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STUDY ON SINTERING FLUE GAS DESULFURIZATION PROCESS SELECTION

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The new flue gas desulfurization system of 108m^2 sintering machine is reformed, combined with the applicable scope of common desulfurization and dust removal process and the basic principles of desulfurization and dust removal process selection, the advanced and reliable rotary spray dryer absorber(SDA) technology is selected for flue gas desulfurization. Taking the process equipment of desulfurization system as the carrier, the process flow of desulfurization and dust removal system is designed.

Key words: iron, steel , desulfurization, sintering flue gas, process selection

INTRODUCTION

Iron and steel industry is an important basic industry, with high energy consumption, high emissions, serious environmental pollution and other characteristics [1]. Its pollution mode is mainly manifested in the sintering flue gas link, which has the characteristics of large smoke volume, high temperature, high dust content, heavy moisture, containing various chemicals and substances that pollute the atmosphere, and wide diffusion range [2]. Sulphur-containing flue gas is of greatest concern. Because sulfur compounds in sintering flue gas will lead to the formation of acid rain and increase the concentration of PM2,5 in the atmosphere. The sintering flue gas desulfurization process selection has important research significance [3].

PROCESS FLOW OF DESULFURIZATION AND DUST REMOVAL SYSTEM

The desulfurization process of this set of dust removal system is as follows: mix water and limestone powder ($CaCO_3$ or CaO) in the slurry tank to make a slurry solution, which is pumped into the desulfurization tower along the slurry pipeline and atomized by the atomizer on the desulfurization tower. The atomized mortar solution is mixed with sintering flue gas in the desulfurization tower as an absorbent. The sulfur dioxide gas in the flue gas and the air pumped by the fan under the desulfurization tower oxidize with the atomized calcium carbonate slurry to form calcium sulfate. When the calcium sulfate concentration reaches saturation, it crystallizes into dihydrate gypsum. The crystallized desulphurization product is sprayed along the pipe to the pulse bag filter. Water-bearing gypsum is concentrated and dehydrated in the dust collector. The water content is reduced to less than 10 %, then solidified and precipitated to the bottom of the dust collector. The products discharged from the dust collector are transported to the gypsum storage warehouse by car for storage and reuse. After desulfurization, the sintering flue gas is removed by the mist removal device to remove the wet fog droplets. As the flue gas temperature decreases after treatment, the low temperature flue gas is heated by the heat exchanger at the end of the dust collector and then discharged to the atmosphere along the chimney.

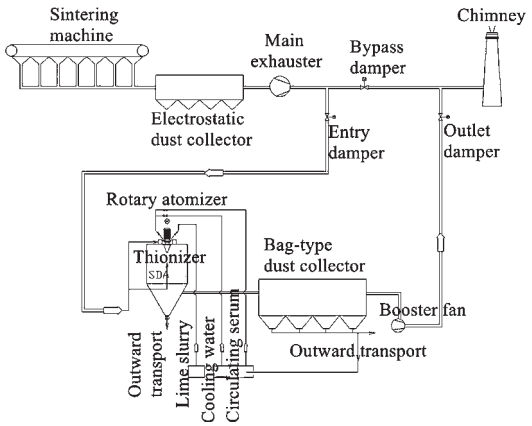

Figure 1 Desulfurization process flow chart

The process flow of desulfurization and dust removal system is shown in Figure 1. After dust removal by electrostatic precipitator, the flue gas of sintering machine head is discharged into sintering main chimney by sintering main exhaust fan. After the addition of desulphurization device, the original sintering flue gas is led out from the outlet flue of the main exhaust fan. After switching between the original flue gas pipe valve and

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the new inlet valve, it is sent to the rotary spray dryer absorber (SDA) desulfurization tower to contact with the atomized alkaline lime slurry for chemical reaction, and the SO_2 in the flue gas is absorbed and purified. After absorbing SO_2 and drying sulfur-containing products mixed with other dust flue gas along the flue into the bag filter for purification, filtration and dust removal, clean flue gas through heat exchanger heating through the outlet flue sent to the original chimney into the atmosphere. The whole desulfurization device is supercharged by the fan, interlocked with the flue gas discharge system at the back end of the main fan, and the original flue gas is used as a bypass system.

