Characterization Of Coal Combustion By-Products For The Re-Evolution Of Mercury Into Ecosystems

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Discussion Areas

- Program Objectives
- Benefits
- Brief Summary
- Background Information
- Experimental Design
- TCLP conclusions to date

Mercury Objectives

- Address concern for mercury re-evolution into ecosystems
- Gather data on
  - Major coal sources
  - Scrubber types
  - By-product end uses

Program Benefits

- This research will help solve problems associated with energy production from coal
- Help understand the fate of the mercury collected in CCB by-product streams
- Help identify appropriate CCB by-product end-uses

Overview

- Data gathered through this research will be useful in determining the environmental impact associated with mercury leaching from solids, volatility, and groundwater issues.
- These results could provide additional CCB by-product utilization opportunities for the utility industry and by-product users.

Hg Background

- Average mercury concentration for coal supply: 0.10 to 0.15 μg/g.
- Mercury fate during combustion
- Coal mercury fate after combustion

In summary, CONSOL is working to determine the impact of the collected mercury on the coal combustion waste and by-product materials.

Experimental Design

- Sample Types
  - Coal, bottom ash, fly ash, FGD sludge, Portland cement, wallboard, aggregates
- Standard leaching tests using the standard methodology and volatility tests of our own design
- Estimate percentage of mercury collected in coal combustion by-product streams.
- Evaluate the fate of mercury in the CCBs
- Groundwater Sampling

Sample Matrix

Plant Code	Sample Type	FGD Type	Coal Source	Sampling Completed	Leaching Completed	Analyses Completed
1	C, BA, FA, FGDS	Mg/Lime	Pittsburgh Seam			
2	C, BA, FA, FGDS	Forced Oxidation	Pittsburgh Seam			
3	C, BA, FA, FGDS	Mg/Lime	Ohio 5, 6, or 11	X	X	
4	C, BA, FA, FGDS	Natural Oxidation	Illinois 6	X		
5	C, BA, FA, SDS	Lime Spray Dryer	Eastern Low Sulfur Bit.			
6	C, BA, FA		Illinois/W KY Blend	X		
7	C, BA, FA		Powder River Basin			
8	C, BA, FA		Powder River Basin			
9	C, BA, FA		Powder River Basin	X	X	
9a	C, BA, FA	"Carbon Injection"	Powder River Basin	X		
10	C, BA, FA	CFB Boiler	Waste Bit. Coal			
11	FA	CFB	Eastern Low Sulfur Bit.	X	X	
13	C, BA, FA, FGDS	Mg/Lime	Pittsburgh Seam			
14	FGDS, SDS, Aggregate	Lime Spray Dryer	Eastern Low Sulfur Bit.	X	X	X
15	FGDS, SDS, Aggregate	Inhibited Oxidation	Pittsburgh Seam	X	X	X
16	C, BA, FA, FGDS	Mg/Lime	High Sulfur Ohio	X	X	X

Volatilization Tests

- Samples of ash, FGD solids, spray dryer solids, aggregate, cement, and wallboard are being analyzed.
- Two ovens at elevated temperatures of 100 °F and 140 °F
- Samples held for six months
- Sampled and analyzed at three and six months by CVAA.

