PLUME OPACITY

Furnace Injection of Alkaline Sorbents for Sulfuric Acid Control

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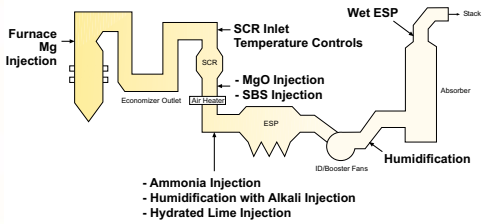
Background

- Boilers firing high-sulfur coal convert ~0.5 to 1.5% of SO_2 to SO_3
- SCR retrofits can double SO_3 conversion
- Condensation of ammonium bisulfate or sulfuric acid downstream can cause problems
  - – SCR catalyst fouling
  - – Air heater plugging
  - – Reduced plant efficiency
  - – Back-end corrosion
  - – Plume opacity

SO_3 Control Technologies

- Downstream of air heater (no benefits to air heater plugging/corrosion or SCR turndown)
  - – Ammonia injection - adverse ash effects
  - – Wet ESP - high capital cost
  - – Humidification/duct sorbent injection - potential for ESP impacts, FGD water balance impacts, duct corrosion, solids buildup
- Alkali injection downstream of economizer
  - – $NaHSO_3$ or $MgO/Mg(OH)_2$ sorbents
  - – Limited data available
- Sorbent injection in furnace
  - – Previous $MgO/Mg(OH)_2$ experience with oil, some with coal
  - – 1980s FSI research showed high SO_3 removal with alkali injection for SO_2 control
  - – Furnace injection maximizes residence time for removing SO_3 upstream of air heater
  - – Possible arsenic removal upstream of SCR
  - – Lowers SO_3 to SCR to improve low load turn down

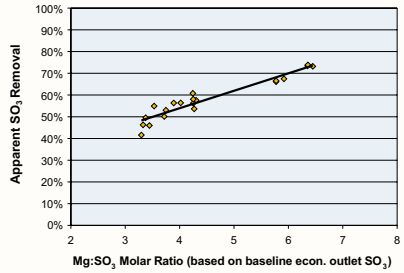
Potential Sulfuric Acid Control Options



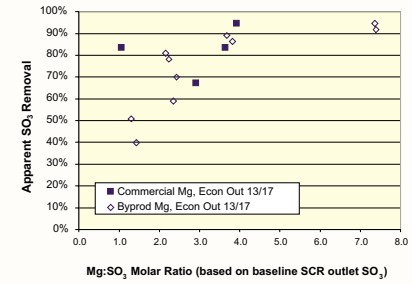
Current Project

- Investigating furnace injection of alkaline sorbents to remove sulfuric acid
- Cooperative Agreement with DOE/NETL
- Co-funding by EPRI, First Energy, TVA, AEP, Dravo Lime
- URS Corporation is the prime contractor

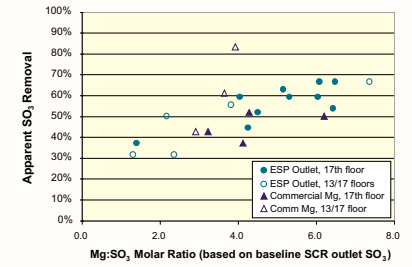
BMP Byproduct Mg Results ESP Outlet



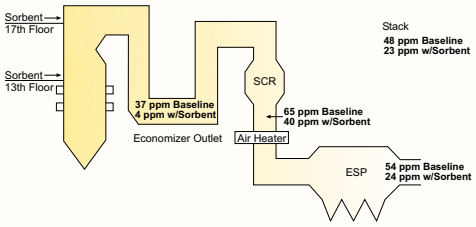
Gavin Byproduct vs. Commercial Mg Results Economizer Outlet



Gavin Byproduct vs. Commercial Mg Results ESP Outlet



Gavin Results Overview



Project Approach

- Test furnace injection of alkaline sorbents on two full-scale coal-fired units (3.5-4% S)
  - First Energy Bruce Mansfield (800 MW)
  - AEP Gavin Plant (1300 MW, SCR in operation)
- Inject as slurries on front wall of furnace
  - Across from "nose," or
  - Across from pendant superheater tubes

Performance Summary

- Commercial $Mg(OH)_2$ and an FGD byproduct $Mg(OH)_2$ were the most effective alkalis
- Bruce Mansfield Plant (BMP):
  - 70% SO_3 removal at 6:1 Mg:SO_3 ratio (molar ratio to baseline econ. outlet SO_3)
- Gavin Plant:
  - 90% removal of furnace SO_3 at 4:1 Mg:SO_3 ratio (molar ratio to baseline SCR outlet SO_3)
  - Limited removal of SCR-formed SO_3
  - Overall SO_3 removal limited to 50-70% at Mg:SO_3 $\geq$ 4:1

Balance of Plant Effects

- ESP impacts:
  - At BMP, SO_3 removal limited to 70% by ESP performance (100 SCA, high resistivity)
  - At Gavin, little or no impact on ESP (400 SCA)
  - Reduced in-stack opacity at ESP outlet due to elimination of acid mist formation at cold spots
- Greatly reduced plume opacity at both plants
- Other balance-of-plant impacts were minor
  - No noticeable impacts on slagging at either plant
  - No adverse effects seen on SCR coupons at BMP, or on actual SCR at Gavin

Conclusions

- Commercial and byproduct Mg performed equally at common Mg:SO_3 ratio (Gavin)
- Commercial or byproduct Mg injection in furnace can remove 90% of furnace-formed SO_3, but little of SCR-formed SO_3
- In-duct and plume opacity were greatly reduced by furnace injection, other plant impacts were minor
- Optimization of sorbent injection locations and mixing may lower sorbent requirements