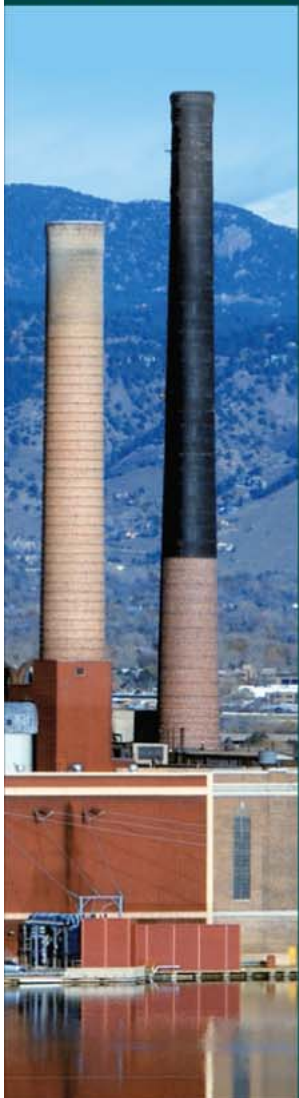


 ALBEMARLE® | Sorbent Technologies

The McIlvaine Company Hot Topics - Nov. 19, 2010

M-PACT™ Unit,
Mercury Control Equipment Optimally
Designed for Industrial Boilers

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Albemarle Corporation





Presentation Overview



- 1. Albemarle's Technologies & Strengths**
- 2. Requirements of ACI Equipment**
- 3. Metering, Conveyance, and Injection Subsystems**
- 4. Economics of ACI Systems**
- 5. M-PACT™**

Albemarle's Presence in Mercury Control



- Field testing equipment & 8 years of testing experience (equip. & CEMS)
 - Field tests performed on utility and **industrial boilers**
 - Mobile test equipment provides effective method to develop control plan for MACT
- Brominated PAC producer
 - Complete mercury control solutions provider
 - High performing gas-phase brominated sorbents
 - High temperature sorbents - >700F (no need to reduce gas temperature further)
- Technical and R&D facilities and staff
 - Customer technical services department
 - CTS backed up by R&D staff
- Innovative reaction control system (distribution and lance system)
 - Standout in industry - high Hg control and low maintenance
- ACI equipment experience list (utility and industrial clients)
 - Overall performance and reliability have been very good – 2007 to present
- Field proven industrial sized ACI, M-PACT™
 - One M-PACT™ Unit effectively controlling Hg since Jan. 1, 2008



Various ways to configure but must satisfy these:

- Have PAC storage
- Controllably meter PAC
- Convey PAC to injection point
- Inject PAC into flue gas
- Handle PACs with a range of bulk densities
- Operate automatically with little operator interface
- Regulate sorbent rate based on process input
- Require little maintenance
- Be priced appropriately to the application

Carbon Metering Options



Screw feeders provide best results for PAC metering at typical injection rates. Two control schemes:

- **Volumetric**

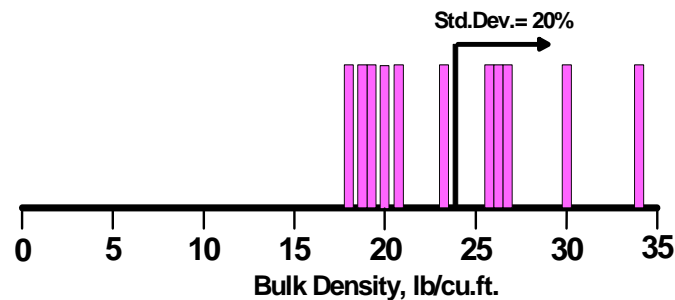
- Motor speed control
- Must be calibrated for each material (each shipment?)
- Does not compensate for internal changes in bulk density

- **Gravimetric**

- Very good control over PAC usage, less over & under feed
- Motor speed control with feedback from scale
- 20:1 turndown on scales, 10:1 for each auger size
- Does not require calibration for different PACs
- Proper algorithms needed to control rate using PAC



Different PACs = Different Bulk Densities



Bulk Density Range = 20 - 50 lb/ft³

AND

Bulk density varies in the
hoppers with amount of aeration,
head pressure, agitation

