfurization Technology in China

The emission of sulfur dioxide in China ranks first in the world. With the increasing requirements for atmospheric environmental protection, the development of desulfurization technology also faces great opportunities and severe challenges. The status quo of the application of flue gas desulfurization technology in China is the large-scale industrial application of high-concentration sulfur dioxide flue gas desulfurization technology, which can recover a large amount of sulfur resources while desulfurizing, but the industrial application of low-concentration sulfur dioxide flue gas desulfurization technology is still in its infancy. In China, the

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industrialization level of low-concentration flue gas desulfurization is relatively low. The technologies that have been applied are mainly flue gas desulfurization equipment imported from abroad in the 1970s and simple dust removal and desulfurization equipment for small and medium boilers. At present, domestic desulfurization equipment has developed to more than 40 However, flue gas desulfurization technology that is stable and reliable in operation, mature in technology, and suitable for China's national conditions is still lacking. In recent years, many large-scale flue gas desulfurization devices and desulfurization demonstration projects have been introduced in China. However, the development of flue gas desulfurization technology that can successfully control sulfur dioxide pollution in developed countries has been very slow in China. The main reason is that the investment and operation costs of desulfurization are too high, making it difficult for manufacturers to install desulfurization facilities. The final solution is also a problem. One sentence can be used to describe this situation vividly: “Can't afford it, it can't be used, and there are more and more heavy burdens to bear.” It is clear that the existing mature desulfurization technology abroad does not meet China's national conditions. Therefore, how can the domestically developed flue gas desulfurization technology (such as the swirl plate tower), which has been successfully applied to small and medium boilers, further improve the technical level, and achieve large-scale, integrated, and complete sets, and develop a suitable country's national conditions The economic and efficient flue gas desulfurization technology and equipment is one of the reconstructions for the development of flue gas desulfurization in China in the future.

Foreign developed countries have successfully applied the flue gas desulfurization technology to solve the problem of sulfur dioxide pollution, but it is undeniable that these desulfurization technologies are achieved by relying on high investment and high consumption. Even if localized, for China's current economic development, Its investment and operating costs are still very high. It is not feasible in China, a developing country in urgent need of development. China's economic situation has determined that we cannot copy the governance model of developed countries. In addition, the desulfurization technology selected by developed countries is also based on their national conditions. For example, Japan and Germany have successfully adopted the “limestone-gypsum method” for desulfurization because the two countries lack natural gypsum resources. They use by-product gypsum as an important gypsum resource. It solves the problem of the outlet of flue gas desulfurization gypsum, and reduces the cost of desulfurization. Therefore, appropriate desulfurization technology should be developed and selected according to China's specific national conditions. By studying and digesting foreign advanced flue gas desulfurization technology and exploring China's own flue gas desulfurization road, it will definitely involve many aspects such as conceptual innovation, technological innovation, and mechanism innovation. Since the introduction of the first batch of flue gas desulfurization technologies in the 1970s, many people have already worked hard for China's flue gas desulfurization road, and also accumulated many valuable suggestions, experiences, results and lessons. After careful summary and Thinking, it will definitely help to accelerate the development of independent flue gas desulfurization technology that is in line with China's national conditions.

3. Comparison and Selection of Technical Solutions for Desulfurization Process

The FCC feedstock usually contains sulfur compounds such as thiols, thioethers, and thiophenols. After the FCC reaction, about 70% -95% of the sulfur oxides in the feedstock oil are converted into H2S and C4H4S, and the remaining sulfur is oxidized. The compounds are converted into relatively large and complex condensates, which exist in oil slurry and coke. After burning the sulfur-containing coke in the regeneration reactor, about 95% is oxidized to sulfur dioxide, and about 5% -10% is oxidized to sulfur trioxide. The sulfur oxides and raw materials sulfur content in the regenerated flue gas, the coke yield, and the regeneration method related. There are three ways to reduce SOX emissions from catalytic cracking units: ① hydrodesulfurization of raw materials; ② use of sulfur transfer aids; ③ flue gas scrubbing treatment. The main raw material of the catalytic cracking unit is residue oil. The non-asphaltene sulfur in the residue is easier to remove under hydrogenation conditions and can reach a higher conversion depth, but the sulfur present in the asphaltenes is difficult to remove because the structure of the asphaltenes is a large molecule. The desulfurization rate in the residue hydrodesulfurization process is about 90%. Because of the high reaction temperature and pressure of the residue hydrogenation unit, the primary investment and operating cost of the unit are very large, so hydrodesulfurization is not used. There are not many flue gas desulfurization devices using sulfur transfer agents, most of the data are from literature reports, and the reliability is not strong. And from the literature reports, the use of desulfurization agents are all industrial experimental, and the scale of the catalytic devices are not large, and the desulfurization rate is limited, which can only meet the discharge standards. The scale of a catalytic plant of a petrochemical company in Dalian is 3 million tons per year. In order to solve the problem of excessive emissions of flue gas, the company conducted experiments with sulfur transfer agents at the end of 2008, but the results were not satisfactory. The main problem was that the smoke machine was coked and shaped. In response to product distribution, the company immediately terminated the sulfur transfer agent experiment.

