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

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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 preformed 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
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.
### Eductors provide the best conveyance and injection technology.

#### Advantages:

**PD Blower (Roots type)**
- **Advantages:**
  - Proven track-record
  - Field repair with off-the-shelf parts
  - Very robust
  - Able to tolerate some dust

**Regenerative Blower (2-stage)**
- **Advantages:**
  - Direct drive
  - Less scheduled maintenance
  - Quiet operation
  - Less expensive
  - Small footprint

#### Drawbacks:

**PD Blower (Roots type)**
- **Drawbacks:**
  - Regular oil changes
  - Noisy operation with out sound enclosure

**Regenerative Blower (2-stage)**
- **Drawbacks:**
  - Factory repair only
  - Lower pressure output
  - Less tolerant of dirty environments

**Two primary types of blowers for eductors:**

- Regenerative
- Lobed PD (Roots)
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
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

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™ 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.
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

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

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

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