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Corrosion Mechanisms and Alloy Performance in Waste-To-Energy Boiler Combustion Environments

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ABSTRACT

The combustion of municipal solid waste in a boiler for power generation produces a very corrosive environment for the boiler tube materials. The environment contains HCl, SO_2, various metal chlorides and sulfates along with typical combustion products. Due to their low melting points and high vapor pressures, metal chlorides are believed to be primarily responsible for the boiler tube corrosion problems encountered in waste-to-energy (WTE) boilers. Without some sort of corrosion protection method, the standard materials of the construction for the boiler, such as carbon and Cr-Mo steels, are subject to severe high temperature corrosion attack. The present paper discusses the possible modes of high temperature corrosion for waterwalls and boiler tubes in the convection section, and the prevailing protection method for these components as well as the performance of various alloys in these hostile combustion environments.

INTRODUCTION

Municipal solid waste typically contains plastic materials, textile, leathers, batteries, food waste, and other miscellaneous materials. These constituents are the source of chlorine, sulfur, sodium, potassium, zinc, lead, and other heavy metals that form corrosive vapors of various chlorides and sulfates during combustion. These chloride and sulfate vapors, along with fly ash, condense and deposit on the cooler surfaces, such as waterwalls, which surround the combustion zone, and heat exchanger surfaces in the convection path, such as screen tubes, superheater tubes and generating banks. These metallic components are subjected to accelerated wastage rates. Wastage rates of 1.3-2.0 mm/yr (50-80 mpy) or higher have been observed for carbon steel waterwalls, and of 2.5 mm/y (100 mpy) and higher have been observed for carbon or Cr-Mo steel superheater tubes. Corrosion problems in waste incineration are very well documented. [1-8] However, modes of corrosion are not very well understood. This paper attempts to examine the modes of corrosion attack in terms of different corrosion morphologies observed. The paper also discusses the prevailing method of corrosion protection for major components of the boiler.