

Effects of Feed Composition on Boiler Corrosion in Waste-to-Energy Plants

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Abstract

Municipal solid wastes (MSW) typically contain plastic materials, leather, textiles, batteries, food waste and alkalis. These materials are sources of chlorine, sulfur, potassium, zinc, lead and other heavy metals that can form corrosive media during combustion of the MSW in waste-to-energy (WTE) facilities. Chlorides and sulfates, along with fly ash particles, condense or deposit on the waterwall surfaces in the combustion chamber and on other heat exchanger surfaces in the convection path of the process gas, such as screens and superheater tubes. The resulting high corrosion spots necessitate shutdowns and tube replacements, which represent major operating costs. The aim of ongoing research at Columbia University is to gain a better understanding of the effects of fuel composition, products of combustion, and chemical reactions that lead to the corrosion of metal surfaces in WTE boilers. The potential chemical reactions and their chance of occurrence were determined by means of thermochemical calculations of the respective equilibrium constants as a function of temperature and gas phase composition.

1. Introduction

A major problem in the operation of WTE facilities is the high corrosion of the heat exchanger tubes through which thermal energy from the combustion gases is transferred to the high-pressure steam that is used to operate the electricity generators. The rate of corrosion in MSW combustion chambers is reported to be much higher than for conventional coal-fired power plants that operate at higher temperatures than WTE facilities. It is generally assumed that this high rate of corrosion is inherent to the heterogeneous nature of the MSW fuel and its variable chlorine content. This heterogeneity makes it difficult for operators to

maintain uniform combustion conditions that are desired in steam boilers. Also, the poor combustion characteristics of the MSW fuel result in incomplete combustion, i.e. localized high CO levels, occasional high heat flux on the wall caused by flame impingement, and the formation of aggressive deposits. MSW contains alkali metals such as sodium and potassium, heavy metals such as lead, tin, and zinc and various chlorine-containing compounds, all of which can form potential corrosive agents.

The surface temperature of the metal wall, gas temperature, gas composition and deposit characteristics are main factors that influence the high-temperature corrosion of WTE boilers. High