

Summary of Session 2

Corrosion in Waste Fired Systems

by

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Summary

Of the four major regions identified as having high corrosion potential (superheater-reheater, waterwall, back passes and air pollution control equipment), the most pressing continuing problems appear to be in high temperature superheater-reheater regions and in the air pollution control equipment (particularly scrubbers).

Similarities between problem areas found in fossil fuel burning steam generators and those found in refuse-fired systems have led to consideration of those measures found to be effective in combatting wastage in fossil systems.

Of the two regions considered lower priority in this evaluation, existing procedures can be employed to alleviate or minimize the problem. Waterwall wastage in incinerators can be controlled by improved combustion (operation) and use of silicon carbide or aluminum oxide refractory retained by studs.

The practical prevention of low temperature wastage is generally achieved by maintaining surfaces above the dewpoint or a combination of controlled excess air and/or neutralization with alkaline additives.

High Priority Research

Superheater:

1. High metal temperature limits
2. Prepared vs. unprepared refuse (determine the role of heavy metals)
3. Determine role of chloride
 - a. short term
 - b. long term
4. Investigation of reactions taking place on tube surfaces (role of sulfur vs. Cl)

Air Pollution Equipment

1. Establish corrosive composition of gas stream
2. Select and evaluate materials of construction appropriate to incinerator gas streams

Discussion

Wastage in Superheaters and Reheaters.--High temperature superheater-reheater wastage continues to pose a challenging research need because these components do not lend themselves to the protective procedures used to control waterwall wastage (studs and silicon carbide refractory). Also, current practice in many steam generating incinerators with extended high heat input refuse firing is either periodic replacement of superheater-reheater surfaces or operation with a combined fuel design in which the superheater is exposed only to fossil fuel products or combined waste fossil fuel in which the waste may have been processed for metal separation.

Specific needs in this area include:

- a. Conducting or updating of a survey of operating waste-fired steam generators with particular emphasis on comparing units with and without wastage problems.
- b. Characterization of fuels-composition and sizing as related to minor products of combustion and ash analysis.
- c. Confirmation of mechanism (a chloride, heavy metal, heat flux, oxidizing reducing atmosphere, gas mixing, cycling load or oxidizing-reducing operation) by means of a coordinated laboratory-field study. Details of this effort should be based on or extrapolated from experience in understanding fossil-fuel wastage mechanisms.
- d. Determination or development of long-life alloys and/or coatings.
- e. Economic evaluation of maintenance (i.e. high temperature alloy vs. replaceable superheaters or improved design for better maintenance).
- f. Optimization of superheater design; radiant vs. convection type versus location along flue gas temperature path.
- g. Development of a procedure for education of consulting engineers and operators in industry; the need for specified operating conditions and procedures.

RESEARCH NEEDS ON METHODS OF RELIEF

<u>Corrosion Type</u>	<u>Priority</u>	<u>Operation</u>	<u>Materials</u>	<u>Additives</u>	<u>Other</u>
High Temperature	1	Reduce flame impingement Improve flue gas mixing Minimize cycling Improve consistency of operation	Develop new alloys and/or coatings	(Refer to fossil systems)	Determine a. basic cause b. effect of heat flux c. effect of mixing fuels
Waterwall	3	Improve flue gas mixing Improve consistency of operation	Find substitute for studs refractory	-	d. fuel composition and size e. effect on fuel preparation
Low Temperature	4	Minimize cycling Understand shutdown behavior (load and oxide reduction)	Known	(Refer to fossil systems)	Improve: f. operator understanding, public awareness
Air Pollution Control Systems	2	Need designs for specific installations	Known	-	-

Notes: A) A number of these needs are best met by utilization of bench or pilot testing. Studies to determine or verify causes, as well as testing for materials development, heat flux influence, the effect of fuel composition, and mixing of fuels; fall in this category. Most other studies require full scale evaluation as would the confirmation of bench and pilot results.

B) Two similar units (20-30 MW) with one base-loaded and the other cycling would provide and excellent pilot study.

