KOH capture by coal fly ash

The KOH-capture reaction by coal fly ash at suspension-fired conditions was studied through entrained flow reactor (EFR) experiments and chemical equilibrium calculations. The influence of KOH-concentration (50–1000ppmv), reaction temperature (800–1450°C), and coal fly ash particle size (D50=6.03–33.70μm) on the reaction was investigated. The results revealed that, at 50ppmv KOH (molar ratio of K/(Al+Si)=0.048 of feed), the measured K-capture level (C_K) of coal fly ash was comparable to the equilibrium prediction, while at 250ppmv KOH and above, the measured data were lower than chemical equilibirium. Similar to the KOH-kaolin reaction reported in our previous study, leucite (KAlSi2O6) and kaliophilite (KAlSiO4) were formed from the KOH-coal fly ash reaction. However, coal fly ash captured KOH less effectively compared to kaolin at 250ppmv KOH and above. Studies at different temperatures showed that, at 800°C, the KOH-coal fly ash reaction was probably kinetically controlled. At 900–1300°C it was diffusion limited, while at 1450°C, it was equilibrium limited to some extent. At 500ppmv KOH (molar ratio of K/(Al+Si)=0.481, and a gas residence time of 1.2s, 0.063gK/(g additive) and 0.087gK/(g additive) was captured by coal fly ash (D50=10.20μm) at 900 and 1450°C, respectively. Experiments with coal fly ash of different particle sizes showed that a higher K-capture level were obtained using finer particle sizes, indicating some internal diffusion control of the process.