

**ANNUAL PROJECT REPORT
AS OF DECEMBER 2001**

1. PROJECT SPONSOR:

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2. PROJECT MANAGER

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3. OCDO GRANT NO. OCRC3-00-2.B2.7 Y2

4. PROJECT UPDATE X OR
FINAL REPORT

5. PROJECT TITLE: Gas Phase Chelating Sorbents for Removal of Mercury from Flue Gases

6. PROJECT TERM: FROM: September 1, 2001 to August 30, 2002

7. BUDGET:

<u>CO-SPONSORS NAME</u>	<u>COST SHARE</u>
OCDO	\$ 79,892
University of Cincinnati	\$ 31,159

TOTAL PROJECT COST: \$111,051

I. ABSTRACT

8. OVERVIEW OF PROJECT & OBJECTIVES:

A research project has been proposed to evaluate the potential of gas-phase chelating sorbents for the removal of mercury vapor from flue gases emitted from coal-fired power plants. A three-year effort is planned with the objective of synthesizing sorbents suitable for implementation in membrane electrostatic precipitators, fixed-bed contactors and baghouse filters. The proposed research is based on a novel concept that will exploit chelation for the removal of mercury directly from the gas phase. Chelating sorbents are currently limited to the removal of mercury from liquid (aqueous) phases. It is expected that if successfully implemented, direct chelation in the gas phase will lead to high capacity, high efficiency mercury capture technology.

In the first year of the project the goal is to synthesize gas-phase chelating sorbents and characterize their capacity and kinetic characteristics. These data will serve

as the springboard for developing the technology for practical implementation in the subsequent years of the project. Specifically, in the first year, the relationship between sorbent characteristics and performance characteristics will be examined. Experiments will be performed to establish the influences of temperature, mercury loading, type of surface-active layer, concentration of surface-active groups, and porosity on the rates of sorption and on the sorption capacity. It is anticipated that at the end of the first year gas-phase chelating sorbents with suitable capacity and kinetic characteristics for the removal of mercury from flue gases will have been synthesized.

9. WORK DONE AND CONCLUSIONS:

The chemical method for immobilizing cysteine on the surface of porous silica has been identified. The method involves three major steps: amination of the silica surface, attachment of an aldehyde functional group, and immobilization of the cysteine through linkage with the aldehyde. All the equipment and procedures necessary to successfully implement these steps have been developed. Preliminary characterizations of the modified silica were performed with FTIR. These data indicate the presence of chelating and linking groups on the surface.

10. PLANS FOR COMING YEAR:

The modified silica surface (cysteine attached) will be more completely characterized with FTIR. The equipment for coating the modified silica with the active solvent will be purchased and installed. Coating experiments will be initiated with the objective of finding the ideal coating conditions to obtain stable, uniform layers of approximately 2 nm in thickness. Experiments will also be initiated to evaluate the thermal stability of the coated adsorbent. Thermogravimetric analysis will be used for this purpose. Subsequently, the equilibrium characteristics of the adsorbent for mercury will be evaluated. The activated forms selected will be based on the results of the thermal stability studies; all alkyl chain lengths that give acceptable thermal stability will be analyzed. The capacity for both mercuric chloride and elemental mercury will be studied. The mercury loading range will be selected to reflect conditions at ESPs in power plants burning Ohio 5/6/7 blend and Clarion 4A. Following the capacity measurements, kinetic studies will be performed to establish rates of sorption. Because of the difficulty with monitoring vapor-phase mercury reliably on a continuous basis, and because of the predominance of the oxidized forms of mercury in flue gases, the kinetic studies will focus on mercuric chloride. The main goal of the kinetic experiments will be to determine whether chelate formation rate, or mass transfer, or both are rate limiting.

II. HIGHLIGHTS /ACCOMPLISHMENTS

11. A activation method has been successfully implemented for immobilizing a chelating group for mercury on a silica substrate.

III. ARTICLES/PRESENTATIONS

12.