Circulating Dry Scrubber Applicability For Industrial and Small Utility Boilers

May 18, 2011
ICAC/MARAMA Advances in Air Pollution Control Workshop

Justin P. Chenevey
Environmental Process Engineer

Jeffrey M. Smith
Environmental Proposal Manager

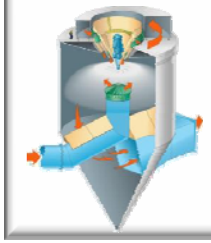
Discussion Outline

- Acid Gas and CDS Technology Discussion
- CDS Process and Performance
- CDS Case Study
- CDS O&M Considerations

B&W FGD and Acid Gas Control Technologies

Dry Sorbent Injection

- 50 - 60% SO_2 removal, primarily SO_3 and HCl
- May use hydrated lime or trona
- Inject before particulate control device
- May impact fly ash disposal
- Lowest capital investment



Spray Dryer Absorber

- Up to 97% SO_2 removal
- Lower sulfur fuels (<1.5% sulfur coal)
- Pebble lime reagent slaked on site
- Particulate control follows scrubber
- Dry byproduct – limited beneficial use
- Low capital and operating costs when it fits

Circulating Dry Scrubber

- Up to 98+% SO_2 removal
- Higher sulfur fuels (>1.5%)
- Pebble lime reagent hydrated on site
- Particulate control follows scrubber
- Dry byproduct – limited beneficial use

Wet Scrubber

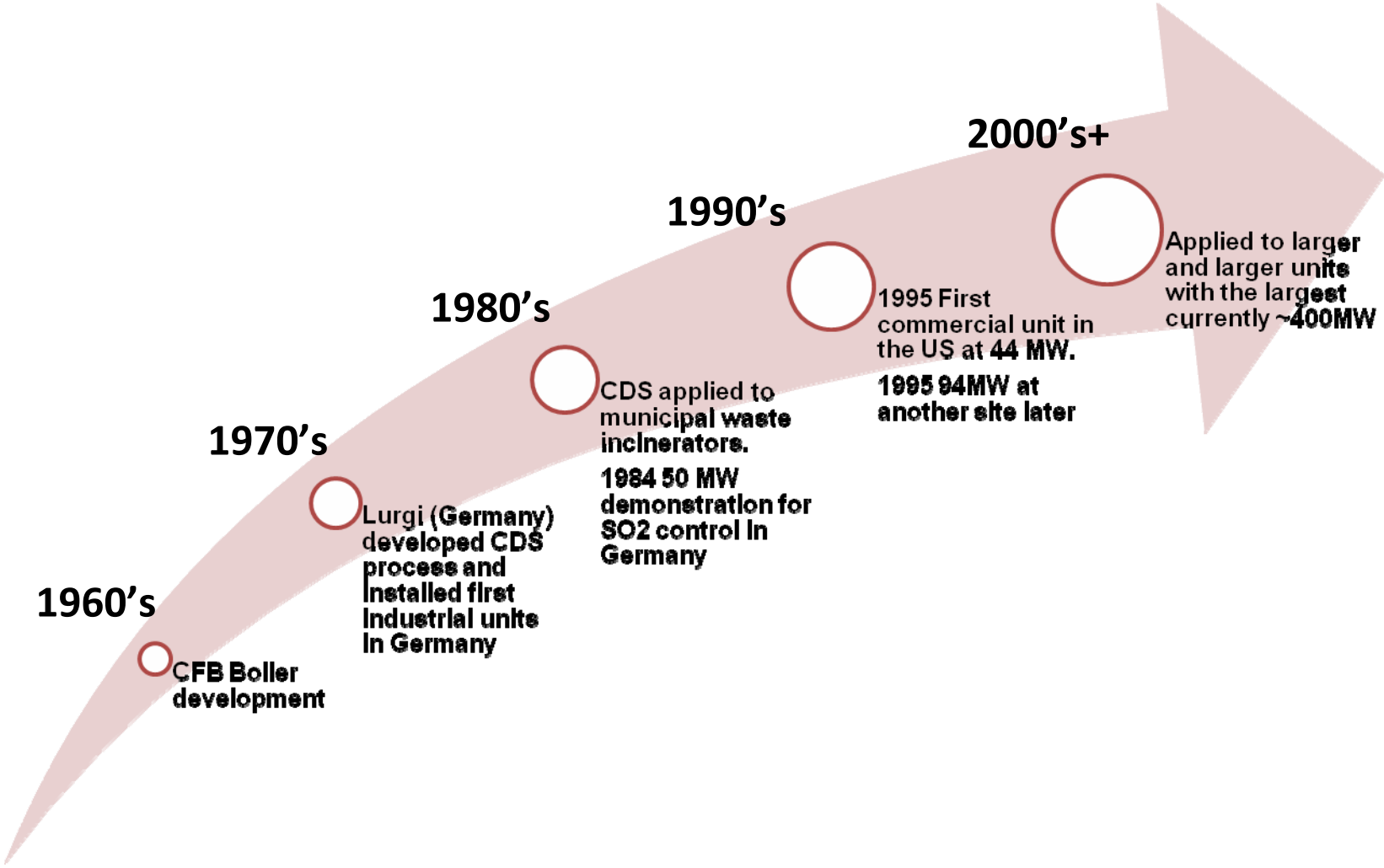
- Up to 98+% SO_2 removal
- High sulfur fuels (>1.5%)
- Limestone reagent
- Scrubber follows particulate removal
- Generally marketable byproduct – gypsum
- Broadest range of applicability

