IAC Capabilities
About IAC

IAC is a 32 year old EPC Contract Organization, with principle headquarters in Mission, KS.

As an EPC / Turnkey Industrial Contractor. IAC, and our wholly owned construction company, Adelphi Construction Company, LLC, perform $10 million up to $150 million projects typically in the following industries within North America, Latin America, and Mexico:

- Frac Sand
- Mining
- Steel
- Food
- Cement / Lime
- Industrial Boiler
- DRI
- DSI / PAC
About IAC

In addition to IAC EPC / Turnkey Construction Projects, IAC is unique in that IAC internally designs and engineers IAC OEM equipment product lines for industrial and utility clients. IAC OEM Product Lines:

- Portable Frac Sand Plants
- Air Pollution Control Equipment
- Frac Sand Rotary Dryer/Cooler
  - Patented Design
- Bulk Material Storage Systems
- Pneumatic and Mechanical Handling Equipment
- DSI / BPAC Flue Gas Acid Treatment System
- Motor Control Centers

- Automated Controls, PLC / DCS
- HMI Management and Software Program
- Dry Recirculating Acid Gas Scrubber for SO$_2$, SO$_3$, and HCL Mitigation – patented process
- High Temperature Filtration Equipment
- High Pressure >15 psig Filters
About IAC

IAC Corporate Headquarters Personnel
- Engineering: 37 people
- Staff: 192 people

IAC Field Personnel
- Sales: 10 people
- Construction: 272 people
- Latin American Sales: 9 people
IAC can provide all of these as EPC contractor with in-house construction through Adelphi Construction.
IAC/Adelphi Core Competencies

**Equipment:**
- APC – Baghouses 300 to 3 Million ACFM
- Bulk Material Handling (Pneumatic and Mechanical)
- Welded and Bolted Tank Farms/Silos
- Automated Controls/MCC
- Dryers, Rock Products
- Central Vacuums and Fume extraction

**Design/Build:**
- Frac Sand Dry Plants
- Frac Sand Wet Plants
- Transload Terminals, Cement and Frac Sand
- Activated Carbon Injection Systems
- Acid Gas Control Flue Gas Treatment; Frac Sand
- Plant Upgrades, High Efficiency Separators

**Services:**
- Frac Sand Plant Optimization
- Engineering – Civil, Structural, Mechanical and Electrical
- Plant Design/Layout
- Plant Construction and Design/Build Services

**EPC:**
- Total Processing and Plant Facility Design/Build
IAC’s in-house construction resource Adelphi specializes in turnkey Frac Sand Plants. Adelphi has lead the completion of simultaneous Frac Sand plant construction in 8 months.
REGULATORY LANDSCAPE

• MACT for Industrial & Utility Boilers
• MATS
  Mercury
  PM (Filterable for non-mercury metals)
  HCL
  SO2
• CSAPR (NOx & SO2); Vacated August 21, 2012
• Regional Haze
• NSPS – PM; NOx & SO2
• BART (Best Available Retrofit Technology)
  Source Specific - SO2 &/or NOx emissions
HCL & SO2 CONTROL TECHNOLOGIES

DSI:  Hydrated Lime – Dry Injection; w/Humidification
Trona / Sodium Bicarbonate

Circulating Dry Scrubber (Quick Lime / Hydrated Lime)

Semi-Dry FGD (Quick Lime / Hydrated Lime)

Wet FGD
The capacity of sorbents to capture mercury decreases at higher temperatures.

Chlorine and other trace acid gases play a significant role in the performance of PAC/BPAC.

SO3 Control Required for high Mercury (Hg) mitigation.

