Priority Subjects — **Development of a Supply/Demand Infrastructure for Next-Generation Electric Power**

Improvement of Operation and Control Technologies to Diversify Fuel Types for Pulverized Coal-Fired Power Plants

Background and Objective

The utilization of low grade coals is sought to diversify fuel types in pulverized coal-fired power plants. For the cost reduction of maintenance and inspection and for environmental preservation, countermeasures to the sulfidation corrosion of boiler tubes and trace elements control are necessary in coal-fired power plants. In this research subject, the guideline for the operating conditions of a mill and a burner, and a blending method, etc. are under development to use low HGI coal*1 (which has low grindability) and low volatile coal (which is low combustibility) in existing pulverized coal-fired power plants. In regards to countermeasures for sulfidation corrosion, an evaluation method of sulfidation conditions and coating technology for the tube will be developed. Estimation methods of trace elements behavior such as Hg, B, Se, and emission control technologies are also under development.

Main results

1 Grindability and combustibility of low HGI coal

The grindability of the low HGI coal (WC coal) produced in Australia was evaluated using a roller mill (coal grinding rate; 300 kg/h), which had a similar structure to that in actual power plants (Fig. 1(1)). When the low HGI coal was grinded to a similar particle size to that of conventional bituminous coal, the grinding power for the low HGI coal became about twice of that for the bituminous coal (CL coal) (Fig. 1(2)). The weight loss of metal test pieces installed on a roller surface was measured to investigate the erosion characteristics concerned with maintenance cost for a roller mill. The weight loss of the metal pieces during the grinding of the low HGI coal was also approximately twice of that during the grinding of the bituminous coal. Both the grinding power and the weight loss of the pieces were reduced when the pulverized particle size was set coarser.

The combustibility of the low HGI coal was evaluated using a coal combustion test facility (coal combustion rate; 100 kg/h). Even though the particles of the low HGI coal were coarser, sufficient combustion efficiency could be kept because the volatile content of the low HGI coal was high. NOx emissions at the exit of the furnace could also be kept low because of the low nitrogen content in the low HGI coal (Fig. 1(3)).

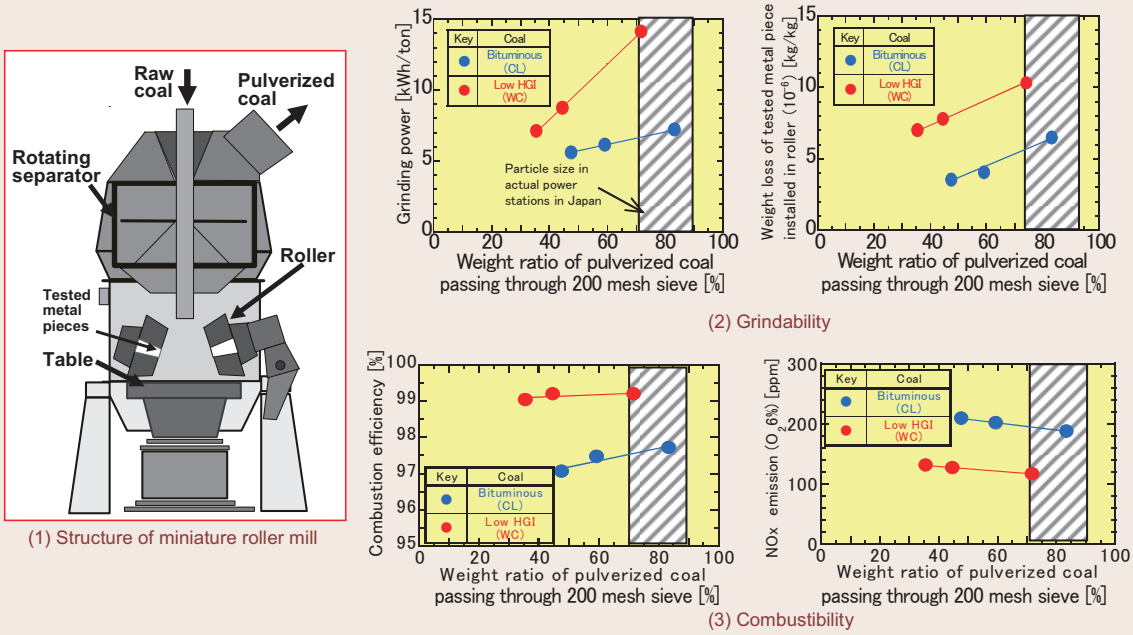
To use low HGI coal, one option is to blend it with a high grindability coal, and another is to set the particle size coarser in a mill (M12008).

