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IMPROVING SEMI-DRY SCRUBBER PERFORMANCE THROUGH GAS FLOW MODELING

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ABSTRACT

Poor flue gas flow distribution in the semi-dry scrubbers used in Waste-to-Energy facilities can cause reduced residence time for lime slurry spray droplet evaporation and subsequent "wet carryover" resulting in solids deposits on the scrubber vessel walls and ductwork and also baghouse bag blinding. In addition to promoting corrosion, the removal of deposits during boiler outages is very labor intensive.

This paper identifies how gas flow modeling conducted in conjunction with Nels Consulting Services, Inc. on several different types of scrubbers at Covanta Energy's Waste-to-Energy facilities resulted in modifications which increased the actual flue gas residence time, considerably reduced the solids deposits (scale) and associated maintenance costs, and in some cases reduced the pressure drop across the scrubbers and baghouses.

The data presented includes typical model study velocity distribution data (before and after the modifications), vessel sketches, and photographs. Associated work included in-field scrubber outlet duct temperature and velocity distribution testing. The results of the in-field scrubber outlet temperature distribution testing, done both before and after the scrubber modifications, confirmed the improvements numerically by showing reduced flue gas temperature variation in the scrubber outlet duct.

INTRODUCTION AND SEMI-DRY SCRUBBING THEORY

Covanta Energy operates twenty-five (25) waste-to-energy facilities, all of which employ semi-dry scrubbers for acid gas (HCl and SO2) control to maintain environmental compliance with all applicable federal, state, and local emission regulations. With the exception of one facility, all facilities are also equipped with fabric filters (baghouses) for particulate control.

In a typical semi-dry scrubber at Covanta, flue gas from exits from the boiler in the range of approximately 400 to 475 degrees F and enters the scrubber vessel through a scrubber inlet section. Figure 1 shows the typical flue gas flow path and Figure 2 shows a typical scrubber/baghouse orientation in a typical Covanta waste-to-energy facility.

Atomized lime slurry containing a suspension of the reagent calcium hydroxide [Ca(OH)2] is sprayed into the vessels. The basic chemical reactions are shown in Figure 3. The actual reactions, however, are much more complex. A gas-liquid mass transfer takes place first whereby the acid gases briefly condense to form aqueous