CDS vs. SDA

CDS Advantage	SDA Advantage
Higher fuel flexibility	Lower capital cost
Independent water and SO_2 control	Lower lime consumption (w/ Recycle)
Control of absorber inlet gas flow	More efficient turndown
Only large power consumer is ID Fan	Smaller and lower fabric filter
No slurry handling	Reduced pneumatic handling

Both Technologies: dry byproduct, equivalent water consumption, carbon steel construction, small footprint, no wastewater treatment or wet stack required

CDS Technology Path



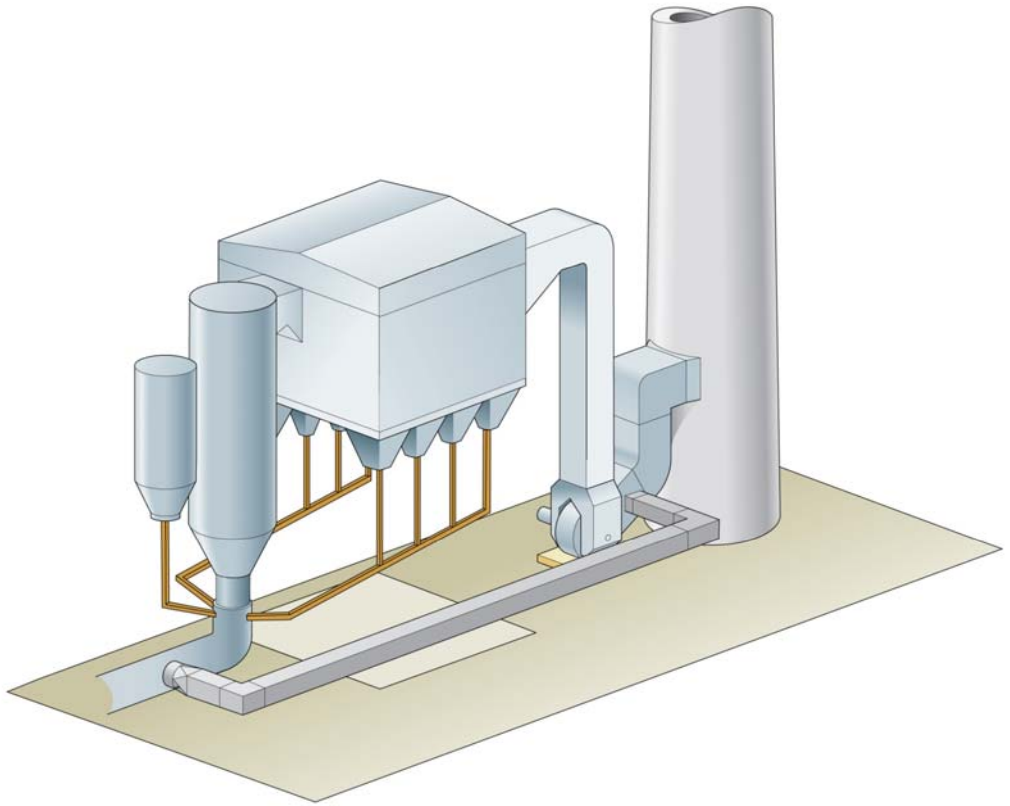
Discussion Outline

- Acid Gas and CDS Technology Discussion
- CDS Process and Performance
- CDS Case Study
- CDS O&M Considerations

