Dry Injection of Sodium Sorbents - Effects of Using Mills

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McIlvaine Company Hot Topic Hour on
“Dry Sorbent Injection and Material Handling in Coal-fired Power Plants”

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# Properties of Trona and Sodium Bicarbonate

|                  | Trona  
(SOLVAir® Select 200) | Sodium Bicarbonate  
(SOLVAir® Select 300) |
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<tbody>
<tr>
<td><strong>Formula</strong></td>
<td>Na$_2$CO$_3$.NaHCO$_3$.2H$_2$O</td>
<td>NaHCO$_3$</td>
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| **Particle Sizes** | $d_{50} : \sim 30 \, \mu m$  
$d_{90} : \sim 130 \, \mu m$ | $d_{50} : \sim 250 \, \mu m$  
$d_{90} : \sim 500 \, \mu m$ |
| **SO$_2$ Removal** | Up to 90% | Over 95% |
| **HCl Removal**   | Over 99% | Over 99% |
| **Sorbent Cost**  | Low | Medium |
| **Milling**       | Optional | Required |
Effect of Particle Size on SO₂ Mitigation – Trona*

* Pilot test at Solvay
Effect of Particle Size on SO₂ Removal – Sodium Bicarbonate

SO₂ removal rate increased from 74 to 95% with d₉₀ decreased from 180 to 32µm
Pros and Cons of Milling

Pros:
- Finer particles improve surface area, distribution and mixing
- Higher mitigation level for acid gases at same sorbent feedrate
- Better sorbent usage:
  - Less unused sorbent (Na$_2$CO$_3$)
  - Lower operation cost

Cons:
- Capital cost
- O&M cost
- Reliability of mill
Milling Trona or Sodium Bicarbonate with Pin Mill

- Air
- Blower
- Dehumidifier / Chiller
- Trona or SBC
- Pin Mill
- To Duct
Build-Up After Six Hours

Trona

Sodium Bicarbonate
Pros and Cons of Pin Mill

Pros

- Simple, low-cost and easy to operate.
- Low air flow
- Low energy consumption

Cons

- Coarser particles
- Wide particle size distribution (PSD)
- Particle size gets coarser at higher feedrates
GTS MG 60B for Sodium Bicarbonate
Configuration of Air Classifier Mill

Downstream Fan

Upstream Fan
Air Classifier Mill With A Collection Bag

Pros:
- No build-up on fan blades.
- Mill redundancy less critical.
- Air flow in mill not dependent on downstream pressure drop - good for mill tuning and operation stability.

Cons:
- More expensive
- Handling fine powders in storage is difficult - long term storage not advised

Recommended for high material feedrates (> 2000 lb/hr)
Build-up from Milling Sodium Bicarbonate

- High temperatures (> 150 °F) inside mill cause calcination of trona or sodium bicarbonate to form $\text{Na}_2\text{CO}_3$ and water, thus build-up.
- Adding additives has shown good effect.
- Mill needs to be cleaned on-line periodically.

*Test with wet sodium bicarbonate

After on-line cleaning with limestone gravel
Pros and Cons of Air Classifier Mill

**Pros:**
- Very low particle sizes can be obtained ($d_{90} < 15 \mu m$).
- Particle sizes not dependent on material feedrates.

**Cons**
- High power consumption.
- High air flow.
- Severe wear when abrasive components are present (i.e. silica)
  - Requires special materials of construction
- More complicated than a pin mill
When You Purchase a Mill, Consider …

- Sorbent Flowrate (lb/h) @ desired particle size
- Power consumption
- Lead time for mill delivery
- Need for air blowers
- Costs
  - Maintenance / redundancy / spare parts
  - Equipment cost
  - Installation cost
  - Warranty cost
- Reference installations
- Turnkey or not
Summary

- Milling trona or sodium bicarbonate can increase the sorbent efficiency or acid gases mitigation rate ($\text{SO}_2$, $\text{SO}_3$ and HCl).
- Design a milling system instead of purchasing just a mill
  - Sorbent feedrate
  - Downstream pressure drop
  - Temperatures at mill inlet and outlet
  - Mill cleaning
- Capital as well O&M costs need to be considered during planning.
Questions?

For more information, please visit www.solvair.us