Industrial Boiler MACT Rule
Impact and Control Options for Mercury and Dioxins/Furans

Hot Topic Hour
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ADA Environmental Solutions
ADA develops and commercializes innovative technologies to sustain the viability of coal as a critical national resource.

(NASDAQ: ADES)
ACI for Mercury and D/F Reductions

• Draw on experiences from other industries
  – Municipal solid waste
  – Coal generation
  – Other?

• Activated Carbon injection has been proven to be effective for mercury and D/F control in the past on various applications

• Determine control capabilities of AC for coal-fired industrial boilers, as well as biomass fired units
Potential Issues to Address for Mercury & D/F Control

- Fuel types/properties being fired in boilers
- Type of boilers: Stokers, FBC, PC
- Flue gas operating temperatures
- $\text{SO}_3$ levels in the flue gas exiting boilers and entering particulate control systems
- Existing APC configuration (SCR/SNCR’s, ESP, FF, Scrubbers & even Cyclones)
Potential Issues to Address for Mercury & D/F Control

- Lack of performance data on P&P/Biomass fired boilers
- Lack of measurement capabilities and reliability for low levels of D/F and Hg
- Uncertainty on need to retrofit with a baghouse to meet PM/HAPs regulations
- **NEED TEST DATA!!**
### Proposed Emission Limits For Major Sources in ICI Boilers and Process Heaters

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>PM $\text{lb}/10^6\text{Btu}$</th>
<th>HCl $\text{lb}/10^6\text{Btu}$</th>
<th>Hg $\text{lb}/10^{12}\text{Btu}$</th>
<th>CO ppm, 3% O$_2$</th>
<th>D/F, total TEQ ng/dscm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Coal Stoker</td>
<td>0.02</td>
<td>0.02</td>
<td>3</td>
<td>50</td>
<td>0.003</td>
</tr>
<tr>
<td>Coal FBC boiler</td>
<td>0.02</td>
<td>0.02</td>
<td>3</td>
<td>30</td>
<td>0.002</td>
</tr>
<tr>
<td>Coal PC boiler</td>
<td>0.02</td>
<td>0.02</td>
<td>3</td>
<td>90</td>
<td>0.004</td>
</tr>
<tr>
<td>Biomass Stoker</td>
<td>0.02</td>
<td>0.006</td>
<td>0.9</td>
<td>560</td>
<td>0.004</td>
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<tr>
<td>Biomass FBC</td>
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<td>0.006</td>
<td>0.9</td>
<td>250</td>
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<tr>
<td>Biomass Suspension Burner/Dutch Oven</td>
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<td>0.006</td>
<td>0.9</td>
<td>1010</td>
<td>0.03</td>
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<tr>
<td>Biomass Fuel Cell</td>
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<td>0.006</td>
<td>0.9</td>
<td>270</td>
<td>0.02</td>
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<tr>
<td>Liquid</td>
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<td>0.0009</td>
<td>4</td>
<td>1</td>
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<tr>
<td>Gas (Other Process Gases)</td>
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<td>0.000003</td>
<td>0.2</td>
<td>1</td>
<td>0.009</td>
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<td><strong>New Units</strong></td>
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<td></td>
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<tr>
<td>Coal Stoker</td>
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<td>0.00006</td>
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<td>7</td>
<td>0.003</td>
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<tr>
<td>Coal FBC boiler</td>
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<td>0.00006</td>
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<td>30</td>
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<td>0.00006</td>
<td>2</td>
<td>90</td>
<td>0.002</td>
</tr>
<tr>
<td>Biomass Stoker</td>
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<td>0.2</td>
<td>560</td>
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<td>1</td>
<td>0.009</td>
</tr>
</tbody>
</table>
### Biomass and Coal-Fired Boilers in CIBO Database Requiring Control for D/F Emissions

<table>
<thead>
<tr>
<th></th>
<th>Dutch Oven Biomass</th>
<th>FB Biomass</th>
<th>Fuel Cell Biomass</th>
<th>Stoker Biomass</th>
<th>All Biomass</th>
<th>FB Coal</th>
<th>PC Coal</th>
<th>Stoker Coal</th>
<th>All Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean emission, TEQ ng/dscm, 7%O₂</td>
<td>0.1573</td>
<td>0.0084</td>
<td>0.2753</td>
<td>0.0118</td>
<td>0.0790</td>
<td>0.0087</td>
<td>0.0235</td>
<td>0.3416</td>
<td>0.1515</td>
</tr>
<tr>
<td>MACT limit*, TEQ ng/dscm</td>
<td>0.0300</td>
<td>0.0200</td>
<td>0.0200</td>
<td>0.0040</td>
<td>---</td>
<td>0.0020</td>
<td>0.0040</td>
<td>0.0030</td>
<td>---</td>
</tr>
<tr>
<td>% requiring control</td>
<td>55.6%</td>
<td>28.6%</td>
<td>57.9%</td>
<td>50.0%</td>
<td>47.3%</td>
<td>66.7%</td>
<td>73.3%</td>
<td>62.2%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Avg. level, if control needed</td>
<td>75.2%</td>
<td>59.3%</td>
<td>64.1%</td>
<td>58.9%</td>
<td>62.1%</td>
<td>65.6%</td>
<td>58.4%</td>
<td>64.2%</td>
<td>62.8%</td>
</tr>
</tbody>
</table>

