Dry Sorbent Injection of Trona or Sodium Bicarbonate for Air Pollution Control

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MARAMA-ICAC SO₂ & HCl Control Technologies Webinar

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Dry Sorbent Injection (DSI) System

- Trona/BICAR
  - Silo
  - Mill (Optional)
- Air
- SO₂, SO₃, HCl, NOₓ, Hg
- Boiler
- Economizer
- Air Heater
- ESP/Bag House
What is Trona?

- Trona is an ore mined underground
- Trona is naturally formed sodium sesquicarbonate (Na₂CO₃•NaHCO₃•2H₂O)
- Green River, Wyoming, has billions of tons of Trona
### Sodium Sorbents from Solvay

<table>
<thead>
<tr>
<th></th>
<th>Trona SOLVAir® Select 200</th>
<th>Sodium Bicarbonate SOLVAir® Select 300*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formula</strong></td>
<td>( \text{Na}_2\text{CO}_3.\text{NaHCO}_3.2\text{H}_2\text{O} )</td>
<td>( \text{NaHCO}_3 )</td>
</tr>
<tr>
<td><strong>Particle Size: ( d_{50} ) (( \mu \text{m} ))</strong></td>
<td>(~ 30 \mu \text{m} )</td>
<td>(~ 150 \mu \text{m} )</td>
</tr>
<tr>
<td><strong>Flue Gas Temperature Range for injection</strong></td>
<td>( 275 \sim 1500 , ^\circ \text{F} )</td>
<td>( 275 \sim 1500 , ^\circ \text{F}^{**} )</td>
</tr>
<tr>
<td><strong>SO(_2) Removal (%)</strong></td>
<td>Up to 90%</td>
<td>Up to 95%</td>
</tr>
<tr>
<td><strong>HCl Removal (%)</strong></td>
<td>Over 99%</td>
<td>Over 99%</td>
</tr>
<tr>
<td><strong>Sorbent Cost</strong></td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

* Needs to be milled before injection
SOLVAir® Select Products: Calcination at >275°F

Trona

Sodium Bicarbonate

Raw → Calcined
Chemical Reactions

- **Trona Calcination**
  \[ 2(\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}) \text{ (s)} \rightarrow 3\text{Na}_2\text{CO}_3\text{(s)} + 5\text{H}_2\text{O}(g) + \text{CO}_2(g) \]

- **Sodium Bicarbonate Calcination**
  \[ 2\text{NaHCO}_3 \text{ (s)} \rightarrow \text{Na}_2\text{CO}_3\text{(s)} + \text{H}_2\text{O}(g) + \text{CO}_2(g) \]

- **Acid Neutralization Reactions**
  - \( \text{Na}_2\text{CO}_3 + \text{SO}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 \)
  - \( \text{Na}_2\text{CO}_3 + \text{SO}_3 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 \)
  - \( \text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 \)
  - \( \text{Na}_2\text{CO}_3 + 2\text{HF} \rightarrow 2\text{NaF} + \text{H}_2\text{O} + \text{CO}_2 \)

\( \text{Na}_2\text{SO}_4, \text{NaCl} \text{ and NaF are collected in fly ash.} \)
SO₂ Mitigation: ESP

- Boiler: 100 MW burning low-sulfur coal (SO₂: 1.2 lb/mmBTU)
- Sorbent injected upstream of hot-side ESP @ 650 °F.
• Boiler: 100 MW burning low-sulfur coal (SO$_2$: 0.59 lb/mmBTU)
• Sorbent injected upstream of bag house @ 290 °F.
HCl Removal with Sorbent Injected at ESP Inlet

* Test results from a pilot plant
HCl Removal with Sorbent Injected at Baghouse Inlet

* Test results from a pilot plant
Power Plant Trial Data - SO$_3$ Removal

![Graph showing SO$_3$ Removal Rate vs. NSR](chart.png)
Effect on Mercury Removal – Trona / with PAC

- SO$_3$ at SCR Outlet: 3 PPM
Summary

- Dry Injection of trona or sodium bicarbonate is a cost effective way to mitigate HCl, SO$_2$ and SO$_3$.
  - Low capital cost.
  - Compatible with ESP and Baghouses.
- Able to achieve high removal rates for HCl (>99%) and SO$_2$ (>90%)
  - Able to meet the HCl limit in MATS (0.002 lb/MBtu) and Industrial Boiler MACT (0.022 lb/MBtu)
- Effective over a wide temperature range (275°F – 1500°F)
- Has been implemented at many coal-fired power plants in the United States and waste incinerators in Europe.
Thanks!

Questions?

For more information, please visit www.solvair.us