

Graymont



CDS Systems for Industrial Boilers

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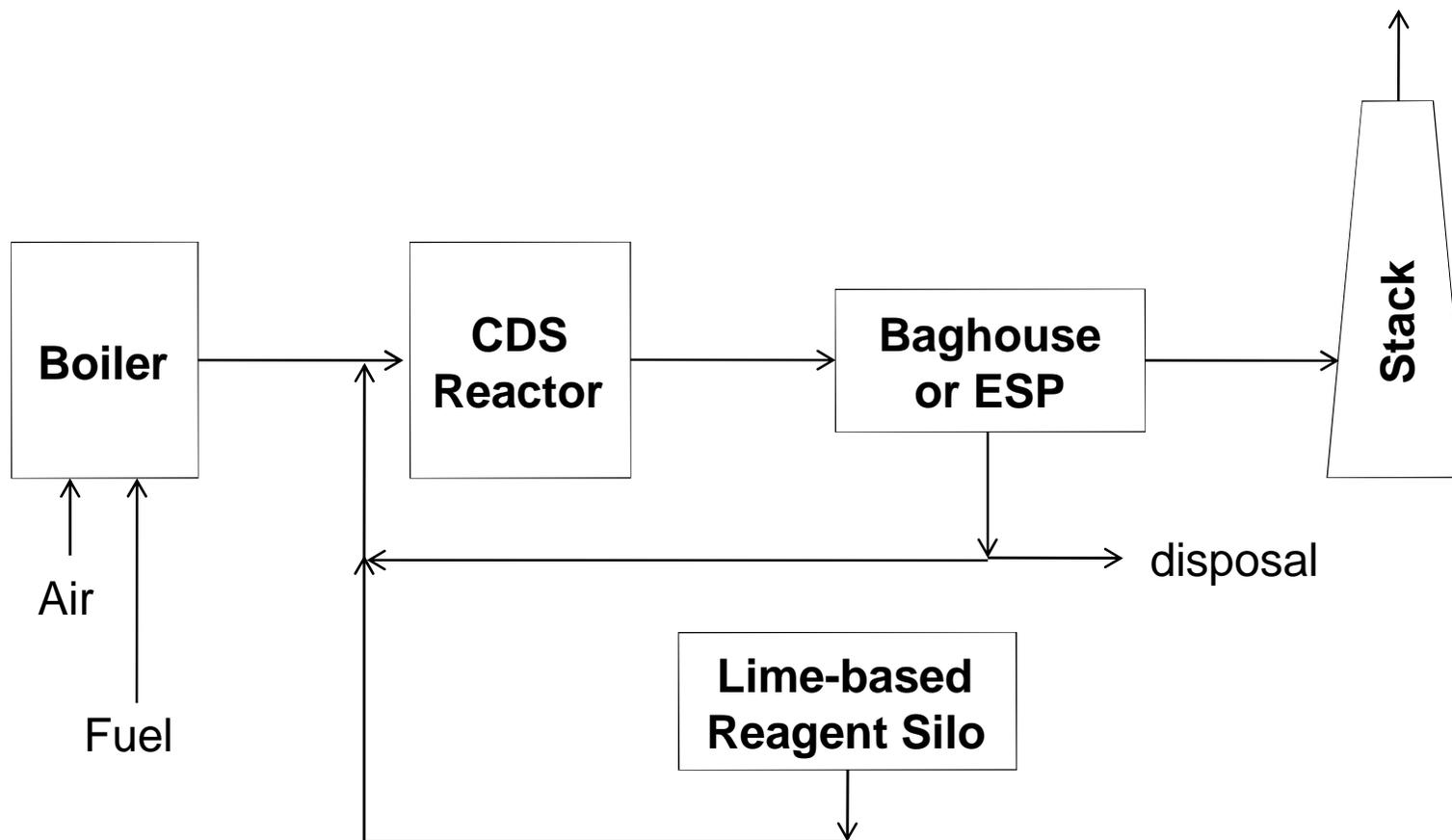
Graymont

- **Graymont, a privately owned company, is headquartered at Richmond (Vancouver), British Columbia, Canada. Graymont owns and operates 8 lime plants in Canada and 8 lime plants in the U.S. Graymont also owns a minority share of Grupo Calidra, the largest lime producer in Mexico.**
- **Graymont produces quick lime, hydrated lime, limestone, and other products for the mining, steel, waste water, flue gas treatment, pulp & paper, chemical, and construction industries. Graymont frequently moves products across the U.S./Canada border to meet the demands of customers.**
- **Graymont has a aggregates/materials division with operations in New York and Quebec areas. Graymont's Ecowaste Division operates a landfill near Vancouver, British Columbia.**

