Mercury Research

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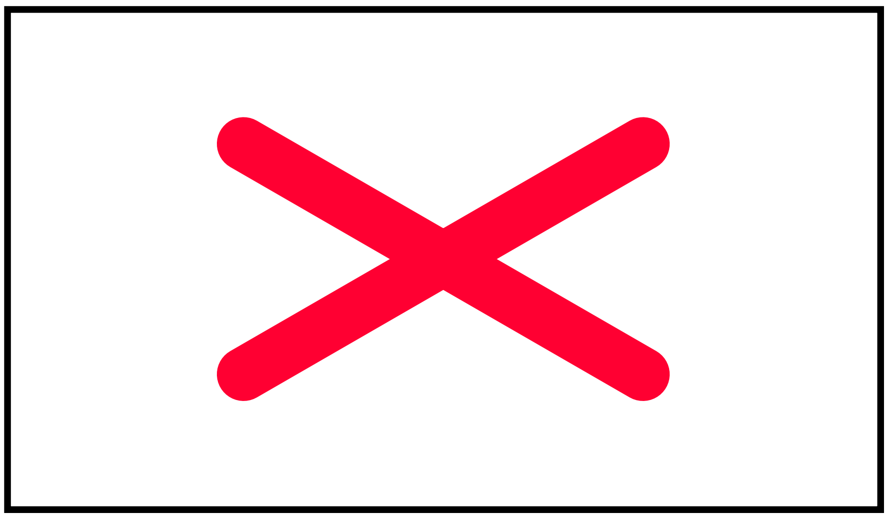
Energy & Environmental Research Center

About the EERC

Since its founding in 1949, the EERC has become a research, development, demonstration, and commercialization facility recognized internationally for its expertise in:



- Cleaner, more efficient energy technologies.
- Air and water pollution prevention and cleanup.
- Water management.
- Contamination cleanup and site remediation.
- Waste management and utilization.
- Advanced analytical methods.
- Education and training.

Mercury Research

- For the past 10 years, the EERC has performed research related to mercury generated during coal combustion.

- Activities have focused on the following:
  - Measurement and removal of mercury and mercury species in flue gas
  - Control technologies
  - Mercury stability within CCBs
  - Continuous emission monitors
  - Impact of selective catalytic reduction

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Center for Air Toxic Metals

By conducting field tests on operating power plants, the EERC helped refine more accurate techniques to measure mercury emissions.

The EPA-designated Center for Air Toxic Metals (CATM) addresses environmental issues regarding the emission of mercury, hazardous pollutants, and fine particulate from power plants and other industrial sources.

CATM has focused on mercury transformations, measurement, and control and conducted a series of conferences on air quality.

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CARRC

The Coal Ash Resources Research Consortium, established in 1985, develops environmentally friendly, commercially viable uses for CCBs.

CARRC works with DOE, EPA, and industry to develop appropriate protocols for evaluating mercury mobility from CCBs.

A specific CARRC task to determine mercury content and leachability from CCBs has provided one of the existing sets of data on actual mercury content of CCBs as managed.

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Mercury Control

The EERC is evaluating the potential of the advanced hybrid particulate collector (AHPC) to remove mercury using commercially available sorbents.

It is anticipated that 90% of the total mercury can be removed at a lower cost than estimated for other proposed mercury controls.

The revolutionary AHPC technology, developed by the EERC in partnership with W.L. Gore & Associates and DOE, was successfully demonstrated at Otter Tail Power Company's Big Stone Power Plant in South Dakota.

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EERC Mercury–CCB Research Team

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Mercury Stability on CCBs

- Leaching studies
- Thermal desorption of mercury and mercury compounds at temperatures between ambient and 600°C
- Short- and long-term ambient and near-ambient vapor release
- Impact of biologic activity on the vapor release of mercury

Leaching Results

ID No.	Sample Type	Bulk , µg/g	Calc. Max., µg/L	18-hr, µg/L	4-week, µg/L	4-week, pH
185	Fly Ash	0.461	46.3	< 0.05	< 0.05	12.6
186	Fly Ash	0.565	56.9	0.24	< 0.05	12.7
187	Fly Ash	0.677	67.8	0.12	< 0.05	12.1
188	FGD Ash	0.112	11.2	< 0.05	< 0.05	12.1
189	Fly Ash	0.736	73.8	< 0.05	< 0.05	11.3
264	WTE Ash	3.520	353.0	0.14	0.09	10.7
265	WTE Ash	75.400	7540.0	0.09	0.09	6.6

