Circulating Dry Scrubbers for PM$_{2.5}$ Compliance

Presentation for the:

McIlvaine Company Hot Topic Hour on Compliance Strategies for PM$_{2.5}$

Thursday, May 12, 2011

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Outline

Circulating Dry Scrubbers for PM$_{2.5}$ Compliance

A. EPA Regulations
B. Particulate Measurement Methods
C. Circulating Dry Scrubbers
EPA Regulations

• National Ambient Air Quality Standards (NAAQS)
• New Source Performance Standards (NSPS)
• Proposed Utility Maximum Achievable Control Technology (MACT)
• Proposed Area and Major Source Industrial Boiler MACT
Proposed Utility MACT Limits

EXAMPLE
Coal-Fired Units (Except Lignite)

Total PM = Filterable (PM$_{2.5}$) + Condensibles
Proposed Utility MACT Limits

Reverse Logarithmic Scale
(Bigger Bar Means Much Smaller Limit)

EXAMPLE
Coal Fired Units (Coals Except Lignite)

- Total PM
- Non-Hg Metal
- HCl
- SO2
- Hg

Emission (lb/10^6 Btu)

- Existing
- New

Measure every 2 months if no PM CEMS
Hg or sorbent trap CEMS required

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Proposed Utility MACT Limits

• 30-day Rolling Averages of Continuous Monitor Readings Compared to Limits

• Limits are All Pollutants for All-Times
  → No Provisions for Startup Shutdown or Malfunction

• Total PM = Filterable (PM$_{2.5}$) + Condensibles (SO$_3$, NH$_4$Cl, etc.)

• Measurement programs mandated within 30 days of compliance date

• Operating practices must be defined and established
A. EPA Regulations

- National Ambient Air Quality Standards (NAAQS)
- New Source Performance Standards (NSPS)
- Proposed Utility Maximum Achievable Control Technology (MACT)
- Proposed Area and Major Source Industrial Boiler MACT

B. Particulate Measurement Methods

C. Circulating Dry Scrubbers
Particulate Matter Measurement Methods

• Method 5 for PM2.5
• Method 17 for Total PM
• Method 202 for Condensibles
  → EPA issued New Method 202 in Dec-10
A. EPA Regulations

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B. Particulate Matter Measurement Methods

C. Circulating Dry Scrubbers

• Process
• Chemistry
• Emissions
Circulating Dry Scrubbers

Turbosorp® CDS

Flue Gas and Solids Path Diagram

Turbulent Reactor Mixing

No Slurry Handling

High Solids Recirculation
Chemistry

SO₂ + Ca(OH)₂ → CaSO₃ + H₂O

SO₃ + ½O₂ + Ca(OH)₂ → CaSO₄ + H₂O

2HCl + Ca(OH)₂ → CaCl₂ + 2H₂O

2HF + Ca(OH)₂ → CaF₂ + 2H₂O
Formation of reaction products layer

**Reaction after first pass**

**Water added to surface during recirculation**

**Sulfite crystal forms, exposing fresh surfaces**

\[
\text{CaSO}_3 \frac{1}{2} \text{H}_2\text{O} \quad \text{Ca(OH)}_2
\]

\[
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\]

\[
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\]
Circulating Dry Scrubbers

Turbosorp® CDS
PM Emission Data Compared to Utility MACT

Condensibles Not Measured with New Method 202

Coal-Fired Units

Emission (lb/10^6 Btu)

- EPA Total PM Limit
- Total PM
  - Plant 1
  - Plant 2
- Filterable PM
  - Plant 3
- 1 CMPT OOS
- All CMPTS

Existing
New
Circulating Dry Scrubbers

Turbosorp® CDS Emissions Summary
(Conclusion)

- CO2: 95 – 98%
- CO3: 95 – 99%
- HCl: 95 – 99%
- HF: 95 – 99%
- Mercury: 90 – 95%

- Coals up to 6 lbs of SO2/10^6 Btu
- SO2 down to 0.03 lb/10^6 Btu

Reduces PM Condensibles