Presentation Outline

- 1. Generic Process Flow Diagram**
- 2. Process Characteristics of a CDS System**
- 2. Pollutant Removals in CDS Reactors**
- 3. CDS Installations**
- 4. CDS System Providers in the U.S.**
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- 6. Take-away**
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Generic Process Flow Diagram



Process Characteristics of a CDS System

- **High circulation rate of finely divided solids**
- **Lower capex (compared with wet scrubbing systems)**
- **Multi-pollutant controls (SO₂, SO₃, HCl, HF, Hg, trace metals)**
- **Fuel flexibility**
- **Small footprint, simple process, easy to maintenance**
- **Low water consumption**
- **Dry byproduct (i.e., no waste sludge to handle)**

Pollutant Removals in CDS Reactors

Acidic Gases:

- $\text{Ca(OH)}_2 + \text{SO}_2 \rightarrow \text{CaSO}_3 + \frac{1}{2} \text{H}_2\text{O} + \frac{1}{2} \text{H}_2\text{O}$
- $\text{Ca(OH)}_2 + \text{SO}_2 + \frac{1}{2} \text{O}_2 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$
- $\text{Ca(OH)}_2 + \text{SO}_3 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O}$
- $\text{Ca(OH)}_2 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + 2 \text{H}_2\text{O}$
- $\text{Ca(OH)}_2 + 2 \text{HF} \rightarrow \text{CaF}_2 + 2 \text{H}_2\text{O}$

Mercury, trace metals and other pollutant are picked up by the ash-sorbent mixture.

CDS Installations

In the U.S.:

- CDS systems are installed or under construction, or under contracts at 23 locations. Most are in the power industry with the largest CDS reactors capable of handling combustion flue gases from 300 MW-sized boilers. At 8 locations with fluidized bed boilers burning waste coal, 12 CDS reactors are designed as polishing scrubbers. About 10 proposed woody biomass fired power plants are designed with CDS.

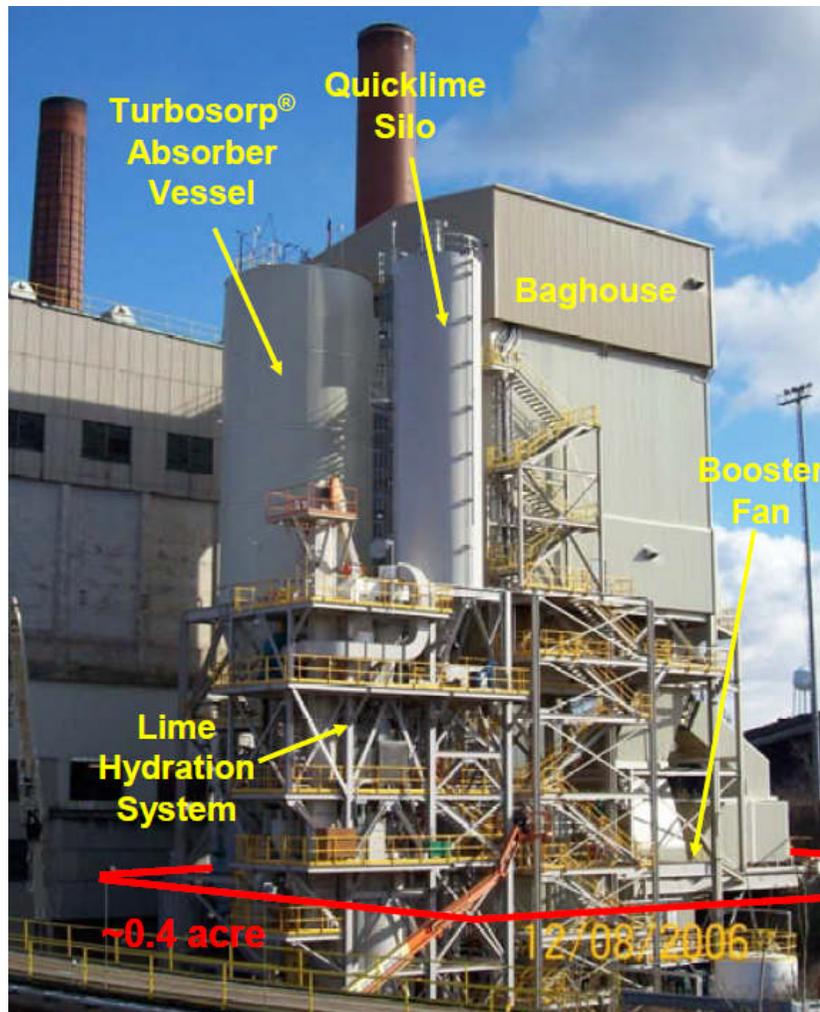
Outside the U.S.