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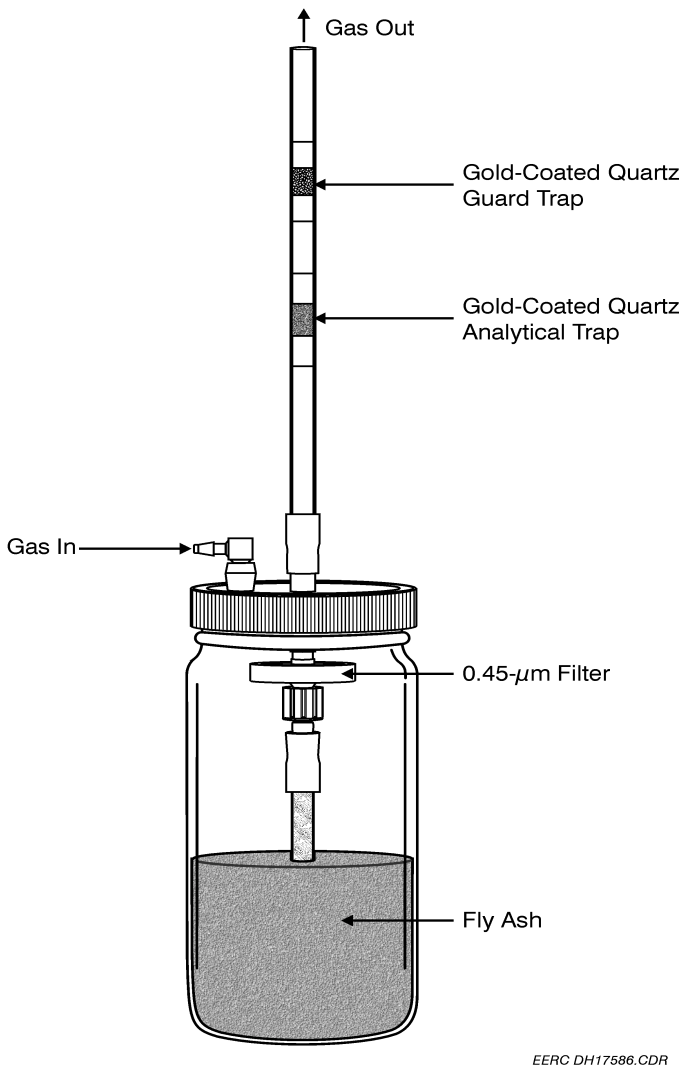
Ambient Experiments

ID No.	Coal/Ash Description	Total Hg, µg/g
99-188	PRB subbituminous fly ash+ FGD material	0.112
99-189	PRB Subbituminous + Petroleum coke fly ash	0.736
99-692	Eastern bituminous fly ash	0.140
99-693	Eastern bituminous fly ash	0.268
99-722	South African fly ash	0.638
99-724	South African fly ash	0.555

Ambient Vapor Release



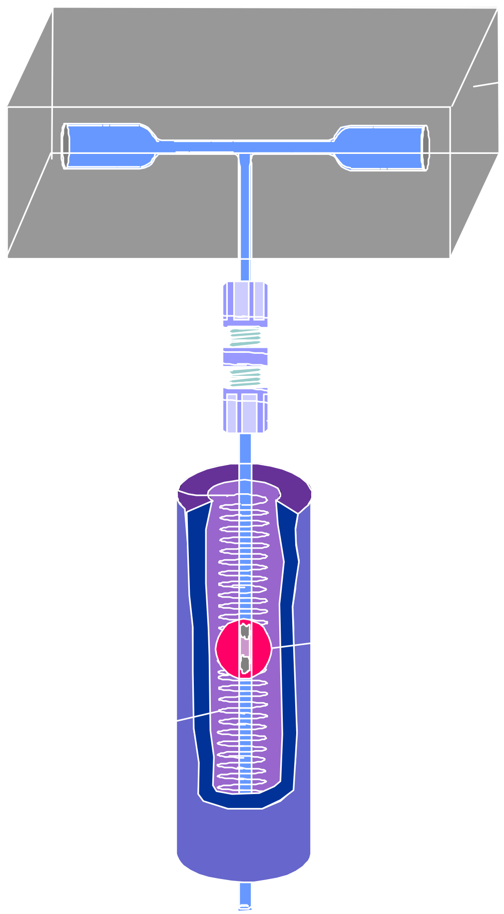
- Six samples were selected containing relatively high concentrations of mercury.
- 100 grams of each sample was placed into an apparatus designed for desorption experiments.
- Air was passed through the ash at an ideal rate of 1 mL/minute.
- Mercury released was determined at regular intervals.

