Meeting Regulatory Needs with Hydrated Lime

Curt Biehn

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Regulatory Reasons for Acid Gas Mitigation

• Pre-MACT
  – Offset additional SO$_3$ generated from SCR installation
  – Control blue plume at stack from Wet FGD addition
    ➢ Appearance
    ➢ Local concerns

• Future
  – Consent decree on acidic gases
    ➢ Specified amount at the stack
      • Limitations of Method 8A
  – Particulate
    ➢ 0.030 lb/MM Btu (filterable)
  – HCl as acid gas surrogate
    ➢ 0.002 lb/mmBTU
    ➢ Protection of PAC for Hg control
  – Consistency and OST of mitigation system will be critical
Questions to Answer

• Are you buying tons or moles of sorbent?
  Forecast annual usage in tons for comparison of sorbents

• Where are you and where do you have to get with pollutants?
  – Potential side benefits of acid gas mitigation
    Hydrated lime effective for \( SO_3 \) and \( HCl \) at a wide temperature range

• What will your injection system look like?
  – Expectations on Operations and Maintenance
    Hydrated lime systems with good design principles are in place and working well in the industry

• Implications of sorbent choice
  – Supply
    Solid, multi-location supply base
  – Logistics
    Availability via truck or rail; low working capital and short lead time
  – Ash
    No leaching issues
Injection Location Options for Hydrated Lime
Acid Gas Emission Control – Baghouse Shawnee

DSI Program targeting HCl emissions to meet 2015 MATS

- Baghouse seasoning is essential for test program (yellow vs green)
- HCl limits easily met with low hydrate requirements
  - Lower limit of feeder capability for consistency
- Results of follow-up study also optimistic

<table>
<thead>
<tr>
<th>Hydrate Injection Rate</th>
<th>HCl (lb/MMBTU)</th>
<th>HF (lb/MMBTU)</th>
<th>H$_2$SO$_4$ (ppmvd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 lb/hr - Baseline</td>
<td>0.0030</td>
<td>0.0045</td>
<td>1.3</td>
</tr>
<tr>
<td>600 lb/hr (in flight)</td>
<td>0.0016</td>
<td>0.0046</td>
<td>0.46</td>
</tr>
<tr>
<td>1,000 lb/hr (in flight)</td>
<td>0.0016</td>
<td>0.0043</td>
<td>0.42</td>
</tr>
<tr>
<td>350 lb/hr</td>
<td>0.0005</td>
<td>0.0006</td>
<td>0.37</td>
</tr>
<tr>
<td>350 lb/hr</td>
<td>0.0007</td>
<td>0.0007</td>
<td>0.35</td>
</tr>
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SO₃ Control with Hydrate ESPs

• SO₃ conditions ESP

• Ash resistivity
  – Sodium reduces; Calcium increases

• Strategy for Unit-specific issues
  – Distribution of particulate in duct
  – Balance hydrate feed and SO₃ levels
    ➜ Important to maintain ESP conditioning
    ➜ ~3ppm SO₃
  – Short Residence time in front of ESP
    ➜ Manage with split injection

Lodge Cottrell presentation from 2011 APC conference
  – Reinholdenvironmental.com library section

Courtesy B&W Lodge Cottrell presentation from 2011 APC conference– Reinholdenvironmental.com library section
Typical $SO_3$ Removal Rates - ESP systems

- Residence time effects
  - Short (<2 sec) will require more sorbent
- Injection system efficiencies
  - Flue gas coverage
  - Feed system

**Removal Rate Examples Using Hydrated Lime**

<table>
<thead>
<tr>
<th>Plant</th>
<th>$\text{lb hydrate: lb } SO_3$</th>
<th>Treated Stack</th>
</tr>
</thead>
<tbody>
<tr>
<td>550 MW</td>
<td>3.9 : 1</td>
<td>&lt;1.5 ppm</td>
</tr>
<tr>
<td>1300 MW</td>
<td>3.9 : 1</td>
<td>3 ppm</td>
</tr>
<tr>
<td>700 MW</td>
<td>3.5 : 1</td>
<td>3.5 ppm</td>
</tr>
<tr>
<td>&gt;500 MW</td>
<td>1.9 : 1 3.8 : 1</td>
<td>&lt;6 ppm &lt;2 ppm</td>
</tr>
<tr>
<td>&gt;500 MW</td>
<td>2.5 : 1 3.9 : 1</td>
<td>4 ppm &lt;2 ppm</td>
</tr>
</tbody>
</table>
Hydrate Prior to Air Preheater

Hot side injection offers additional benefits:

- Better utilization of sorbent
  - Longer reaction time
- APH operation
  - Eliminate ABS buildup from ammonia slip
  - Flexibility on SCR operation
- Lower heat rate
  - Reduce acid dew point through APH

Neutralization of $\text{SO}_3$ by hydrate will occur at pre-APH temperatures

- Sodium sorbents:
  - Byproducts and intermediates can form without temperature and concentration control
- Calcium sorbents
  - No issues with reaction byproducts or intermediates
  - Multiple trials of Pre-APH since ’09
  - Utility – Pre-APH since 2010
    - No issues reported
Pre-SCR Injection with Hydrated Lime for $\text{SO}_3$

- **Potential benefits**
  - Residence time
  - Mixing/sorbent utilization

- **Initial program**
  - Unit <250MW
  - Bituminous coal
  - Injected over several days

- **Observations**
  - No operational issues during this limited test period
  - Noticeable reduction in hydrate required to achieve low $\text{SO}_3$ levels measured at APH outlet (vs injection at SCR outlet)

- **Additional testing planned**
Summary

Hydrated lime DSI is effective for acid gas mitigation

• Meeting HCl MATS Requirements
• ESP applications
• Pre-APH
  – Additional benefits of early $\text{SO}_3$ removal
• Interesting results with Pre-SCR injection
Contact Information

Curt Biehn
Manager, Marketing & Technical Services
crbiehn@mississippilime.com
(314)543-6309

Mississippi Lime Company
3870 S. Lindbergh Blvd.
Suite 200
St. Louis, MO 63127
www.mississippilime.com