

**Characterization of Coal Combustion By-Products
for the Re-Evolution of Mercury into Ecosystems**

**Quarterly Technical Progress Report
January 1, 2002 through March 31, 2002**

April 2002

**A. M. Schwalb, J. A. Withum, R. M. Statnick
CONSOL Energy Inc.
Research & Development
4000 Brownsville Road
South Park, PA 15129**



Under Contract to:

**United States Department of Energy
Cooperative Agreement No. DE-FC26-00NT40906**

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ABSTRACT

EPA and state environmental agencies are suggesting that mercury (Hg) in coal combustion by-products is re-emitted into local ecosystems by additional processing to final products (i.e., wallboard, etc.), by dissolution into groundwater, or by reactions with anaerobic bacteria. This perception may limit the opportunities to use coal combustion by-products in recycle/reuse applications. In this program, CONSOL Energy is conducting a comprehensive sampling and analytical program to address this concern. If the results of this work demonstrate that re-emissions of Hg from waste disposal and by-product utilization are over-stated, additional regulations regarding coal combustion, waste disposal, and waste material utilization will not be required. This will result in continued low energy cost that is beneficial to the national economy and stability of local economies that are dependent on coal.

In this quarter, fly ash and FGD slurry samples from five coal-fired utilities were collected for leaching; four samples were leached.

TABLE OF CONTENTS

	<u>Page</u>
Introduction	1
Overview	1
Agreement Objectives	1
Cooperative Agreement Activities – This Period	2
 RESULTS AND DISCUSSION	 3
Task 1 – Program Management	
Task 2 – Literature Review of the Chemistry in Both Natural and Industrial Environments Specific to Factors That Enhance or Inhibit Mercury Methylation	3
Task 3. – Sampling and Characterization of Coal Combustion Samples and By-Products	3
Additional Activities	4
Additional DOE Reporting and Support	4
 CONCLUSIONS	 4
 REFERENCES	 4

INTRODUCTION

This is the Technical Progress Report for the sixth quarter of activities under DOE Cooperative Agreement No. DE-FC26-00NT40906. It covers the period January 1, 2002 through March 31, 2002.

OVERVIEW

In a number of policy papers, EPA and state environmental agencies suggest that mercury (Hg) in coal combustion by-products may be re-emitted into the ecosystem by processing into products (i.e., wallboard), by dissolution into groundwater, or by reactions with anaerobic bacteria. This perception may limit the opportunities to use coal combustion by-products in recycle/reuse applications.

CONSOL Energy Inc. Research & Development recently conducted a study, co-funded by DOE and the Ohio Coal Development Office (OCDO), which showed that the mercury disposed with fixated FGD solids was stable. The solids passed the standard TCLP toxicity test procedures, and no re-emissions occurred when the FGD solids were exposed to an elevated temperature for three months. While these results are encouraging because they do not show any adverse environmental impacts, they represent only two data points. In this program, CONSOL Energy will expand this data set by conducting a comprehensive sampling and analytical program to include ash, FGD products, and coal combustion by-products representative of the entire coal-fired industry. This work is necessary to help identify potential problems and solutions important to energy production from fossil fuels. If the results of this work prove that re-emissions of Hg from waste disposal and by-product utilization are over-stated, additional regulations regarding coal combustion, waste disposal, and waste material utilization will not be required. This will result in continued low energy cost that is beneficial to the national economy and stability of local economies that are dependent on coal.

AGREEMENT OBJECTIVES

Specific research objectives are to:

- Determine the Hg concentration in coal combustion waste streams

- Estimate the percentage of Hg collected in the combustion waste streams
- Determine if the Hg in these samples is leachable or volatile
- Evaluate the fate of Hg in coal fly ash during the manufacture of Portland cement
- Evaluate the fate of Hg in FGD gypsum during the manufacture of wallboard
- Evaluate the fate of Hg in coal ash material used to make manufactured aggregate
- Compile a literature review of the Hg chemistry and transformations in ecosystems
- Evaluate the extent that Hg is leached and converted to methylmercury in sulfite sludge FGD landfill
- Evaluate the extent that Hg is leached and converted to methylmercury in fly ash slurry impoundments
- Objectively report findings to the scientific community and regulatory agencies

