Presentation to

2^{nd} US – China NO_x and SO_2 Control Workshop

Hosted by

US DOE Office of Fossil Energy
& Chinese Ministry of Science & Technology

Wet, Semi-Dry & Ammonia FGD Technologies

August 2005

MARSULEX

Presentation Contents

- ***Marsulex Company Overview***
- ***FGD Experience & Licensing Strategy***
- ***Conventional FGD Technologies***
  - *Wet Type*
  - *Semi-Dry Type*
- ***Advanced Ammonia-Based FGD***

Marsulex Power Group 2005 – Formation History

GE Environmental Services

- *Component of GE Power Systems Division (1981-1997)*
- *Predominant market segments were utilities and refineries*
- *Global market leader in wet FGD*
- *Market co-leader in refinery FCCU cyclones*
- *Developed & commercialized ammonium sulfate process in USA*

Marsulex in 1997

- *Publicly traded company (TSE)*
- *$400 million (Cdn) revenue*
- *Served refinery, smelting & industrial clients in N. America, Europe & Asia*
- *Creates value from sulfur byproducts*
- *Experienced in plant asset ownership, O&M, "fee for service" contracts*

Marsulex Power Group 2005

- *Developer of advanced air pollution control technologies – ammonium sulfate, potassium sulfate, liquid re-dist tech, and sulfur trioxide mitigation;*
- *Provider of environmental compliance solutions focused on opportunities where customers can lower operating and/or power generation costs using an advanced Marsulex technology;*
- *Leader in global applications of calcium-based technologies through extensive licensee network;*

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FGD Design Experience Summary

- ***Marsulex has 66,900 MWe of FGD technology experience in 21 countries***
- ***Technology Base includes conventional & advanced systems:***
  - *limestone with usable gypsum by-product*
  - *lime with disposable by-product*
  - *soda ash with usable by-product*
  - *ammonia with ammonium sulfate fertilizer by-product*
- ***Experience base includes wide range of fuel characteristics, system configurations and materials of construction***
  - *low sulfur (<0.5% wt) to high sulfur (>5.0% equivalent) fuels*
  - *worldwide leader in single absorber per boiler installations*
  - *various reheat schemes, reagent preparation and dewatering options*
  - *"multiple boilers into single vessel" experience*
  - *vessel construction using carbon steel, alloys, fiberglass and concrete substrates*
  - *corrosion protection using FRP/GRP & rubber linings, alloys and tiles linings*
- ***Experienced in applying various business models***
  - *Lump sum, firm price (historic)*
  - *Technology Licensing*
  - *Cost reimbursable with fixed fee*
  - *Build, own, operation & maintain (BOOM)*

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Marsulex FGD Installations

Marsulex's technology licensing strategy has resulted in global leadership in the application of FGD technology – over 30 years of experience

Total FGD Awards:	***66,500 MWe***
• ***United States***	***20,000 MWe***
• ***International Total***	***46,500 MWe***
➢ ***W. Europe***	***18,405 MWe***
➢ ***Asia***	***22,715 MWe***
➢ ***E. Europe***	***3,795 MWe***
➢ ***Other (Can, SA, Scandinavia)***	***1,585 MWe***

Marsulex has Extensive Experience - USA & Around the World

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Marsulex Technology Licensing

Marsulex's business strategy:

- *Develop cost-effective flue gas desulfurization technologies*
- *Improve the technologies through R&D to ensure competitiveness in international markets*
- *Seek strong, local licensee partners*
- *Transfer technology to enable licensees to become self-sufficient*

Marsulex licensees have become highly respected as independent entities:

- *L.C. Steinmueller (currently part of Fisia BBP Environmental*
- *IHI*
- *Austrian Energy & Environment*
- *Doosan*
- *Hoogovens (currently Corus)*

Marsulex Licensees' Success Reflects Effective Technology Transfer

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Current Marsulex Licensed FGD Installations in China

Plant	Licensee	MW	Status
Shaojiao	ECE	1x300	Startup 2/2005
Gaojing	ECE	4x400	In startup
Chaozhou	ECE	2x600	In design
Baotou	CHEC	2x300	In design
Shimen	CHEC	2x300	In design
Heze	CHEC	2x300	In design
XiangFan	CHEC	2x600	In design
Kunming	CHEC	2x300	In design
Dalong	CHEC	2x300	In design
Wanting	CHEC	1x320	In design
Dafang	CHEC	2x300	In design
Tongling	CHEC	1x300	In design
Qinzhou	SEPEC	2x600	In design
Wusitai	KRJS	2x300	In design

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Wet FGD Technology
Lime & Limestone/Gypsum

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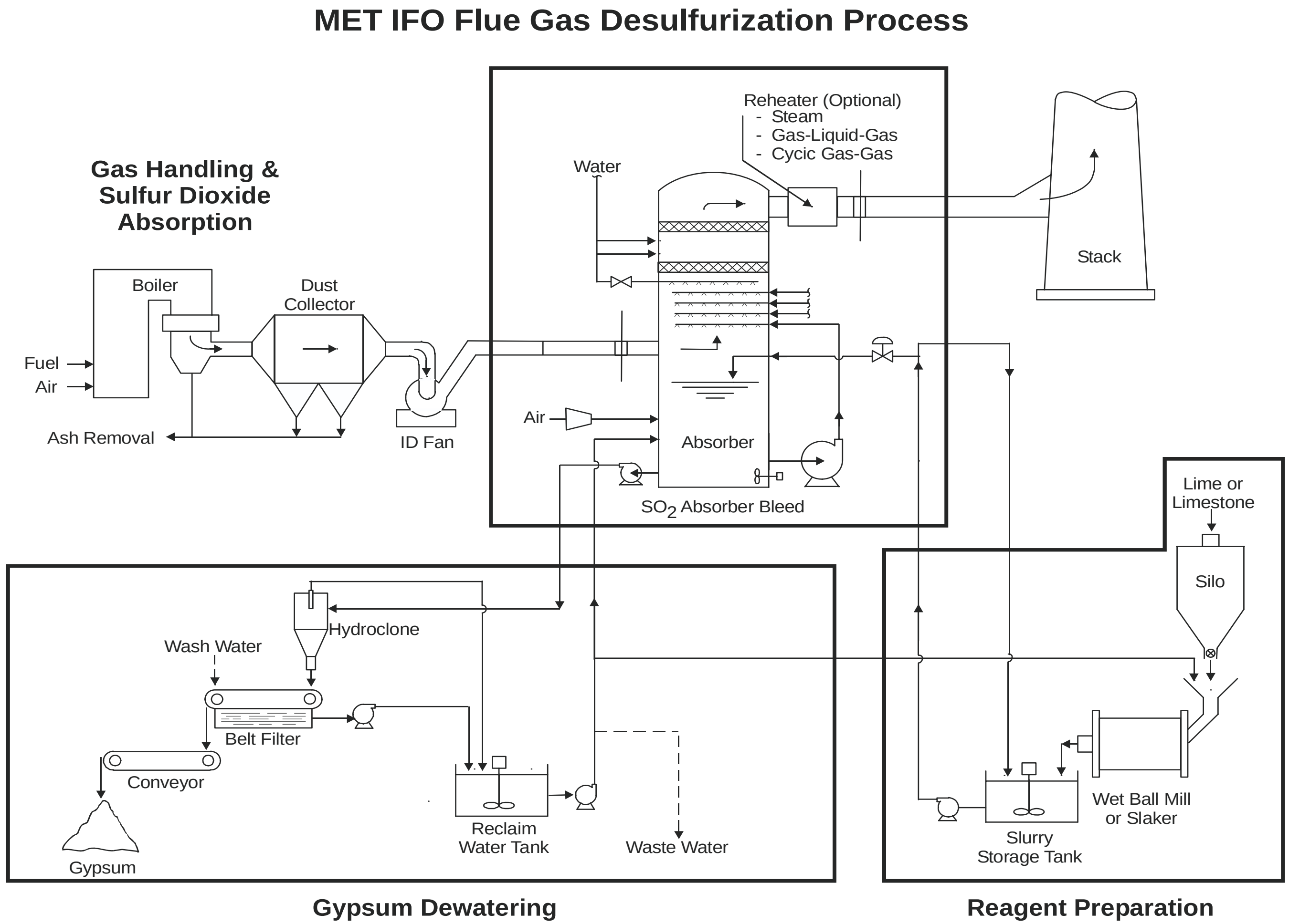
Lime & Limestone / Gypsum Process Flow Diagram - Basic



