O&M Issues DSI Systems
Startup, Shutdown & Cycling Loads

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McIlvaine Hot Topic July 10, 2014
EPA Requested Comments on Proposed New Rules Startup-Shutdown-Maintenance (SSM)

- Request published on 6/25/13 based on rules proposed 12/30/12
- Reopened comment period limited to 3 questions
- Institute of Clean Air Companies (ICAC) submitted comments on 8/26/13 addressing
  - SCRs & SNCR
  - ESPs
  - Baghouses
  - Wet and Dry FGD
  - DSI & carbon injection
O&M Issues Coal Fired Plants

- Startup – Shutdown Rules
- Start averaging time using a default electrical production
  - 25% of nameplate capacity plus 3 hrs. or
  - the start of electricity generation plus 6 hrs., whichever comes first;
- Other Industry Challenges Cycling Loads
  - “Green” Energy and gas price: coal plant cycling
    - Shutdowns: hours to a few days
- Low load operations
- Improved heat rate for CO₂ Rule
DSI Challenges

• How soon can we turn or turn off on DSI & carbon systems.
• Prevent deposits forming in ductwork.
• Sorbent contact with acid gases/Hg at low flow conditions - mass transfer
• Does the chemistry work at lower temperatures seen during startup/shutdown?
• Contact time
• Impacts on balance of plant
What Can We Do?

• Modeling - most modeling for flow distribution and deposition done at full load conditions.
• Need to model at low flow conditions
• Inspections of ductwork after cycling operations
• Use CEMS when possible to optimize sorbent injection.
• Other
  • Better distribution
  • More frequent tuning
  • Frequent cleaning of catalyst & airheater
  • DSI injection ahead of airheater
Benefits of DSI Injection During Start/Shutdown and Cycling Operations

- With increased cycling operations we expect to see increased corrosion along the flue gas path. Lime injection could mitigate corrosion that will develop with these operating conditions.

- Allow SCRs to startup earlier (lower operating temp.)
  - Startup - Shutdown Conditions
    - Turn on ammonia $\approx 600 \, ^\circ\text{F}$
      - Actual depends on fuel primarily sulfur
    - SCRs are temperature driven – no relationship to MW generation

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Typical SCR Startup & Shutdown

• Startup - Shutdown Conditions
  • Temperature limited by ABS formation that fouls airheater
  • ABS needs SO$_3$ and NH$_3$
  • Take SO$_3$ out and you can start injecting NH$_3$ sooner which will result in reducing NOx and being in compliance sooner limit to less than 5 ppm
  • Inject before catalyst or airheater
    • May be able to lower startup temperature from 600 → 540 °F
Benefits of Pre-APH Removal of SO₃

Improve Heat Rate/Reduce CO₂ Emissions

• Reduce SO₃ Dew Point prior to APH
• Reduce operating temperature of APH

40°F reduction → 1% heat rate improvement → 1% savings on fuel budget

• Reduction in CO₂ emissions
  • 1 lb coal → 2.5 lb CO₂
DSI Challenges

- Emissions Control
- Operate over wide range of load conditions
- Can it play a role in heat rate improvement
- “Net” low cost sorbents that do not impact other APC equipment performance and ash management
DSI Design

• Periods of operation, especially for boiler startup, characterized by rapid transient changes in flue gas composition, quantity, temperature, and moisture conditions.
• The problems are aggravated with installation of multiple APC equipment and processes, especially those required to achieve MATs compliance.
• Minimize Sorbent usage
  • Cost
  • Ash
  • Other APC equipment
Key To DSI Design

- Distribution of sorbent
- Get the sorbent to the pollutant in the flue gas
- Adjustable feed rate – don’t overfeed or underfeed
- Modeling
- Mixing
- Maintain Ca/air ratio in transport pipe and injectors

  - Plugging at low flow
  - Mat need to overfeed

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DSI System – for SO₃ Control

- Target feed rates established during stack test period
  - Complete load profile, not all at full load
  - Coal sulfur content ranges

- In line monitoring of emissions
  - SO₃ : Breen, SICK, Stack visual
  - SO₂ : CEMS
  - Hg : CEMS (indirect method)
Injection Pre-SCR

Benefits

• Earlier control of $\text{SO}_3$
• Longer contact time
• Enhanced mixing

Concerns

• Fouling of catalyst
• No signs of deactivation on test conducted to date
Questions & Answers

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