Deposition Properties of Biomass Fly Ash

This study investigated deposit formation of biomass fly ash on steel tubes, in a lab-scale Entrained Flow Reactor. Experiments were conducted using model biomass fly ash, prepared from mixtures of K$_2$Si$_4$O$_9$, KCl, K$_2$SO$_4$, CaO, SiO$_2$ and KOH, as well as three different boiler fly ashes: a wood fly ash, a straw fly ash, and a straw + wood cofired fly ash. The fly ashes were injected into the reactor, to form deposits on an air-cooled deposit probe, simulating deposit formation on superheater tubes in boilers. The results revealed that increasing flue gas temperature, probe surface temperature, time, fly ash flux and fly ash particle size increased the rate of deposit formation. However, increasing flue gas velocity resulted in a decrease in the deposit formation rate. A mechanistic model was developed for predicting deposit formation in the reactor. Inertial impaction was the primary mechanism of deposit formation, when pure K$_2$Si$_4$O$_9$, SiO$_2$ or CaO was injected into the reactor, forming deposits only on the upstream side of the steel tube. However, feeding KCl, K$_2$SO$_4$ or KOH into the reactor resulted in deposit formation on both sides of the steel tube, via condensation, thermophoresis, and inertial impaction.

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