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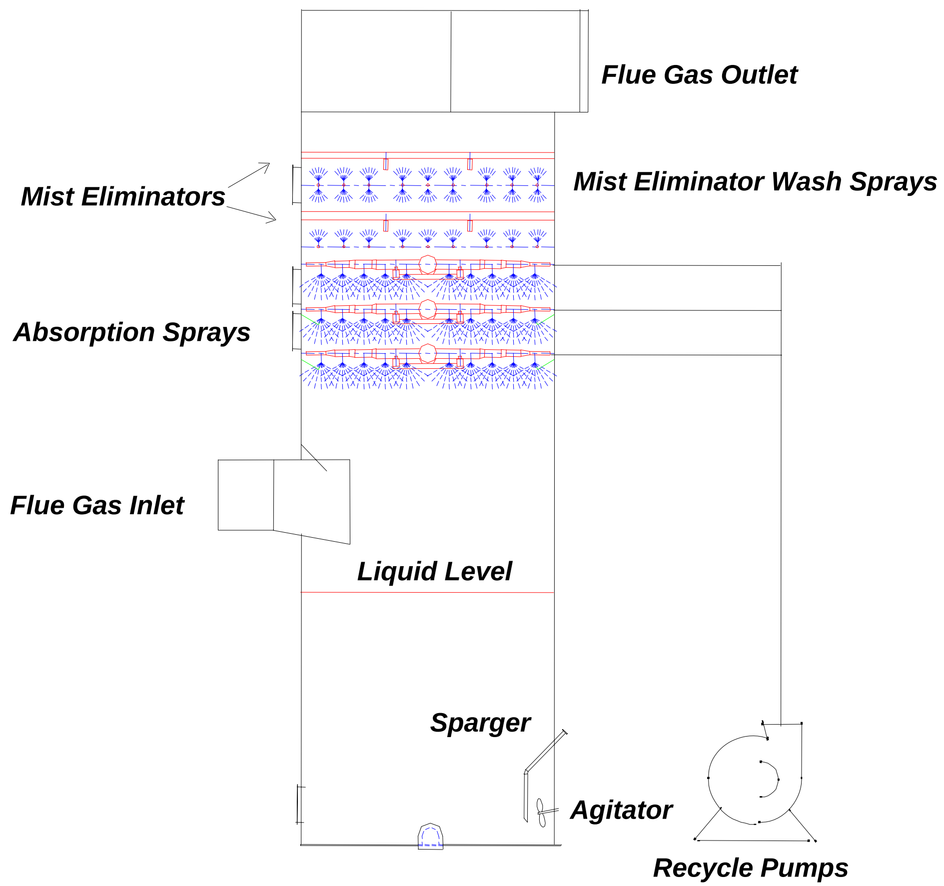
Wet Flue Gas Desulfurization Process

Conventional Absorber (Spray Tower Design)



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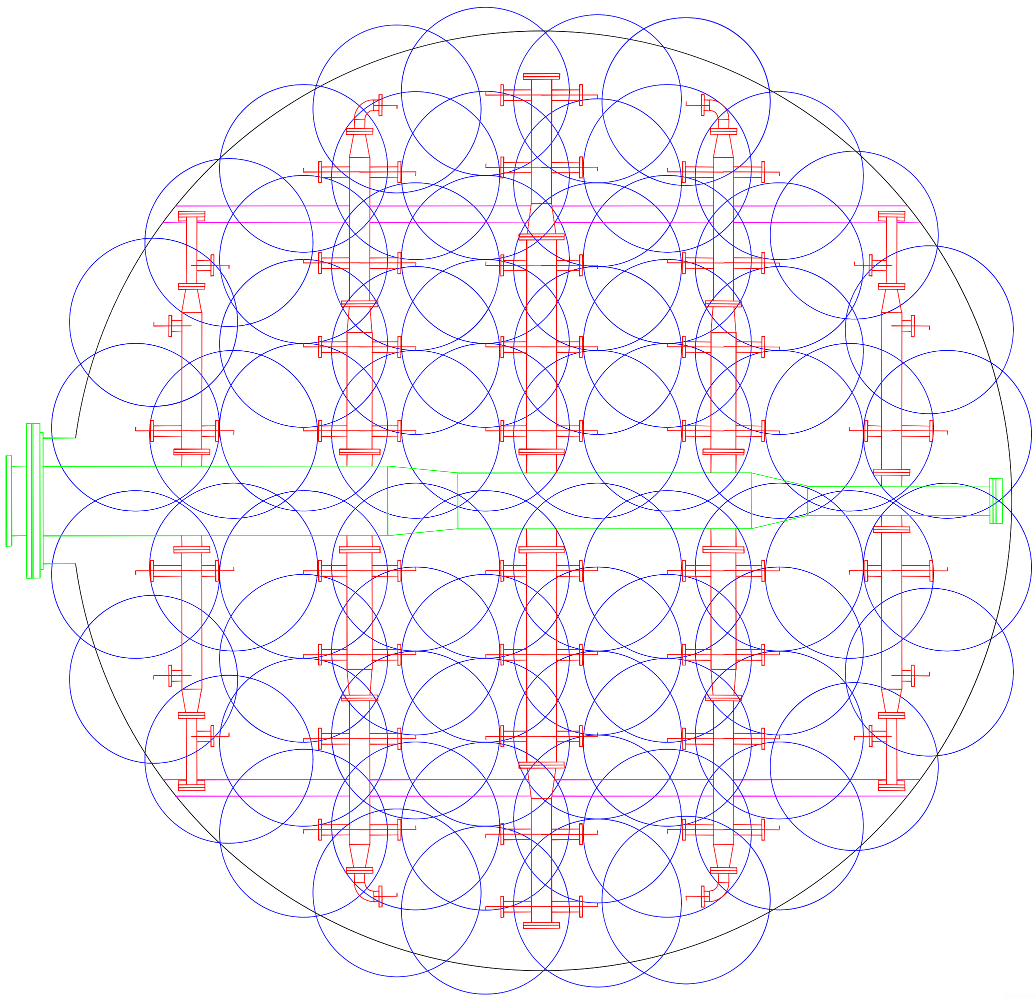
Typical Absorption Zone Spray Nozzle Configuration



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Demonstrated WFGD Technology Enhancements

High Velocity Operation

- ***Operation of several early FGD systems above design points has verified gas velocity impact on absorber design***
  - Santee Cooper, Cross Unit #1 - 550 MW – 3.7 mps
  - APS Harrison, Units 1-3 - 3 x 650 MW – 3.7 mps
  - AEC, BL England Station, Unit #2 - 170 MW – 3.4 mps
  - IP&L Petersburg Units 1&2 - 278 MW & 438 MW – 3.4 mps design
- ***Good results resulted in several designs above 3 mps***
  - KDHC - 2 x 50 MW – >4.0 mps
  - DGC (ammonium sulfate) 1 x 300 MW – 3.4 mps
  - KEPCO - Yosu Units 1&2 250 MW & 400 MW – 4.0 mps
- ***All units have met SO_2 removal performance and verified design basis for SO_2 removal and pressure drop***
- ***Advantages of higher gas velocity is improved mass transfer resulting in lower cost designs***

Marsulex's extensive high velocity experience results in standard designs up to 4.0 mps

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MLX High Velocity Scrubber - Pilot Test Facility

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Demonstrated WFGD Technology Enhancements

Tower Dimension Optimization

- ***Independent verification of reaction zone height impact on model performed by Dr. Gary Rochelle of University of Texas for Marsulex***
- ***Optimum absorber dimensions result in similar reaction zone:***
  - Inlet stub to first spray level
  - Distance between sprays
- ***Recent units have used optimum dimensions to balance SO_2 removal with pressure drop to optimize capital and operating cost***

Marsulex's extensive experience results in optimized design to minimize capital and operating costs

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Demonstrated WFGD Technology Enhancements

High Velocity Mist Eliminators

- ***Standard chevron mist eliminators demonstrated successfully at high velocity:***
  - Santee Cooper, Cross Unit #1 - 550 MW
  - APS Harrison, Units 1-3 - 3 x 650 MW
  - AEC, BL England Station, Unit #2 - 170 MW
- ***Exceptional results from high velocity mist eliminators at DGC:***
  - Approximately 60 mg/Nm^3 at velocities exceeding breakthrough
  - At velocities of > 4.1 mps, small amounts of breakthrough measured

MLX's extensive high velocity experience employs state of the art mist elimination devices for high velocity applications

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Demonstrated WFGD Technology Enhancements

Absorber Liquid Re-Distribution Device

- ***Flue gas contact with recycle liquid along wall results in phenomenon known as wall slip***
- ***Several Phase 1 units tested for wall slip phenomenon:***
  - AEC BL England Unit #2, 1 x 170 MW
  - IP&L Petersburg, Units 1&2; 278 MW & 438 MW
- ***Most units show 99-100% SO_2 removal in center center area of tower***
- ***Absorber Liquid Distribution (ALRD) device installed commercially demonstrated in several units at over 300 MW with outstanding results;***
  - ***2-5% SO2 efficiency improvements on 90% “baseline” efficiencies;***
  - ***In some cases, ALRD will enable the reduction of one recycle pump while maintaining constant or improved SO2 efficiency;***
- ***ALRD patent has been awarded to Marsulex in USA; other countries in process;***

Application of MLX ALRD Technology Offers Economical Efficiency Upgrades or Power Savings