4. Fgd System Design

In order to separate the desulfurization system from the boiler, three flue gas baffle doors (flue gates) with electric actuators are provided in the entire flue gas system, that is, the original flue gas baffle (set in the desulfurization system population), Clean flue gas baffle (set at the outlet of the desulfurization system) and bypass baffle. When the desulfurization system is operating normally, the bypass baffle is closed, the original flue gas baffle and the clean flue gas baffle are opened, and the flue gas enters the absorption tower through the original flue gas baffle to react, and the reacted flue gas passes through the clean flue gas baffle. The plates are transported to the chimney and discharged into the atmosphere. When the desulfurization system fails or the desulfurization system is required to stop running, the bypass baffle is opened, the original flue gas baffle and the clean flue gas baffle are closed, and the flue gas is directly discharged into the chimney through the bypass flue. The flue gas baffle is the main component connecting the FGD system and the boiler. There are three important equipments: FGD inlet baffle door, outlet baffle door, and bypass baffle door. They are used for FGD isolation and input. There are usually three types of single-louvered baffle, double-louvered baffle and shutter door. The baffle door generally needs to be equipped with a sealed fan. When the FGD is out of service, it can prevent hot smoke from leaking into the FGD system from the blade gap of the baffle, causing corrosion in the system. The sealing wind of the baffle can be heated and not heated. The heating and sealing wind is said to prevent deformation of the blades of the baffle.

Because the FGD system has some resistance, it must be overcome. The resistance of the FGD system to be overcome is the pressure drop along the flue, the local loss pressure drop and the change in self-suction, the resistance of the FGD inlet and outlet baffles, the resistance of the flue gas-to-gas heat exchanger, the resistance of the absorption tower, and the chimney Changes in resistance, chimney pullout force, etc. For an old domestic unit to install a desulfurization device, it is not enough to rely on the induced draft fan alone to overcome this resistance. Therefore, a fan is generally arranged behind the common flue of the two induced draft fans that were operated in parallel. Boost-up Fan (BUF). The newly-built unit is equipped with a desulfurization device. One boiler can be equipped with two induced draft fans, and the induced air adopts a secondary impeller. One boiler can be equipped with two induced draft fans and one booster fan. Auxiliary equipment for booster fans are booster fan cooling fans. Each booster fan is equipped with one, one and two cooling fans.

Whether to reheat the desulfurized flue gas depends on the environmental requirements of various countries. Flue gas-flue gas heater is a kind of regenerative heating process, often called GGH. GGH's auxiliary equipment includes low leakage fans, sealed fans, soot blowers, high-pressure water flushing pumps, etc. Use it to heat the non-desulfurized flue gas (usually 130-150 ° C) to heat the desulfurized flue gas, which is generally heated to about 80 ° C and then discharged. Its main functions are: ① to enhance the diffusion of pollutants ② to reduce the visibility of plume ③ to prevent drops from falling from the chimney ④ to avoid corrosion of equipment downstream of the scrubber. Its working principle is the same as that of the rotary air preheater used in the power plant. GGH is an important equipment of wet desulfurization process. Due to the high sulfur content and high temperature of the hot-end flue gas. The cold end temperature is low and the moisture content is large. Therefore, generally, GGH import and export need to use corrosion-resistant materials, such as glass lined, cold steel, etc., air distribution plate can use plastic. The heat-conducting area is generally made of enamel steel. These parts must be manufactured very carefully, or corrosion will occur very quickly. The price of one GGH accounts for about 10% of the total investment in the desulfurization equipment, and the cost is expensive.

In the absorption tower, after the flue gas reacts with ammonia water, the reaction product is a mixture of ammonium sulfate compounds and other substances. In order to separate the products to form ammonium sulfate fertilizers, the products are first discharged into a turbid liquid pool and passed through the turbid liquid pool. Sedimentation and filtration, enter the clear solution tank. The solution in the clear solution tank can be sent to the reaction tower for reaction by the circulating pump, and then circulated in order to increase the concentration of ammonium sulfate in the solution. When the concentration of ammonium sulfate in the clear solution tank reaches a certain degree of supersaturation, the centrifuge is turned on to achieve solid-liquid separation to form solid ammonium sulfate. The centrifuged liquid is returned to the liquid pool for recycling. In this process design, in order to reduce equipment investment, only the centrifuge was used for the extraction of ammonium sulfate, and the moisture content of the dehydrated product can be controlled within 10%. Dehydrated ammonium sulfate is blended with a certain amount of fly ash, which can be used directly as a fertilizer or as a raw material for preparing high-quality fertilizers.

The process water system is mainly used to provide equipment sealing water, equipment cooling water, oxidized air pipe spray water, demister flushing water, absorption tower makeup water, all contacting equipment, conveying pipelines, and flushing water for storage tanks. The process water of the system is stored in a process water tank set on the island, which must meet the process water of the desulfurization process system under normal operating conditions and accident conditions of the device. The DCS control system can be divided into data acquisition system (DAS), analog quantity control system (MCS), and sequence control system (SCS) according to the requirements of process control functions. The purpose is to achieve automatic detection and control of desulfurization indicators. The desulfurization system of small and medium-sized units should also adopt a perfect automatic control system, so that when the operating conditions change, each control parameter will change accordingly, in order to improve the system's operating stability and adaptability, and thus the desulfurization efficiency.

5. Conclusion

In many industrial production processes, a large amount of alkaline waste liquid is generated. Generally, these waste liquids are directly discharged after sewage treatment. This is a waste of resources and energy. If these alkaline waste liquids can be used as absorbents, The flue gas desulfurization process for the enterprise's own boilers serves two purposes. At present, all flue gas desulfurization systems are designed for a specific absorbent. The system has poor compatibility with the absorbent and limits the use of other absorbents in the system. It is difficult to use alkaline waste liquid in such a system. . If you can design and develop a flue gas desulfurization system that can run two or more absorbents, this problem can be solved.

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