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

Silo

Trona/BICAR

Mill

Optional

Air

Boiler

SO₂, SO₃, HCl, NOₓ, Hg

Economizer

Air Heater

ESP/Bag House
What is Trona?

- Trona is an ore mined underground
- Trona is naturally formed sodium sesquicarbonate \( (\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}) \)
- 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>Na₂CO₃.NaHCO₃.2H₂O</td>
<td>NaHCO₃</td>
</tr>
<tr>
<td><strong>Particle Size: d₅₀ (µm)</strong></td>
<td>~ 30 µm</td>
<td>~ 150 µm</td>
</tr>
<tr>
<td><strong>Flue Gas Temperature Range for injection</strong></td>
<td>275 ~ 1500 °F</td>
<td>275 ~ 1500 °F**</td>
</tr>
<tr>
<td><strong>SO₂ 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

Raw

Calcined

Sodium Bicarbonate
Chemical Reactions

◆ **Trona Calcination**
   
   \[ 2\text{(Na}_2\text{CO}_3\cdot\text{NaHCO}_3\cdot2\text{H}_2\text{O})\text{(s)} \rightarrow 3\text{Na}_2\text{CO}_3\text{(s)} + 5\text{H}_2\text{O}\text{(g)} + \text{CO}_2\text{(g)} \]

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

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

\[ \text{Na}_2\text{SO}_4, \text{NaCl and NaF are collected in fly ash.} \]
SO$_2$ Mitigation: ESP

- Boiler: 100 MW burning low-sulfur coal (SO$_2$: 1.2 lb/mmBTU)
- Sorbent injected upstream of hot-side ESP @ 650 °F.
SO$_2$ Mitigation - Baghouse

- Boiler: 100 MW burning low-sulfur coal (SO$_2$: 0.59 lb/mm BTU)
- 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

![SO$_3$ Removal Rate vs. NSR Graph](image-url)
Effect on Mercury Removal – Trona / with PAC

With Trona
No Trona

SO$_3$ at SCR Outlet: 3 PPM
Summary

◆ Dry Injection of trona or sodium bicarbonate is a cost effective way to mitigate HCl, SO₂ and SO₃.
  ● Low capital cost.
  ● Compatible with ESP and Baghouses.
◆ Able to achieve high removal rates for HCl (>99%) and SO₂ (>90%)
  ● Able to meet the HCl limit in MATS (0.002 lb/MMBtu) and Industrial Boiler MACT (0.022 lb/MMBtu)
◆ 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