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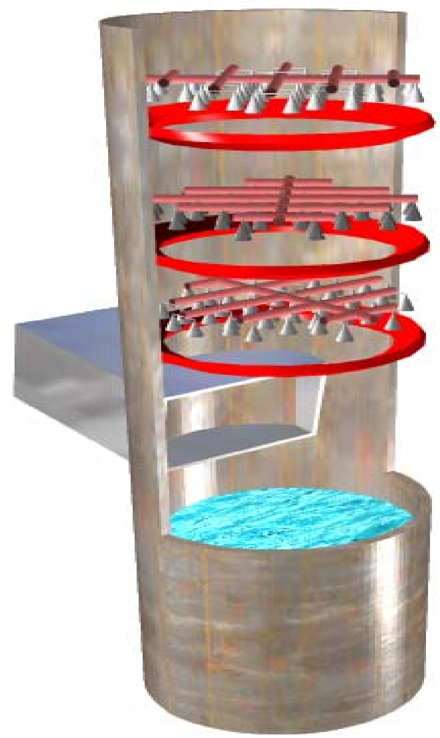
Absorber Liquid ReDistribution Device



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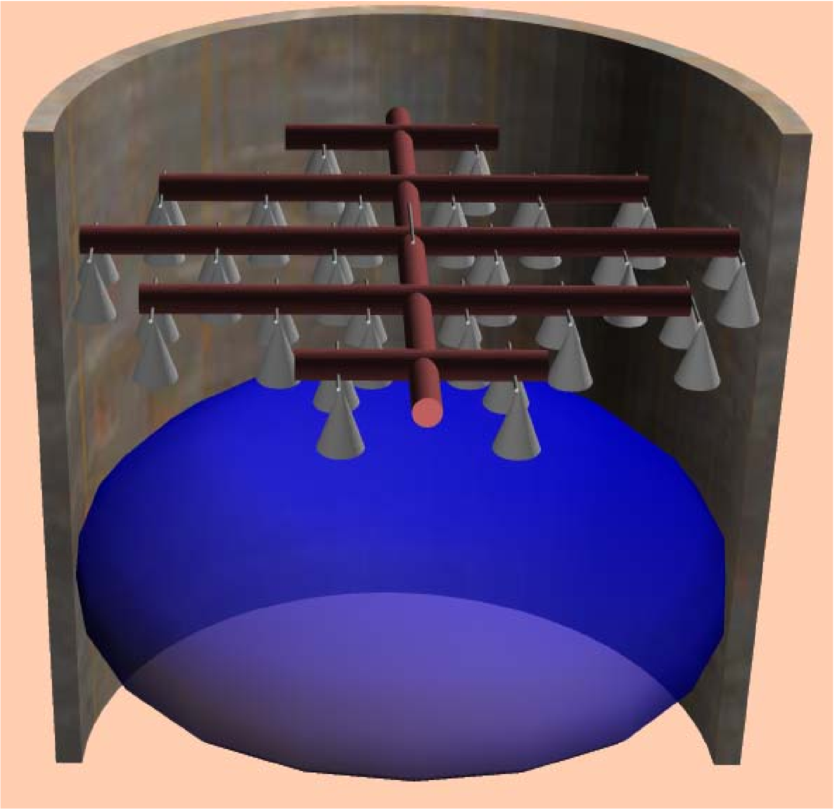
What is Sneakage?

- ***Sneakage, (noun) flue gas which goes untreated or essentially untreated due to poor gas-liquid contact***
  - *Poor nozzle layout*
  - *Insufficient nozzle coverage*
  - *Uneven spray density*



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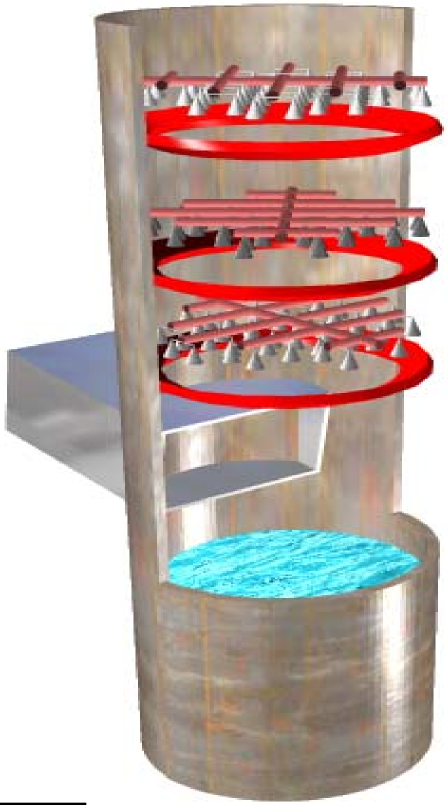
What are Absorber Liquid Re-Distribution Rings?

- ***Located below each spray level***
  - *redistributes liquid running down the absorber walls*
  - *acts as wall nozzles and evens out the liquid density profile*
  - *dramatically improves SO_2 removal performance*



Proprietary and Patented Technology

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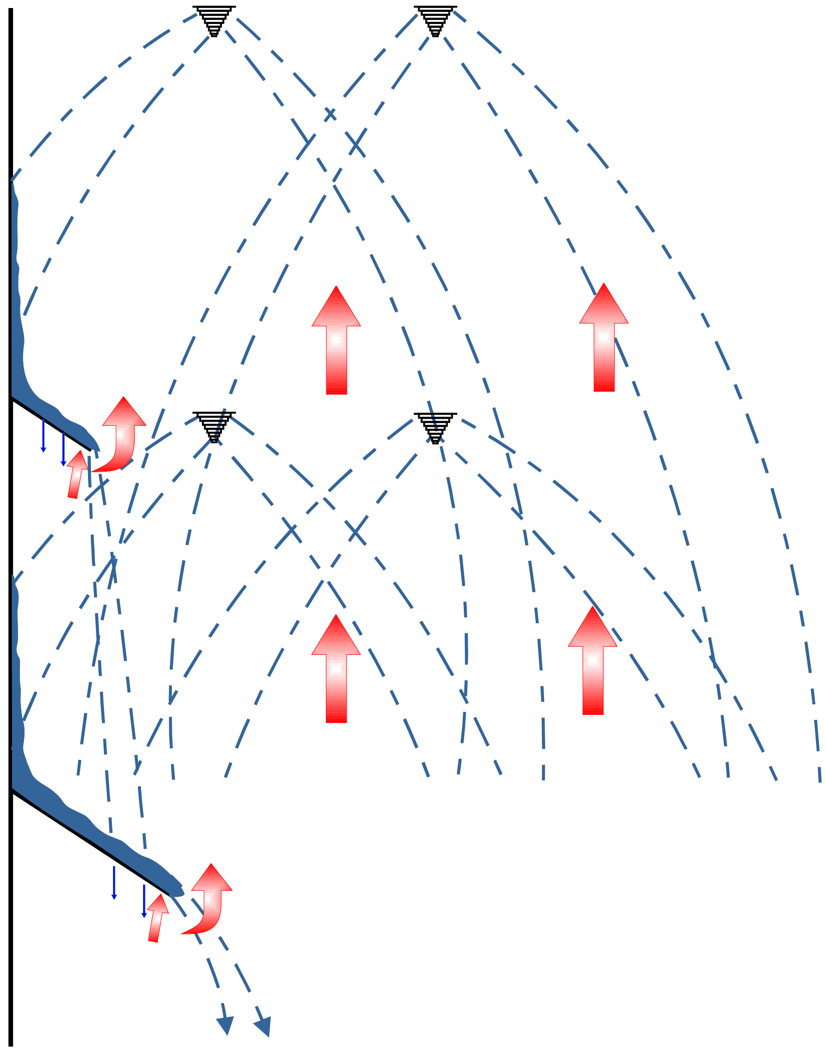
Absorber Liquid Distribution Device



- *Slurry / liquor on wall re-entrained*
- *Gas / liquid evenly distributed*
- *Improved gas-liquid contact near wall*
- *Lower pH slurry / liquor*

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Demonstrated WFGD Technology Enhancements

Example: Dakota Gasification ALRD Performance

- ***Ammonia absorber, 13.3 m diameter***
- ***Four (4) operating recycle spray levels***
- ***93% SO_2 removal initially (design value)***
- ***Three (3) ALRD units installed***
- ***Improvement to 96% - 97.7% SO_2 removal with ALRD units***
- ***Enables lower operating pH or saving of recycle pump power***

ALRD Technology Can Improve Efficiency & Reduce Power Consumption

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Semi-Dry FGD Technology

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General Description

- ***The primary element in the process is a spray dryer using flue gas as the drying medium.***
- ***The material dried is an alkali sorbent slurry which captures SOx present in the flue gas as drying process occurs.***
- ***The SOx is absorbed and chemically neutralized by a fine spray or sorbent droplets.***
- ***Chemical reactions are the same as in wet lime FGD, but kinetics are more involved due to the tie-in with the drying process occurring simultaneously.***
- ***Reaction products are dried to a particulate collected along with flyash. Further reactions occur in fabric filter.***
- ***Other major elements are the sorbent preparation system, particulate collector and waste handling system.***