SO3 control with Lime Hydrate; Hg control with BPAC / Amended Silicate.
IAC M-Pulse Baghouse

DESIGN FEATURES:
1. Intermediate Pressure – 35 PSIG
2. Bag – 6” Dia.; up to 10m Long
3. Split Cage Design
4. 20 Bags Per Blowpipe
5. 25 Rows of Bags
6. 12” to 14” ASME Header, as Required Pulse Air
7. Integrated Double Diaphragm 3” Solenoid Valves
8. Casing Inlet With Internal Diverter Plate
9. Automated Controls
10. Penthouse Access
11. Lift-Off Roof-Top Doors for Compartment
12. Hoist For Top Door Removal
IAC M-Pulse Baghouse

TYPICAL INLET DESIGNS FOR "LONG BAG" INTERMEDIATE PULSE BAGHOUSE

Outlet Popup Dampers

Inlet / Outlet Plenum
w/ Common Walls
Horizontal Inlet Damper
Internal Dispersion Screen/Plates
w/baffles or holes
DP does drop large particles
DP not effective Spark Arrestor

Outlet Popup Dampers

Inlet / Outlet Plenum
w/ Common Walls
Horizontal Inlet Damper
Internal Dispersion Screen/Plates
w/baffles or holes
No dust drop in to the Hopper
DP does drop large particles
DP not effective Spark Arrestor

Outlet Popup Dampers

Inlet / Outlet Plenum
w/ Common Walls
Horizontal Inlet Damper
Solid Internal Plate for upward flow
Flow to Hopper has no control

Outlet Popup Dampers

Inlet / Outlet Plenum
Not Common Wall
No leakage possible
Wires not transferred
Vertical Inlet Damper
Solid Internal Baffle Plate
Measured Flow to hopper & Upper Chamber
Spark Arrestor Design
Large Particles to Hopper / not to bags
IAC M-Pulse Baghouse Inlet

Inlet Flow distributed to upper Casing & Hopper
Inlet Flow strikes an inner plate for null flow
60% Flow to Upper Casing; 40% Flow to Hopper
Heavy Particulate Falls to Hopper
Flow from Upper Casing Continuously Cleans Bags
Low Can velocity from Hopper
Cleaning Air at 50 to 70 PSI; Venturi Not Required
2 Piece Cage for Long Bag Design

Traditional Design for Short Bags
100% Flow to Hopper
24'6" Long Bag is too long for Bag Cleaning.
16'0" Long bag max. for Hopper Entry
Can Velocity Critical for Effective Design
High Pressure Cleaning Required
Cage with Venturi Required
3 Piece Cage with Short Walk-in-Plenum Design.
“M” - Pulse Baghouse
Bag Filtering & Pulse Cleaning

IAC M-Pulse design allows for continuous cleaning of bags:
• Staggered bag arrangement for distribution
• Inline bag arrangement will channel the flow
• Air distributions continuously strips the dust off the bag
IAC M-Pulse Baghouse
Module Velocity Profile

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<th>acfm</th>
<th>Am3/hr</th>
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<td># of Compts.</td>
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<td>Inlet Damper-Height</td>
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<td>Inlet Damper-Width</td>
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<td>Compt. Outlet - Height</td>
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<td>Compt. Outlet - Width</td>
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<td>Poppet Damper Size</td>
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<td>Outlet Plenum Height</td>
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**VELOCITY PROFILE:**

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<td>1143</td>
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<tr>
<td>A Across Inlet Damper</td>
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<td>533</td>
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<td>B 40% Flow to Hopper</td>
<td>785</td>
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<td>C 60% Flow to Casing</td>
<td>1177</td>
<td>359</td>
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<td>D In to Upper Casing</td>
<td>84</td>
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<td>E From Hopper</td>
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<td>33</td>
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<td>F Exit from Compt</td>
<td>2058</td>
<td>627</td>
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<td>G Across Poppet</td>
<td>2313</td>
<td>705</td>
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<td>H Outlet Plenum:</td>
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<td>Can Velocity</td>
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<tr>
<td>Interstitial Velocity</td>
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IAC “M” – Intermediate Pressure Pulse Jet Baghouse 6 x 234TB-BHTP-288

