Approaches to Improve Air Preheater Thermal Efficiency

Louis Bondurant
Alstom Air Preheater
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LGOT R&D Program
(Low Gas Outlet Temperature)

• Objective of the LGOT Program
  - Develop the design of the Ljungstrom® air preheater for operation at gas outlet temperatures down to 220°F (105°C) on coal fired boiler applications.

• The Potential Benefits of LGOT
  - Significant reduction in “Dry Gas Loss” a key metric in unit heat rate
  - Reduced volumetric flow rates for downstream FGD, CO2 capture, etc.
  - ESP can benefit from reductions in both volumetric flow and fly ash resistivity

• Potential Issues for LGOT
  - Enhanced risk of air preheater acid dew point fouling problems
  - Added potential for low temperature corrosion from halogen acids near the H₂O dew point.
Bench-Scale Test Apparatus

Simulated gas flow included controlled amounts of:

- SO3
- Water vapor
- Solid particulate

Cleaning cycle:

- Duration of tests mimicked typical sootblowing interval
- Translational movement in the path of the cleaning nozzle mimicked rotor rotation
- Tube removal required in order to clean
Simulated URS SBS Injection™ Technology
Full Mitigation (5ppmv SO$_3$ + Na$_2$SO$_4$ By-Product)

Tower 1 Gas Side Pressure Drops

Stable Pressure Drop Response for ~ 2 Months
Simulated URS SBS Injection™ Technology
Full Mitigation (5ppmv SO₃ + Na₂SO₄ By-Product)

No Significant Deposit Thickness Was Found
Conclusions from Pilot Scale Testing
Simulated URS SBS Injection™ Technology

With SO$_3$ levels reduced to 5 ppmv …
- Cold layer pressure drop did not increase
- No significant deposit thickness was found

With SO$_3$ levels at 10 ppmv …
- Rapid increases in cold layer pressure drop occurred
- Significant sodium bi-sulfate deposit was found

Note: Sodium based SO$_3$ mitigation must reduce SO$_3$ concentrations to 5 ppmv or less entering the air preheater
RGOT Vs LGOT Operation
(Reduced Gas Outlet Temperature)

- Simple modifications to an existing air heater typically cannot achieve a 220°F gas outlet temperature.

- An increase in airflow can provide a significant reduction in gas temperature. Co-benefit, if this incremental hot air can be used elsewhere in the plant.

- Reduced gas outlet temperature (> 220°F) can be pursued in lieu of LGOT. Basic benefits retained, implementation cost lowered significantly.

- Reduced potential for corrosion, but need to stay above H₂O dewpoint.
RGOT Operation
Means to Accomplish

• Fill empty voids in APH rotor with additional basket layers

• Utilize special basket designs to maximize useable space for heat transfer surface

• Consolidate shallow basket layers into single deeper layers

• Modify APH rotor to more efficiently support basket layers

• Switch to more efficient types of heat transfer surface
RGOT Operation
Considerations

- Fuel compatibility
- Thermodynamic limitation
- Available space within the existing APH rotor
- Load bearing limits on rotor bearings, rotor drive and APH structure
- Ability of draft fans to accommodate expected pressure drop levels
- Ability of APH sealing system and structure to operate at higher pressure levels
- Ability to maintain temperature levels above H₂O dew point at all load and ambient conditions
Benefits Derived from RGOT

- Reduced coal consumption (potentially as much as 3%)
- Significant reduction in activated carbon required for mercury capture
- Enhanced ESP performance (due to fly ash resistivity)
- Reduced O&M costs associated with steam coil air preheaters
- Reduced CO2 emissions resulting from improved boiler efficiency
- Co-benefit if additional hot air can be used elsewhere on site
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