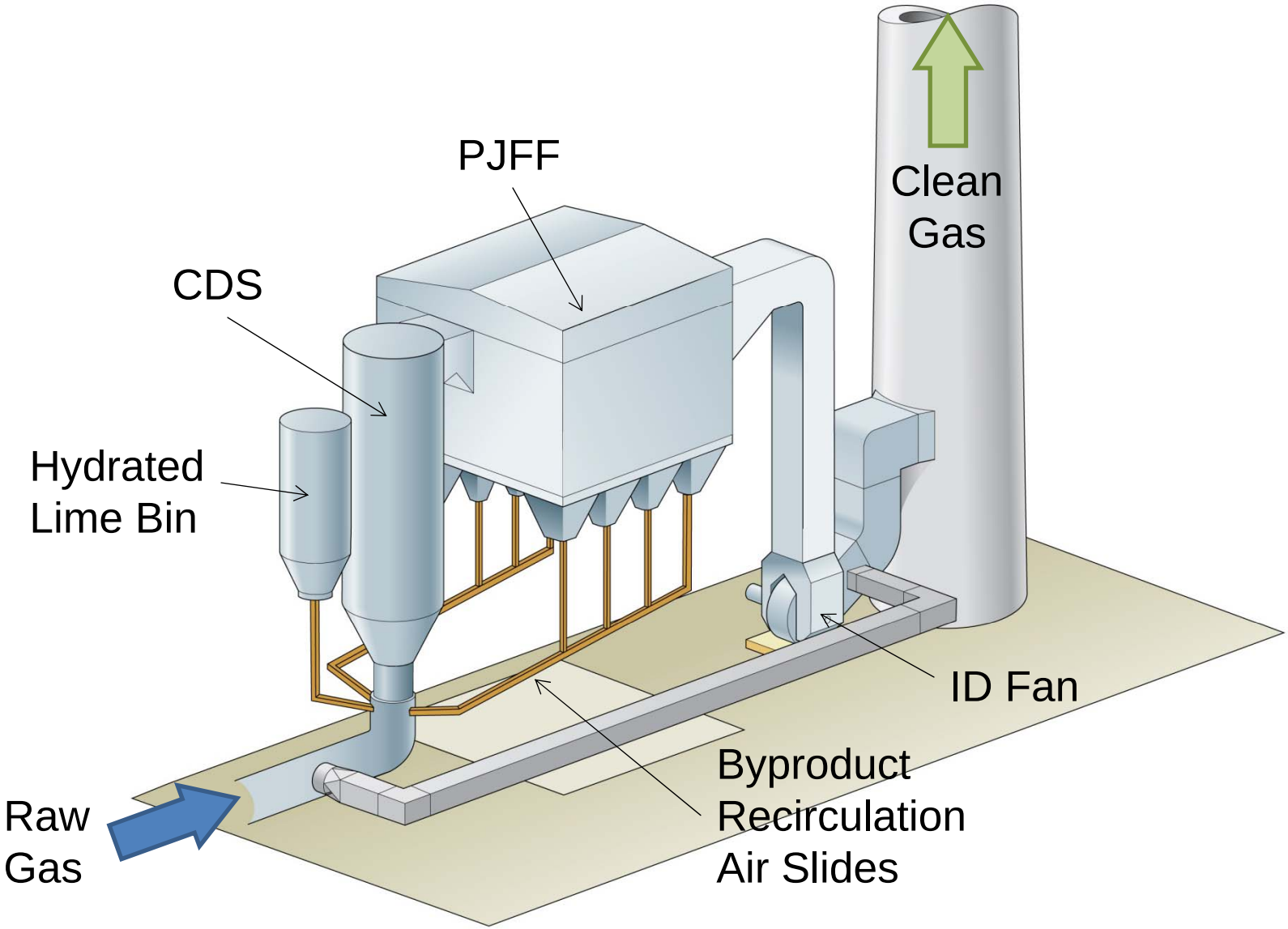
CDS Applications

CDS can be applied to a range of fuels

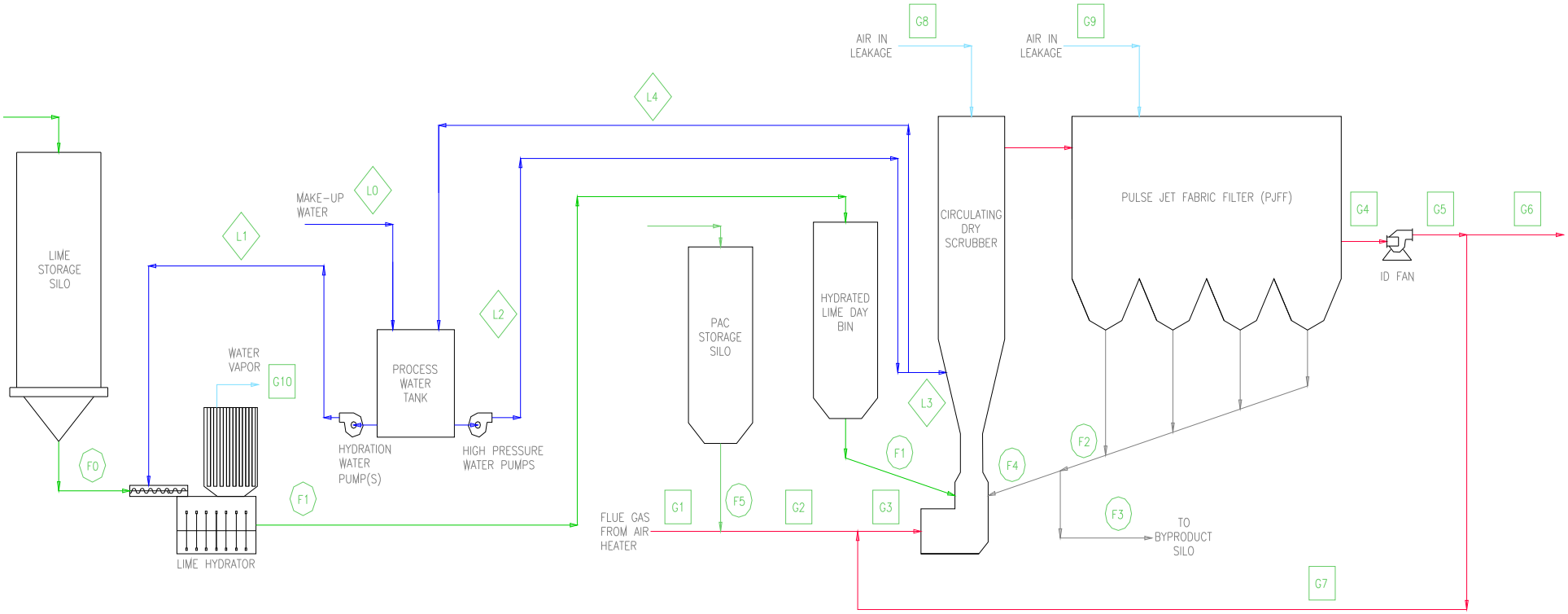
- **Utility and Industrial Boilers**
- **Coal**
- **Biomass**
- **Pet coke**
- **Waste Incinerators**
- **High HCl/SO2 ratio**



CDS Components



Mass Balance Diagram



CDS Process Basics

- Simple and reliable process
- Long solids retention time
- Water evaporation independent of sorbent feed rate
- No limitation on SO_2 / SO_3 concentrations
- Very high SO_2/SO_3 removal efficiencies up to 98+%
- High flexibility regarding changing SO_2 concentrations
- No precollection of ash needed
- Application for other flue gas cleaning purposes (biomass, waste)

