

[초청강연]

High-Temperature Air Combustion Technology (HiCOT) and Its Fundamentals

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The high-temperature air combustion technology (HiCOT) is a key combustion technology developed as a national project in Japan since 1993. The main objective of this project was to increase the thermal efficiency and to reduce CO₂ emission of industrial furnaces, such as heating furnace and melting furnace, whose number exceeds 30,000 in Japan. We successfully accomplished this project in 1998 and as a result the thermal efficiency of the improved industrial furnaces increased about 30%. The recent development and applications of HiCOT are boilers, incinerators and steam reformers, and the new project started in 1999. The outline of remarkable achievements of these projects is described together with their fundamental mechanisms and reasons of high efficiency and low emission of pollutants.

The high-temperature air is produced by a regenerative heat exchanger with ceramic honeycomb in some cases; that is, the heat exchange media is heated by flue gas passing through it in the heat accumulating mode, and then it is cooled by releasing the accumulated heat to air supplied from the opposite side in heat releasing mode. Since the combustion is very stable when the high-temperature air is used, we can decrease the oxygen concentration in air as low as 3 %. As a result, compared with the case of ambient air combustion in conventional systems, a very uniform temperature distribution is obtained in furnaces and NO_x emission drastically reduced.

The fundamentals in HiCOT are not fully clarified yet, in spite of the efficient performance in real industrial furnaces. By use of the counterflow flames, we investigated experimentally and numerically combustion mechanisms for blended fuels such as CO, H₂, CH₄, C₃H₈ and their mixtures produced from wastes in incinerators, the radiation reabsorption effect of combustion gaseous products on NO_x emission, and the flame stability of premixed flame anchored by a hot wall such as tube surface of steam reformers. Clarification of the fundamentals will stimulate and promote further applications in industries.