Coal Fired Boiler Baghouse
220,000 ACFM @ 420 F
IAC “M” – Intermediate Pressure Pulse Jet Baghouse 6 x 294TB-BHTP-240

Ferro-Nickel Smelter Baghouse
220,725 ACFM @ 500 F
M-PULSE FOR CEMENT KILN/RAW MILL
50MM GPY ETHANOL PLANT
COAL FIRED WITH IAC M-PULSE BAGHOUSE

IAC SCOPE OF WORK
• Combustor
• Boiler – HRSG
• M-Pulse Baghouse & FGD
• ID Fan & Motor
• Duct from Boiler to ID Fan
• Fly Ash Handling
• Silo & Truck Loadout
• I&C’s (APV & Flyash)
• Automated Controls
• Mechanical Installation
• Start-up

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<td>Lincolnway Energy</td>
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<tr>
<td>Red Trails</td>
<td>Richardton, ND</td>
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<tr>
<td>Heron Lake Energy</td>
<td>Heron Lake, MN</td>
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IAC AIR-TO-AIR HEAT EXCHANGER & 4-COMPARTMENT M-PULSE BAGHOUSE
APPLICATION: CLINKER COOLER – CEMENT
IAC M-Pulse Baghouse
Penthouse Enclosure

Header Design
• Shut-off Valve
• Pressure Transmitter
• Moisture Purge Valve

Baghouse Design
• Compt. Pr. Transmitter
• Baghouse Pr. Trans.
• Temp. Transmitters

Pneumatic Dampers
• Inlet Butterfly
• Outlet Poppet
IAC M-Pulse Penthouse

Poppet Damper Operator

Air Inlet to Header
IAC M-Pulse Baghouse
Module Roof Top Doors with Hoist for Lift Off
“M” - Pulse Baghouse Bag Changeout & Installation
IAC M-Pulse Baghouse
Automated Controls
<table>
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<tr>
<th>FEATURE</th>
<th>BENEFIT</th>
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<tr>
<td>Module Header Pressure</td>
<td>Required Cleaning Air Utilization</td>
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<tr>
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<td>Sense/Alarm Leak in Solenoid Valve</td>
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<tr>
<td>DP Cleaning</td>
<td>Individual Module DP</td>
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<td></td>
<td>Baghouse DP</td>
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<td>Required “Open Time” per Header Pulse Valve</td>
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<td>Monitoring &amp; Alarms</td>
<td>Temperature</td>
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<tr>
<td></td>
<td>Pressure</td>
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<td>Hopper Heaters</td>
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<td>Hopper Vibrators</td>
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<td>Hopper Level Controls</td>
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<tr>
<td></td>
<td>Inlet / Outlet Dampers</td>
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<tr>
<td></td>
<td>Hopper Valves and Dust Handling Systems</td>
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<tr>
<td>Trend Analysis</td>
<td>Baghouse &amp; Individual Module</td>
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<tr>
<td>Broken Bag Detection</td>
<td>Detection per Module and Individual Row</td>
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<tr>
<td>Communication</td>
<td>Plant DCS &amp; Local Printer</td>
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<tr>
<td></td>
<td>Local and Remote Controls</td>
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# IAC MPULSE BAGHOUSE_ALARMS

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<th>item</th>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
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<tr>
<td>1</td>
<td>Poppet and inlet damper translation time alarm</td>
<td>s</td>
<td>30</td>
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<tr>
<td>2</td>
<td>Air Header pressure LowLow Alarm</td>
<td>PSI</td>
<td>25</td>
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<tr>
<td>3</td>
<td>Temperature Hi Alarm</td>
<td>C</td>
<td>240</td>
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<tr>
<td>4</td>
<td>Temperature HiHi Alarm</td>
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<td>260</td>
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<tr>
<td>5</td>
<td>Inlet pressure HiHi Alarm</td>
<td>kPa</td>
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<tr>
<td>6</td>
<td>Delay in general</td>
<td>s</td>
<td>10</td>
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HMI in Remote control
NUCOR SOUTH EAF BAGHOUSE
1,200,000 ACFM @ 250F
IAC M-Pulse (1,200,000 ACFM)
IAC M-Pulse Hopper Enclosure
Suction conveying from hopper to storage and load-out silo

