Trace-metal speciation during sludge combustion and incineration

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Abstract

Municipal waste combustion has been opted as a method for reducing the size of the volume, and consequently, for reducing the necessary requirement of areas for direct disposal. However, the emission of the conventional gaseous pollutants are not the only problem; traces of metal fumes emanate from the metallic compounds that are in the wastes. Efforts to control these metal fumes have not been so successful because of the complicated mechanisms of the metallic compounds during combustion. Failure of the conventional systems to trap the trace elements is due to their appearance with the submicron particles from the combustion and incineration systems. In this work, a thermochemical equilibrium approach is employed to study the combustion and gasification behavior of trace metals with a case of lead, cadmium, and chromium during the incineration of sewage sludge. In this work, sulfur and chlorine have been found to play a key role in the speciation of the trace metals. However, these elements are only active when oxygen is present. A test on alkali metals mixed with trace metals showed that at low concentrations of S and Cl, the alkali metals react first with these elements before other metals. Chlorine assists in retaining most of the trace metals in the vapor phase while sulfur keeps them in the condensed form. The presence of iron, as is the case with most sorbents, hinders the reaction of Cl with the metals, thus suppressing the formation of volatile compounds.