ICAC / EPA ROUND TABLE
THE GROWTH OF DRY SORBENT INJECTION (DSI) TECHNOLOGY AND IMPACTS BEYOND ACID GAS CONTROL

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December 5, 2016
Overview

- What is Dry Sorbent Injection
- Why is DSI viable
- Current State of the Art of Engineered Hydrated Lime Sorbents
- ESP Resistivity Impacts: Not your father’s hydrate!
- Importance of Particle Size and Moisture
- Summary
What is Dry Sorbent Injection (DSI)?

- Motive Air + Conditioning System
- Dosing System
- Flow + Sorbent Partitioning Device
- Injection Lances
- Product Storage Silo
- Flue Gas Duct
Why is DSI a Viable Solution?

- Simple proof of concept testing
- Adaptable to a variety of fuels and process
- Technology is mature and proven
- Process and regulatory agility
- Easy process retrofit
- Low Capital Expenditure
- Simple equipment with a small footprint
- 9 to 12 month schedule (award to installation)
Current State of the Art of Engineered Hydrated Lime Sorbents

- **Improved Performance and Versatility**
  - Improvements in DSI Technology and Associated Tools
    - Modeling, distribution, mixing tools, and reaction models
    - Evolved material handling design / understanding have driven high system availability and reliability
    - Better understanding of flue gas considerations (i.e. flue gas temperature, moisture, competing reactions)

- **Improvement in Sorbents**
  - Standard hydrated limes
    - “FGT” grade hydrated limes
  - Enhanced hydrated limes
    - Fine particles to create surface area
    - High pore volume which creates surface area
Why Consider Hydrate DSI?

- **SO₂** removals >50% with enhanced hydrates
  - Some Utility ESP Removals > 80% and Industrial Applications > 95%

- **High SO₃** removals => Protect PAC, ↓↓ SAM plume and ↓ corrosion
  - Reduce PAC consumption while not impacting Hg removal

- **High HCl** removals => Reduce corrosion and Cl⁻’s going to FGD

- If in front of an SCR potential to evaluate MOT
  - Can also evaluate ammonia slip to increase catalyst life?

- If in front of an AH provides protection and lower cold end temps=> possible unit heat rate improvements = fuel savings
  - ↓ gas temps also tend to facilitate better ESP particulate control

- **Calcium sorbent** disposal tends to be easier than sodium
  - Pozzolanic reaction facilitates decreases in volatile metal leaching (i.e. Se & Ar)
Resistivity Study

CUSTOMER: LHOIST
LOCATION: NORTH AMERICA
APPLICATION: SORBACAL SP & SPS
TEST DATE: 9/22/15
GAS MOISTURE: 10% (Vol.)
APPLIED VOLTAGE: 1.667 KV/CM
Studies indicated that hydrate samples have the best flow properties in and between the tested ranges of 0.88% moisture and 1.45% moisture.
Studies indicate that Flow Factor increases with higher \( D_{50} \) PSD.

A 32\% improvement in flow properties associated in size between a \( D_{50} = 2 \) \( \mu m \) and a \( D_{50} = 11 \) \( \mu m \).

Effective superficial gas (saltation velocity) is a function of particle size.

Set a limit for the \( D_{90} \).

On-going Flowability Study in cooperation with Nol-Tec Systems.
For a given gas volume and sizing design, precipitator performance is dependent on the following:

> Particle Size
> Ash Loading
> Ash Resistivity
ESP efficiency is proportional to the particle drift velocity which is proportional to the particle size:

$$\eta \propto \omega \propto d$$

Collection efficiency of an ESP is better for particle sizes are greater than 2μm:

- Very fine particles are more difficult to charge.
- Very fine particles require more treatment time to charge adequately.
- Very fine particles migrate to the plates in an indirect/random motion instead of a more direct path as taken by larger particles.

“Typical particle size for a utility pulverized-coal fired boiler would be a mass mean of 12 microns and a standard deviation of 3.8”

R. Mastropietro, “Fine Particulate Collection using Dry ESP”
Summary

• Demonstrated, reliable and repeatable success in achieving high removals of SO$_2$, SO$_3$, and HCl with Enhanced Hydrate DSI
  
  • Enhanced Hydrates typically perform >30% better than standard hydrated lime

• Testing to date suggests the ability of resistivity modified enhanced hydrates help maintain a well performing ESP within permitted particulate limits

• Impacts of Particle Size and Moisture are important to evaluate and can have potential balance of plant impacts.
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