Pneumatic conveying from flap valve(s) at hopper discharge
Receiver filter at top of silo
Articulating arm w/telescoping load-out chute for rail car/truck loading
Load-out Silo with Receiver Filters
IAC (BAUMCO) REVERSE AIR BAGHOUSE
POSITIVE PRESSURE
IAC REVERSE AIR BAGHOUSE
NEGATIVE PRESSURE
IAC REVERSE AIR BAGHOUSE
NEGATIVE PRESSURE
IAC M Pulse Baghouse & DSI

MPulse Module DSI w/Trona
SORBENT INJECTION LOCATION
## TYPICAL DRY SORBENTS

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<thead>
<tr>
<th>Calcium Compounds:</th>
<th>Sodium Compounds:</th>
<th>Amended Silicates:</th>
<th>Activated Carbon:</th>
<th>Mixtures and Custom Blends:</th>
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</thead>
<tbody>
<tr>
<td>Calcium Oxide</td>
<td></td>
<td></td>
<td></td>
<td>SOx; HCL; HF; Hg</td>
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<tr>
<td>Calcium Hydroxide</td>
<td></td>
<td></td>
<td></td>
<td>Hg</td>
</tr>
<tr>
<td>Limestone/Micronized Lime</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium Halides</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sodium Compounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trona</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td></td>
<td></td>
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<tr>
<td>Magnesium Oxide / Hydroxide</td>
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<tr>
<td>Amended Silicates</td>
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<tr>
<td>Activated Carbon</td>
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</tr>
<tr>
<td>Mixtures and Custom Blends</td>
<td></td>
<td></td>
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</table>

SOx, HCL, HF, Hg, ORGANIC HAPS

<table>
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<tr>
<th>SEMI DRY FGD</th>
<th>DRY SEMI DRY FGD Furnace Injection (SO2)</th>
<th>DRY FGD</th>
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</thead>
<tbody>
<tr>
<td>DRY FGD</td>
<td>DRY FGD</td>
<td>DRY FGD</td>
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</table>
CaSO$_3$, CaSO$_4$, CaCl$_2$ and CaF$_2$ are collected in fly ash.
SODIUM BICARBONATE / TRONA REACTIONS

- \( 2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \)
- \( 2(\text{Na}_2\text{CO}_3\cdot\text{NaHCO}_3\cdot2\text{H}_2\text{O}) \rightarrow 3\text{Na}_2\text{CO}_3 + 5\text{H}_2\text{O} + \text{CO}_2 \)
- \( \text{Na}_2\text{CO}_3 + \text{SO}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 \)
- \( \text{Na}_2\text{CO}_3 + \text{SO}_3 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 \)
- \( \text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 \)
- \( \text{Na}_2\text{CO}_3 + 2\text{HF} \rightarrow 2\text{NaF} + \text{H}_2\text{O} + \text{CO}_2 \)
- \( \text{Na}_2\text{CO}_3 + \text{NO}_x \rightarrow \text{NaNO}_3 + \text{CO}_2 \)

\( \text{Na}_2\text{SO}_4, \text{NaCl}, \text{NaF} \) and \( \text{NaNO}_3 \) are collected in fly ash.
# DESIGN VARIABLES FOR DRY SORBENT INJECTION