Typical CDS Guarantee Levels

Emissions

- **SO_2 - 0.06 lb/mmbtu**
- **SO_3 – 0.004 lb/mmbtu**
- **HCl – 0.0029 lb/mmbtu**
- **Filterable Particulate – 0.010 lb/mmbtu**
- **Total Particulate – 0.018 lb/mmbtu**
- **Hg – coal dependent**
- **Dioxins/Furans – limited data available**

Discussion Outline

- Acid Gas and CDS Technology Discussion
- CDS Process and Performance
- **CDS Case Study**
- CDS O&M Considerations

Case Study

	WTE	Industrial Boiler	Utility
MW	32 MW_e	65 MW_s	205 MW_e
Inlet Load	HCl 1.0 lb/mmbtu (755 ppm)	SO_2 2.5 lb/mmbtu (1,040 ppm)	SO_2 3.2 lb/mmbtu (1,400 ppm)
Removal (Emission)	95% (0.05 lb/mmbtu)	95% (0.12 lb/mmbtu)	98%+ (0.06 lb/mmbtu)
Lime Consumption	1,020 lb/hr	2,900 lb/hr	14,700 lb/hr
Power Consumption	1.5 – 3 %	1.5 – 3 %	~2%
Pressure Drop	14 inwc	14 inwc	14 inwc
Water Consumption	22 gpm	72 gpm	220 gpm
Maintenance Costs	$17 - 20 / kW	$15 – 17 / kW	$15 / kW
Capital Expenditure (material only)	$180 / kW	$150 / kW	$130 / kW

Discussion Outline

- Acid Gas and CDS Technology Discussion
- CDS Process and Performance
- CDS Case Study
- CDS O&M Considerations

O&M Considerations

- **Fuel – sulfur, chloride**
- **Water supply – solids, chloride**
- **Absorber outlet temperature**
- **Power consumption**
  - **>80% of power consumed by the ID Fan**
- **Lime consumption**
- **Reagent supply**
  - **Spare hydrators**
  - **On-site hydration > 2,200 lb/hr hydrated lime required**