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Dry FGD vs Wet FGD

- ***Dry FGD uses lime (CaO), Wet FGD uses Limestone ($CaCO_3$)***
- ***Dry FGD for <95% SO_2, Wet FGD >95% SO_2***
- ***Dry FGD for coal sulfur <2%***
- ***Dry FGD limited to approximately 300 MW / absorber***
- ***Dry FGD has lower up-front cost, higher operating cost***
- ***Wet FGD byproduct gypsum ($CaSO_4$), Dry byproduct is landfill***

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Spray Dryer Absorber Design

SDA Features:

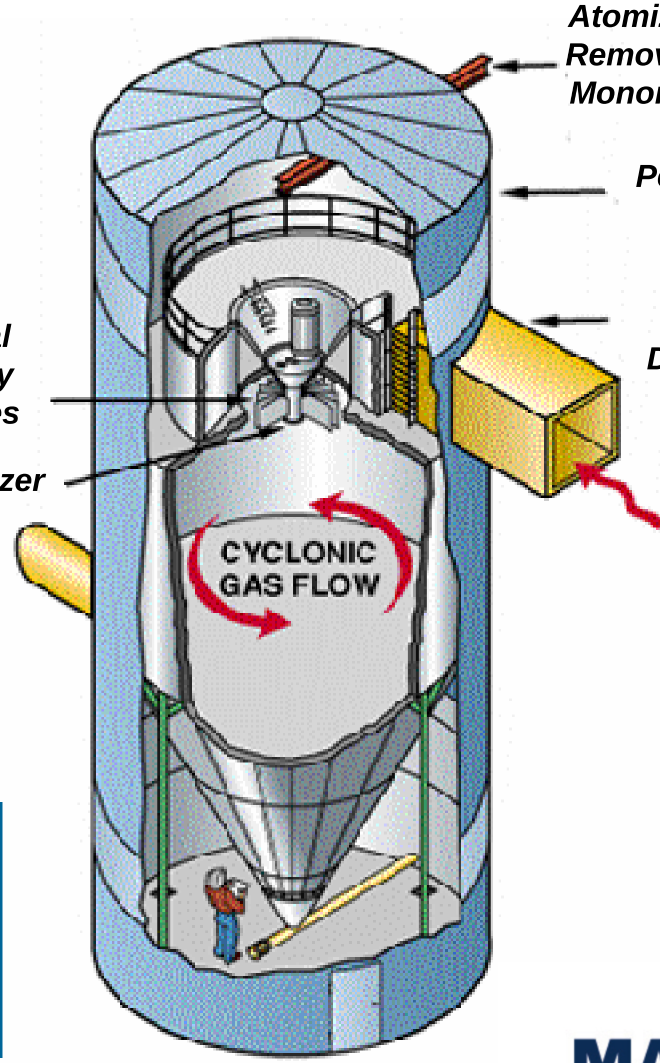
Single Atomizer / Single Gas Inlet

- ***Symmetrical flow***
- ***Simple gas distribution / turn down***
- ***Complete gas / slurry mixing***
- ***Elimination of wall buildup***

Cyclonic Flow / High Exit Outlet Design

- ***Particulate dropout: 10 – 20%***
- ***Reduced outlet dust loading***
- ***Optimized system pressure drop***
- ***Protection during upset conditions***

Design Simplicity and Symmetry Result in Higher System Performance, Flexibility and Reliability



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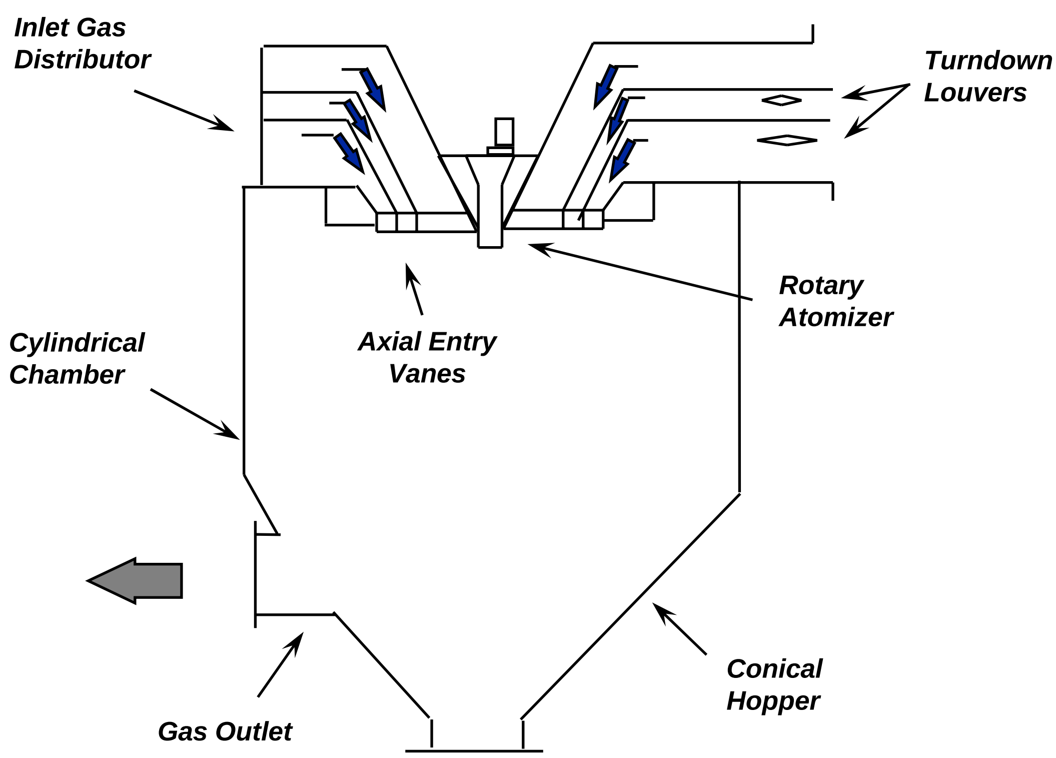
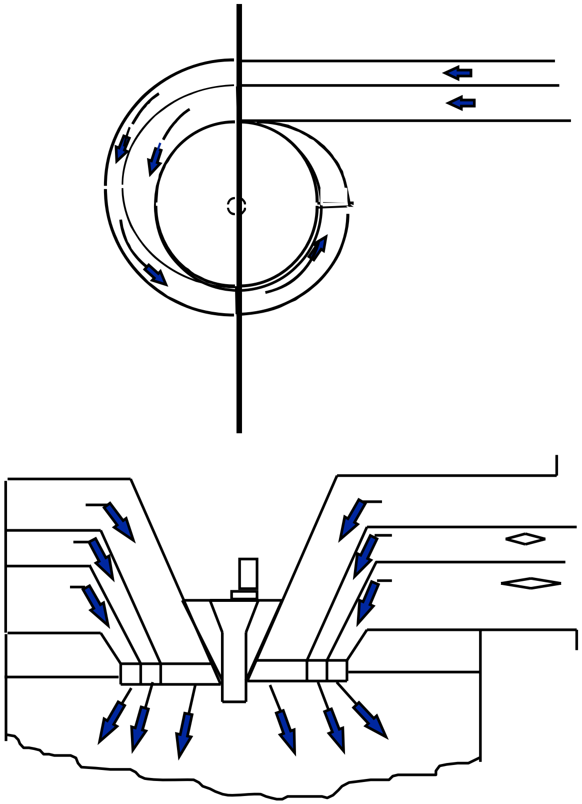
Gas Flow Mixing and Control Devices



