McIlvaine Company
Hot Topic Hour
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Dry Sorbent Injection
Options and Issues

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Presentation Overview

- Lhoist Overview
- Dry Sorbent Injection (DSI) Advantages
- Hydrated Lime Sorbents
- DSI Case Studies
- Lhoist trial Capabilities
- Conclusions
- Summary
Lhoist Overview

• Sounds like ‘Luh-wost’

• **Chemical Lime** and **Franklin Industrial Minerals** merged to form Lhoist North America (LNA)
  - Suppliers of high quality chemical grade calcium products including Limestone, Quicklime, Slurry, and Hydrate (Sorbacal®)

• Part of Lhoist Group
  - World’s largest lime company
  - In lime business for more than 125 years
  - Over 6,000 employees, 30 nationalities
  - 88 plants in 25 countries

Ste. Genevieve, MO Plant
Why Dry Sorbent Injection (DSI)?
Why Dry Sorbent Injection (DSI)?

• Simple equipment with a small footprint

• Mature Technology
  ✓ In use for over 30 years
  ✓ Injection equipment continues to evolve
  ✓ Sorbent improvements

• Low CapEx

• ~12 month schedule (award to installation)
Hydrated Lime Sorbents
## Product Introduction

<table>
<thead>
<tr>
<th>Sorbent</th>
<th>Standard Hydrated Lime</th>
<th>Sorbacal® H</th>
<th>Sorbacal® SP</th>
<th>Sorbacal® SPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure</td>
<td>![Figure Icon]</td>
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<td>![Figure Icon]</td>
</tr>
<tr>
<td>Typical Available Ca(OH)$_2$ [%]</td>
<td>92 – 95</td>
<td>93</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Typical Surface Area [m$^2$/g]</td>
<td>14 – 18</td>
<td>&gt; 20</td>
<td>~40</td>
<td>~40</td>
</tr>
<tr>
<td>Typical Pore Volume [cm$^3$/g]</td>
<td>~0.07</td>
<td>0.08</td>
<td>~0.20</td>
<td>~0.20</td>
</tr>
</tbody>
</table>
Why Enhanced Sorbents?

• Reduced sorbent consumption vs. “standard” hydrated lime sorbents
• Achieve higher removal performance
• Potential operating cost savings associated with lower sorbent consumption
• Potential capital cost savings on equipment if designed based on enhanced hydrated lime
• Lower mass loading on particulate control device and ash handling systems
• Fewer deliveries
• Less fly ash / spent sorbent required for disposal
DSI Case Studies
DSI Case Study #1

- Application → Industrial Manufacturing Process
- Goal → ~70% HCl Removal Efficiency (baseline 35-40 ppm)
- Why → Meet Future Regulations
- Boiler → AH → DSI → CS-ESP → Stack
- Flue gas temperature at DSI location 300-350°F
- DSI → One (1) Injection Lance @ AH Outlet
- Sorbent → Sorbacal® SP
DSI Case Study #1

70% HCl Removal @ Mass Ratio of ~14 lb sorbent / lb Inlet HCl

~60% HCl Removal @ Mass Ratio of ~24lb sorbent / lb Inlet HCl
DSI Case Study #2

- Application → 500 MW Electric Utility
- Goal → Increase Overall SO$_2$ Reduction to ~70%
- Why → Meet Future SO$_2$ Regulations
- Low Sulfur Coal → Boiler → AH → DSI → SDA → FF
- Process Conditions,
  - ✓ Flue gas moisture ~20% relative humidity at stack
  - ✓ Baseline concentration ~225-250 ppmv SO$_2$
  - ✓ Flue gas temperature at DSI location 275-300°F
- DSI → Five (5) Injection Ports @ DSI Location
- Sorbent → Sorbacal® SPS
40-45% Overall SO₂ Removal at Mass Ratio of ~1.25 – 1.50 lb sorbent / lb Inlet SO₂ to achieve 70% SO₂ Removal Overall
Lhoist Trial Capabilities
Trial Equipment & Residue Analysis
Example Test Data

![Graph showing HCl ppm vs time with key data points and feed set points at 50%, 75%, and 100%.]

- HCl ppm
- 7.74 ppm Baseline Average
- 2.09 ppm Average
- 0.75 ppm Average
- 0.70 ppm Average
- 1.1 ppm Limit of Quantitation

Time (0800 to 1800)
Conclusions / Discussion
Conclusions

- Both cases were successful in achieving required removal efficiency using DSI technology with hydrated lime sorbent
- Case 1
  - DSI using Sorbacal® SP able to achieve high HCl removal efficiencies (> 80%)
- Case 2
  - DSI using Sorbacal® SPS effective solution for utility scale SO₂ trim control.
Summary

- DSI technology using hydrated lime sorbents viable reagent for acid gas compliance requirements ($SO_3$, HCl, HF & $SO_2$)
- Sorbent properties also important (standard lime vs. enhanced hydrated limes)
- Path Forward:
  - Additional $SO_2$ trials to understand how different parameters impact performance
  - Improve flue gas to sorbent mixing
  - Improve understanding of impacts of competitive reactions, flue gas temperature, flue gas moisture, sorbents, etc. on $SO_2$ removal
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