HCl Reduction with Trona for MATS Compliance

Jarret McClendon - Applications Engineer
Josh Allen – Applications Engineer
Outline

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• Trona Chemistry
• MATS Compliance – 3 trials
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  – Plant 2
    • Load variation
  – Plant 3
    • Milled vs. Unmilled trona
• Conclusion /Questions
Natronx Technologies

Earth’s Technology Providing Cleaner Air

TATA CHEMICALS LIMITED

CHURCH & DWIGHT CO., INC.

FMC
Natron\textsubscript{X} Overview

- Natron\textsubscript{X} Technologies, LLC is a partnership created by three of the world's most forward-thinking and cutting-edge chemical, manufacturing and mining companies.
- The Scope of the Natron\textsubscript{X} Technologies:
  - To develop, manufacture, market, sell and distribute sodium products for use in dry injection acid gas scrubbing processes
- First Trona Plant designed and built from the ground up for the acid gas control market
Trona Sorbent Reactions

Trona- (EnProve TR)

2 Na₂CO₃•NaHCO₃•2H₂O + 3 SO₂ → 3 Na₂SO₃ + 4 CO₂ + 5 H₂O

Na₂CO₃•NaHCO₃•2H₂O + 3 HCl → 3 NaCl + 2 CO₂ + 4 H₂O

Stoichiometry

• 2.40 lbs of Trona neutralizes 1lb of SO₂ (g)
• 2.11 lbs of Trona neutralizes 1lb of HCl (g)
Normalized Stoichiometric Ratio

NSR

\[
NSR = \frac{\text{lbs Trona/hr}}{\left(\frac{\text{mmBtu/hr}}{\text{heat input}} \times \frac{\text{lbs acid gas}}{\text{mmBtu}}\right) \times \left(\frac{226 \text{ g trona/mol}}{\text{g acid gas/mol}} \times \frac{\text{mol Trona theoretically reacted}}{\text{mol acid gas theoretically reacted}}\right)}
\]

• NSR
  • An adjusted ratio of showing the actual over theoretical (efficiency) of the reaction compared to ideal conditions

• NSR >1
  • More sorbent than the theoretical is injected

• NSR <1
  • Less sorbent than the theoretical is injected
Factors in Acid Gas Mitigation

- Sorbent Particle Size
- Residence time to Baghouse/ESP
- Temperature of injection point
- Particulate collection equipment
- Material Handling
  - Moisture
  - Pre calcination
- Material Distribution
Utility MATS Limitations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Regulatory Limitation (lb/mmBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO$_2$</td>
<td>0.2</td>
</tr>
<tr>
<td>HCl</td>
<td>0.002</td>
</tr>
</tbody>
</table>
MATS Compliance Trial - Plant 1

- Size: 240 MW
- Fuel: PRB
- Baseline HCl: 0.001 lb/mmBtu
- Baseline SO2: 0.46 lb/mmBtu
- Particle Collector: ESP
- Injection points
  - APH inlet: 750°F
  - APH outlet: 300°F
HCl & SO₂ Removal Results – Plant 1
Trona Injected at APH Inlet

Note: Milled Trona
ESP Collector
HCl & SO₂ Removal Results – Plant 1
Trona Injected at APH Outlet

Note: Milled Trona ESP Collector
NSR Based on SO₂
MATS Compliance Trial - Plant 2

- Size: 115 MW
- Coal Type: PRB
- Baseline $SO_2$: 2.29 lb/mmBtu
- Baseline HCl: 0.130 lb/mmBtu
- Injection point: APH inlet
- Injection temperature: 612° F
- Particulate Collection Device: ESP
MATS Compliance Trial - Plant 2

Material Handling Description

- Particle Size unmilled trona: D50 ~30 microns
- Particle Size milled trona: D50 ~22 microns
- Post Mill Temperature: 105°F
MATS Compliance Trial-Plant 2
HCl Reduction vs. NSR at Varied Load

NSR (HCl & SO2) vs. HCl Reduction

- High load
- Med Load

0.002 lb/mmBtu HCl

HCl Reduction

86% 88% 90% 92% 94% 96% 98% 100%

0 0.5 1 1.5 2 2.5 3 3.5
MATS Compliance Trial-Plant 2
HCl Reduction vs. Injection rate

HCl Reduction (%)

injection (lb/hr)

0.86 0.88 0.9 0.92 0.94 0.96 0.98 1

0 5,000 10,000 15,000 20,000 25,000

high load

med load

0.002 lb/mmBtu HCl

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MATS Compliance Trial-Plant 2
HCl Removal Level at Varied Loads

![Graph showing HCl removal level at varied loads](image-url)
MATS Compliance Trial - Plant 3

- Size: 90 MW
- Coal Type: PRB
- Baseline SO$_2$: 0.53 lb/mmBtu
- Baseline HCl: 0.00489 lb/mmBtu
- Injection point: APH inlet
- Injection temperature: 735° F
- Particle Collection Device: ESP
MATS Compliance Trial-Plant 3
Milled Trona HCl Reduction

Percent Reduction

0 500 1,000 1,500 2,000 2,500
Injection Rate (lb/hr)

0.002 lb/mmBtu HCl

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MATS Compliance Trial-Plant 3
Milled vs. Unmilled Trona for HCl reduction

Percent Reduction vs. NSR for milled and unmilled trona.
Conclusions

• Trona has the ability to reduce HCl by up to 98%
• Temperature does effect the sorbent utilization efficiency
• Milling Trona will reduce the amount of sorbent required to achieve removal targets
• Dry Sorbent Injection with Trona is an effective solution for compliance
QUESTIONS

Contact Information

Jarret McClendon
Application Engineer
973.262.0991
Jarret.mcclendon@natronx.com

Joshua Allen
Application Engineer
312.480.7244
Joshua.Allen@natronx.com