Spray Dryer Absorber



Inlet Gas Distributor

Gas Disperser Design Critical to System Flexibility and Performance

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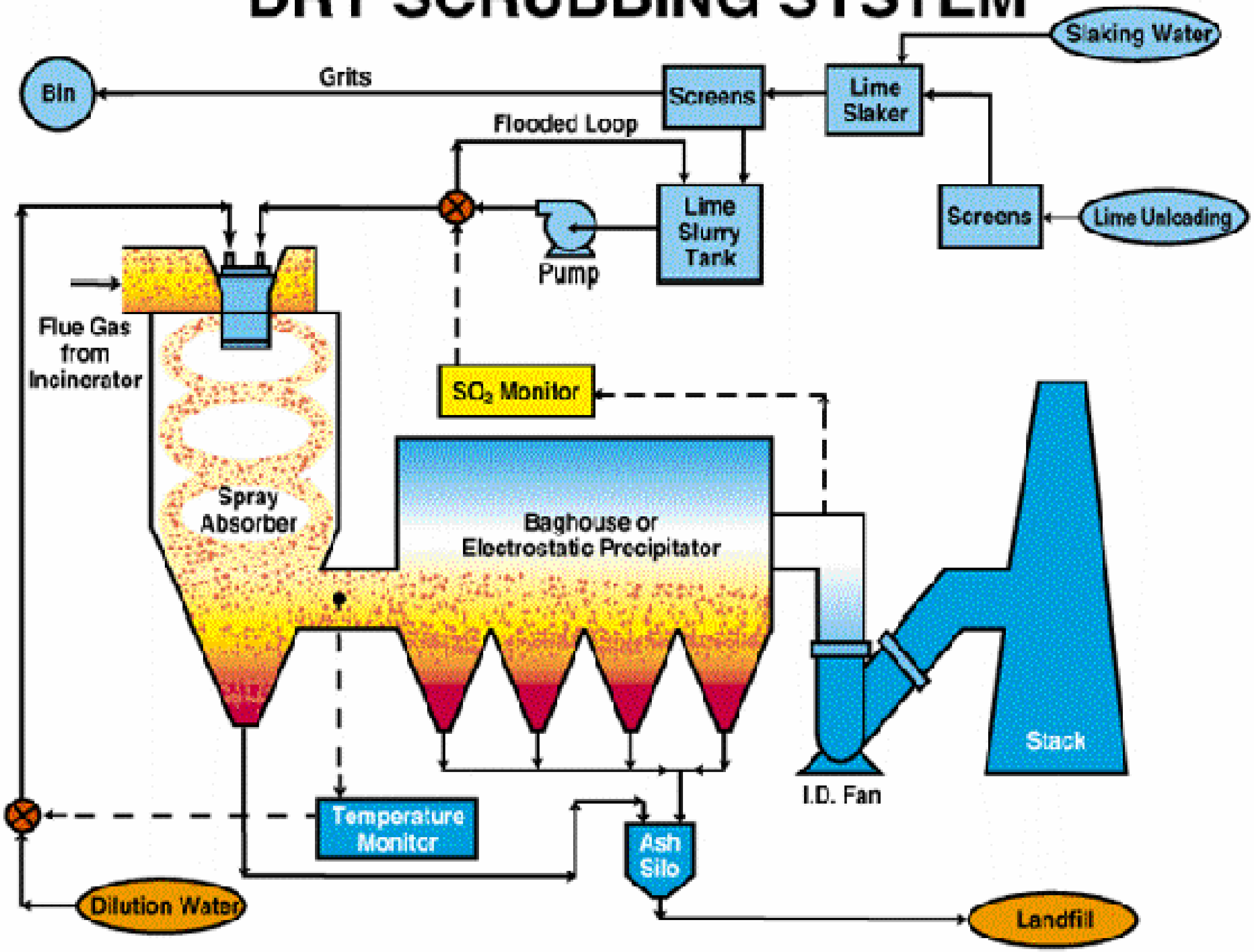
DRY SCRUBBING SYSTEM



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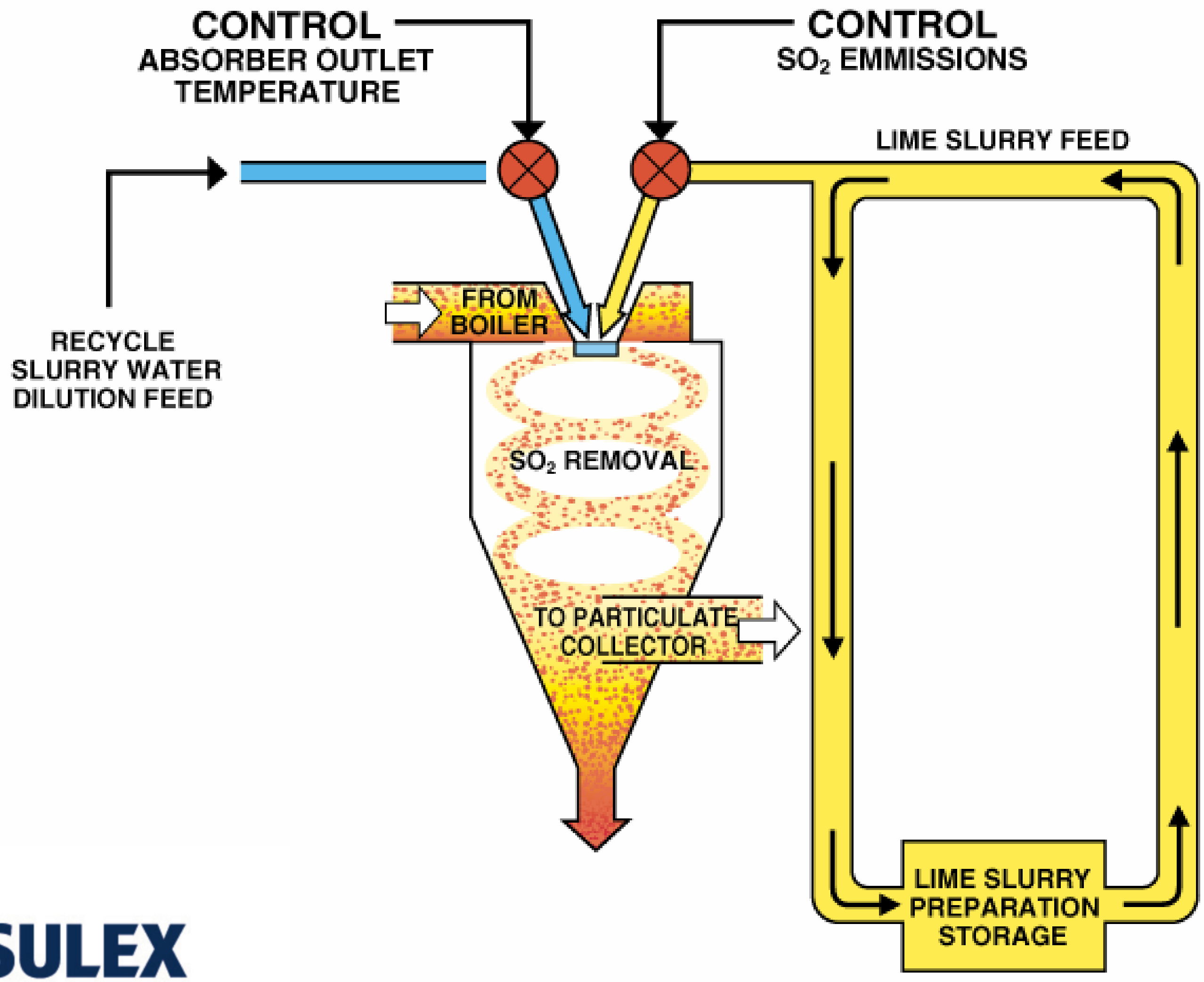
TWO LOOP CONTROL



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Marsulex DFGD System Differentiators

Direct Drive Atomizer ⇒
- *Minimized atomizer maintenance*
- *Operating speed flexibility*
- *Lowest power consumption*

Two Loop Control ⇒
- *Independent slurry supply lines*
- *Most responsive to load swings*
- *Optimum lime utilization*

Single Top Inlet Design ⇒
- *Maximum control for turndown*
- *Optimum gas/slurry mixing*
- *Elimination of wall buildup*

System Differentiators Ensure Meeting Availability & Performance Requirements

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Atomizer Design

Rotary Atomizer

- ***Demonstrated technology by GE & Anhydro***
- ***5 HP to 600 HP units in operation***
- ***Over 2,800 atomizer installations***

Reliable & Low Maintenance Drive Systems

- ***Flat belt drive up to 200 HP***
- ***Variable speed direct drive over 200 HP***
- ***Speed variation simple and flexible***

Lubrication System

- ***Once through oil mist***
- ***No special filters, coolers or recirculation pumps***
- ***Maximum bearing service life***

Key Material Selections

- ***Stainless steel for wet slurry contact***
- ***Solid stainless steel or C22/276 alloy atomizer wheel***
- ***Silicon carbide nozzles and tiles in atomizer wheel***

Demonstrated Atomizer Design Applied to FGD & DAGS Installations

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Rotary Atomizer Selection Summary

Application	***Model***	***Drive System***	***HP Range***
FGD & DAGS	CF-250	Flat Belt	25 - 75 HP
FGD & DAGS	CC-400	Flat Belt	75 - 200 HP
FGD	CD-400	Direct Coupled	200 - 425 HP
FGD	HCA-400	Direct Coupled	425 - 800 HP

FGD - Flue Gas Desulfurization
DAGS - Dry Acid Gas Scrubbing

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Model CD-400 Atomizers w/315 KW Motors in Maintenance Stand

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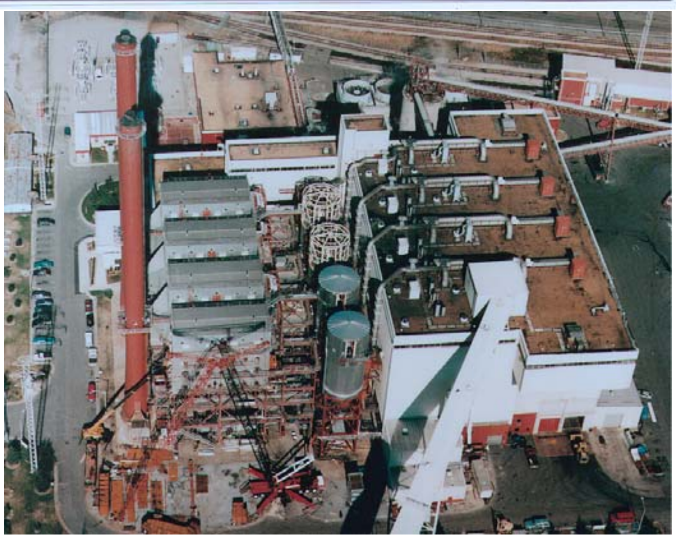
Southeastern Public Service Authority, Virginia
Norfolk Naval Shipyard



Fuel..........................MSW-RDF

Inlet Gas Volume

(acfm)...................... ..147,000

Unit Rating (tpd)................4x560

Reagent..................Pebble Lime

Absorber Type..........Spray Dryer

Removal Efficiency

SO_2...................................85%

HCl...................................95%

Startup Date..............1996-1997

Low cost retrofit of Dry Acid Gas Scrubbing System that includes retrofitting a pulse jet baghouse into the existing precipitators.

