Controlling Acid Gas Emissions from Industrial Boilers

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Overview of Talk

• Acid gas limits in vacated MACT rule and NACAA guidance for industrial boilers
• Technologies for acid gas controls to meet limits
  ▪ Trade-offs among technology choices
• Possible affect of recent changes in alkali markets on technology choices
Acid Gas Control for Industrial Boilers

- HCl only acid gas in vacated MACT rule and NACAA guidance
- HCl limits for coal
  - Vacated MACT: 0.09 lbs/MM Btu
  - NACAA: 0.015-0.03 lbs/MM Btu
- Uncontrolled HCl emissions from coal
  - 0.03-0.15 wt.% Cl in coal
  - 0.024-0.125 lbs/MM Btu
- ~38-88% HCl removal required
HCl Control Technologies

- Pulverized or stoker coal combustion
  - Mostly same as for SO$_2$ (FGD)
  - Wet FGD following particulate control
    - Extensive experience in electric generating plants
    - >98% SO$_2$ removal
    - >99% HCl removal but infrequently measured
    - Lime/limestone [CaO/Ca(OH)$_2$/CaCO$_3$]
    - Wastewater and/or solids byproducts

- Wet FGD in refineries
  - Caustic (NaOH)
  - Very high reliability
HCl Control Technologies

- Pulverized or stoker coal combustion
  - Dry FGD ahead of particulate control
    - Extensive experience in electric generating waste-to-energy industries
    - Up to 94% SO₂ removal in electric generation
    - >95% HCl removal in waste-to-energy
    - Lime [CaO/Ca(OH)₂]
    - Solids byproducts to disposal
    - Spray-dryer type
    - Circulating-fluid-bed type
HCl Control Technologies

- Pulverized or stoker coal combustion
  - Furnace sorbent injection
    - Lime/limestone or sodium-based
  - Sorbent injection ahead of baghouse
    - Lime or sodium-based
  - Wet scrubber with water
    - Recovers HCl or CaCl$_2$ solution as byproduct
    - > 90% HCl removal
  - Dry FGD/baghouse after existing ESP
    - Solid byproduct separate from flyash
HCl Control Technologies

• Circulating fluid bed boiler
  ▪ Limestone or dolomite addition for SO$_2$ control
  ▪ Dry FGD or sorbent injection ahead of baghouse for additional SO$_2$ control and HCl control

• Regenerable processes for SO$_2$ control
  ▪ Not applicable for HCl control
HCl Control Technologies

- Effect of alkali cost on technology choices
  - Wet FGD
    - Lime/limestone used in largest FGD units
      - 800 MW electric generating plant
    - Lime used in medium and large FGD units
      - Waste-to-energy plant
    - Caustic used in small units
      - Refinery cat cracker unit
  - Relative costs of limestone/lime/caustic:
    - 2 years ago: 1/3/15
    - Now: 1/3/25
  - Shift smaller units to dual-alkali wet FGD or dry FGD
Summary of Talk

• Effect of proposed limits for HCl emissions from industrial boilers on technology choices

• Technology choices based on experience with SO\textsubscript{2} controls in electric generation and HCl controls in waste-to-energy

• Impact of relative alkali costs on technology choices
Compounds for $\text{SO}_3$ Control in Coal-fired Plants

- Magnesium hydroxide
- Micronized limestone
- Furnace
- Wet FGD
- Hydrated lime
- Sodium bisulfite
- Ammonia
- Trona
- Soda ash
- ESP
- SCR
- Scraper
- Kiln dust
- Dolomite
- Limestone
- Magnesite
- Magnesium hydroxide
- Dolomite, lime

Dedicated graphs and images illustrate the processes and applications of these compounds in coal-fired plants for $\text{SO}_3$ control.
HCl Control Technologies

- **Other Factors in technology choice**
  - Wet FGD produces
    - Lime/limestone used in largest FGD units
      - 800 MW electric generating plant
    - Lime used in medium and large FGD units
      - Waste-to-energy plant
    - Caustic used in small units
      - Refinery cat cracker unit