COOPERATIVE AGREEMENT ACTIVITIES – THIS PERIOD

The Cooperative Agreement is divided into six tasks: 1) Program Development; 2) Literature Review of the Chemistry in Both Natural and Industrial Environments Specific to Factors that Enhance or Inhibit Mercury Methylation; 3) Sampling and Characterization of Coal Combustion Samples and By-Products; 4) Characterization of Ground Water Around an Active FGD Disposal Site to Determine the Potential for Hg Release into the Local Ecosystem; 5) Characterization of Ground and Surface Water from Active Fly Ash Slurry Surface Impoundments to Determine the Potential for Hg Release into the Local Ecosystem; 6) Data Reduction and Reporting; 7) Technology Transfer; and 8) Final Report. Agreement activities for this quarter are listed below.

- Task 2 (Literature Review of the Chemistry in Both Natural and Industrial Environments Specific to Factors that Enhance or Inhibit Mercury Methylation). The literature review was updated with current literature and will be documented in the second quarter 2002.
- Task 3 (Sampling and Characterization of Coal Combustion Samples and By-Products) sample collection and laboratory work continued.

RESULTS AND DISCUSSION

TASK 1 – PROGRAM DEVELOPMENT

This Task was completed in November 2000.

TASK 2 - LITERATURE REVIEW OF THE CHEMISTRY IN BOTH NATURAL AND INDUSTRIAL ENVIRONMENTS SPECIFIC TO FACTORS THAT ENHANCE OR INHIBIT MERCURY METHYLATION

The objective of Task 2 is to conduct a comprehensive literature review that includes data from recent studies (i.e., within the last two years) conducted as a result of a variety of clean water initiatives. Work conducted in Task 2 for this reporting period includes updating the review written last quarter by collecting papers published in the last three months. We plan to issue the review in the second quarter 2002.

TASK 3 - SAMPLING AND CHARACTERIZATION OF COAL COMBUSTION SAMPLES AND BY-PRODUCTS

The objective of Task 3 is to obtain coal ash, FGD sludge, by-product feedstock, and by-product samples, and determine their Hg content and potential for ground water contamination. The potential for Hg re-emission during the manufacturing of Portland cement, wallboard, and manufactured aggregate also will be determined. Work conducted in Task 3 for this reporting period includes leaching samples collected during the previous reporting period. Samples from four plants were leached; mercury analyses are pending. Additional samples will be obtained and leached in the next quarter. This brings the total number of samples leached to: seven from coal-fired power plants, one from a coal-fired power plant with carbon injection for mercury control, and one coal by-product utilization material (manufactured aggregate).

By agreement with the COR, the plants are identified by code number. The following table shows the progress of sample collection and analysis:

Plant Code	Coal Source	Particulate Control	FGD Type	Sampling Completed	Leaching Completed	Analyses Completed
1	Pittsburgh Seam	ESP	Mg/Lime			
2	Pittsburgh Seam	ESP	Forced Oxidation			
3	Ohio 5, 6, or 11	ESP	Mg/Lime	X	X	X
4	Illinois 6	ESP	Natural Oxidation	X	X	
5	Eastern Low Sulfur Bit.	Baghouse	Lime Spray Dryer			
6	Illinois/W KY Blend	ESP		X	X	
7	Powder River Basin	Baghouse				
8	Powder River Basin	Baghouse				
9	Powder River Basin	ESP	COHPAC	X	X	
9a	Powder River Basin	ESP	COHPAC w/ carbon injection	X	X	
10	Waste Bituminous coal	Baghouse	CFB Boiler			
11	Southern Appalachian Bituminous	Baghouse	Circulating Fluidized Bed	X	X	X
12	Manufactured aggregate			X	X	X
13	Pittsburgh Seam	ESP	Mg/Lime			
14	Eastern Low Sulfur Bit.	Baghouse	Lime Spray Dryer	X	X	X
15	Pittsburgh Seam	ESP	Inhibited Oxidation	X	X	X

ADDITIONAL ACTIVITIES

A presentation was made at the DOE Hg control workshop describing the mercury re-emission study interim results.

CONCLUSIONS

The major conclusions in this quarter are summarized below:

1. Task 2, the literature review, was completed.
2. Samples from four plants were leached in Task 3.

REFERENCES

(None)