

Purification of Waste Gas at High Temperatures Using Alkaline Minerals

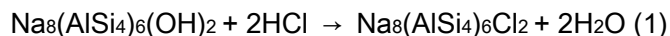
SUZUKI, Kenzi

EcoTopia Science Institute, Nagoya University, Japan

Abstract:

The energy conversion technology of the organic waste is mainly classified in three ways, fermentation by microbe or enzyme, gasification by catalyst and incineration using an incinerator. In heat recovery by the incineration of the waste, it is a serious technical problem to recover thermal energy efficiently. The energy conversion efficiency improves if the heat recovery at high temperature is possible without cooling flue gas. However, high temperature corrosion occurs in a heat exchanger because acid gas such as HCl is included in flue gas. Therefore, the heat exchange is performed at lower temperatures expressly to prevent corrosion. The removal technology at high temperatures of HCl gas included in flue gas is expected to enable the heat exchange at high temperatures.

A purpose of this study is to remove HCl gas in flue gas at high temperature around 800°C directly. It is effective to use an alkaline mineral for removing HCl gas. Hydroxyl sodalite (HSD), $\text{Na}_8(\text{AlSi}_4)_6(\text{OH})_2$ and Hydrogrossular (HGR), $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_{0.8}(\text{OH})_{8.8}$ are known as the alkaline mineral. These minerals have many cages of nano-size and have the property to fix Cl⁻ ions in the cages at high temperature above 400 °C. The HSD reacts with HCl, and then changes to Sodalite, $\text{Na}_8(\text{AlSi}_4)_6\text{Cl}_2$ (Equation 1) . The amount of HCl gas that reacts with HSD increases with increasing reaction temperature, then becomes greatest at 800°C, 73g-HCl/kg-HSD.



On the other hand, HGR changes to Mayenite, $\text{Ca}_{12}\text{Al}_{10}\text{Si}_4\text{O}_{35}$, by heating, then Mayenite reacts with HCl (Equation 2). The amount of HCl gas that reacts with Mayenite is 154g-HCl/kg-mayenite at the maximum.



The HCl concentration decreased drastically from 174ppm to 13ppm as a result of introducing the HSD powder into a large-scale furnace, 750±50°C. In the case of HGR, a similar result was obtained.

Keywords:

Alkaline mineral, HCl removal, High temperature treatment, Waste combustion