UCC Dry Sorbent Injection
Multi-Pollutant Removal with DSI
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Need for Simultaneous $\text{SO}_2$, $\text{SO}_3$, Hg, HCl Removal

- **MATS**
  - Hg limit of 1.2 lb/TBTU
  - HCL limit of 0.002 lb/MMBTU for most units
  - Both readily attainable with DSI

- **SO$_2$ Removal**
  - MATS Alternative Limit
  - CAIR/Future CSAPR?
  - BART
  - State Rules
  - Consent Orders, etc.
SO$_2$, SO$_3$, Hg, and HCl Removal with DSI

SORBENT CHOICE
AND INJECTION LOCATIONS
SO₂ and HCl Removal – Sorbent Choice

**Trona**
- Use when:
  - Moderate SO₂ removal needed (approx. 80% or less)
  - Need very high HCl removal

**Sodium Bicarbonate**
- Use when:
  - High SO₂ removals needed (> 80%)
  - Want to minimize loading to ESP and/or ash removal systems
  - Want to inject at air heater outlet on PRB units to allow PAC injection air heater inlet

**Hydrated Lime**
- Use when:
  - Only require HCl Removal or only need low SO₂ removal
  - Want to preserve ash sales
  - Possibly to avoid NO₂ plume (when have fabric filter)
Hg Removal – Sorbent Choice

**PAC**
- Use for:
  - High Cl E. Bituminous coals
  - Use in combination with CaBr2 fuel additive for PRB

**Brominated PAC**
- Use for:
  - PRB coals
  - Want to inject alkali sorbent at air heater inlet and therefore can’t use fuel additive

**Non-Carbon/Low Carbon Sorbents**
- Use when:
  - Want to retain ash sales
  - ESP cannot accommodate carbon
SO₂ and HCl Removal – Injection Locations

Trona
- Economizer Inlet
  - If < 1000°F
- AH Inlet
  - Often the best choice
- AH Outlet
  - Performance decreases below 250°F

Sodium Bicarbonate
- AH Inlet
  - If < 660°F
- AH Outlet
  - Performance decreases below 250°F

Hydrated Lime
- Effective at both Air Heater inlet and outlet
- Generally use less at Air Heater Outlet for HCl removal
Hg Removal – Injection Locations

Air Heater Inlet
- Generally has shown better performance for PRB coals than air heater outlet since Hg is removed in air heater.

Air Heater Outlet
- Typically used for E. Bituminous coals when alkali sorbents are used at air heater inlet to remove SO₃.
SO$_2$, Hg, and HCl Removal with DSI

TEST RESULTS
SO₂, Hg, HCl Removal Results from DSI Demonstration Tests
SO₂, Hg, HCl Removal Results from DSI Demonstration Tests
Typical Multipollutant Removal for PRB Unit - ESP

SO₂ Removal

HCl Removal

Trona Injection for HCl Removal
PRB Unit

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Typical Multipollutant Removal for PRB Unit Fabric Filter

![Graph showing typical multipollutant removal for PRB unit fabric filter]
Typical Multipollutant Removal for PRB Unit - ESP

Hg Removal

Hg Removal (%) vs PAC Injection Rate (lb/hr)

- Brominated PAC @ AHI
- Brominated PAC @ AHI w/ Trona @ AHI
- Brominated PAC @ AHI w/ SBC @ AHO
- High SA Brominated PAC @ AHI w/ SBC @ AHO
- High SA Brominated PAC @ AHI w/ Trona @ AHI
Typical Multipollutant Removal for PRB Unit - ESP

%Hg Removal vs ACI Injection Rate (lb/MMacf)

- PAC - Air Heater In
- PAC - Air Heater In, Fuel Additive
- PAC - Air Heater Out
- PAC - Air Heater Out with Trona
- BPAC - Air Heater In
- BPAC - Air Heater Out
- BPAC - Air Heater Out with Trona
- BPAC - Air Heater In with SBC
Mercury Removal on E. Bituminous Unit

Hg Removal Percent
BPAC Injection

- BPAC Only
- Unmilled Trona (high volume) & BPAC
- Unmilled Trona (low volume) & BPAC
- Log. (BPAC Only)
SO$_3$ Removal
Hydrated Lime with ESP
SO$_3$ Removal

Unmilled Trona vs. Milled Trona

![Graph showing SO$_3$ Removal efficiency vs. Trona Injection Rate (lb/hr)]

- **Sorbent Usage Reduction** with VIPER MILL
- **Unmilled Trona**
- **Milled Trona**
- **Log. (Unmilled Trona)**
- **Log. (Milled Trona)**
SO₂, Hg, HCl Removal with DSI

CONCLUSIONS
Conclusions for E. Bituminous Fuels

- Trona and sodium bicarbonate demonstrated as effective sorbents for SO$_2$ and HCl removal
- Hydrated lime effective for HCl removal, but less so for SO$_2$ removal
- Simultaneous high Hg removals for E. Bituminous coals usually requires SO$_3$ Removal
  - PAC or Brominated PAC typically used at AH outlet, with hydrated lime or trona at AH inlet for SO$_3$ removal
- Over 90% SO$_2$ removal, up to 99% HCl removal, and over 90% Hg removal
Conclusions for PRB Fuels

- Fuel additive and PAC upstream of AH performs the best, but any trona/SBC injection must be at AH outlet
  - Otherwise, trona/SBC will react with halogen from fuel additive
- Brominated PAC at AH inlet with trona/SBC at AH outlet performs very well
  - Trona/SBC at AH inlet would remove HCl/SO₂ needed to oxidize Hg in AH
- Trona/SBC at AH inlet with Brominated PAC injection at AH outlet is effective, but more Brominated PAC needed
  - May be due to NO₂ formation and/or HCl removal upstream of BPAC
Questions
Thank You

For Further Information on
Dry Sorbent Injection Systems for SO₂, SO₃, Hg and HCl Reduction

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