MACT Update
McIlvaine Hot Topic Hour
May 7, 2015

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Lhoist North America
How has industry been preparing for MACT success?

• Performance and Versatility

✓ Improvements in DSI Technology and Process Tools
  ▪ Demonstration and optimization
  ▪ Sorbent injection, distribution and mixing tools coupled with tools such as CFD modeling, reaction models
  ▪ Improved understanding/design around material handling; better system reliability, flue gas constituents (temp, other acids, moisture)

✓ Improvements in Sorbents (calcium based)
  ▪ Standard hydrates
    • “FGT grade” hydrates
  ▪ Enhanced hydrates
    • Small particles
    • High surface area/pore volume
      - Sorbacal® SP/SPS
Why Consider Enhanced Sorbents?

- **Performance**
  - Higher removal performance
  - Less mass loading into the particulate control device

- **Operational Cost Savings**
  - Lower Sorbent Consumption
  - Capital Equipment
  - Fewer Deliveries
  - Less waste

- **Different sorbents will likely behave differently, testing is important!**

"Not All Hydrates are Created Equally"
## Lhoist Sorbent Information

<table>
<thead>
<tr>
<th>Sorbent</th>
<th>Standard Hydrated Limes</th>
<th>FGT Grade Sorbacal® H</th>
<th>Sorbacal® SP</th>
<th>Sorbacal® SPS</th>
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<tbody>
<tr>
<td>Figure</td>
<td><img src="image1" alt="Cube" /></td>
<td><img src="image2" alt="Hexagonal" /></td>
<td><img src="image3" alt="Porous" /></td>
<td><img src="image4" alt="3D" /></td>
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<tr>
<td>Typical Available Ca(OH)$_2$ [%]</td>
<td>92 – 95</td>
<td>93</td>
<td>93</td>
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<tr>
<td>Typical Surface Area [m$^2$/g]</td>
<td>14 – 18</td>
<td>&gt; 20</td>
<td>~40</td>
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<tr>
<td>Typical Pore Volume [cm$^3$/g]</td>
<td>~0.07</td>
<td>0.08</td>
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DSI Trial Experience
Trial Equipment & Residue Analysis

HCl [ppm]

MultiGas™

50% Feed Solvent
75% Feed Solvent
100% Feed Solvent

7.74 ppm Baseline Average
2.09 ppm Average
0.75 ppm Average
0.70 ppm Average

1.1 ppm Limit of Quantitation
Lhoist Experience

- Commercial Trial Library
  - Example: $\text{SO}_2$ removal in baghouse applications
  - Wide range of process conditions, applications
  - Sorbacal® SP twice as active as Sorbacal H (FGT type)
LNA has been active in more than 30 trials in the last 18 months

- Utility & Industrial
- BMACT, MATS, Permit
- HCl, SO$_3$, SO$_2$, and HF
- Trials important to confirm performance
  - Various injection configurations
  - Fuels
  - Sorbents
  - Changes in load/process
  - Site specific equipment needs

<table>
<thead>
<tr>
<th>No.</th>
<th>Driver</th>
<th>Pollutant(s)</th>
<th>Sorbents</th>
<th>Application</th>
<th>Sorbent FTIRs DSI</th>
<th>LNA Customer</th>
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DSI Case Studies
Case Study - Summary

1. Utility MATS multi-pollutant compliance for HCl and Hg using Sorbacal® SPAC

2. Conversion from sodium bicarbonate (SBC) to Sorbacal® SPS
Case Study - Utility Multi-Pollutant

- Application → 60 MW Coal Fired Power Plant
- Goal → ~50% HCl & ~65% Hg Removal Efficiency
- Why → Meet Hg + HCl MATS Limit
- Boiler → Air Heater → ESP → DSI → FF

- Process Conditions
  ✓ Flue gas flow rate ~265,000 ACFM
  ✓ Flue gas moisture ~11-12% by volume
  ✓ Baseline concentrations ~2 ppmv HCl / 3-3.5 lb/TBtu Hg
  ✓ Flue gas temperature at DSI location ~315 degrees F

- DSI → One (1) Injection Lance @ DSI Location
- Sorbent → Sorbacal® SP / BPAC Blended Sorbent
- Challenges → Simultaneous HCl + Hg Compliance with Single Sorbent
Case Study - Utility Multi-Pollutant

< 50 lb/hr of Blended Sorbent Able to Achieve ~½ MATS HCl Limit & ~½ MATS Hg Limit

HCl Reading Below FTIR Detection Limit
Case Study - Tile

- Plant used sodium bicarbonate (SBC) and Sorbacal® SP

- SBC used for SO₂ and HCl control but HF over permitted levels; 2nd system was installed to inject Sorbacal® SP for HF

  System #1 Goal → 90% HCl, 85% HF & 60% SO₂ Reduction
  System #2 Goal → 95% HCl & 65% HF Reduction

- Residue could not pass TCLP (selenium and chromium)
  - classified as hazardous waste: $550/ton to landfill

- Sorbacal® SPS able to achieve SO₂, HCl and HF limits and passed TCLP test; reduced landfill costs by $480/ton

- Continue to work with customer to optimize Sorbacal® SPS performance for all acid gases
  ✓ Humidification, mixing, injection lances
Case Study - Tile

• Kiln → Heat Exchanger → DSI → FF

• Process Conditions
  ✓ Flue gas flow rate ~25,000 ACFM (system #1) & ~16,000 ACFM (system #2)
  ✓ Flue gas moisture ~10-11% by volume
  ✓ Baseline concentrations ~50 ppmv HCl / ~25 ppmv SO₂ / ~25 ppmv HF
  ✓ Flue gas temperature at DSI location 300-350 degrees F

• DSI → One (1) Injection Port @ DSI Location

• Sorbent → Sorbacal® SPS

• Challenges → Simultaneous Multi-Acid Gas Control
Case Study - Tile

System #1 Data Points

Acid Gas Removal Efficiency

lb sorbent / lb Inlet Acid Gas
Summary

- DSI is mature and viable control technology
- Sorbent properties are important
  - Standard limes vs. Enhanced hydrated limes
- Calcium DSI sorbents are capable at achieving high removals for a variety of pollutants
  - $\text{SO}_3$, HCl, and HF
  - $\text{SO}_2$
- Case studies and prior trial experience help predict performance and compliance options
  - Testing is the most reliable way to verify.
Please feel free to contact me at:

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