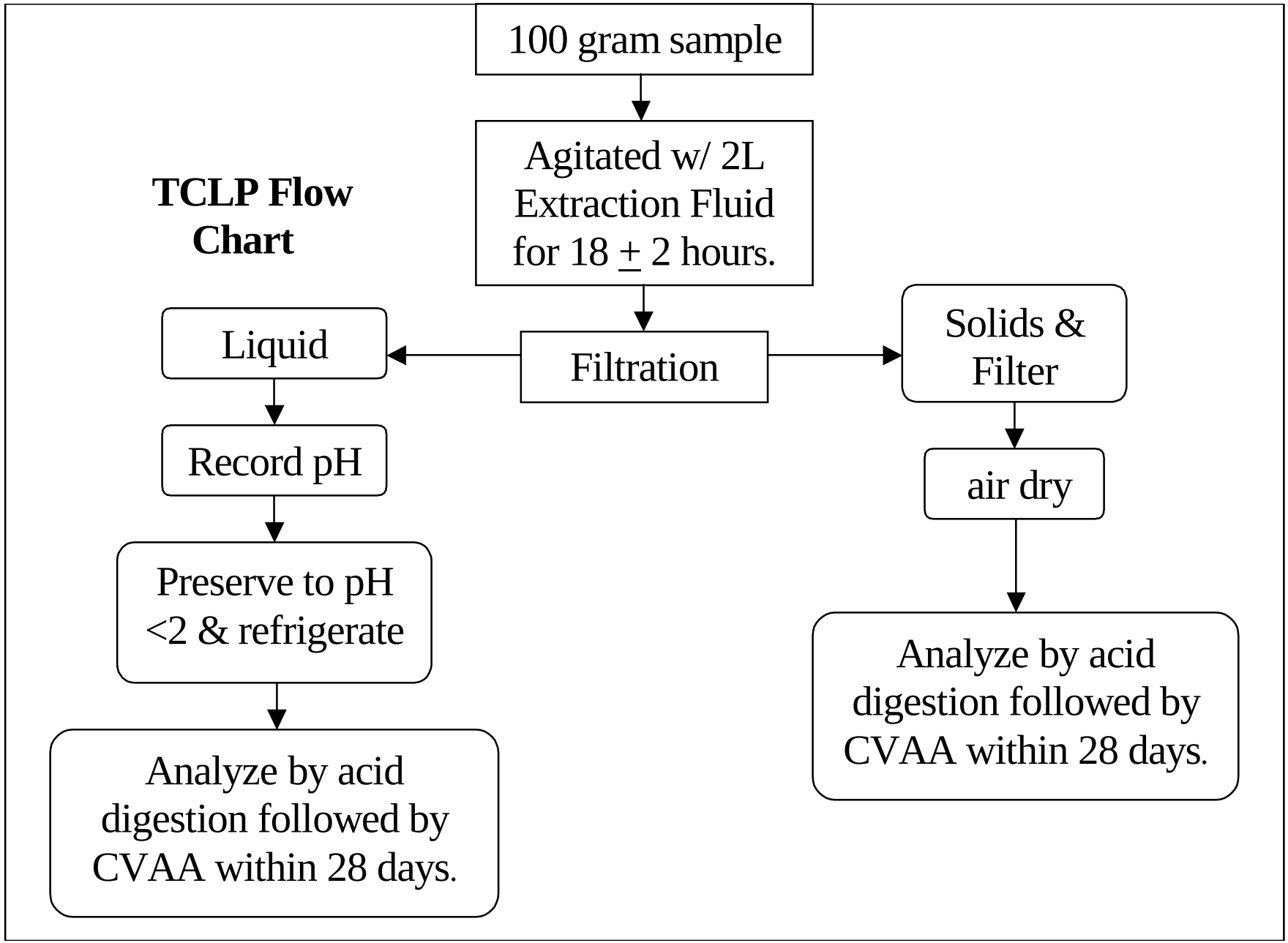
Groundwater Study

- To determine the potential for mercury release from an active FGD sludge disposal site.
- Sampling sites
- Samples collected quarterly
- Sample analysis

These data will be used to evaluate the environmental risk associated with FGD waste disposal.

TCLP Analysis

- EPA Method 1311 & ASTM Method D3987
- Leaching was conducted at three pH values.
  - Acetic acid buffered to a pH of 4.9 with NaOH
  - Acetic acid buffered to a pH of 2.8
  - Distilled water


TCLP Flow Chart
100 gram sample
Agitated w/ 2L Extraction Fluid for 18 ± 2 hours.
Filtration
Liquid
Solids & Filter
Record pH
air dry
Preserve to pH <2 & refrigerate
Analyze by acid digestion followed by CVAA within 28 days.
Analyze by acid digestion followed by CVAA within 28 days.

