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The effects of varied hydrogen chloride gas concentrations on corrosion rates of commercial tube alloys under simulated environment of WTE facilities

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ABSTRACT

In order to clarify the effects of HCl concentrations on corrosion rates of commercial tubing in Waste-to-Energy (WTE) boilers, a corrosion test was made by altering the HCl concentration from 0 to 1000ppm, together with simulated flue gas composition. Three commercial tubing SA178A, SA213 T11 and NSSER-4 samples were investigated under a well controlled thermal gradient where the gas temperature was at 700^0C and metal temperatures ranged from 480 to 580^0C. The duration of each test was 100 hours. The post-test analyses included observations of surface morphology and elementary composition analysis of corrosion products by scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS). The corrosion rates were acquired by measuring the mass loss of samples after the test.

The results showed that the addition of HCl to the flue gas increased the corrosion rates of test samples, but the relation between the HCl concentration and corrosion rate was not linear. The HCl effects on corrosion rates were more prominent when its concentration changed from 0 to 500ppm. In addition, the HCl effects were promoted by the increase of metal temperature in particular when metal temperature was over 560^0C.

INTORDUCTION

Chlorine induced high temperature corrosion that degrades the boiler tubes has long been a major issue of maintaining the Waste-to-Energy (WTE) facilities. The difficulty of combating corrosion problem in WTE facilities is that it varies from unit to unit and is highly related to the composition of feed and the boiler design. Municipal Solid Wastes (MSW) typically consists of paper, plastics, leather, wood, glass, metals and food waste. During combustion, nearly all of the chlorine content in the various components of the MSW, both natural organics and chlorinated plastics is volatilized and converted to hydrogen chloride gas. In the U.S. MSW contains about 0.5% of chlorine [1], and the hydrogen chloride gas concentration in the flue gas is calculated to be about 580 ppmv [2]. The practical concentrations of hydrogen chloride gas in WTE facilities vary during the operation because of the heterogeneous nature of the feed.

Laboratory investigations on the corrosion behavior have been performed in chlorine-containing atmospheres with different