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WERT Corrosion Research

The Waste-to-Energy Research and Technology Council is conducting research on the corrosion phenomena in boilers of waste-to-energy facilities. The objective is to explore ways for reducing corrosion in WTE boilers.

Corrosion in WTE units

- Corrosion is the cause of shutdowns in WTE plants and a major operating cost.
- Corrosion sensitive areas are: waterwall above refractory lining in the combustion chamber, evaporator screen, and superheaters.
- Corrosion is mostly associated with chlorine, and consists of active oxidation and salt-mixture induced corrosion.

Methods of Reducing Corrosion

Primary methods:

1. Avoidance of high temperature and high velocity spots by means of improved process control.
2. Design modification, such as process gas recirculation to alter flow dynamics and encourage mixing gases, and arrangement of the steam generation system.

Secondary methods:

1. Use of refractory lining and/or ceramic tiles in the combustion chamber.
2. Application of protective layers of alloys designed to shield the steel tubes from corrosive deposits and flue gases.
3. Use of alternative corrosion-resistant alloy combined with application of new engineering practice such as the use of overlay welding with nickel-based alloys.
4. Reducing HCl/Cl₂ concentration in combustion gases by injection of appropriate chemicals and forming of salts that can be dislodged easily.

Past Research

- Critical literature search of corrosion phenomena (Themelis-Albina).
- Corrosion survey on WTE companies (Themelis-Albina-Lee)

Current Research

- Corrosion resistance tests on developed alloys (Castaldi-Lee).
- Development of patented process for reducing concentration of active chlorine in combustion gases (Themelis-Lee).

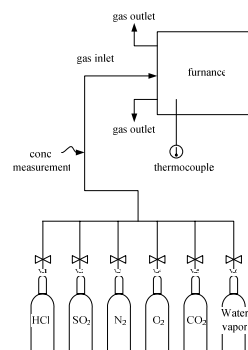
Corrosion Resistance Test

- Objective:
 1. Determine corrosion rate of various metals under controlled conditions.
 2. Characterization of corrosion products
- Selected alloys:

SA178A, SA213-T12, SA213-T22, QSX5 (from Japan), NSSER-4 (from Japan), and Inconel 625.

Control variables:

1. Temperature
 - waterwall: 300°C
 - superheater: 450 °C
2. Atmosphere
 - HCl: 300-600ppmv
 - SO₂: 50-150ppmv
 - O₂: 8-10%
 - CO₂: 8%
 - Water vapor: 15%
 - N₂: balance
3. Salt deposit
 - no deposit
 - alkali sulfate
 - alkali chloride
 - mix



Furnace



Alloy: NSSER-4

- Analyses:
 1. Measurement of corrosion rate by TGA (mass change) measurements
 2. Metallographic corrosion rate measurement
 - Atomic Force Microscope (AFM)
 3. Corrosion product analyses
 - Scanning Electron Microscope (SEM) / Energy Dispersive X-ray (EDX)
 - X-ray Diffraction (XRD)

Corrosion Abatement Laboratory and Field Tests

- Injection of Ca(OH)₂ or Mg(OH)₂ into the furnace to reduce the concentration of acidic gas.