- More than 200 CDS units are operational in China, India, Taiwan, Europe, and South America.
- China has the most CDS installations in the power, municipal waste incineration, steel, brick, chemical and other industries. The largest CDS reactor is capable of handling the combustion flue gas from a coal-fired electricity generating unit rated at 360 MW.

CDS System Providers in the U.S.

- **Allied Environmental Solutions**
- **Alstom Power**
- **Babcock Power Environmental**
- **Babcock & Wilcox**
- **Beaumont Environmental Systems**
- **Marsulex Environmental Technologies**
- **Solios**

CDS at AES Greenidge Unit #6



AES Greenidge Unit #4 (Boiler #6)

- Dresden, NY
- 107 MW (net)
- Combustion Engineering T-fired boiler
- Boiler commissioned in 1953
- 780,000 lb/h steam @1465 psig and 1005°F
- Easter bituminous coal w/2.5% S

CDS vendor: Babcock Power Environmental

- CDS startup: Dec 2006
- Onsite hydrator

Source: Paper presented by Daniel P. Connell of CONSOL Energy at 2007 Annual AWMA Conference.

CDS Performance at AES Greenidge

Fuel: 2.5-3.0% sulfur eastern U.S. bituminous coal

Parameter	Target	Measured
NO _x emissions	≤ 0.10 lb/mmBtu	0.10 lb/mmBtu (Stack CEM, 3/28/07)
SO ₂ removal	≥ 95%	96% (Stack CEM, 3/29/07)
Hg removal Without ACI With ACI	≥ 90%	≥ 95% (Ontario Hydro, 3/28/07) ≥ 94% (Ontario Hydro, 3/30/07)
SO ₃ removal	≥ 95%	97% (Controlled Condensation, 5/2/07)
HCl removal	≥ 95%	97% (EPA Method 26, 5/4/07)

Source: Paper presented by Daniel P. Connell of CONSOL Energy at 2007 Annual AWMA Conference.

CDS Units at Virginia Tech



**Newer CDS
on Boiler 7**

**Older CDS
on Boiler 11**

**CDS vendor:
Solios
(formerly Procedair).**

Picture and data provided by Byron Nichols of Virginia Tech, Blacksburg, Va

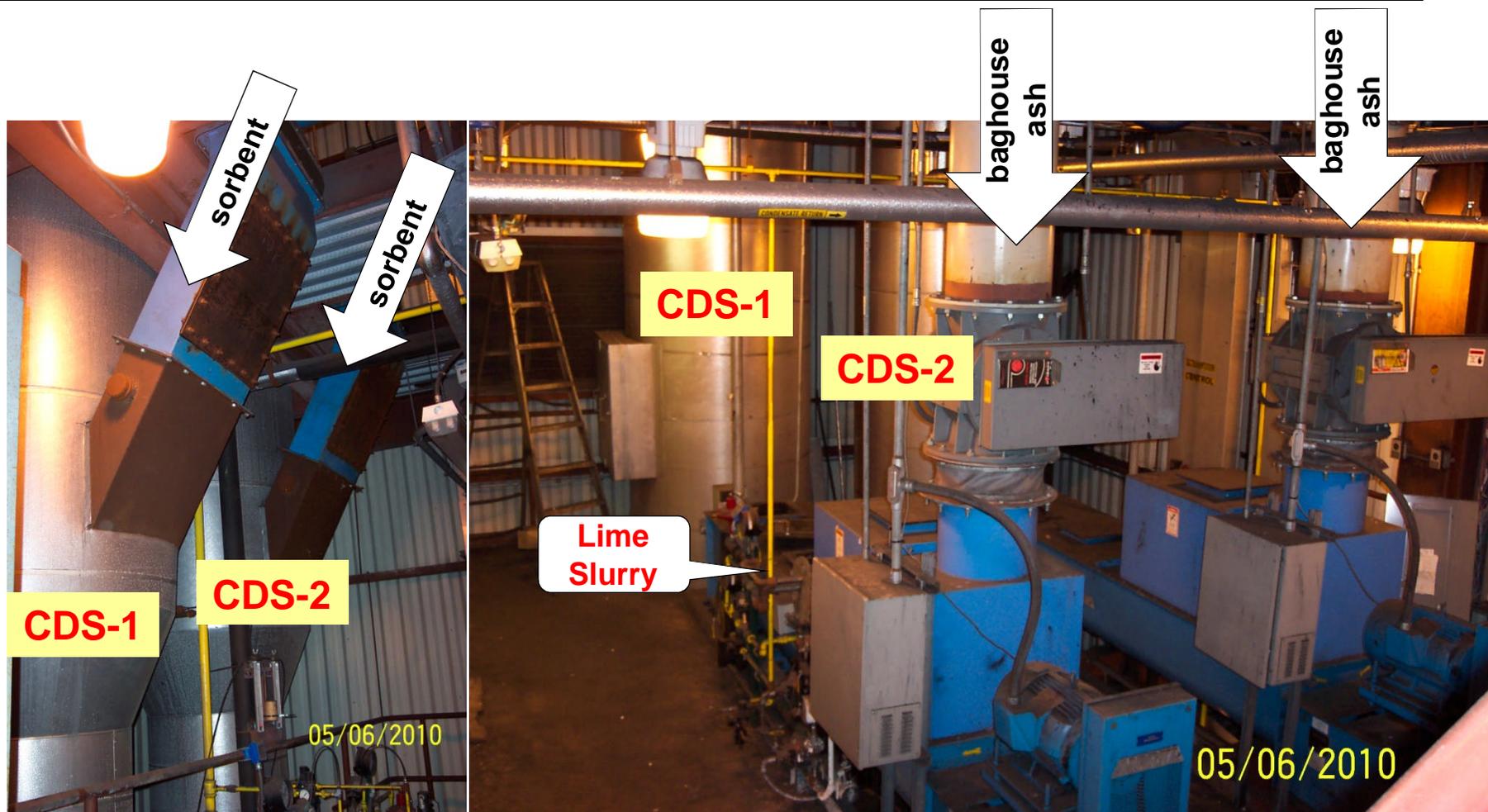
Performance of CDS Units at Virginia Tech

