Study on trace metal partitioning in pulverized combustion of bituminous coal and dry sewage sludge

Abstract:
A study of the influence of co-firing of dry municipal sewage sludge on the behavior of the metals Cr, Hg, Mn, Ni, Pb, Zn during pulverized coal combustion is presented. Sewage sludge contains higher concentrations of the metals listed above than the reference coal, but a lower concentration of Cl, that enhances the volatility of many metals. Experiments were performed in a semi-industrial scale pulverized fuel combustion chamber (500 kW). Ash was collected at four locations: bottom hopper (T=850 K), air preheater (T=750 K), cyclone (T=620 K), and bag filter (T=480 K). From the bottom hopper to the filter, the particle size decreased and ash particles were progressively enriched in volatile elements. Mass balances of the metals were performed and the enrichment trends on the ash collected at the different locations were calculated. Increasing the sewage sludge share in the blend caused a significant increase in the recovery rate in the solid phase. In spite of that, the calculated concentrations in the flue gas of Hg and Zn increased. Sewage sludge co-firing influences the combustion process and the post-combustion environment in many ways. This study focuses on the effect of the different flue gas composition on the condensation temperature of metal species. The system was modeled by assuming thermodynamic equilibrium. The results indicated that the increasing recovery of Zn might be caused by enhanced condensation and the increasing recovery of Hg by adsorption on ash particles. The
increasing recovery of the other metals seemed referable to failure in vaporization and it cannot be studied with an equilibrium approach.