<table>
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<tr>
<th>Design Variable</th>
<th>Options</th>
<th>Considerations &amp; Requirements</th>
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<tr>
<td>Flue Gas Design Flow</td>
<td>Max / Normal / Low</td>
<td>Turndown Considerations &amp; Requirements</td>
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<tr>
<td>Sorbent Characteristics</td>
<td></td>
<td>Milling (Reactivity increases w/surface area)</td>
</tr>
<tr>
<td>Injection Location</td>
<td></td>
<td>Increase reactivity</td>
</tr>
<tr>
<td>Injection Location</td>
<td>Flue Gas Temp.</td>
<td>Temperature is critical for increased reactivity</td>
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<tr>
<td>Injection Location</td>
<td>Mixing</td>
<td>Sorbent &amp; Flue Gas Mixing (turndown required)</td>
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<tr>
<td>Injection Location</td>
<td>Residence Time</td>
<td>Increased time allows for better improved reaction</td>
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<tr>
<td>Type of Particulate Collector</td>
<td>Baghouse / ESP</td>
<td>Required NSR</td>
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<tr>
<td>Computational Fluid Dynamics (CFD)</td>
<td>Mixing</td>
<td>CFD to determine injection locations</td>
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<tr>
<td>Injection Lance Design</td>
<td>Open or w/Nozzles</td>
<td>Mixing &amp; Flue Gas turndown required</td>
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<tr>
<td>Sorbent Feed Rate Controls</td>
<td>Fixed Feed Rate</td>
<td>CEM's control not practical (Hg)</td>
</tr>
<tr>
<td>Sorbent Feed Rate Controls</td>
<td>Adjustable Feed Rate</td>
<td>CEM's controls Feed Rate (SOx)</td>
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<tr>
<td>Demonstration Testing</td>
<td>Full Scale Testing</td>
<td>Verification and Validation of Design</td>
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SORBACAL PERFORMANCE AS A FUNCTION OF FLUE GAS HUMIDITY

DSI Case Studies #1a and #1b

- Application → Industrial Manufacturing Process
- Goal → 95+% \( \text{SO}_2 \) Removal Efficiency
- Why → Meet Future \( \text{SO}_2 \) Permit Limit
- Process → SDA → Multi-Clone → DSI → FF
- Flue gas temperature at DSI location 300-350°F
- DSI → One (1) Injection Lance @ Fabric Filter Inlet
- Sorbent → Sorbacal\textsuperscript{®} SPS

<table>
<thead>
<tr>
<th>Case</th>
<th>Flue Gas Volume</th>
<th>Moisture Content</th>
<th>Baseline ( \text{SO}_2 ) Conc.</th>
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<td></td>
<td>ACFM</td>
<td>Vol. %</td>
<td>ppmv</td>
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<tr>
<td>1a</td>
<td>10,000</td>
<td>~14</td>
<td>100</td>
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<tr>
<td>1b</td>
<td>55,000</td>
<td>~36</td>
<td>300</td>
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SORBACAL PERFORMANCE AS A FUNCTION OF FLUE GAS HUMIDITY

- 95% SO$_2$ Removal at Mass Ratio of ~16 lb sorbent / lb Inlet SO$_2$
- 95% SO$_2$ Removal at Mass Ratio of ~4 lb sorbent / lb Inlet SO$_2$
Owner: Big Rivers Electric Corporation
Plant Nameplate Capacity: 528 MW (Megawatts)
Units and In-Service Dates: 264 MW (1979), 264 MW (1981)
Location: 9000 Hwy. 2096, Robards, KY 42452
GPS Coordinates: 37.645833, -87.503056
HYDRATED LIME DSI & ACI SILOS FOR TWO TRAINS
### TYPICAL DATA

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<th>Fuel Flow</th>
<th>AH Gas Out Temp</th>
<th>DSI Rate</th>
<th>ACI Rate</th>
<th>Stack Temp</th>
<th>CO2</th>
<th>NOx</th>
<th>SO2</th>
<th>CEMS Hg</th>
<th>Opacity</th>
<th>Stack Flow</th>
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<tbody>
<tr>
<td>MW</td>
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<td>Deg F</td>
<td>Lbs/Hr</td>
<td>Lbs/Hr</td>
<td>Deg F</td>
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<td>ppm</td>
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<td>lb/Tbtu</td>
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### TARGET / DESIGN

