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ANALYSIS OF BOILER FOULING AND BOILER CLEANING METHODS AT THE COMMERCE REFUSE-TO-ENERGY FACILITY

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ABSTRACT

Waste-to-energy boiler fire-side fouling is a major operational issue for many facilities, including the Commerce Refuse-to-Energy Facility. The Commerce Refuse-to-Energy Facility is a 350 ton per day, mass burn waterwall facility that began operation in 1987. Fouling occurs throughout the convection sections with the highest differential pressure occurring across the generating bank. Flue gas differential pressures and temperatures have been tracked and analyzed at the facility for approximately ten years during various operating conditions. It has been determined that the rate of increase of the differential pressure across the generating bank is correlated with flue gas temperature and the extent of fouling. Several different cleaning methods have been used to clear the convection zone of ash deposits, including off-line hydroblasting, on-line hydroblasting, on-line explosives cleaning, sootblowers and sonic horns. . Better understanding of the fouling trends and evaluation of cleaning methods has led the facility to use a combination of on-line hydroblasting and explosives cleaning and off-line hydroblasting. The facility is now able to operate one year between planned outages, compared to ten weeks during the initial operation of the facility. Additional savings have also been achieved by reducing induced draft fan load, and possibly a reduction in tube wastage.

INTRODUCTION

Fire-side fouling of the convection sections of waste-to-energy facilities contributes to a number of serious operational problems: 1) extensive fouling is a major impediment to extended runs, 2) heavy fouling and buildup of clinkers necessitates significant work during planned outages, and 3) ash deposits markedly reduce heat transfer, and hence plant efficiency. The causes and effects of increased flue gas pressure differential due to fouling have been examined in detail. The focus of this study has been on actual and theoretical pressure differential: 1) pressure differential is the primary negative impact of fouling on plant operation and 2) extensive plant pressure data is available. Other aspects, such as ash chemistry and heat transfer have not been examined. Ash and slag composition has not been tracked over time and it would be difficult to collect enough representative samples to correlate composition to fouling and other plant operating parameter. Heat transfer impacts, while reducing efficiency, does not lead to downtime or other major operational and maintenance issues.

Fouling of the convection section leads to increased flue gas pressure drop and reduced heat transfer. As the pressure drop increases, the induced draft fan power draw increases, leading to additional parasitic load and reduced power sales. When the pressure drop increases to the point the induced draft fan is at maximum speed, additional fouling limits combustion air flow, which may result in poor combustion. The pressure drop at which the fan is at maximum speed varies depending on the amount of in-leakage downstream of the boiler, but it can range from 2 to 5 inches water. High pressure drop across the convection zone is the determining factor in scheduling cleanings, and in some cases may force an outage.

The reduction in heat transfer that occurs as a result of fouling leads to lower boiler efficiency, loss of sufficient superheat, and hotter flue gas temperatures. Although the heat transfer impact of fouling is an important issue, heat transfer rates are easily restored to acceptable levels with an on-line waterwash or explosives cleaning at the Commerce facility.

Determination of flue gas pressure differential across the convections sections, and analysis of the causes of increased pressure differential, have been examined in three ways: 1) theoretical pressure differential; 2) trends of pressure differential relative to type of cleaning; and 3) determination of the rate of increase in pressure differential as a function of tonnage burned and flue gas temperatures.

In this paper, the term "differential pressure" refers to the difference in flue gas pressure from the generating bank outlet to the furnace. Pressure differential is measured in inches of water, which corresponds to the units logged by the plant control system.