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MLX Two-Loop Control System

A major advantage of the MLX Two-Loop Control System (separate lime slurry and recycle slurry flooded loops) is:

Quick response to upsets like steam sootblowing.

This is accomplished by backing off recycle slurry flow without allowing the SO_2 emissions to increase.

The lime slurry flow is essentially unaffected.

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Preferred Lime Type

- ***Soft burned rotary kiln***
- ***High reactivity***
- ***Available CaO of 88 - 96%***
- ***Pebble type (1/4” - 3/4”)***
- ***Quick Slaking***
- ***70°F temperature rise in 3 minutes @ 3-4:1 water/lime mixture***

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Waste Product Characteristics

- ***Dry, free-flowing powder***
- ***Spray absorber - fabric filter virtually the same product***
- ***20-25% added moisture yields compressive strength >45psi after 25 days curing***
- ***Product is stable and non-leaching***
- ***Permeability - 10^{-6}***
- ***Heavy metals extraction shows levels typically below EPA maximum***

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Dry Scrubbing Experience

Project	*Fuel & Unit Rating*	*Removal Efficiency*	*Startup*
City of Colorado Springs Martin Drake Station	(1.0+% S)	40% - 99% SO_2	1979
Board of Light & Power Marquette, MI Shiras Unit 3	Coal (1.5% S) 44 MW	80% SO_2	1983
Maine Energy Recovery Co. Biddeford, ME	MSW-RDF, Wood, Oil 2 x 300 TPD	80% SO_2, 95% HCl	1987
EPRI High Sulfur Test Center NYSE&G Kintigh Station	Coal (4% S)	70% - 93% SO_2	1987
PETC - Department of Energy In-Duct Scrubbing Project	Coal (4% S)	30% - 60% SO_2	1987
Penobscot Energy Recovery Co. Orrington, ME	MSW-RDF, Wood, Oil 2 x 400 TPD	92% SO_2, 95% HCl	1988
Puget Sound Naval Shipyard Bremerton, WA	Coal (1.7% S) 20 MW	85% SO_2	1988
United Power Association Elk River Station	MSW-RDF 1,050 TPD	90% HCl	1989

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Dry Scrubbing Experience

Project	Fuel & Unit Rating	Removal Efficiency	Startup
Turners Falls Cogen Turners Falls, MA	Coal (3.0% S) 25 MW eq	90% SO_2	1989
T.E.S. Cogen Filer City, MI	Coal & Wood Waste (3.0% S) 60 MW	90% SO_2	1990
SPSA - Navy Power Plant Portsmouth, VA	MSW-RDF 4 x 550 TPD	85% SO_2, 95% HCl	1995/96
SKODA Energetika Plzen, Czech Republic	Lignite Coal (1.2% S) 120 MW eq	90% SO_2	1996
CEZ Elektrarna Ledvice, Czech Republic	Lignite Coal (1.2% S) 2 x 160 MW eq	85% SO_2	1996
Cokenergy - HRCF East Chicago, IN	Coal (1.5% S) 300 MW eq	83% SO_2 (across SDA)	1998
Elektrownia Siersza, Poland	Lignite Coal (1.2% S) 150 MW eq	87% SO_2	1998
Quezon Power Mauban, Philippines	Coal (1.0% S) 510 MW	73% SO_2	1999
Edmonton Power Co. Genesee Unit 3 Alberta, Canada	Sub-bituminous Coal (0.32% S) 490 MW	80% SO_2	2004

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Wet FGD Technology

Advanced Ammonium Sulfate

New Market Factors Drove Ammonia Technology Development

Emissions trading mechanisms created new "competition"

- ***USA's Clean Air Act Amendments of 1990 created "emissions trading" mechanism***
- ***Utilities' true cost of SO_2 emissions, absent local or extraordinary regulations, became "the value of credits on the market"***
- ***Credits reached relatively low levels of approximately US$ 63 per ton in the 1990's***
- ***This low cost of "compliance" estabished a very high, competitive "bar" for conventional FGD technologies***
- ***A new approach was needed, one which could compete with low emission credit values***

Marsulex (then General Electric) developed and commercialized an improved version of ammonia scrubbing technology

Marsulex's Ammonium Sulfate FGD Technology
Meets the Competitive Challenge
by Lowering Compliance Costs

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Ammonium Sulfate Process Chemistry

$$SO_2 + 2NH_3 + H_2O \longrightarrow (NH_4)_2SO_3 \quad (1)$$

$$(NH_4)_2SO_3 + 1/2\ O_2 \longrightarrow (NH_4)_2SO_4 \quad (2)$$

- *For every kilogram of SO_2 removed:*
  - *Need one-half kilograms of Ammonia*
  - *Produces two kilograms of Ammonium Sulfate*
- *One tonne of Ammonia generates four tonnes of Ammonium Sulfate*

Economic leverage derived from the 4:1 production ratio between ammonium sulfate and feed stock ammonia

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Annual Net Back Analysis

	Ammonium Sulfate Process ($MM)	Limestone/Gypsum Process ($MM)
Reagent Cost	(8.0)*	(1.8)**
Byproduct Revenues	19.0*	(1.3)**
Net Back	11.0	(3.1)

Ammonium Sulfate Process Generates Positive Revenues

* Ammonia $145/ton; Consumption 56,000 ton/year
Ammonium Sulfate $85/ton; Production 224,000 ton/year

** Limestone $10/ton; Consumption 180,000 ton/year;
Gypsum $-4/ton; Production 330,000 ton/year

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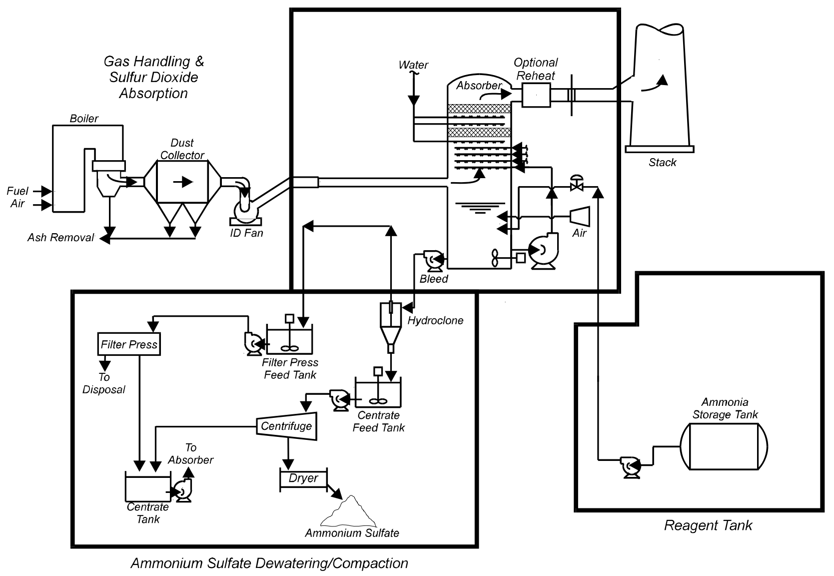
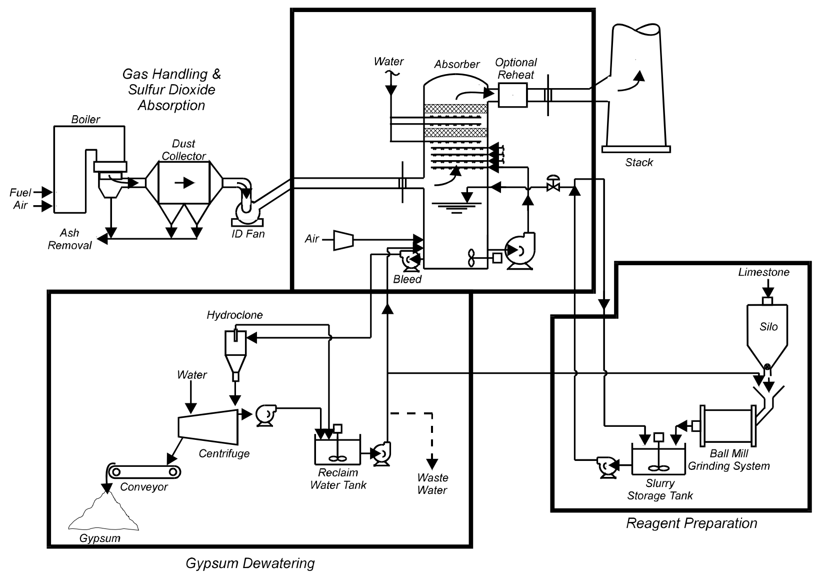
Process Comparison

