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Development of Pulverized Coal/Ammonia Co-firing Technology with Single-burner and Multi-burner Furnaces

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Abstract

Combustion experiments in a 0.8 MW-class single-burner furnace and a 2.4 MW-class multi-burner furnace equipped with three coal burners vertically were carried out to investigate the co-combustion characteristics of pulverized coal and ammonia (NH_3). As a result, at an NH_3 co-firing rate of 20% at a lower heating value, the nitrogen oxides (NO_x) concentration in the exhaust gas equivalent to that of pulverized coal combustion was achieved by changing the NH_3 injection positions, NH_3 injection nozzle shapes, and operating conditions in the multi-burner furnace. The main findings of this study are presented below.

[Single-burner furnace]

- When an axial injection nozzle was used for NH_3 injection, the NO_x emission increased as the NH_3 co-firing rate increased, but the increase was sufficient to be handled by the existing NO_x removal equipment.
- Unburned NH_3 concentration increased by injecting NH_3. the value was low enough considering the detection limit.

[Multi-burner furnace]

- When the axial injection nozzle was used for NH_3 injection, at an NH_3 co-firing rate of 20%, outlet NO_x concentration increases with the increase of NH_3 co-firing rate at any NH_3 injection position. Outlet NO_x concentration at NH_3 injection into the lower burner is the lowest in NH_3 co-firing rate of 20.0%. NH_3 injection into the lower burner increases the residence time of NH_3 in the furnace and effectively reduces the NO_x emission in the reducing atmosphere formed by two-stage combustion.
- For the NH_3 injection nozzle shape, the nozzle, which injects NH_3 simultaneously in the axial and radial directions of the burner, has the lowest unburned content in the ash.
- When the nozzle described above is used for NH_3 injection at the lower burner at an NH_3 co-firing rate of 20% and the two-staged combustion rate of 35%, NO_x concentration in the exhaust gas and the unburned carbon in the fly ash can be achieved at a level equivalent to those of pulverized coal.
- Under the above conditions, NH_3 concentration in the exhaust gas was below the lower limit of detection, and nitrous oxide (N_2O) concentration in the exhaust gas was the same level as that of pulverized coal combustion.

This abstract is based on the results obtained from projects, “Energy Carrier” in Strategic Innovation Promotion Program (SIP) by Japan Science and Technology Agency (JST) and JPNP16002 commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

Note: This document will be opened to the participants on IERE website before the Workshop and opened to the public afterward.