Mercury Control Technology Using Sorbent Enhancement Additives

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VP Sales
Midwest Energy Emissions Corp
The Company – ME₂C

* Commercialization of UND- EERC Technology

* Provide Technologies that Meet New EPA MATS Standards
  * With the Most Effectual Approach (Meet Emission Reduction Goal)
  * Most Economical Manner (Meet Plant Capital and O&M Budgets)
  * Least Balance of Plant Disruptions (Reduce MW-hr Costs)

* Develop and Deliver Cost Effective Mercury Capture Systems
  * 21 Patents – US, Canada, China, & Europe

* Strong Focus on Continuous Innovation - EERC
ME$_2$C’s Technology Development

Since 2000, our Total Mercury Control™ was developed with over $60M spent by ME$_2$C, EERC, DOE, Utilities

All coal types, various boiler designs & operational configurations

ME$_2$C has partnered with EERC for its testing & demonstrations last 6 years

15 Utility Field Demonstrations
Mercury–Sorbent Interactions

The EERC’s chemisorption model for mercury–flue gas interactions with sorbents is both descriptive and predictive.

Based on years of CATM research and empirical data, it shows the interactions involved in mercury capture by sorbents. Understanding flue gas interactions is critical.
ME2C Total Mercury Control Program

* A tunable (2 Chemical) approach to mercury capture

* **Sorbent Enhancement Additives** (Front End)
  * Proprietary Chemicals
  * Designed to Promote and Protect activated sites
  * Distribute chemical throughout furnace system

* **Sorbent** (Back End)
  * Proprietary Chemicals
  * Provide active capture sites for mercury adsorption
  * Protect activated capture sites
Injection and Sampling Locations
ME$_2$C Technology vs. Brominated Activated Carbon

700 MW Unit

- PRB – Southern Region
- ESP Equipped
- Scrubber Equipped
- Fly Ash Salability
- Majority of Hg Removal in Ash

Annual Cost ($000) vs. % Mercury Removal

- BAC
- ME$_2$C
ME$_2$C Technology vs. Brominated Activated Carbon

700 MW Unit

- PRB – Southern Region
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- Majority of Hg Removal in Ash

Annual Cost ($000)

% Mercury Removal

69% Program Savings for MATS Compliance
Demonstration Results (2009)

Injection Rate, lb/Macf (at 350°F)

Mercury Removal, %

Back-End Injection Rate, lb/hr

- SF10-SB24
- BAC 1
- BAC 2

Injection Rates:
- 25 lb/hr SF10
- 38 lb/hr SF10
- 60 lb/hr SF10
- 20 lb/hr SF10
## Demo Summary at 700 MW Unit

<table>
<thead>
<tr>
<th>Brominated Activated Carbon</th>
<th>Midwest Energy Emissions Corp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>90% Capture Rate</strong></td>
<td></td>
</tr>
<tr>
<td>Not Able to Achieve 90%</td>
<td>SF10 @ 52#/hr - (0.3#/MACFM)</td>
</tr>
<tr>
<td>(Cost Effectively)</td>
<td>SB24 @ 178#/hr - (1.2#/MACFM)</td>
</tr>
<tr>
<td><strong>80% Capture Rate</strong></td>
<td></td>
</tr>
<tr>
<td>BAC - 475#/hr</td>
<td>SF10 @ 23#/hr - (0.15#/MACFM)</td>
</tr>
<tr>
<td>(3.2#/MACFM)</td>
<td>SB24 @ 84#/hr - (0.7#/MACFM)</td>
</tr>
<tr>
<td>LOI &gt;3.5% (adjusted)</td>
<td>LOI &lt;0.8% (adjusted)</td>
</tr>
<tr>
<td>Fly ash sales - NO</td>
<td>Fly ash sales - OK</td>
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</tbody>
</table>
Commercial Program Performance (as MACF)

Commercial Unit #2
Mercury Removal Performance Curve

Percent Hg Removal, %

0.3#/MACF – SF10
92.7%

0.3#/MACF – SF10

Actual Removal

Guaranteed Removal

~1.15#/MACF – SB24

Backend SB24 Injection Rate, lb/MACF at 325F

Commercial Program Performance (as MACF)
Material Handling Concerns:

- Engineering Up Front
- Proper Auger Sizing
  - Low Feed Rates due to Technology
- Just-In-Time Chemistry
- Vacuum System for Fugitive Dust
- Preventive Maintenance
Sorbent Feed System

Material Handling Concerns:

Engineering Up Front

Proper Auger Sizing
• Low Feed Rates due to Technology
• Load Following – Turn Down

Off Loading/Handling

Preventive Maintenance
Economic Summary
ME₂C vs. Brominated Activated Carbon (BAC)

- Plant 1: Lignite
- Plant 2: Subbit.
- Plant 3: Subbit.
- Plant 4: Subbit.
- Plant 5: Bit.
- Plant 6: Subbit.

Cost, US $Million/yr (7600 hr/yr)
- 80% removal
- 90% removal

Mercury Removal

<table>
<thead>
<tr>
<th>Plant</th>
<th>Mercury Removal</th>
<th>Cost, US $Million/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant 1</td>
<td>47%</td>
<td>6</td>
</tr>
<tr>
<td>Plant 2</td>
<td>51%</td>
<td>7</td>
</tr>
<tr>
<td>Plant 3</td>
<td>70%</td>
<td>8</td>
</tr>
<tr>
<td>Plant 4</td>
<td>70%</td>
<td>9</td>
</tr>
<tr>
<td>Plant 5</td>
<td>28%</td>
<td>10</td>
</tr>
<tr>
<td>Plant 6</td>
<td>57%</td>
<td>11</td>
</tr>
</tbody>
</table>

Midwest Energy Emissions Corp
Thank You

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