*Existing boilers

About half the biomass and 2/3rds the coal-fired boilers identified in the CIBO data base would require controls under the current proposed rules based upon the reported emission levels. As noted above, the average % reduction levels would be around 62%.
Anticipated Industrial Boiler ACI System MACT Compliance Timeline

Testing & Evaluation

Compliance Strategy, Eng. & Specifications by Customers

Place ACI Equipment Orders

Install ACI Equipment
2/2012 -2/2013

Start-up, Test and Optimize
1/2013 – 6/2013

Final MACT Rule
1/14/2011

Don’t Wait!!!

Draft MACT Rule
5/2010


MACT Compliance

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ACI and Sorbent Injection Systems

- ACI systems available for a variety of injection and operating requirements
- Depending upon expected coal type and operating conditions, dual injection of both PAC and other alkaline dry sorbents may be required to ensure effective Hg capture
- Same alkaline sorbents (Trona/Hydrated Lime) may also be used for meeting HCl reduction limits as an option to scrubbers
- PAC feed rates are typically tied to “feed forward” signals from boiler/steam flow rates, boiler load and/or flue gas volumes as injection rates are tied to lb/MMacf
ACI Performance Guarantees

- Mercury reduction guarantees are currently being provided to coal-fired utility market
- Guarantees typically tied to measurements from EPA Mtd. 30b or certified Hg CEMS
- Current Hg emission targets for new biomass fired boilers very low at 0.2 lb/Tbtu which is both difficult to measure and guarantee
- Reduction guarantees for dioxins and furans may also be difficult due to reduction levels required and lack of performance data on both coal and biomass fired boilers.
Activated Carbon Injection – Summary of Results (Source: Utility Coal-Fired Boilers)

Will Industrial coal-fired boilers produce the same results??

![Graph showing Hg Removal (%) against Injection Concentration (lb/MMacf)]
Tools for Evaluating ACI Performance

ADA Currently Owns Fleet of Certified Hg CEMS

Portable Hg CEMS and Mtd 30a IR Calibration Units

Transportable Silo for Long-Term Full-Scale Tests

Sorbent Screening Device

Portable Feeder for Short-Term Full-Scale Tests
Fabric Filter Screening Device

- Mercury Control
- Dioxin/Furan Control
- THC control
- Particulate Control
Typical Commercial ACI Systems for Both EGU’s and Industrial Boilers
ADA ACI System Experience

• Currently ~150 commercial electric utility ACI systems sold to date as reported by ICAC members
  – Of these ADA has sold ~47 commercial ACI systems
  – ~30 now in operation
  – Balance starting up over the next year
• This is in addition to another 50+ demonstration programs that have utilized industrial size systems including:
  – Bulk bag systems
  – Small portable silos
  – Hybrid systems (Small silo attached to bulk trailer for PAC supply)
Industrial Boiler ACI System Cost Expectations:

- Typically lower flow rates in comparison to larger EGU’s.
- Bulk Bag type injection systems likely used by majority of smaller boilers due to low relative feed rates & cost.
- Smaller steel ACI system silos will likely be utilized by balance of larger boilers or combined boiler systems.
- Capital cost expectations: (Pricing includes required lances and manifolds)
  - Bulk Bag Systems (<$150K/unit)
  - Smaller Steel Silos (<$350-450K/unit)
  - Larger Utility Size Systems (<$1mm/unit)
  • Could serve multiple boilers from single silo.
PAC Distribution is Key to Enhanced Performance

Shown below is Larger EGU PAC Distribution Manifold Design

ADA In-House CFD Modeling
Summary

- Many lessons learned from the utility power sector can be applied to industrial boilers
- Industrial boilers have unique concerns
  - Full-scale demonstration testing is being recommended to reduce uncertainties in data
  - Additional data is needed for D/F emission reductions
- Commercial equipment and activated carbon is currently available but Utility MACT rule coming up fast……
- Activated carbon can be delivered to flue gas via many types of commercial injection systems, including:
  - Portable (~1,000 lb. Super Sacs) injection systems
  - Shop welded and assembled steel silos
  - Hybrid, lower cost designs
Thank You

Questions?

ADA-CS Red River Parish, Activated Carbon Production Facility

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