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Simulation and Validation of a Mass Burn WTE Boiler Using CFD Modeling

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American Ref-Fuel Company (ARC) spends millions of dollars each year on corrosion related costs in the boilers. The corrosion is caused by chloride salts in the slag that deposit on the boiler tubes, coupled with the high temperatures of flue gas going through the boiler. Corrosion rates are known to be very sensitive to the flue gas temperature and velocity, surface temperature and heat flux through the slag, oxygen in flue gas distribution, etc. These parameters are primarily determined by the firing rate of the boiler, and they are also affected by combustion control and air distribution in the boiler. Some design parameters, such as surface area of refractory, tile, and inconel overlay, also affect the flue gas temperature throughout the boiler, and thereby impact corrosion.

To identify areas with higher corrosion rate potential and to quantify the operating conditions in these areas, which affect corrosion, ARC developed a three-dimensional numerical model of the mass burn WTE boiler. The objective of the modeling is to understand and quantify the impact of the firing rate, air distribution, slagging, and design characteristics on the combustion flow patterns and heat transfer in the boiler. The initial results of the model simulation are found credible based on an extensive validation procedure. As this information is currently being analyzed, it already helps ARC to predict areas where corrosion would most likely occur. ARC keeps on tuning and improving the model, in order to use it for parametric study and potential design modifications to minimize corrosion rates.