Wastage in Air Pollution Control Equipment

The importance of this area is magnified by the current lack of agreement on choice of collection equipment; electro-static precipitators, wet scrubber or fabric filter. Since the potential wastage problems in electro-static precipitators and fabric filters would also be included in the list of potential wet scrubber corrosion problems, this discussion will be restricted to resolution of scrubber problems. Research needs for scrubbers include:

- a. Characterization and sizing of constituents of the effluent gas stream.
- b. Confirmation of failure mechanisms (solution corrosion, concentration cell-deposit wastage, stress corrosion fatigue) by means of coordinated laboratory-field evaluation.
- c. Assessment of available materials for incinerator scrubber use (combined laboratory and field testing/evaluation may be required).

Details of test programs should be established by the group or organization undertaking the specific R&D effort within the scope and objectives established by the implementing agency or organization (i.e. ASME corrosion and deposits committee, etc.).

Confirmation or upgrading of existing technology represents a more immediate research need than background research on developing technology.

Additional Research Needs

Characterization of Fuel(s) (A. L. Plumley):

1. Raw material and prepared refuse
Sampling techniques evaluation for proportional representation; analytical techniques - review for validity; characterization:
1) proximate and elemental analysis, 2) Thermogravimetric and differential thermal analyses (ash, fusion analyses), 3) burnability, 4) reactivity.
2. Compare raw material and prepared refuse as to the effect of feedstock on combustor (steam generator)
Sizing of heat recovery equipment - manufacturer; selection of materials and selection of operating conditions (see report of Session 2).

3. By-product disposal

- a) Study solid and liquid by-products for direct disposal; study solid and liquid by-products for recovery; study absorption of gaseous by-products.
- b) Disposal of solid by-products from: 1) Impoundment; 2) structural landfill; 3) leachability of soluble substances.

(Zoltan Kerekes)

1. Tabulate worldwide refuse composition analysis. Results would be stored by computer.
2. Carry out a statistical analysis of deviation of the various elements.
3. Establish phase diagrams for the corrosive agent:
 - a) Binary system
 - b) Tertiary system
 - c) Multi components system
4. Establish (high) temperature limitation based on phase diagrams and compositions collected from data-bank.

Valuable accumulation of corrosion data can be summarized from service experience, as well as from published data as follows:

- a) The best service life of fireside heat recovery system for municipal incineration will be obtained when tube metal temperature is kept below 500°F (260°C).
- b) The metal temperature in the low temperature region in the boiler and in the effluent gas stream should be kept high enough to avoid either H₂SO₄ or HCl dew point condensation. The temperature should stay above 300°F (149°C).
- c) The downtime cycle should be reduced to prevent hygroscopic salt formation (MgSO₃ x H₂O etc.) CaSO₃ x H₂O.
- d) The mechanism of attack at metal temperature below 800°F (427°C) is essentially a chloride reaction.
- e) The mechanism of attack at metal temperature above 800°F (427°C) is predominately a chloride assisted sulfide reaction.
- f) The deleterious function of the heavy metals (Pb, Zn) salts particularly chlorides could be the formation of molten-salt layers, since their melting points are low and when mixed with

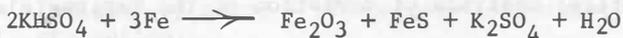
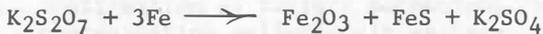
other low melting points of chloride (NaCl, KCl) they form eutectic compositions which melt at even level temperatures.

7. The high corrosivity of the salts of sulfur bearing compounds is related to the fact that these compounds have relatively low melting points about:

a) Pyrosulfates (Na, K)

b) Bisulfates

8. The oxidation and sulfide flow of metal waste can be expressed by the following reaction:



9. Establish temperature limits according to regional chemistry of the refuse. Temperature monitoring systems (flue gas, tube metal temperature) should be installed.

10. Improve Operation Condition:

a) Providing an optimal parallel flow of refuse and air.

b) Good technique for agitation of the flue gas.

c) Homogenizing the refuse before incineration.

11. Protecting the heat exchanger surfaces by:

a) Blowing air on heating surface.

b) Coating the tubes with materials of a chemical composition insuring a specific oxygen partial pressure on the tube surface.

c) Installing ceramic deflectors.

d) Controlling gas volume and velocity, 3-5 m³ combustion air/kg at a velocity of 4-6 m/second.

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