Characteristics of SO2 removal by using CaCO3 sorbent particle in an oxy-PC combustion system

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CCS (CO2 capture and storage) is the technology which can directly reduce the emission of greenhouse gases. oxy-PC combustion system (which is one of the CCS capture technology) has advantages over other systems because it is economical and recovers the CO2 with high purity. In oxy-PC combustion, flue-gas recirculation creates an atmosphere that is primarily CO2 with a small amount of O2. Therefore, the phenomena of sorbent particles in an oxy atmosphere are different compared with those in an air atmosphere.

SO2 removal experiments by using CaCO3 sorbent particle was performed in a drop tube furnace experimental setup in air atmosphere and oxy-PC atmosphere.

To estimate the effect of temperature in a reactor on a particle behavior and SO2 removal characteristics, experiments were conducted by varying a temperature 800-1100°C. Reaction time in a reactor was set to 2 sec. As seen in Fig. 1, SO2 removal efficiency increased with temperature rise in an air atmosphere, while it had maximum value between 900-1000°C in an oxy-PC atmosphere. In general, adsorption became enhanced as the temperature increased. However, in an oxy-PC atmosphere, the degree of adsorption showed the maximum value due to the significant sintering effect. Furthermore, decomposition phenomenon of the adsorbed SO2 from the sorbent particle accelerated the decline of the SO2 removal efficiency.

Figure 1. SO2 removal rates by varying a temperature in air and oxy-PC atmospheres, respectively.

To estimate the effect of reaction time in a reactor on a particle behavior and SO2 removal characteristics, experiments were conducted by varying a reaction time 1.0-2.0 sec. Temperature in a reactor was set to 1000°C. Figure 2 shows the SO2 removal efficiencies by varying a reaction time in an air and oxy-PC atmospheres, respectively. As seen in Fig. 2, SO2 removal efficiency showed the same level within the experimental conditions in an air atmosphere, while it increased until the reaction time of 2 sec. It was attributed to CO2 partial pressure in an oxy-PC atmosphere. In an oxy-PC atmosphere, calcination was delayed due to the higher CO2 partial pressure in a surrounding medium. Thus, it takes long time to make the sufficient SO2 adsorption in an oxy-PC atmosphere.

Figure 2. SO2 removal rates by varying a reaction time in air and oxy-PC atmospheres, respectively.

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