- **Hydrated Lime Feed Rate:** 1,400 Lbs/Hr.
- **BPAC Feed Rate:** 200 Lbs/Hr.
- **Mercury in Stack:** 0.71 Lbs/TBTU
- **Stack Opacity:** 2.5%
ARSENIC MITIGATION

PEBBLE LIME; LIMESTONE ADDITION TO COAL BELT
ARSENIC & SELINIUM MITIGATION

The retention of As and Se during combustion:

\[
\text{CaO} + \frac{1}{2} \text{SO}_2 + \text{O}_2 \rightarrow \text{CaSO}_4
\]

\[
3\text{CaO} + \frac{1}{2} \text{As}_4\text{O}_6(g) + \text{O}_2 \rightarrow \text{Ca}_3(\text{AsO}_4)_2
\]

\[
\text{CaO} + \text{SeO}_2(g) \rightarrow \text{CaSeO}_3
\]

FORMATION TEMPERATURES in Boiler:
- Ca$_3$(AsO$_4$)$_2$ formation at 1400 °C
- CaSeO$_3$ formation at 740 °C
- CaSO$_4$ formation range 600 °C to 1000 °C

Recommended Ratio of Ca/S: 6 to 10
DSI – DEMONSTRATION TESTING
Milled Trona Injection for 80% SO2 Reduction; 36,000 PPH

- 570 MW (5116 mmBtu/hr); PC Boiler
- Tangentially Fired
- Low Sulfur; Subbituminous Coal
- ESP for Particulate Control
- Three DSI Trains with 3 Blowers
- Silos w/LIW Scale for Varied Feed Rates
- Each PD Blower in Sound Enclosure
- One 6-Ton/Hr Pin Mill per Silo
- Pin Mill in Sound/Weather Enclosure
- System Controls: Automated PLC
DSI – DEMONSTRATION TESTING

PD BLOWER IN ENCLOSURE – 800 ICFM CONVEY AIR
HEAT EXCHANGER
SILO ON SCALES
PIN MILL IN ENCLOSURE; RATED CAPACITY: 6 STPH
DSI – TESTING EQUIPMENT

PD Blower in Enclosure
Pin Mill w/ Controls in Enclosure
Bin Discharge with Live Bottom & Feeder
IAC “TRAILER MOUNTED BBU RIG” PAC INJECTION FOR MERCURY REMOVAL TESTING
IAC “BBU RIG” PAC INJECTION FOR MERCURY REMOVAL TESTING
MERCURY TESTING
315 MW PLANT / AIR HEATER OUTLET
OPTIONAL LANCE TIP DESIGNS
1. Bayonet Tip for even dispersion.
2. Flat end at staggered depths.
3. Flared end for co-current flow.
4. Dispersion “V” tip end.

Note:
1. Lance tip design is based on duct layout and arrangement
2. Lance diameter based on flow rates and quantity of lances utilized.
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Together we design, engineering, install turnkey wet and dry plants and transload facilities. We are the largest in the industry because we offer innovation, durability, and complete systems operation.

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  - CIVIL & STRUCTURAL
  - ELECTRICAL & INSTRUMENTATION
- PROVEN PRODUCTS AND TECHNOLOGIES
  - FILTRATION
  - PNEUMATIC TRANSPORT
  - FANS AND BLOWERS
  - CONTROLS; PLC; WONDERWARE INTERFACE
- FLEXIBILITY
- ON-TIME PROJECT EXECUTION
- IN-HOUSE CONSTRUCTION COMPANY – ADELPHI
- IN-HOUSE SERVICE STAFF FOR 24-HR SERVICE