World's Largest-Class High-performance, Economical Flue Gas Desulfurization Facilities for US Coal-Fired Plants

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Because sulfur oxides (SOx) and nitrogen oxides (NOx) emissions from coal-fired power plants are stringently regulated in the US, Mitsubishi Heavy Industries, Ltd. (MHI) established a joint corporation with URS Corporation, which is a US-based engineering company, called Advatech LLC in May 2002. Advatech LLC received orders for flue gas desulfurization (FGD) facilities for three plants run by Southern Company, a US utility, and the facilities came online beginning in December 2007. The Gorgas Power Plant of Alabama Power became operable in December 2007, followed by the Hammond Power Plant of Georgia Power in March 2008 and the Miller Power Plant of Alabama Power in 2010 (four power boilers in total).

The FGD facilities successfully achieved a desulfurization efficiency of 99% or higher and a reliability of 100% during the trial operation period in the Gorgas and Hammond Power Plants, where they have already been incorporated into actual operation. At the same time, these plants allowed for a reduction in the energy consumed by the FGD facilities through the optimized operation control following variations in power generation load.

This technical report outlines the features of MHI FGD facilities based on the operation performances in the US power plants mentioned above.

1. Introduction

The MHI FGD facility has a double-contact-flow scrubber (DCFS) structure in which absorbent is sprayed upward from spray nozzles placed in the FGD absorber towers so that flue gas is brought into contact with the absorbent. By reaction in scrubber, the facility can remove not just SOx but also particulate matter, mercury, etc. In addition, the facility is easy to maintain and can be operated with high reliability because the towers have neither packing nor internal structures other than the spray nozzles and the piping on which they are attached.

With the rise of global environmental regulations in recent years, MHI developed a desulfurization technology based on a wet limestone-gypsum process, and has installed FGD facilities for coal-fired power plants since 1972. As of 2009, MHI has delivered wet limestone-gypsum FGD facilities to more than 200 plants and has a high share of the global market. Since its establishment in 2002, Advatech has received orders in the US market, including those from the Southern Company for its three plants: Gorgas, Hammond and Miller.

2. Performances of FGD Facilities in the Southern Company's Three Plants

2.1 FGD Facility in the Gorgas Power Plant of Alabama Power

2.1.1 Facility Overview

The FGD facility in the Gorgas Power Plant treats flue gas from three power boilers by a single scrubber. The total generating capacity of the three boilers is 1.02 million kW. Considering the amount of flue gas treated by one scrubber, it is one of the largest FGD facilities in the world.

The FGD scrubber shown in **Figure 1**, which is a co-current & counter-current DCFS (twin tower). The flue gas from the boilers is fed from the top of the left tower (co-current DCFS) in Figure 1 and comes in contact with the absorbent. The gas is then redirected 180 degrees and flows into the bottom of the right tower (counter-current DCFS) to contact the absorbent again.

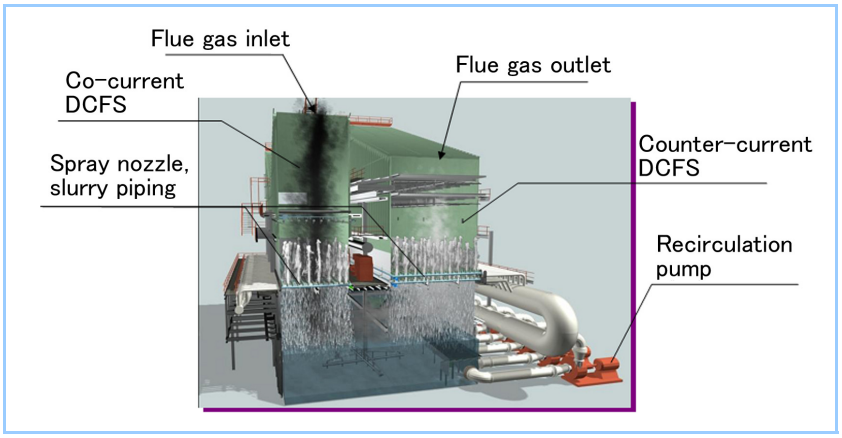

Figure 1 Co-current and counter-current DCFS (twin tower)

2.1.2 Summary of Operation Performance

A performance test conducted before delivery showed that the FGD facility had a desulfurization efficiency of 98% or higher. The facility also exhibited high dust removal efficiency and high gypsum purity.

In addition, the facility achieved a reliability of 100% during an 18-month continuous operation to test its dependability. As discussed above, since this FGD facility treats flue gas from three boilers, a high dependability is required for stable power generation. The continuous operation test, which resulted in 100% reliability, demonstrated the high dependability of MHI's FGD facilities.

2.2 FGD Facility in the Hammond Power Plant of Georgia Power

2.2.1 Facility Overview

In the Hammond Power Plant, flue gas from four power boilers is treated by a single FGD facility. In a similar setup to the Gorgas Power Plant, the type of scrubber is co-current and counter-current DCFS.

One of economical features of the FGD facility in the Hammond Power Plant is that it can be adjusted to follow the power generation load of the boilers. To reduce the power consumption of the facility during low-load periods, the number of recirculation pumps involved in circulating the absorbent is changed according to variations in power generation load, as shown in **Figure 2**. As a result, the facility can save energy during low-load periods.

