Mercury Oxidation in Coal-Fired Combustion Systems

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Recently, very little is known about these reaction mechanisms and rates. This information is vital in formulating reaction models. Mathematical models are useful to determine the species present in the flue gases. These models can then be used in coal-fired combustion systems to help in determining and quantifying efficient methods for reducing mercury emissions.

The most useful oxidation reaction to study is that with chloride. At the University of Utah Combustion Lab a drop tube furnace equipped with a 1000 BTU/hour natural gas flame, is set up to simulate the temperature profile of a coal-fired boiler. Mercury is introduced into the drop tube via a mercury calibration gas generator. After a baseline has been taken and a mass balance closed over the reactor, dichloromethane is introduced and the change in mercury species recorded using a Tekran 2537A CVAF analyzer. A decrease in elemental mercury can be clearly seen as the chlorine concentration is increased, indicating that the chlorine is in fact oxidizing the mercury within the reactor.

There are 2500 tons of anthropogenic mercury emitted per year world-wide. When introduced into aquatic environments, it is converted to methyl mercury and has the potential to bioaccumulate up to a factor of ten thousand times. In order to curb anthropogenic mercury released into the environment, the EPA has announced plans to regulate power plant mercury emissions beginning in 2007. Mercury is present in coal-fired combustion flue gases as both elemental and oxidized species. Oxidized species are effectively removed from the combustion flue gases while elemental mercury is not. This is due to differences in solubility. The extent of oxidation is dependant on many plant and reaction parameters.

The understanding of fundamental mercury reactions is essential for mercury control technologies.