TCLP Filtrate Results

							Hg Drinking
Plant	Sample	Scrubber	Coal	Mercury Concentrations, ppb			Water Std.
ID #	Type	Type	Source	pH 4.9	pH 2.8	DI H_2O	ppb
14	SDA	Lime Spray Dryer	Eastern Low Sulfur Bit.	<1.0	<1.0	<1.0	2.0
14	Aggregate	Lime Spray Dryer	Eastern Low Sulfur Bit.	1.5	<1.0	<1.0	
15	Aggregate	Inhibited Oxidation	Pittsburgh Seam	<1.0	<1.0	<1.0	
11	Fly ash	Circulating Fluidized Bed	Eastern Low Sulfur Bit.	<1.0	<1.0	<1.0	
3	Coal	Mg/Lime	High Sulfur Ohio	<1.0	<1.0	<1.0	
3	Fly ash	Mg/Lime	High Sulfur Ohio	<1.0	<1.0	<1.0	
3	Fly ash	Mg/Lime	High Sulfur Ohio	<1.0	<1.0	<1.0	
3	Bottom Ash	Mg/Lime	High Sulfur Ohio	<1.0	<1.0	<1.0	
9	Ash	Carbon Injection - ESP	Powder River Basin	<1.0	<1.0	<1.0	
16	Sludge	Mg/Lime	High Sulfur Ohio	<1.0	<1.0	<1.0	

TCLP Solid Results

Plant	Sample	Scrubber	Coal	Mercury Concentrations, ppm			
ID #	Type	Type	Source	as received	pH 4.9	pH 2.8	DI H_20
14	SDA	Lime Spray Dryer	Eastern Low Sulfur Bit.	0.52	0.57	0.56	0.54
14	Aggregate	Lime Spray Dryer	Eastern Low Sulfur Bit.	0.39	0.41	0.43	0.40
15	Sludge	Inhibited Oxidation	Pittsburgh Seam	0.41	0.53	0.57	0.54
15	Aggregate	Inhibited Oxidation	Pittsburgh Seam	0.39	0.31	0.29	0.33
11	Fly ash	Circulating Fluidized Bed	Eastern Low Sulfur Bit.	0.33	0.36	0.53	0.47
3	Coal	Mg/Lime	High Sulfur Ohio	0.28	0.30	0.28	0.28
3	Fly ash	Mg/Lime	High Sulfur Ohio	0.07	0.07	0.08	0.08
3	Fly ash	Mg/Lime	High Sulfur Ohio	0.08	0.08	0.08	0.07
3	Bottom Ash	Mg/Lime	High Sulfur Ohio	0.04	0.02	0.01	0.03
9	Ash	Carbon Injection - ESP	Powder River Basin	0.08	0.06	0.07	0.07

Sample From CCB To Product

- This is an example of a CCB, spray dryer ash, that was turned into an aggregate.
- These findings show that from CCB to product the mercury leached remained below the drinking water standard.

							Hg Drinking
Plant	Scrubber	Coal	Sample	Mercury Concentrations, ppb			Water Std.
ID #	Type	Source	Type	pH 4.9	pH 2.8	Dl H_2O	ppb
14	Lime Spray Dryer	Eastern Low Sulfur Bit.	Spray Dryer Ash	<1.0	<1.0	<1.0	2.0
14	Lime Spray Dryer	Eastern Low Sulfur Bit.	Aggregate	1.5	<1.0	<1.0	

Leaching Test Conclusions

- Data support minimal leaching of the coal combustion by-product materials at the three pH values.
- To date, the data show <1.0 ppb of mercury in the filtrates.
- Less than the Drinking Water Standard Value of 2 ppb.

Schedule For Completion Of Work

Project Milestone	Completion Date
Literature Review	03/02
Topical Report - Literature Review	04/02
Collect Solid Samples	05/02
Analyze Solid Samples	07/02
Topical Report - Solid Samples	09/02
Collect Groundwater Samples	10/02
Analyze Groundwater Samples	11/02
Topical Report - Groundwater Samples	01/03
Final Report	02/03

Acknowledgments

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