Ammonium Sulfate Process



Limestone/Gypsum Process



Based on Proven Equipment - Different Reagent

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Ammonia Scrubbing Basis of Design

First Generation Ammonia Systems

- *First Attempts At Ammonia Scrubbing Utilized High Ammonia Reactivity Resulting in Very Aggressive Absorber Designs - pH, L/G, Absorber Size*

- *As a Result, Early Generation Ammonia Scrubbers Resulted Very High Ammonia Slip and High Opacity Issues*

- *Higher pH's and Incomplete Oxidation Produce Free Ammonia in the Gas Phase*

MET Ammonia Scrubbing Process

- *MET Demonstrated and Patented Optimum Operating Range to Minimize Ammonia Slip And Opacity*

- *Free Ammonia in the Gas Phase Determines opacity Levels and is a function of Three Process Parameters; pH, Degree of Oxidation and Ammonia Injection Methods*

- *MET Demonstrated Minimal Gas Phase Ammonia and Zero Impact on Opacity From Ammonia and Ammonium Salts*

Essence of MET Patents Ensures Operation In Optimum pH Range, Complete Oxidation and Optimum Ammonia Injection Methods

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Ammonia Scrubbing Technology Summary

Ammonia Scrubbing Development History:

- *1985-87 Developed bench-scale ammonia scrubbing technology*
- *1987 GEESI awarded first ammonia scrubbing patent*
- *1992-93 10 MW pilot demonstrated for two modes of operation*
- *1994 Awarded commercial contract with DGC*
- *1994 Second ammonia scrubbing patent awarded*
- *1996-97 Startup and successful demonstration of 350 MW eq. Ammonia scrubbing with production of granular ammonium sulfate*
- *1997 Marsulex purchased substantially all the assets of GEESI*
- *1998 Applied for three (3) additional patents*

Commercial NH_3 System Performance at DGC:

Design Parameter	***Guarantee***	***Performance***
SO_2 Removal Efficiency	*93%*	*95-98+%*
Ammonia Slip, ppm	*< 10*	*3 – 7*
Opacity	*<4% from NH_3*	*0% from NH_3*
Pressure Drop, "WC	*< 11*	*7 – 8*
Purity, %	*99*	*99.5*
Moisture, wt%	*< 1.0*	*< 0.1*
Hardness, %	*< 5*	*1 – 2*
Size Guide Number	*240 – 290*	*240 - 260*

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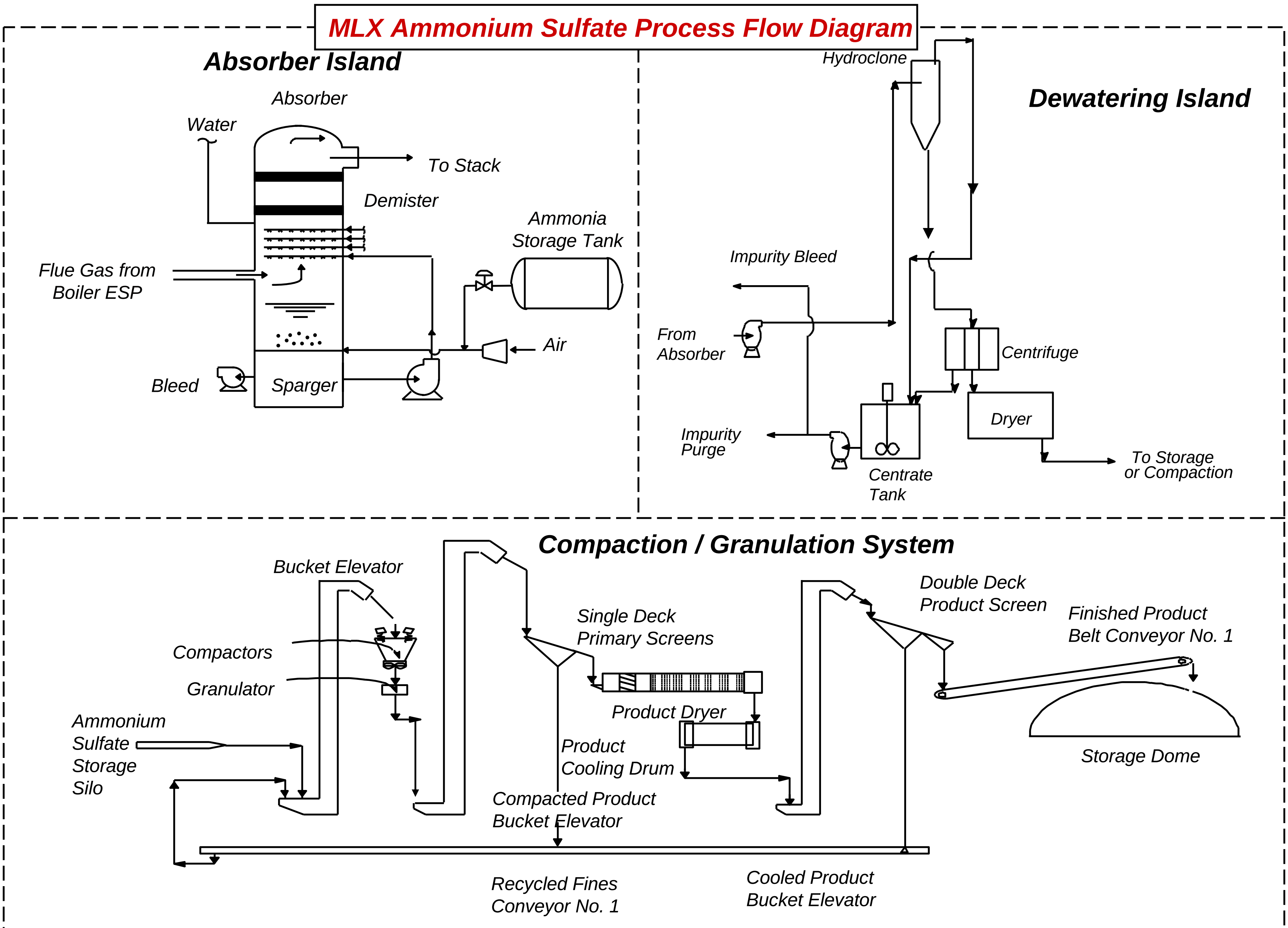

MLX Ammonium Sulfate Process Flow Diagram
Absorber Island
Absorber
Water
To Stack
Demister
Ammonia
Storage Tank
Flue Gas from
Boiler ESP
Air
Bleed
Sparger
Hydroclone
Dewatering Island
Impurity Bleed
From
Absorber
Centrifuge
Dryer
Impurity
Purge
Centrate
Tank
To Storage
or Compaction
Compaction / Granulation System
Bucket Elevator
Single Deck
Primary Screens
Double Deck
Product Screen
Finished Product
Belt Conveyor No. 1
Compactors
Granulator
Product Dryer
Ammonium
Sulfate
Storage
Silo
Product
Cooling Drum
Storage Dome
Compacted Product
Bucket Elevator
Recycled Fines
Conveyor No. 1
Cooled Product
Bucket Elevator

Dakota Gasification Company, North Dakota
Great Plains Synfuels Plant, 350 MW

Fuel..........................Heavy Resid.

% Sulfur................................5.0%

Inlet Gas Volume

(acfm)........................1,187,000

Reagent........................Ammonia

Absorber Type.........Spray Tower

SO2 Efficiency Capability...98+%

Startup Date.......................1996

The DGC subsidiary of Basin Electric is a partner in the first application of MLX's patented ammonium sulfate FGD technology. This process produces a high value byproduct which can generate a positive revenue stream for the Owner, thus offsetting a portion of the operating expenses of the system. DGC selected the MLX process over conventional limestone scrubbing.

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Optimizing the Value of Ammonium Sulfate FGD Product

Ammonium Sulfate is produced in two main forms:

- *Standard grade crystals which are sugar-like in appearance;*
- *Granular product in the 1.0 – 3.5 mm size range depending on local preferences;*

- ***Standard grade can be used as feed material for ammoniated NPKS compounded products; limits application effectiveness for different crops & growing situations;***
- ***Granular product can be custom blended to meet exact needs of soils given their composition, previous crops and current year target crops;***
- ***Granular product enables farms to optimize the nutrients applied while minimizing the "non-effective" use of NPKS constituents;***
- ***FSU "maximum production" techniques over applied certain nutrients leading to serious runoff and water pollution problems;***
- ***Granularization techniques preclude the majority of such problems;***

Marsulex's Use of Granularization Differentiates & Maximizes the Market Value of AS

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Ammonium Sulfate Product Quality Characteristics

Purity - 99+%

- Nitrogen - 21.0 - 21.1%
- Sulfur - 24.0 - 24.2%
- Water Insoluble Matter - < 0.1%
- Color - White to Beige
- Heavy Metals - < 10 ppm

Exceeds Fertilizer Standard

Residual Moisture

- Multiple Drying Steps
- Less Than 1.0 wt% Moisture
- Coated with Anti-caking Agent

Excellent Storage & Handling

Particle Size

- 1.0 mm - 3.5 mm
- 240 - 275 SGN
- Uniformity Index - 45 - 50

Ideal for Bulk Blending
& Direct Application

Hardness

- Demonstrated Compaction Technology
- Expertise in Product Hardening Technology
- 1 - 3% Attrition in Industry Test

Can be Handled and Transported
Without Generating Dust

High Quality Commercial Product!

