Assessment of Low Cost Novel Sorbents for Coal-Fired Power Plant Mercury Control

Quarterly Technical Progress Report

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Abstract

This is the first Technical Report under a program funded by the Department of Energy's National Energy Technology Laboratory (NETL) to obtain the necessary information to assess the viability of lower cost alternatives to commercially available activated carbon for mercury control in coal-fired utilities.

During this reporting period, a Request for Candidate Sorbents was sent to fourteen groups including activated carbon manufacturers and research groups. Several sorbent samples have been sent to URS for laboratory fixed-bed testing. A preliminary Test Plan has also been developed.

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Introduction

This program is funded by the Department of Energy's National Energy Technology Laboratory (NETL) to obtain the necessary information to assess the viability of lower cost alternatives to commercially available activated carbon for mercury control in coal-fired utilities. Up to 12 sorbents will be tested in a slipstream fixed-bed device and up to 6 of the most promising sorbents will be tested by injecting into a slipstream baghouse and ESP modules at two utility sites. The two sites chosen burn Eastern bituminous and Western subbituminous coal to provide data to determine costs and capabilities of these novel sorbents for a large proportion of coal-fired utilities. Tests will be conducted at Wisconsin Electric Power Company's Valley Power Plant and Midwest Generation's [Edison Mission Energy] Powerton Generating Station. Select characteristics of the two test sites are shown in Table 1.

Table 1. Select Characteristics of Test Sites

	Site 1	Site 2
Plant	Valley Power Plant Boiler 3	Powerton Generating Station Unit 5 or 6
Owner	Wisconsin Electric	Midwest Generation (Edison Mission Energy)
Unit Rated Size	650,000 lb/hr steam	893 MW
Coal Type	85% bituminous, 15% pet coke	100% western subbituminous (Powder River Basin)
Coal Mercury ¹	0.011 – 0.11 µg/g	0.06 – 0.3 µg/g
Coal Sulfur	0.87 %	0.4 %
Coal Chloride ¹	50 - 1500 ppm	20 - 250 ppm

1. Mercury ICR Data

The approach to successfully complete this program is to use existing, proven techniques and equipment that were developed by Apogee and URS for EPRI members to evaluate novel sorbents and site-specific sorbent injection. Sorbents will be selected from several developed for EPRI by the Illinois State Geological Survey (ISGS), one developed by PSI through DOE sponsorship, or from other sources including research and commercial organizations. Sorbents selected for testing must demonstrate a significant cost savings over commercial activated carbons.

Experimental

Experimental methods that are used in sorbent evaluations are referenced in an EPRI Report TR-110533 (1). The equipment used during the laboratory and field sorbent evaluations are referenced in EPRI Report TR-110532 (2).

Results and Discussion

The primary objectives of the program will be achieved through a series of technical tasks. During this reporting period, activities were focused on Task 1, Sorbent Selection and Laboratory Measurements and Task 6, Management and Reporting. Task 1 is devoted to selecting, preparing, and confirming the performance of prepared sorbents in the laboratory.

A sorbent selection criteria was developed so that sorbent vendors/developers can clearly understand the needs and requirements of this program. This selection criteria is attached as Appendix A. In summary an alternative sorbent must:

1. Demonstrate a projected cost of mercury control at least 25% less than FGD carbon;
2. Show that this sorbent will be available in sufficient quantities to supply at least 100 tons per year by 2010; and
3. Have a capacity above the threshold mercury adsorption capacity for the specific sorbent size as measured in the laboratory by URS Corporation.

A Request for Candidate Sorbents was sent to fourteen groups including activated carbon manufacturers and research groups. Several of these groups have sorbents available that meet the projected cost and availability criteria listed above and have submitted samples to URS for evaluation in the laboratory. Results should be available in January 2002.

A preliminary Test Plan has also been developed during this reporting period.

Conclusion

Several interested parties have sorbents available that meet the projected cost and availability criteria and have submitted samples to URS for evaluation in the laboratory. Results should be available in January 2002. A number of sorbents will be selected based on the URS laboratory evaluation and projected cost/availability criteria. These selected sorbents will then be evaluated in the field in a fixed bed arrangement.