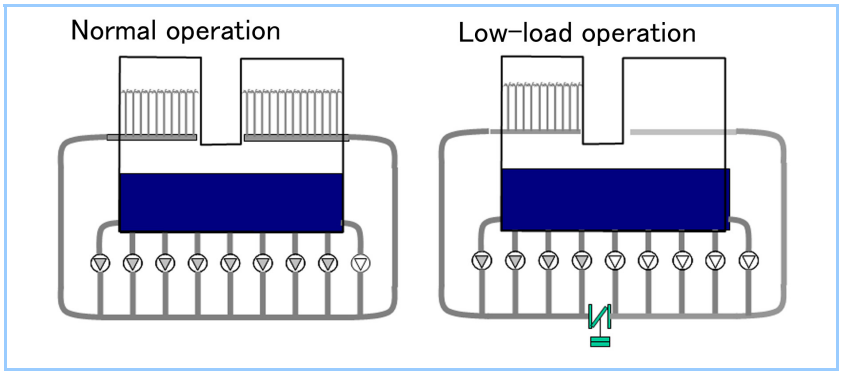

Figure 2 Set up to control the number of recirculation pumps

2.2.2 Summary of Operation Performance

As in the case of the Gorgas plant, a performance test showed that the facility had a desulfurization efficiency of 98% or higher, as well as a high mercury removal efficiency and high gypsum purity. In addition, the number of recirculation pumps in operation was properly

controlled, thereby enabling the optimum operation of the facility.

As with the plant in Gorgas, a reliability of 100% was achieved during a 12-month continuous operation, and the merit of MHI FGD facility, i.e., the simple internal structure of the absorber towers, was clearly demonstrated.

2.3 FGD Facility in the Miller Power Plant of Alabama Power

The FGD facility in the Miller Power Plant consists of four absorber towers that treat flue gas from a 0.66 million-kW power boiler. **Figure 3** shows the structure of the towers, a counter-current DCFS. Flue gas from the boiler enters at the bottom of the tower and contacts the absorbent as it flows upward.

In the FGD facility, sulfite ions in the absorbent must be oxidized to sulfate ions to recover gypsum from the absorbed SO_2. For this purpose, Miller Power Plant uses Jet Air Sparger (JAS), an oxidation system based on MHI's proprietary technology. As illustrated in **Figure 4**, part of the slurry discharged from the absorber recirculation pump is sprayed by the JAS into the tower, and the pressure generated by the slurry stream is used to introduce atmospheric air to cause oxidation. This eliminates the use of an oxidation air blower in the plant, resulting in a simplified facility structure.

The Miller Power Plant is launching a total of four FGD facilities in series, and all of them are scheduled to be in operation by 2011.

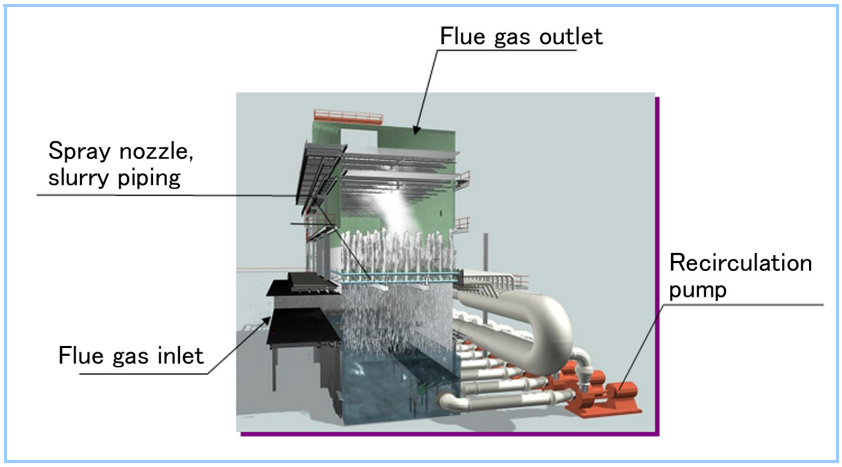

Figure 3 Counter-current DCFS

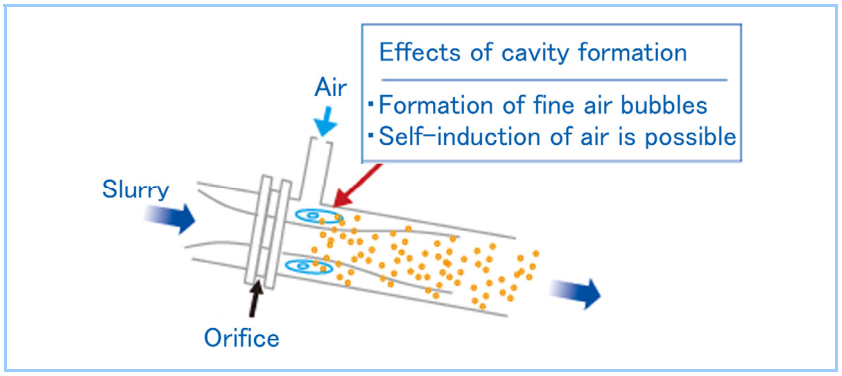

Figure 4 Jet Air Sparger (JAS)

3. Conclusions

The FGD facilities for the Southern Company meet the desulfurization efficiency required in each plant and all achieved a reliability of 100% during the continuous operation tests.

In the future, MHI intends to promote the high desulfurization efficiency and dependability of its FGD facilities based on the success of these plants. The company also plans to further expand its sales by marketing its multi-emission control technology developed in compliance with new regulations to restrict emissions of mercury and other regulated compounds.