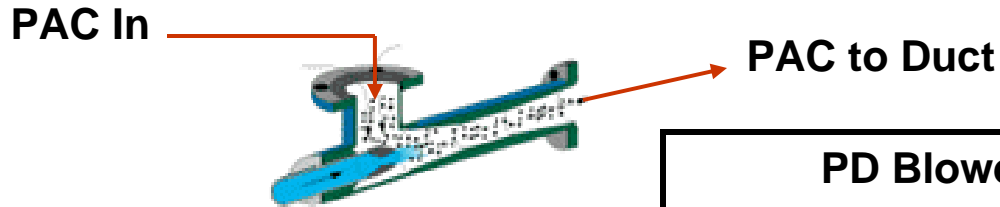
**Warning: Product sheet bulk density may be
Packed Bulk Density**

**This is NOT the bulk density which feeder and
conveyance systems will encounter.**

Conveyance Systems



Eductors provide the best conveyance and injection technology.



Two primary types of blowers for eductors:

- Regenerative
- Lobed PD (Roots)



Regenerative



PD Blower

PD Blower (Roots type)	Regenerative Blower (2-stage)
<p><u>Advantages:</u></p> <ul style="list-style-type: none"> - Proven track-record - Field repair with off-the-shelf parts - Very robust - Able to tolerate some dust 	<p><u>Advantages:</u></p> <ul style="list-style-type: none"> - Direct drive - Less scheduled maintenance - Quiet operation - Less expensive - Small footprint
<p><u>Drawbacks:</u></p> <ul style="list-style-type: none"> - Regular oil changes - Noisy operation with out sound enclosure 	<p><u>Drawbacks:</u></p> <ul style="list-style-type: none"> - Factory repair only - Lower pressure output - Less tolerant of dirty environments



Integrated conveyance, distribution, and lance systems.

- **PACLoop™** for distribution to lances
 - Large diameter piping for plugging resistance, wear-backed bends
- **Orifice controlled** flow to each lance
 - Inspection cover allows access from outside
- **X-a-Lance™** for PAC dispersion into flue gas
 - Non-plugging lances
 - Structurally strong lance bundles
- **PACFlow™** lance flow monitoring
 - allows CFD model verification



Field Testing



Why perform full-scale testing?

- Accurately determine injection rates.
- Understand potential of different sorbents.
- Cost effectively size and design ACI system.

Albemarle Testing Services

Preliminary testing may save \$100Ks on capital equipment by determining the optimum injection rate beforehand.



Economics of ACI Silo Systems



**Albemarle ACI Silo System with
Optional Controls & Blower Building**

Standard ACI Systems are Silo Based

For Silo ACI at Large Boilers

- **ACI Project Cost = ~25% of Annual Sorbent Costs (assume 5lb/MMacf rate)**

For Silo ACI at Industrial Boilers

- **ACI Project Cost = ~ 300% of Annual Sorbent Costs (assume 5lb/MMacf rate)**

M-PACT™ ACI Unit



M-PACT™ Unit Features

- Wide sorbent feed rate range
 - 5 lb/hr to 100s lbs/hr
- One or two PAC feeders
- On board PAC storage - ~ 4,000 lb
- PLC based control system
- Pneumatic conveyance with eductors
- Arrives on site fully assembled and wired
- Refilled from pneumatic trailer which remains on site



M-PACT™ Unit's small footprint provides more installation options which can reduce costs.

M-PACT™ Operations



Unattended, Automatic Operation - but operator must attend to M-PACT™ bin refill procedure



Limiting use factor is frequency of bin refill and acceptance of refill to plant operators



Push the On-Button and the System Starts Automatically

Open the Trailer Valve

Watch the Panel for an Indication to close the Valve - Shuts Down Automatically

Redundant Level and Pressure Sensors Safeguard Against Storage-Bin Overfill During Transfer from Bulk-Trailer by Automatically Shutting Down Transfer

At many industrial plants, operator time = 1 hr/week

M-PACT™ Unit for Low Rate Injection



Why the need for M-PACT™ Unit? Delivers reliability and accuracy for industrial boilers at ~30% of ACI Silo System Cost

First M-PACT™ Unit sold in 2007, Still operating with good reliability and 90% mercury control.

