Evaluation of Gold MerCAP™ Process for Flue Gas Mercury Removal

Mercury Control Technology R&D Program Review Meeting
July 12-14, 2005
Presentation Outline

• Project Description and Objectives

• Host Site 1 (Spray-Dryer Application)
  – Installation
  – Operation
  – Results

• Host Site 2 (Wet-Scrubber Application)
  – Installation
  – Schedule

• Project Status
  – Future plans
DOE/NETL Financial Assistance Programs

• Evaluation of MerCAP™ Technology
  – DE-FC26-03NT41993
  – Polishing technology - downstream of dry or wet scrubber
  – Six-month flue gas exposure tests

• Total Program Cost - $1.73 MM
MerCAP™

Project Objectives

Evaluate gold MerCAP™ performance in flue gas derived from ND lignite and bituminous coal

• Great River Energy Stanton Station
  – Installed in single compartment of full-scale baghouse
  – 6 MW equivalent (20,000 acfm)

• Georgia Power Plant Yates
  – Installed downstream of pilot wet scrubber
  – 1 MW equivalent
MerCAP™ Basic Concept
(Mercury Control via Adsorption Process)

Parallel plates with sorbent-coated surfaces
Mercury Control by MerCAP™

Summary of Previous Results

• Promising Results Downstream of SD-BH
  – Hg removal demonstrated for extended period in lignite-derived flue gas
  – Regeneration appears feasible (laboratory tests)

• High Removal Downstream of Wet FGD Absorber
  – Demonstrated during short-term tests in scrubbed bituminous flue gas

• Lower Removal in Unscrubbed Gases
MerCAP™ Installation - Stanton
Unit 10 Baghouse Outlet

Boiler → APH → Spray Dryer → Baghouse or ESP → Stack

MerCAP™ Array Installed in Baghouse Compartment
MerCAP™ Installation - Stanton
Unit 10 Baghouse Outlet

Measurements and Sampling Locations

1. MerCAP™ Array dP
2. Compartment dP
3. Compartment Static Pressure
4. Compartment Flow
5. Adjacent Compartment dP (not shown)
6. MerCAP™ Inlet Temperature
7. MerCAP™ Outlet Temperature
8. Inlet MerCAP™ Hg Concentration
9. Outlet MerCAP™ Hg Concentration
10. HCl Measurement Location
Baghouse Cross-Section

MerCAP™ Duct Channels

Outlet Ports & Instrument Feed-throughs
MerCAP™ Design Parameters

• Target Mercury Removal Rate of 55%
• 10-foot Active Length
• 1-inch Spacing Between Substrates
• 25-feet per Second Gas Face Velocity
• Expected Pressure Drop of 0.3 inches H₂O
MerCAP™ Installation - Stanton
Duct 1 of 4
Results Full-Scale Compartment Demonstration

Coal Switch 1700 hrs.

ND Lignite → Subbituminous (PRB)

Method 324 Measured Removal
Hg Removal Performance related to SD Operation

- Inlet Total
- Outlet Total
- 324 Inlet Run 1
- 324 Outlet Run 1
- 324 Inlet Run 2
- 324 Outlet Run 2

- Slurry & Water Flow (GPM)
- Water Feed
- Slurry Feed
- Temperature
# Measurement Comparisons

## CEM and Method 324

<table>
<thead>
<tr>
<th>Run Date</th>
<th>Mercury CEM (ug/nm³)</th>
<th>Method 324 (ug/nm³)</th>
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<tbody>
<tr>
<td></td>
<td>Inlet Total</td>
<td>Outlet Total</td>
</tr>
<tr>
<td>1/25/05</td>
<td>4.29</td>
<td>3.35</td>
</tr>
<tr>
<td>4/30/05 #1</td>
<td>5.73</td>
<td>5.38</td>
</tr>
<tr>
<td>4/30/05 #2</td>
<td>4.77</td>
<td>3.02</td>
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4/30/05 #1 was conducted during minimal spray dryer SO₂ scrubbing conditions
4/30/05 #2 was conducted during optimal spray dryer SO₂ scrubbing conditions
## Measurement Comparisons
### CEM and OH Method

<table>
<thead>
<tr>
<th>Mercury CEM (ug/nm³)</th>
<th>Ontario Hydro Method (ug/nm³)</th>
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<tbody>
<tr>
<td><strong>Inlet Total</strong></td>
<td><strong>Outlet Total</strong></td>
</tr>
<tr>
<td>8.24 (.71)</td>
<td>6.68 (.16)</td>
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*Value in parenthesis is (Standard Deviation)*
Regeneration Results

• Thermal regeneration (3 cycles) conducted on same gold substrate section.

• Post regeneration mercury removal performance has been comparable or better than that measured prior to regeneration.

• Ten gold substrate modules installed in the full-scale test compartment were subjected to chemical regeneration (acid bath) and demonstrated improved performance when returned to service.

• Analysis of acid bath showed minimal loss of gold coating demonstrating this as an alternative regeneration technique.
MerCAP™ Status

Full-scale SD-BH Demonstration Complete

– Over 7000 Hours of Operation
  • 1700 Hours on North Dakota Lignite
  • 5300 Hours on Subbituminous (PRB)
– Removal levels ranging from 65%-5%

– Removal performance demonstrated wide variability. The primary identified variable is slurry feed to the scrubber unit indicating a possible acid gas constituent or concentration level that limits or degrades the Hg capture performance.

– Non-ideal operating conditions do not cause permanent degradation of the gold substrate.
MerCAP™ Installation-Plant Yates Southern Company Pilot Unit
MerCAP™ Test Setup for Wet Scrubbers
MerCAP™ Screen Module
Plant Yates
Proposed Schedule

• Installation in August 2005
• Initial Startup in September 2005
• Planned Operation for 6 Months
  – Plant outage scheduled for Oct. 1 – Nov. 20
  – Unit will be isolated during outage and restarted in November
MerCAP™ Status

Wet Scrubber Demonstration

– Installation August 2005
Mercury Control by MerCAP™

• Information Needed to Further Determine MerCAP™ Applicability
  – Better identify / establish relationship of interferents
  – Investigate alternative amalgamation coatings
  – Improve overall removal efficiencies (>70%)

• Economic Analysis
  – Full-scale regeneration costs (thermal/chemical)
  – Optimize geometry for retrofits
  – Gold integrity - Substrate life