References

1. “Laboratory Investigations and Model Development of Flue Gas Mercury Adsorption Using Solid Sorbents,” EPRI Report TR-110533, EPRI, Palo Alto, CA, 1998.
2. “Development and Evaluation of Low-Cost Sorbents for Removal of Mercury Emissions from Coal Combustion Flue Gas,” EPRI Report TR-110532, EPRI, Palo Alto, CA, 1998.

Appendix A

Sorbent Selection Criteria

REQUEST FOR ALTERNATIVE SORBENTS

DOE and EPRI are sponsoring the program called “Assessment of Low Cost Novel Sorbents for Coal-Fired Power Plant Mercury Control”. Apogee Scientific, Inc. and its team members are conducting the program. The overall objective is to obtain the necessary information to assess the viability of lower cost alternatives to commercially available activated carbon for mercury control in coal-fired power plants. Several sorbents will be evaluated in the laboratory. Up to 12 sorbents will be tested in a slipstream fixed-bed device and up to 6 of the most promising sorbents will be tested by injecting into a slipstream baghouse and ESP modules at two power plant sites. The two sites chosen burn Eastern bituminous and Western subbituminous coal to provide data to determine costs and capabilities of these novel sorbents for a large proportion of coal-fired utilities. Tests will be conducted at:

1. Wisconsin Electric Power Company’s Valley Power Plant, Boiler 3, a cogeneration facility burning a mix of pulverized low-sulfur bituminous coal (85%) and petroleum coke (15%).
2. Midwest Generation’s [Edison Mission Energy] Powerton Generating Station, Unit 5 or 6. The boilers are B&W Cyclone boilers burning pulverized subbituminous coal from the Powder River Basin.

A standard activated carbon will be included at each of the test sites. The standard sorbent will be a lignite-derived activated carbon, supplied by American Norit™. The second sorbent will be site-specific, show the appropriate capacity for mercury uptake, and will be economically attractive.

Apogee, as prime contractor on the project, is looking for sorbents other than the baseline FGD carbon to evaluate during this program. Apogee will be using a multi-step process for evaluating alternative sorbents, leading to slip stream testing as follows.

1. Request for Evaluation. The vendor or developer of an alternative sorbent submits a request for evaluation to Apogee. This request should contain enough information to allow Apogee and the members of the team to make a decision as to whether the sorbent is a candidate for testing. At a minimum, this request should
 - a) describe the sorbent in non-proprietary terms (note that the name of the sorbent and developer can be kept confidential in public release of information, but will be disclosed to team members, as well as to DOE and EPRI),
 - b) provide evidence that the cost for removing mercury (per 453.6 grams (1 pound) of mercury removed) will be at least 25% less than that of FGD carbon (including not only the cost for producing the carbon but transportation, handling, feeding, and waste handling costs that may differ from FGD), and

- c) provide evidence that sufficient quantities will be available to supply at least 90718.6 metric tons (100,000 tons) per year by 2010, three years after mercury emission regulations for coal-fired power plants are expected to be in force.
- 2. Laboratory characterization. If the team members feel that the sorbent has potential based on the information disclosed in Step 1, then a small sample of sorbent will be provided by the sorbent developer for characterization by URS Corporation (previously Radian International) as to the mercury adsorption capacity and reactivity of the sorbent. Costs for these tests will be paid for by the vendor or developer (\$450/test). The program will provide \$225 towards the \$450 cost for the first sample analyzed for each provider.
- 3. Estimate of sorbent requirements. The team members will use information from Step 2 to calculate how much sorbent will be required per pound of mercury removed and will compare this against the baseline sorbent. If the amount is reasonable from both an operational and cost standpoint, the sorbent will be added to the field selection list.
- 4. Twelve sorbents will be selected from the field selection list for fixed-bed field screening. Selection criteria will include performance projections and estimated cost. Costs associated with special permitting requirements for specific sorbents will also be included.
- 5. Small-scale field screening. The sorbent will be tested at the specific site using a small fixed-bed screening device supplied and operated by URS Corporation. Selected sorbents will be field tested at no cost to the sorbent provider.
- 6. Final evaluation decision. The team will evaluate all the results (cost and performance) and choose up to six of the samples screened in the field for slipstream injection tests.
- 7. Field testing. If the sorbent is approved at a particular site, Apogee will conduct parametric tests for the alternative sorbents and for the baseline sorbent.

Note that information generated or disclosed in the process described above will be made available to Apogee and all team members as well as to the sponsoring agencies (DOE, EPRI).