2 Development of a coating technology for preventing sulfide corrosion on boiler tubes - Effects of surface preparation -

In order to investigate the effects of surface preparation on sulfidation corrosion-resistance, the corrosion tests were performed on metal substrates prepared as per three preparation grades (U.S.A steel structure painting councils; SSPC-SP-10, SSPC-SP-6, SSPC-SP-3*2) in our laboratory and at an actual power plant. For the substrate prepared as per SSPC-SP-6, the thickness of corrosion layer on a coated part was reduced to 10 percent or less compared with an uncoated part. The metal substrate prepared as per SSPC-SP-6 was found to have better corrosion-resistance than that prepared as per SSPC-SP-10 (Fig. 2). The sulfidation corrosion-resistance on metal substrate prepared as per SSPC-SP-3 was also high, though there was the problem of existing corrosion layer detachment. (M12006)

*1 HGI (Hardgrove grindability Index) is an evaluating factor for coal hardness. As HGI decreases, coal becomes harder to grind. The HGI of bituminous coal utilized in Japan ranges from 40 to 70. The HGI of low HGI coal in this study is lower than 40.

*2 SSPC-SP-10: A near-white blast cleaned surface. Other foreign matter is completely removed except for very light shadows. SSPC-SP-6: Commercial blast cleaning. It requires removal of loose scale, rust, and other contaminants. SSPC-SP-3: Power tool cleaning. It will remove only loose scale, rust or other detrimental foreign matter.



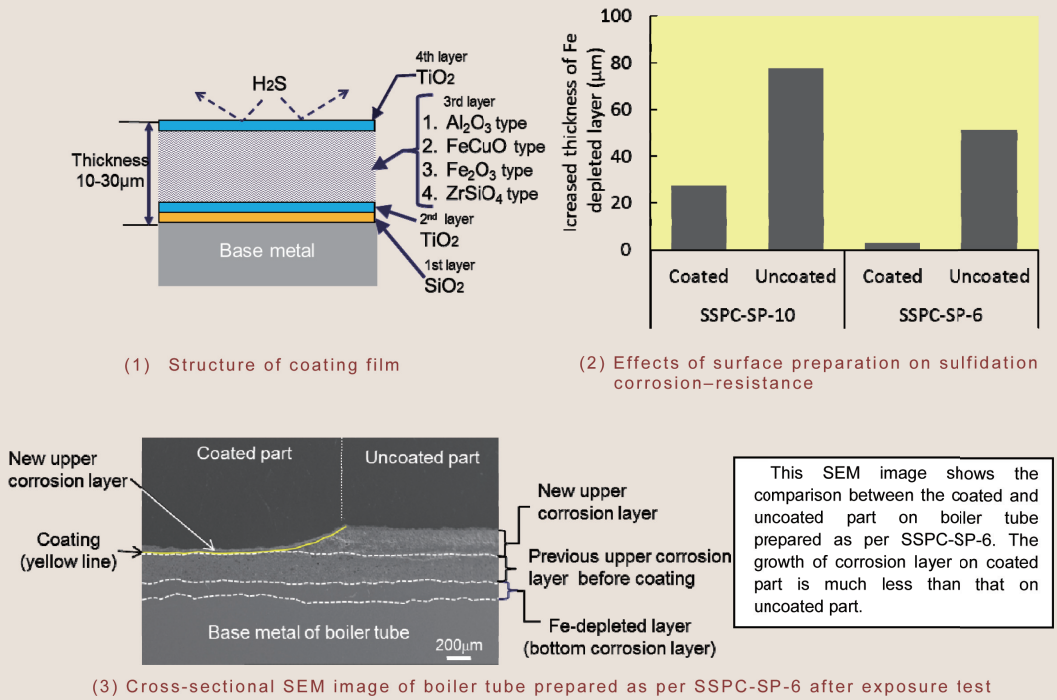
(1) Structure of miniature roller mill

(2) Grindability

(3) Combustibility

Fig. 1: Influence of pulverized coal size on grindability and combustibility

The grinding power of low HGI coal is around twice of that for the bituminous coal when the passing weight ratio of a 200 mesh (75μm) sieve is 70%. The weight loss of metal test pieces during the grinding of low HGI coal was close to twice of that of bituminous coal (CL coal). Both the grinding power and the weight loss of the pieces decreased as the passing weight ratio of 200 mesh sieve increased. The combustibility of the low HGI coal is better than that of the bituminous coal. It may be acceptable to set the particle size coarser in a mill to use low HGI coals, since the sufficient combustion efficiency is maintained and NOx emissions do not worsen.



(1) Structure of coating film

(2) Effects of surface preparation on sulfidation corrosion–resistance

This SEM image shows the comparison between the coated and uncoated part on boiler tube prepared as per SSPC-SP-6. The growth of corrosion layer on coated part is much less than that on uncoated part.

(3) Cross-sectional SEM image of boiler tube prepared as per SSPC-SP-6 after exposure test

Fig. 2: Effects of surface preparation on sulfidation corrosion–resistance of the coating film

The structure of coating film is designed in terms of the chemical reactivity with H_2S and the coal ash elements (Na, K, etc.), and wear resistance. In order to verify the corrosion resistance of the film, an exposure test utilizing Al_2O_3 type film was performed for 3700 hours in an actual power plant. The result showed that the metal substrate prepared as per SSPC-SP-6 had higher corrosion-resistance than that prepared as per SSPC-SP-10.