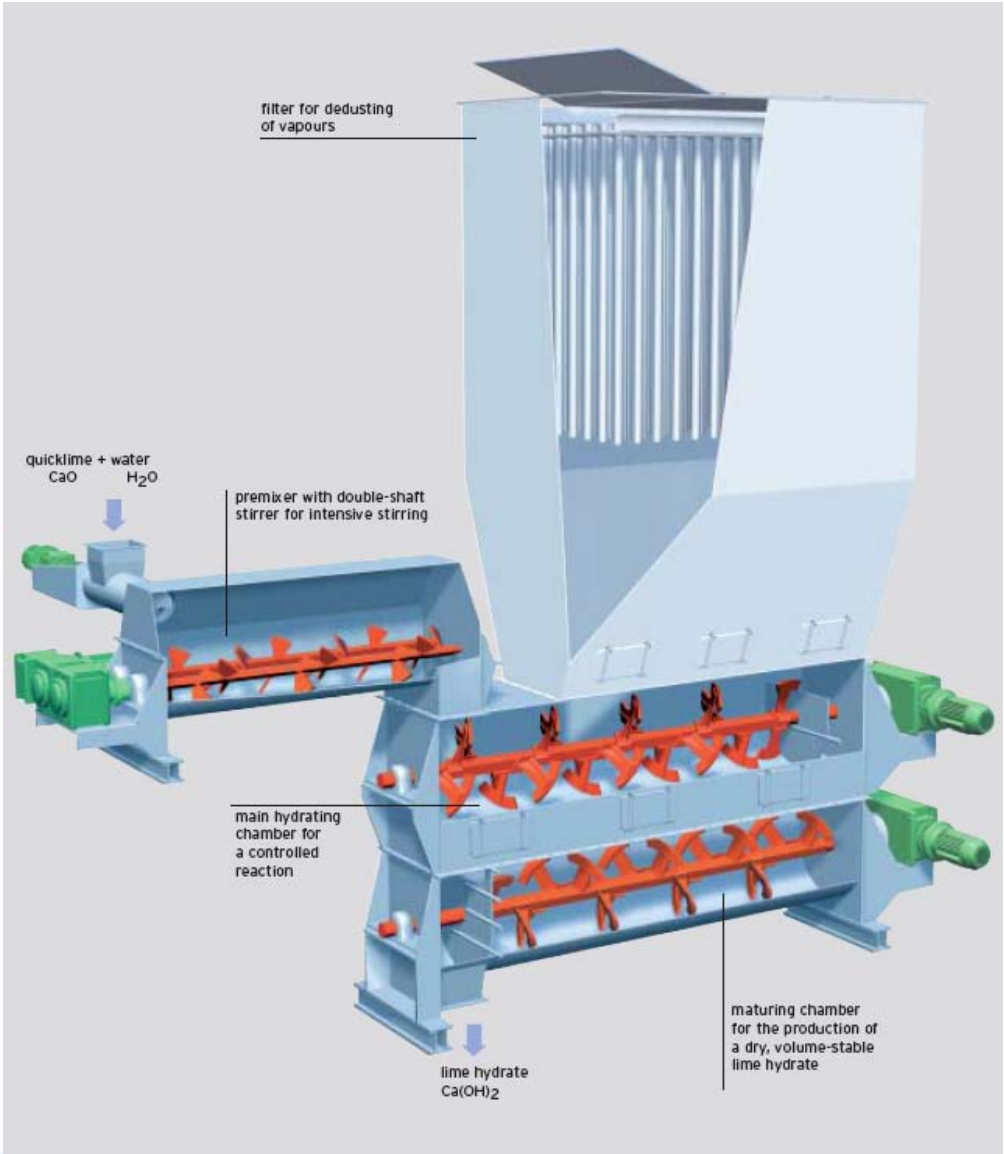
Stoichiometry

Design Stoichiometry is dependent on:

- **Removal efficiency**
- **Approach to the water dew point**
- **HCl-content in raw gas**
- **Hydrated lime quality**
- **Solids retention time in the absorber**
