“Effective SO₃ and Mercury Control Using SBS Injection™”

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McIlvaine Hot Topic
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SO$_3$ Adversely Impacts...

- Mercury Capture
- Air Heater Reliability
- NO$_x$ Removal
- Heat Rate
- CO$_2$ Emissions
- Equipment Corrosion
SBS Injection™ Technology

**Features**
- Patented Technology
- Simple Solution Injection
- Sodium-Based Reagent
- Dual-Fluid Atomization
- Selective Reactions
- High SO$_3$ Removal
- Low Injection Rate
- Product Collected with Ash

**Benefits**
- Opacity Elimination
- Corrosion Reduction
- ESP Enhancement
- HCl and Se Removal
- Potential Heat Recovery
- SCR/SNCR Flexibility
- Hg Capture Enhancement
- CO$_2$ Reduction

Maximum Benefits with “Upstream” Injection
SBS Injection Installations

- **Installation List**
  - 24 Boilers
  - 11 Plants
  - 15,000 MW

- **Since 2005…**
  - All “upstream” of APH
  - Some “downstream” systems relocated

- **“Pre-SCR” Injection**
  - 4 Plants
  - 5100 MW
  - 3 yrs Op experience

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### Utility Plant State MW Design SO₂ Injection Location Reagent Startup Date

<table>
<thead>
<tr>
<th>Utility</th>
<th>Plant</th>
<th>State</th>
<th>MW</th>
<th>Design SO₂</th>
<th>Injection Location</th>
<th>Reagent</th>
<th>Startup Date</th>
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<tr>
<td>FirstEnergy</td>
<td>Mansfield 1-3</td>
<td>PA</td>
<td>3 x 860</td>
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<td>Sodium Sulfite</td>
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<td>AL</td>
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<td>Vectren</td>
<td>Culley 3</td>
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<td>Sodium Carbonate</td>
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<td>PPL</td>
<td>Montour 1-2</td>
<td>PA</td>
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<td>DP&amp;L</td>
<td>Killen 2</td>
<td>OH</td>
<td>635</td>
<td>34 / 36</td>
<td>Econ Outlet / SCR Outlet</td>
<td>Sodium Carbonate</td>
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<td>Sodium Carbonate</td>
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## Sulfuric Acid Emission Results

Recent installations demonstrate <1 ppm SO₃ and <0.003 lb/MMBtu SAM.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Inlet SO₃ (ppmvd - 3% O₂)</th>
<th>Stack SO₃ (ppmvd - 3% O₂)</th>
<th>SO₃ Removal (%)</th>
<th>H₂SO₄ Emissions (lb/MMBtu)</th>
<th>Particulate Control Device</th>
<th>SO₂ Control Device</th>
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<td>A</td>
<td>32</td>
<td>1.3</td>
<td>95.9%</td>
<td>0.0038</td>
<td>ESP</td>
<td>WFGD</td>
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<td>B</td>
<td>65</td>
<td>1.6</td>
<td>97.5%</td>
<td>0.0046</td>
<td>Venturi Scrubber</td>
<td>WFGD</td>
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<tr>
<td>C</td>
<td>36</td>
<td>1.3</td>
<td>96.4%</td>
<td>0.0038</td>
<td>ESP</td>
<td>None</td>
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<tr>
<td>D</td>
<td>66</td>
<td>1.2</td>
<td>98.2%</td>
<td>0.0035</td>
<td>ESP</td>
<td>WFGD</td>
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<tr>
<td>E</td>
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<td>0.0006</td>
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<td>WFGD</td>
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<td>0.0017</td>
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<td>G</td>
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<td>0.5</td>
<td>98.9%</td>
<td>0.0015</td>
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<td>WFGD</td>
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</table>
Impact of $\text{SO}_3$ on ACI Performance

![Graph showing injection concentration (lb/MMacf) vs. vapor Hg removal across PM control (%)]

- WC, FF or TOXECON
- WC, ESP, brominated carbon
- LSEB, ESP
- HSEB, ESP

Source: EPRI

WC = Western Coal  
LS = Low Sulfur  
HS = High Sulfur  
EB = Eastern Bituminous
SO$_3$ Impact on Ash Hg Capture

![Graph showing the impact of SO$_3$ on Ash Hg Capture. The x-axis represents the Measured or Estimated SO$_3$ Conc at ESP Outlet (ppm), and the y-axis represents the Mercury Fraction in Ash LOI (ug/g). The graph includes data points for Plant A, Plant B, Plant C, Plant D, Plant D (Downstream) 2009, Plant D (Pre-SCR) 2009, and Plant E.]}
Mercury Co-Removal Results

Mercury Concentration in Fly Ash, ug/g of Unburned Carbon

Soda Ash to SO3 Molar Ratio

- **With SBS ~ 33-50% Hg Control w/o ACI**
- Injection upstream of the air heater (Duct B)
- Injection downstream of the air heater (Duct A)
- Baseline ~ 5% Hg Control
Impact on Hg Removal with ACI

![Diagram showing impact of ACI injection rate on Hg removal with and without SO3 removal. The y-axis represents Total Hg Removal (%) ranging from 0 to 100, and the x-axis represents Activated Carbon Injection Rate in lb/Macf. There are bars for 0 lb/Macf, 2 lb/Macf, 5 lb/Macf, and 10 lb/Macf. Bars are colored red for No SO3 Removal and blue for With SO3 Removal. Source: EPRI, Mercury Research Center, March 2007.](image-url)
Summary

• SO$_3$ can adversely affect plant reliability, efficiency, and performance of emissions control systems – including mercury controls

• Recent regulations and rules will require significant reductions in mercury emissions as well as increasing control of sulfuric acid mist

• SBS Injection can significantly reduce SO$_3$ levels prior to the APH - and reduce stack SO$_3$ emissions to < 1 ppm (<0.003 lb/MMBtu SAM)

• Mercury capture rates of 50-90% are achievable with high-efficiency SO$_3$ control - and little to no carbon injection
Questions?

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