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 coal is sought to diversify fuel types in pulverized coal-fired power plants. In the diversification of fuel types, the countermeasures against sulfide corrosion of boiler tubes and the control technologies of trace elements such as Hg, B, Se, are also important issues.

In this research subject, the guideline for the suitable operating conditions of a mill and a burner, the blending method of coals, etc. will be formulated to use low HGI coal*1 (low grindability coal) in existing pulverized coal-fired power plants. In regards to sulfide corrosion, countermeasures for the tube will be developed. Control technologies of trace elements in flue gas and in waste water treatment processes are also under development. These technologies contribute to the diversification of fuel types in pulverized coal-fired power plants.

Main results

1 Clarification of roller mill operating condition for the blend of low HGI coal and bituminous coal

The combustion test of low HGI coal mined in the Surat Basin in Australia demonstrated high combustion efficiency and low NOx emission. Under ordinary grinding conditions in a roller mill (weight ratio of pulverized coal passing through 75 μm mesh of the sieve: 70-80%), the low HGI coal required high grinding power due to low grindability. As the fuel ratio*2 of the blended coal composed of bituminous and low HGI coals decreased, grinding power increased and the maximum blending ratio of low HGI coal under the permissible power of the roller mill decreased. When the rotation speed of separator in the roller mill was decreased to make coal particles coarse, the weight ratio of pulverized coal passing through 75 μm mesh of the sieve decreased to 30-50%, and grinding power decreased. Then, it was discovered a high blending ratio of low HGI coal could be obtained, though the blended bituminous coal of low fuel ratio had low grindability.

Furthermore, when low HGI coal was blended with the bituminous coal of a higher fuel ratio, the combustion efficiency improved significantly.

Based on grinding and combustion characteristics of the low HGI coal and the coal blends, a guideline for the suitable operating conditions to use low HGI coal in pulverized coal-fired power plants was formulated (Fig. 1).

2 Verification of sulfide corrosion-resistant coating in actual boilers

A sulfide corrosion-resistant coating was developed in order to economically and easily prevent sulfide corrosion on boiler tubes. The developed coating could be fabricated in a manner similar to spraying paint. To evaluate the operational durability of the coating, verification tests were performed through the application in six actual coal-fired boilers and two actual oil-fired boilers. Through verification testing in actual boilers, it was found that the coating suppressed corrosion to less than one-fourth of the corrosion on uncoated tubes as shown in Figure 2. Also, the coating was found to maintain a good condition for a minimum of 2 years (M04). CRIEPI has licenses this coating technology to a company.

*1 HGI (Hardgrove Grindability Index) is an evaluating factor for the grindability of coal. As HGI decreases, it becomes harder to grind. The HGI of bituminous coal utilized in Japanese power stations ranges from 40 to 70. The HGI of low HGI coal in this study is below 40.

*2 Fuel ratio is the mass ratio of content of fixed carbon to volatile matter in coal. As fuel ratio decreases, combustion efficiency increases and grinding power increases.

