Pollution Control for Cement Kilns
Presentation Topics

Environmental Regulations Review

- SO$_2$ and HCl Removal
- Wet FGD Technology
- Dry FGD – Spray Dryer Absorber (SDA) Technology
- Circulating Fluid Bed Dry Scrubber (CDS) Technology
- Technology Comparisons
# U.S. Cement MACT & NSPS Emission Limits

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Existing Kilns 8/17/71 - 6/16/08</th>
<th>New Source Kilns After 6/16/08</th>
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</thead>
<tbody>
<tr>
<td>HCl</td>
<td>5 mg/dry Nm³ @ 7% O2</td>
<td>5 mg/dry Nm³ @ 7% O2</td>
</tr>
<tr>
<td>SO₂</td>
<td>N/A</td>
<td>0.2 kg / tonne</td>
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<tr>
<td>1-3 kg / Metric Tonne</td>
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<tr>
<td>PM(10)</td>
<td>0.02 kg / Tonne</td>
<td>0.005 kg / Tonne</td>
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- Mass values based on tonne of clinker
- Emissions based on 30 day rolling average
- PM(10) is used as surrogate for toxic metals other than Hg
- PM(10) = solid particulate (excludes condensables)

**Major Source Definition** = emits > 10 TPY of single HAP or > 25 TPY combined HAPs
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Fuels and Scrubber Types

Wet Flue Gas Desulfurization (Wet FGD)

Dry FGD

- Spray Dryer Absorber (SDA)
- Circulating Dry Scrubbers (CDS)

Fuels

- Coal, Oil, Petroleum Coke
- Biomass, Refuse
- Tires

Fuel Switching

- Lower Sulfur – Higher sulfur?
- Lower Cl
- Lower Hg
HCl Removal in Wet and Dry FGD

≥ 99% Removal Efficiency

HCl Emissions: <1.0 ppmdv (1.7 mg/dNm³)@ 7% O₂

Measurement

- EPA Method 26A
- Practical Detection Limit: 0.3 ppmdv (0.5 mg/dNm³)

HCl Emission independent of inlet concentration?
SO2 Removal

WFGD and CDS 98% - 99% Typical Removal Efficiency

SDA – 95% SO2 Removal

Measurement

- EPA Method 6
- Practical Detection Limit: 3-5 ppmdv (8-14 mg/dry Nm³)

Reagents

- WFGD – Kiln Dust, Raw Meal or Limestone
- CDS and SDA – Lime (hydrated)
SO2 Removal vs. SO2 in Coal 0.2 kg/tonne Emission

% Removal

SO2 in coal, kg/kj x 10^6

- 7 million kj/tonne
- 6 million kj/tonne
- 5 million kj/tonne
- 4 million kj/tonne
SO2 Emissions at 90% Removal

Inlet SO2, kg/kj x 10^6

SO2 out, kg/tonne

- 7 million kj/tonne
- 6 million kj/tonne
- 5 million kj/tonne
- 4 million kj/tonne
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Typical Utility Boiler Wet FGD Configuration

- Coal Pulverizers
- Boiler
- SCR
- SO$_2$ Scrubber
- Fabric Filter
- SO$_3$ and Mercury
Characteristics of Wet FGD Systems

- Fuel sulfur levels to 8%
- 98-99% Typical Removal
- Reagent flexibility
- Can use Kiln Dust
- Excellent fuel flexibility
Presentation Topics

- CEMEX Environmental Update
- B&W PGG Overview
- Wet FGD Technology
- Dry FGD – SDA Technology
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Typical Spray Dryer Absorber (SDA) Configuration
**Dry Scrubber – Spray Dryer Absorber**

Reagent is slaked lime slurry

Slurry is atomized by rotary atomizer

**Critical Design Parameters**
- Inlet temperature
- Drying of lime slurry
- Approach to saturation
- Fabric Filter (baghouse) required

**SO₂ Removal**
- \(\approx 95\%\)
- Approximate limit of 1.5% sulfur
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Typical CDS Arrangement

- Stack
- Product Silo
- CDS
- Lime Silo
- Fabric Filter
- Raw Gas Duct
- Clean Gas Duct
- ID-Fan
- Clean Gas Recirculation
CDS Process Basics

- Simple and reliable process
- Long solids retention time
- Very high byproduct recirculation
- >98% $\text{SO}_2$ removal efficiency
- High fuel flexibility-high S fuels
- Compact plant arrangement
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Flue Gas Desulfurization

Spray Dryer FGD
- ≈ 95% SO₂ removal
- Lower sulfur fuels <1.5%
- Carbon steel
- Limited fuel flexibility
- Second Baghouse
- Expensive Lime reagent

Wet FGD System
- ≥ 98% SO₂ removal
- High sulfur fuels
- Kiln dust reagent – no cost
- No second baghouse
- Wastewater treatment
- Wet stack – converted or new
- Alloy or linings

Circulating Dry Scrubber
- ≥ 98% SO₂ removal
- Carbon steel
- Compact Footprint
- Higher sulfur fuels
- Second baghouse
- Expensive Lime reagent
- Clean gas recirculation
Selection of FGD System

- Capital Cost Lower for SDA and CDS

- Operating Cost depends on
  - SO2 removal
  - Sulfur in fuel

- Reagent
  - Lime = $75 USD per ton
  - Kiln dust = $0
  - Limestone = $15 per ton

- Lower sulfur and lower removal favor SDA

- Higher sulfur, higher removal favor WFGD or CDS
Thank You.

B&W and PrecipTech

Powerful Solutions for the Cement Industry

Questions?