DESULPHURIZATION AND DUST REMOVAL PROCESS DESIGN MODEL

The sintering flue gas is purified by a four-electric field electrostatic precipitator and enters into a sintering main exhaust fan. The inlet of the fan is equipped with a louver window electric valve and the outlet with a muffler, as shown in Figure 2.

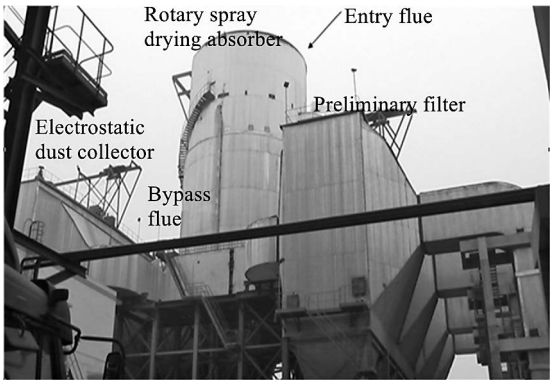

Figure 2 Physical view of desulphurization tower

The flue gas discharged from the main exhaust fan of sintering machine is discharged into the atmosphere through flue system, flue gas desulfurization system, electric pulse dust collector system and chimney. When the flue gas desulfurization system fails, close the flue gas inlet baffle valve of the flue gas desulfurization system and open the flue bypass valve. The flue gas can be directly sent to the main chimney through the original flue and discharged to the atmosphere. The height of the chimney is 155 m, and the dust emission concentration in the exhaust gas of the sintering flue gas is less than or equal to 100 mg/m^3 after the electric dust removal from the head. The relationship between flue gas temperature and desulfurization efficiency and Ca/S of SDA desulfurization tower is shown in Figure 3.

This figure shows the relationship among export smoke temperature, Ca/S and desulfurization efficiency. That is, at the same Ca/S, export smoke temperature is low, high desulfurization efficiency, at the same desulfurization efficiency, export smoke temperature is low, low Ca/S. That control the lower outlet smoke temperature can obtain high desulphurization efficiency low calcium sulfur ratio, SDA desulfurization system operation more economic, but exports easy condensation at low temperature of flue gas system, high flue gas temperature at the outlet for the system reaction, which requires to desulfurization efficiency, calcium sulfur ratio, dew point, concentration of SO_2 emissions, the flue gas outlet temperature under the influence of factors such as interaction, Find an equilibrium temperature point that can make SDA system run stably and economically.

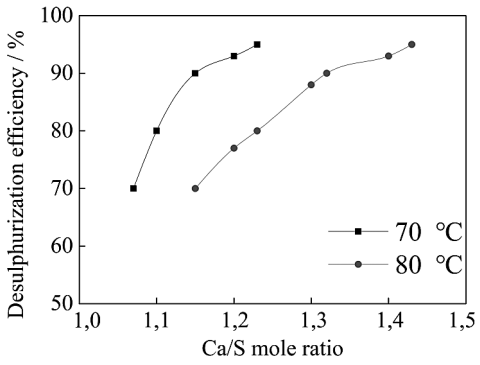

Figure 3 The relationship between flue gas temperature and desulfurization efficiency and Ca/S of SDA desulfurization tower

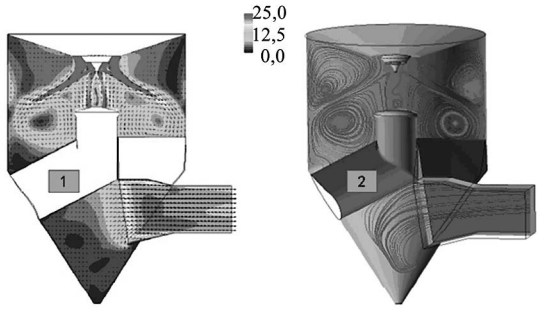

Figure 4 Smoke reaction particle tracking model diagram

Figure 4 is the flue gas reaction particle tracking model of the process principle and model, which shows the change of airflow velocity and movement track in the desulfurization tower. The specific situation is described as follows: 1-The interaction between the upper flue gas and the central flue gas makes the slurry sprayed

