

Modeling the use of sulfate additives for potassium chloride destruction in biomass combustion - DTU Orbit (09/11/2017)

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Potassium chloride, KCl, formed from biomass combustion may lead to ash deposition and corrosion problems in boilers. Sulfates are effective additives for converting KCl to the less harmful K_2SO_4 . In the present study, the decomposition of ammonium sulfate, aluminum sulfate and ferric sulfate was studied respectively in a fast-heating rate thermogravimetric analyzer (TGA) for deriving a kinetic model. The yields of SO_2 and SO_3 from the decomposition were studied in a tube reactor, revealing that the ratio of the SO_3/SO_2 released varied for different sulfate and for ammonium sulfate the ratio was affected by the decomposition temperature. Based on the experimental data, a model was proposed to simulate the sulfation of KCl by different sulfate addition, and the simulation results were compared with pilot-scale experiments conducted in a bubbling fluidized bed reactor. The simulation results of ammonium sulfate addition and ferric sulfation addition compared favorably with the experimental results. However, the model for aluminum sulfate addition under-predicted significantly the high sulfation degree of KCl observed in the experiments, possibly because of an under-estimation of the decomposition rate of aluminum. Under the boiler conditions of the present work, the simulation results suggested that the desirable temperature for the ferric sulfate injection was around 950-900°C, whereas for ammonium sulfate the preferable injection temperature was below 800°C.

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