ANNUAL PROJECT REPORT
AS OF DECEMBER 2001

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3. OCDO Grant No. OCRC3-01-B.2.1.

4. Project Update **X** or Final Report

5. Project Title: Capture of Air Toxics by Membrane Electrostatic Precipitator

6. Project Term: From: September 1, 2001 To: August 31, 2002

7. Budget

Name	Cost Share
OCDO	$79,785
Ohio University	$57,293
Total Project Cost	$137,078

I. ABSTRACT

8. Overview of Project and Objectives

The goal for the proposed program is to develop cost-effective control technology for mercury and other air toxics using novel membrane-based electrostatic precipitation. The first year of this work (which covered January-September 2001) focused on identifying suitable coating technologies for precipitator collector membranes, depositing coatings on membranes, and testing coatings for air toxics captured in a electrostatic precipitator test facility. The second year objectives (September-December 2001) have been to focus on the application of membrane precipitation to facilitate collection of mercury, especially via combined systems to convert Hg^0 to oxidized forms to facilitate capture and to examine the application of wet membrane precipitation to facilitate and enhance subsequent capture.

Present work is underway to examine the collection of oxidized mercury (Hg^{2+}), activated sorbents, and use of highly reactive radicals to oxidize mercury in a novel wet electrostatic precipitator for the control of air toxic emissions. Specifically, the collection of Hg^{2+}, which may be enriched in fine particulates, will be investigated, because Ohio coals have been shown to produce far more Hg^{2+} than Hg^0. The collection of fine particulates is well-known to be enhanced in wet precipitation, because of the higher specific powers due to the absence of back corona. Further, collection of sorbents, particularly injected fine TiO_2, which is activated by ultraviolet (*uv*) radiation produced by precipitator corona, will also be examined. Finally, the response of the membrane collector to extremely reactive environments produced by oxidation schemes (such as electrocatalytic oxidation) will be examined for potential low-cost application in the collection of Hg released from the combustion of Ohio coals.

9. Work Done and Conclusions

The work done this year included mercury collection testing for coated dry precipitator collecting membranes and construction of a wet precipitator collecting experimental facility. The dry precipitator testing revealed significant collection of elemental mercury – between 9 and 18%, confirmed through both gas phase and solid (or captured) phase measurements, with increasing levels of collection when using additional *uv* radiation to activate the TiO_2 on the membranes. This collection level was significant because of the low collection area used and that the collection was in the gas phase, not in the solid (particulate) phase. The collection results also showed that gas phase Hg remained in the elemental state (as determined through measurements made using the Ontario Hydro method), while over 93% of all Hg species on the coated membranes were in the oxidized state.

10. Plans for Coming Year

In the coming year, the experimental facility for wet electrostatic precipitation will be completed and a recently purchased Mastersizer 2000 particle analyzer will be put on-line. Tests will be conducted to investigate specific power, corona discharge and fine particulate collection for Hg^{2+} using uncoated wet membranes. Further, tests will be performed to investigate addition of photo-catalytic sorbent activation and capture with wet collectors and finally, to investigate performance of wet collectors in highly oxidizing atmospheres that are capable of converting elemental into oxidized mercury.

II. HIGHLIGHTS/ACCOMPLISHMENTS

11. It has been found that gas phase elemental Hg can be captured on TiO_2 coated membranes in a dry electrostatic precipitator. This is especially important because the transport processes for gas phase pollutants, such as vaporized mercury, are not the same as for solid phase pollutants, such as fly ash. In the gas phase, the electrostatic forces are negligible (gas molecules do not hold a charge unless they are ionized), so bulk turbulent flow or some other force must move the gas molecules to the collecting surfaces. Mathematical modeling of the transport in the precipitator test section indicates that turbulence is not sufficient to achieve the capture level that was experimentally measured. It is theorized that the effect known as "corona wind," present due to transport of ionized gas, coupled with the interstitial gaps in the woven membranes, allows for greater delivery of gas molecules to the surface of the coated membranes. The gas phase elemental Hg then interacts with the TiO_2, resulting in the oxidation of the mercury and "capture" on the coated membrane that would not otherwise be possible if the underlying substrate was continuously solid.

III. ARTICLES/PRESENTATIONS

12. None. This was the first full year of the project.