Ambient Results

ID No.	2 Days	90 Days	55 Days	26 Days	90 Days	Total (263 Days)
99-188	0.059	1.439	0.142	0.011	4.245	5.896
99-189	< 0.001	0.489	0.133	< 0.001	4.501	5.123
99-692	< 0.001	0.953	< 0.001	< 0.001	3.167	4.120
99-693	< 0.001	0.648	< 0.001	< 0.001	4.980	5.628
99-722	< 0.001	1.619	0.033	< 0.001	6.878	8.530
99-724	< 0.001	0.240	0.007	< 0.001	6.071	6.318

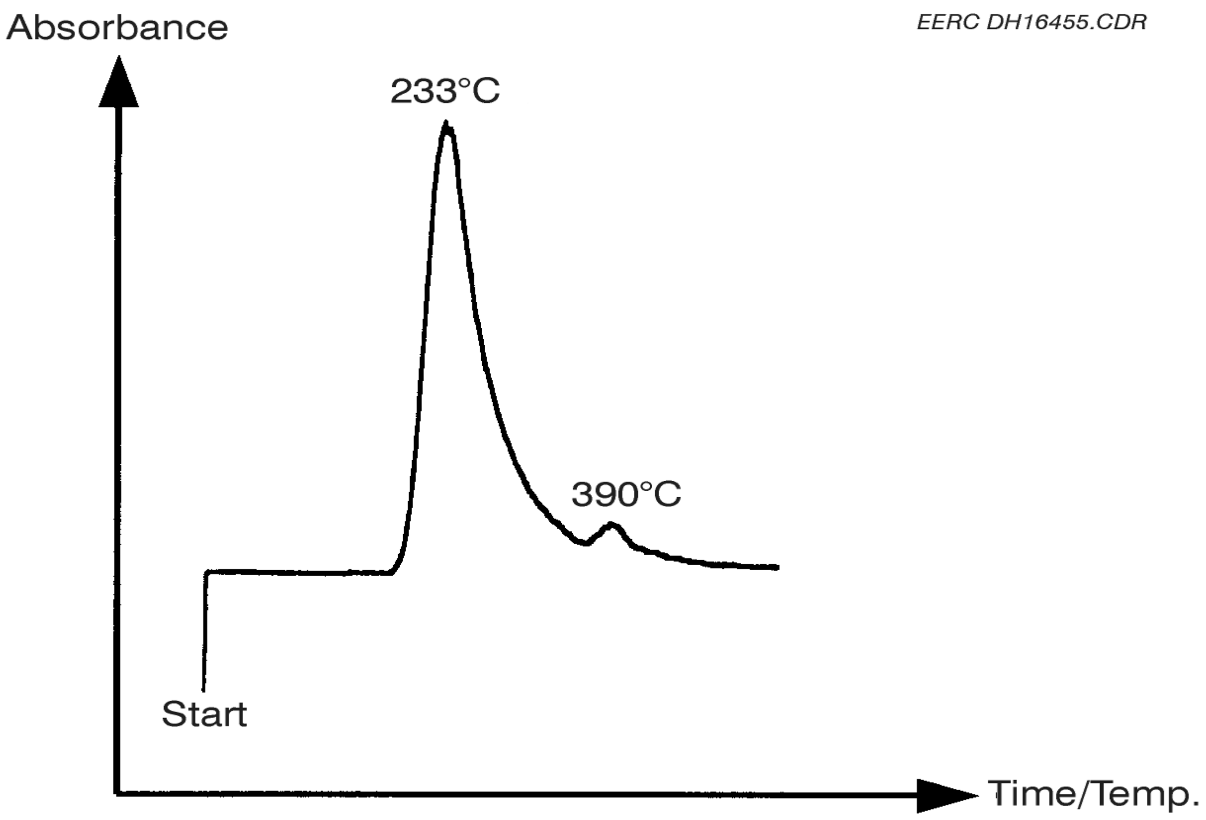
*Picograms of mercury per gram of ash.

Thermal Desorption



This apparatus was designed to study the thermal desorption of mercury and mercury compounds from CCBs at temperatures between ambient and 600°C.

Thermal Desorption Results



Thermal Desorption Results

- PRB ash spiked with HgO desorbed at 355°C
- The same ash spiked with $HgCl_2$ desorbed at 220°C
- HgO decomposes at 500°C
- $HgCl_2$ volatilizes unchanged at about 300°C

Microbiological Experiments

Two ashes were selected:

1. 99-189 0.609 micrograms/gram
   (.736 before leaching)
   PRB + petcoke
2. 99-692 0.140 micrograms/gram
   Eastern bituminous

Microbiological Results (189)

Metabolism	Mercury
Air	81 ng
Fe	103 ng
NO_3	95 ng
Ferm	99 ng
SO_4	158 ng
Sterile	116 ng

Microbiological Results (692)

Metabolism	Mercury
Air	1.40 ng
Fe	1.40 ng
NO_3	1.00 ng
Ferm	.40 ng
SO_4	.40 ng
Sterile	1.20 ng

Conclusions

- Coal ash samples leached only very low concentrations of mercury.
- Thermal desorption indicated little potential for environmental impact because no significant mercury peaks were detected at temperatures below 150°C.
- Ambient temperature desorption work has shown very low release rates.
- Microbiological work has indicated an increased mercury desorption rate compared to release rates seen in ambient and near-ambient temperature work.
- If this were applied to an annual coal-fired power plant production of 200,000 tons of fly ash per year, there would be a potential release of 0.0044 pounds of mercury released per year, which is equivalent to 2.00 g of mercury.

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