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AS Summary: Marsulex Technology Enables a Comprehensive Approach

Full Integration with Boiler Unit & Fuel:

- ***Ammonia technology facilitates and encourages the use of higher sulfur fuels or fuel blends***
- ***Higher sulfur fuels are typically priced lower per thermal unit of heat content than lower sulfur fuels***
- ***Lower cost fuels enables utilities operators to reduce power generation costs***
- ***Production of high quality, granular fertilizer makes maximum use of nitrogen/sulfur species***
- ***Fertilizer granularization encourages customized blending & optimum crop feeding***
- ***Ammonia technology reduces CO_2 emissions versus conventional technologies***
- ***Ultimately, carbon adsorption can be used to reduce Hg & organics emissions***
- ***Enables a highly beneficial, synergistic approach to infrastructure integration***

Marsulex AS Technology offers benefits to Power Producers, Refineries & Infrastructure Planners

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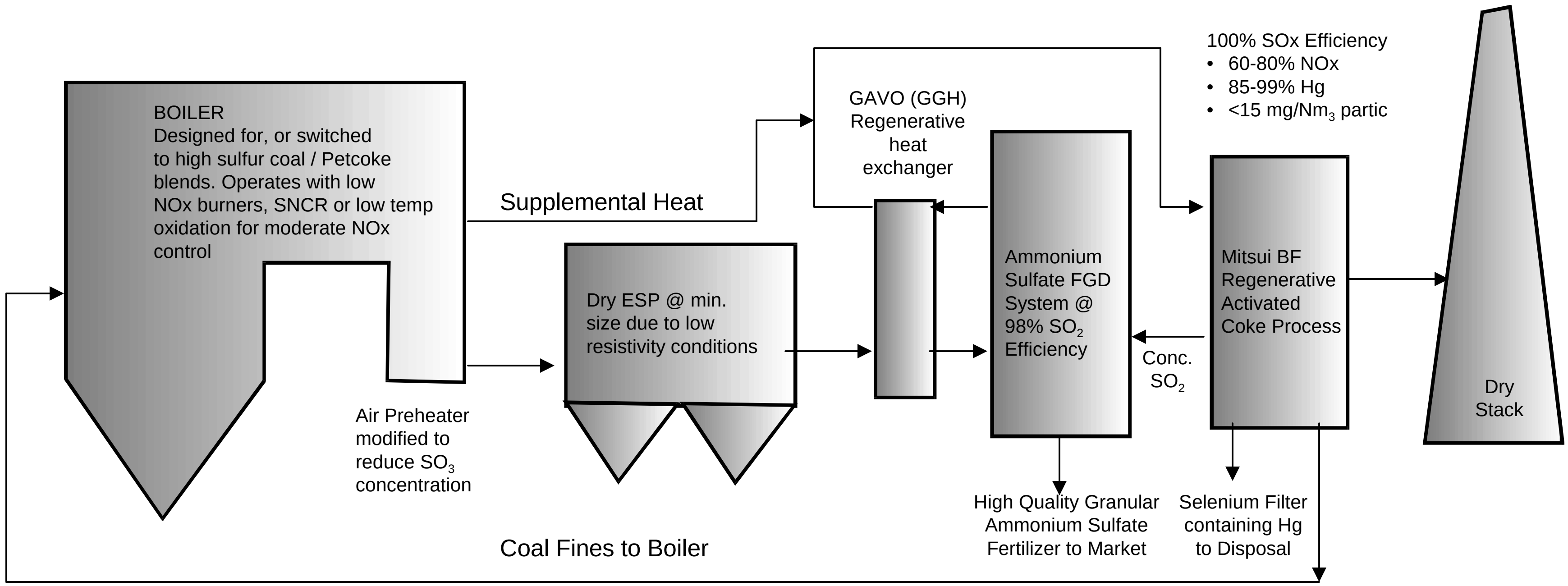
Future BACT for Coal-Fired Power Plants



Impacts:
- Significantly lower fuel costs
- Avoids SCR

Minimal Dry ESP costs

Precludes new chimney or high alloy design

"Toll" value of AS vs. ammonia is positive

Final polishing step for residual SOx, particulate. NOx & Hg reduction

Revenues from AS "toll" and Fuel Savings cover Total System O&M Costs

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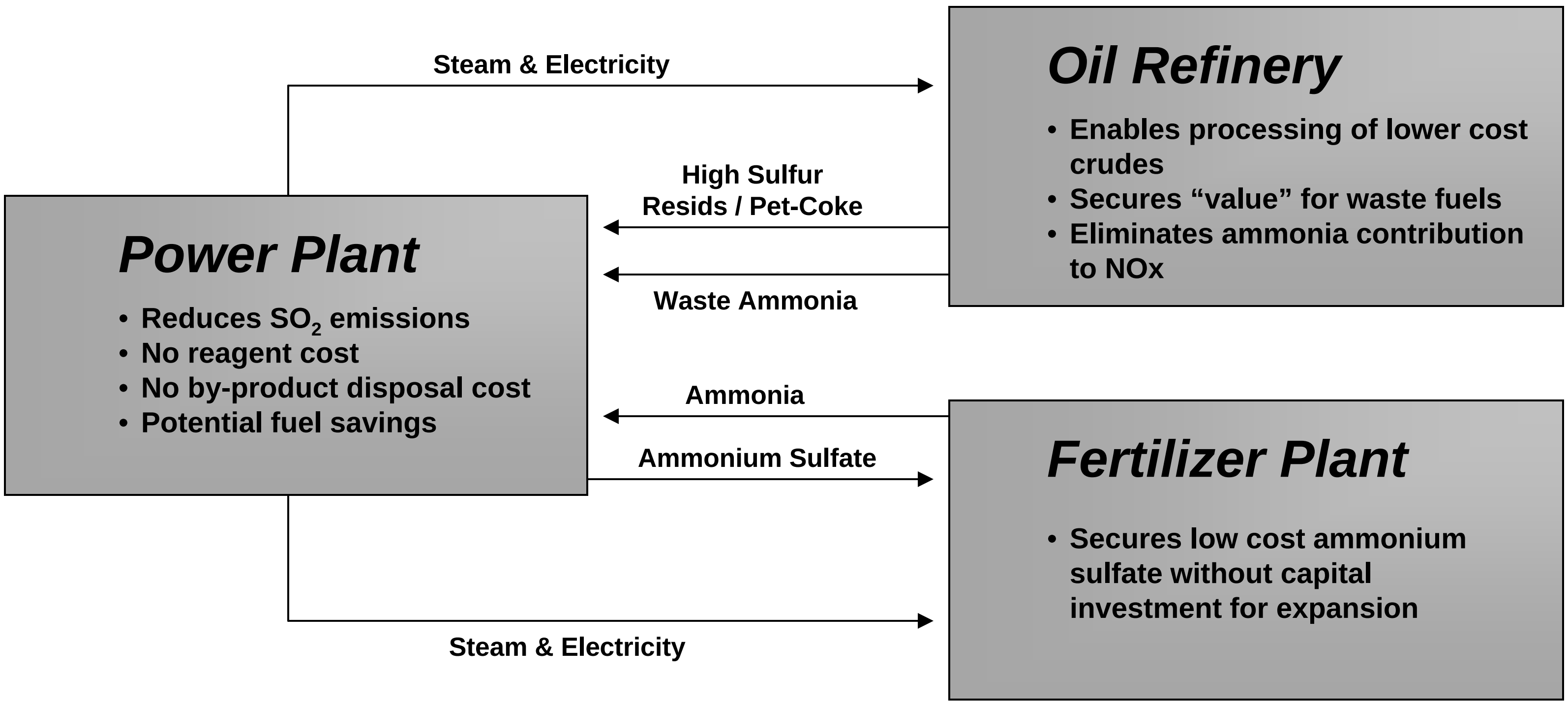
Energy & Environment Infrastructure Integration



Marsulex Technology Can Provide Benefits to China's Industrial Infrastructure Base

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Summary - Marsulex FGD Technologies & Services

Marsulex Offers Several Benefits to its Customers

- ***A strong group of conventional & advanced Wet & Dry FGD technologies***
- ***An extensive, worldwide FGD experience base exceeding 66,000 Mwe which includes a broad range of designs to meet various situations***
- ***Continuous technology advancements resulting from R&D***
- ***Successful history of effective technology transfer through licensing***
- ***A proven ammonia-based FGD system whose economics thrive on applications using low cost, high sulfur fuels and which produces high quality fertilizer***
- ***The technology to impact a country's infrastructure planning to take advantage of synergistic benefits between power, fertilizer and oil refining capacity***

Marsulex Technologies Provide Cost Effective Solutions To Power Producers & Refineries Worldwide

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