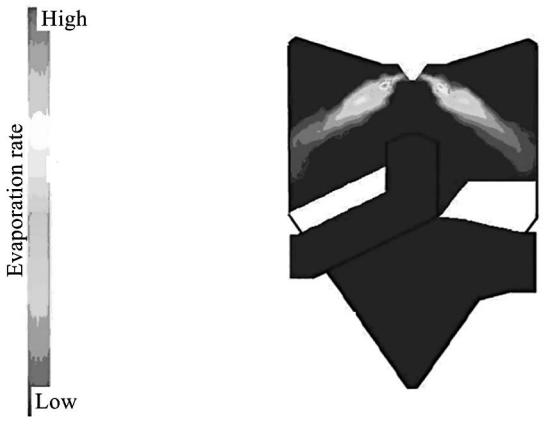

Figure 5 Model diagram of droplet evaporation rate

into the desulfurization tower form an umbrella droplets distribution and is gradually dried; 2-After drying, the particles are driven by negative pressure and move according to eddy current track, and then the desulfurization tower is discharged.

Figure 5 is the drying absorption model of SDA desulfurization tower, which shows the change of evaporation rate of slurry droplets. The slurry droplets gradually evaporate in the umbrella-shaped distribution area, and the evaporation rate is high at high temperature and low at low temperature.

ENERGY MEDIUM CONDITIONS OF FLUE GAS DESULFURIZATION SYSTEM

(1) Industrial water and water reuse, industrial water is mainly river water, pressure: 0,2~0,3 Mpa, dosage: 25~60 m^3/h.

(2) Compressed air, pressure: 0,5~0,6 MPa, consumption: 2 100 Nm^3/h.

(3) Steam,0,2~0,3 Mpa saturated steam, consumption 0,725 t/h.

(4) Power supply: there is a standby high voltage cabinet in the high voltage distribution room of sintering machine to provide a 10 kV power supply. This project newly built a low voltage electrical room, electrical room power supply from the low voltage load center low voltage distribution cabinet sintering machine.

FLUE GAS DESULFURIZATION SYSTEM MAIN EQUIPMENT

The high-pressure load of the project is only one turbocharged fan (900 kW, 10 kV), which is also the largest transmission equipment; Low-voltage power loads mainly include atomizer motor, cooling fan, pump, stirrer, ash discharge valve, scraper, electric valve, etc., all of which belong to the three types of loads. PLC control system uses a set of UPS device for its power supply.

FLUE GAS DESULFURIZATION ABSORBENT INFORMATION

The quality of quicklime powder is as follows: the desulfurizer is quicklime powder, which is screened by quicklime production line with particle size ≤5 mm and CaO /% ≥80. It is loaded into the silo of desulphurized lime powder by pneumatic conveying system. (Note: Activity: T40 ≤3 min, T40 means the time required for heating lime to 40 °C after adding water).

TARGET VALUE OF FLUE GAS DESULFURIZATION AND DUST REMOVAL

(1) When the inlet SO_2 concentration is less than 2 000 mg/Nm^3, the concentration of SO_2 in flue gas after treatment is less than 100 mg/Nm^3; When SO_2 concentration ≥2 000 mg/Nm^3, the desulfurization efficiency must be ≥ 90 %. This requirement should be met at all running test points or when load changes.

(2) The concentration of dust in the flue gas after treatment is less than 50 mg/Nm^3.

(3) After treatment, the noise from one meter away from the fan is less than 85 decibels.

(4) Net flue gas emission temperature > 75 °C after desulfurization under design conditions.

(5) The annual running time of the designed desulphurization system shall be no less than 98 % synchronous with the sintering machine, and the running time of the sintering machine shall be calculated as 350 days.

CONCLUSIONS

According to the natural conditions and constraints of steel pipe plant, combined with the applicable scope of common desulfurization and dust removal process and the basic principles of desulfurization and dust removal process selection, the rotary spray dryer absorber (SDA) is determined as the best scheme under the existing conditions. After the whole system is put into operation, the desulfurization effect reaches the expected target value.

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Note: The responsible translator for English language is Z.H. Yan, Anshan, China.