2007 Test Results:

STACK EMISSIONS	BOILER MACT STANDARDS	RESULTS, AS PERCENT BELOW LIMIT	
		BOILER 7	BOILER 11
PM	0.07 lb/million Btu	- 90.8 %	- 80.8 %
HCl	0.09 lb/million Btu	- 99.6 %	- 99.5 %
Hg	9 lb/trillion Btu	- 61.6 %	- 89.4 %
TSM	0.001 lb/million Btu	- 95.5 %	- 97.4 %

Data provided by Byron Nichols of Virginia Tech, Blacksburg, Va.

CDS System at Medical College of Ohio



Performance of the CDS System at Medical College of Ohio

SO2 Control

Morning Start Up with the Recycle Lean
Cooling Water Being Added Slowly

	<u>Date</u>	<u>ACFM</u>	<u>Efficiency</u>	<u>Stoich</u>	<u>Util%</u>	<u>Temp Out</u>	<u>PPM SO2 In</u>	<u>PPM SO2 Out</u>	
		Start Up - No Water Added							
1	6/12/02	33,780	85.38	2.94	29.00	276	212	31	0.848 S Coal
		30 Minutes Later							
2	6/12/02	33,083	95.2	1.91	49.74	263	333	16	1.332 S Coal
		30 Minutes Later							
3	6/12/02	33,404	92.85	1.17	79.37	250	539	38	2.156 S Coal
		30 Minutes Later							
4	6/12/02	37,213	93.39	0.94	99.72	262	604	40	2.416 S Coal

First 3 are at 140% of Reactor Rating
Fourth reading at 160% of Reactor Rating

Data provided by Will Goss of Beaumont Environmental Systems

CDS at Graymont's Pleasant Gap Lime Plant



Pleasant Gap, PA
Kiln #7
Type: Rotary
Capacity: 1,050 tpd lime
Power Plant: 3.5MW
Fuel: coal/petcoke

CDS Reactor: Solios
Engineering: Graymont
Startup: January 2008

CDS Performance:
> 93% SO₂ Removal
for 3% sulfur coal
(kiln outlet-to-stack)

Take-away

- **Lime-based CDS systems are widely deployed to control emissions of SO₂, SO₃, HCl, HF, mercury and other pollutants from various types of coal-fired boilers.**

- **Lime is available from plants located across the U.S.**

- **Data obtained from several CDS installations indicate a CDS system can be a viable option for industrial boilers to meet MACT regulations.**
 - **Lower capex**
 - **Proven multi-pollutant controls**
 - **Fuel flexibility**
 - **Small footprint, simple process, easy to maintenance**
 - **Dry byproduct (i.e., no waste sludge to handle)**

Acknowledgement

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- Amy Evans of Marsulex Environmental Technologies
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