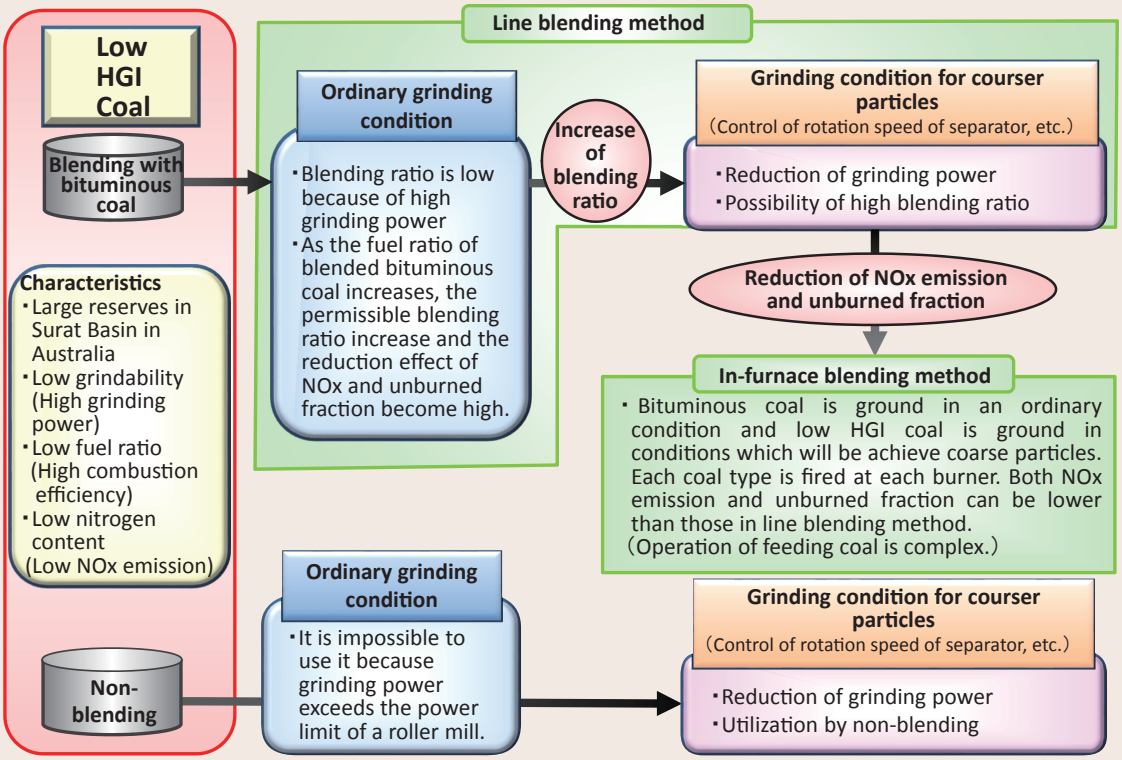

Fig. 1: Suitable operating condition for low HGI coal in pulverized coal-fired plants

Suitable operating conditions for low HGI coal under blending and non-blending conditions are clarified.
Line blending method: Two types of coals are blended before the roller mill and are fired at the same blending ratio for each burner.
In-furnace blending method: Two types of coals are ground at each mill and are fired at each burner.

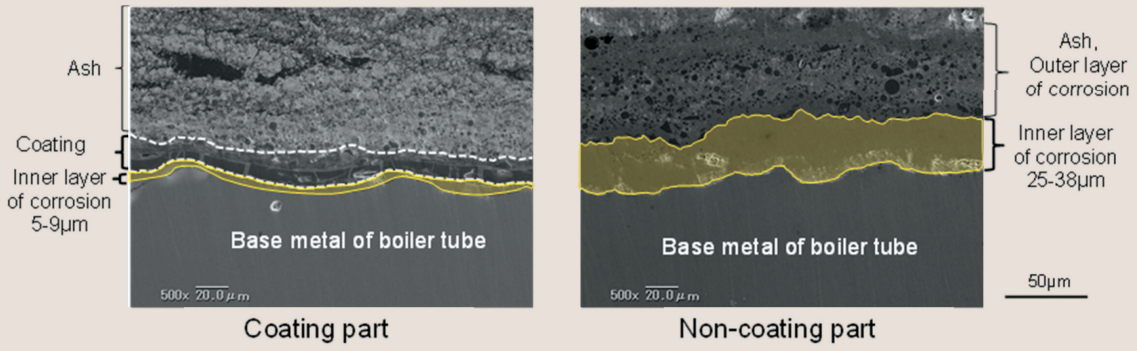

Fig. 2: Cross-sectional SEM image of the coated and uncoated parts on the coal-fired boiler tube

The developed coating has a four-layered structure comprising thin films of (1) a SiO_2 layer, (2) a TiO_2 layer, (3) an Al_2O_3-based layer, and (4) a TiO_2 layer. This coating process can be applied to a large area in a short period. When the coating area is 100 m^2, the work takes 3 days and total spraying time is only 7 hours. CRIEPI coating reduced corrosion to 25% or less compared with an uncoated part. It was found that CRIEPI coating on boiler tubes is exceptionally durable and continues to be effective for more than 2 years in actual power plants.