- **Reactive alkaline particles in fly ash**
- **Agglomeration of recycled solids**

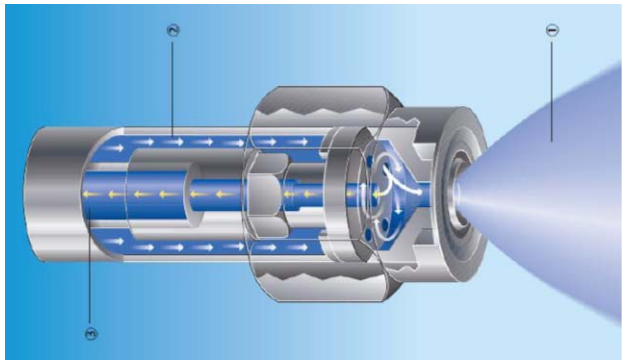
Lime Hydrators

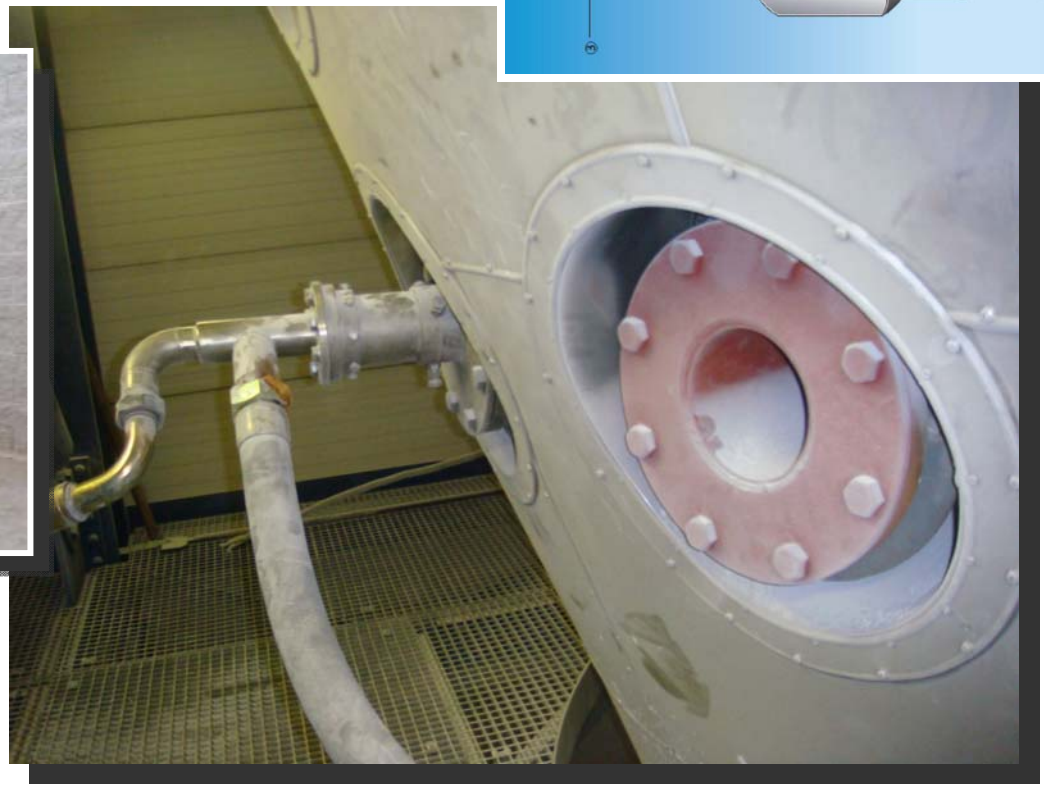
- Continuous operation
- Dry product
- Filter bag replacement
- Lime quality dependent



Water Supply and Injection System

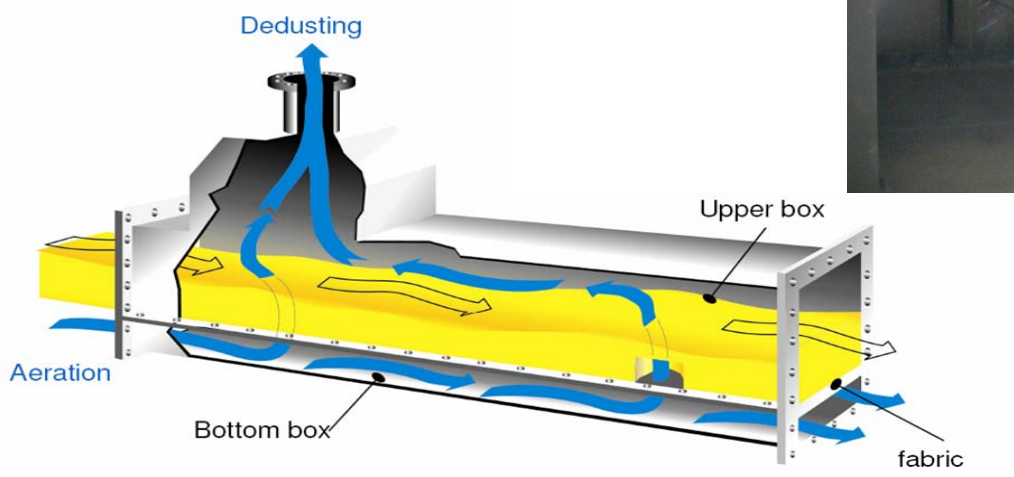
- **Multiple water injection points**
- **Online removal and replacement**
- **Adjustable depth for optimization**

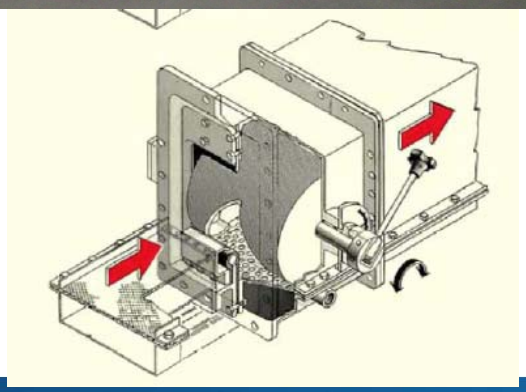




Solids Handling

- Byproduct composition
- Air slides
- Flow control gates
- Screw pumps





Today's Takeaways

- **CDS is a mature technology but is fairly new technology <u>in the US</u>**
- **Simple process that is generally low maintenance**
- **CDS can be applied to a range of fuels**
- **High acid gas removals can be achieved**

power generation group

Thank you!