

Apogee's Upcoming Mercury Research Activities

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Outline

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 - Mercury Sorbents for Elevated Acid Gas Flue Gas Streams
 - Advanced Mercury Sorbents with Low Impact on Power Plant Operations
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Goal

To utilize the unique blend of technical expertise and capabilities possessed by Apogee to aide in the development of the next generation of sorbent materials for vapor-phase mercury control and capture.

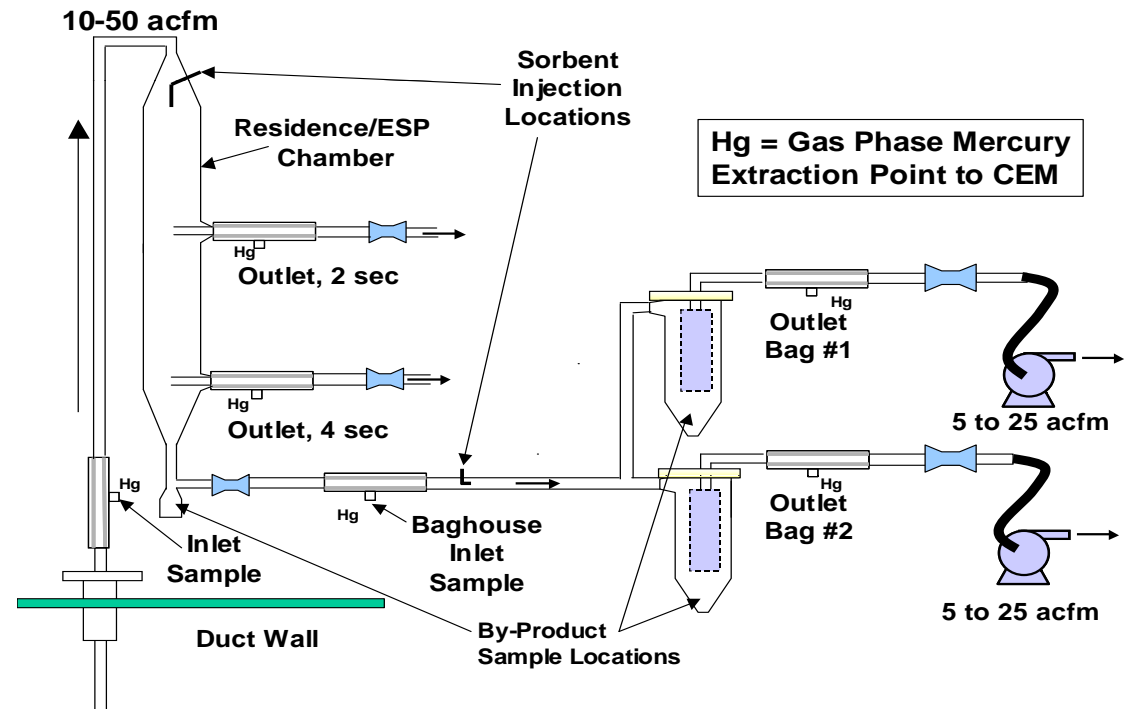
Background/Experience

- Apogee has been involved in mercury control research and development for over 10 years
- Apogee has the equipment and expertise to evaluate a wide assortment of sorbent materials quickly and efficiently
- Leverage working relationships with key members of industry and academia to further development
- Real world testing to validate technology
- Building on previous work in sorbent development efforts that have helped in development of current commercial sorbents

Background/Experience

The PoCT System

- Owned by EPRI, operated by Apogee
- Pilot System capable of testing sorbent materials in both fabric filter and in-flight modes
- Sorbents tested on actual flue gas to validate laboratory results
- Real by-products samples – full fly-ash loading



Background/Experience

Continuous Mercury Monitors (CMMs)

- Apogee owns and operates CMMs in support of these programs
- Over 30,000 hours of monitoring on real flue gas
- Proven, reliable technology coupled with experienced profession operators



Research Programs

Apogee has received two awards from the DOE to perform research activities related to advanced mercury sorbents

- DOE SBIR Award - Mercury Sorbents for Elevated Acid Gas Flue Gas Streams
- DOE/NETL Cooperative Funding Agreements - Advanced Mercury Sorbents with Low Impact on Power Plant Operations

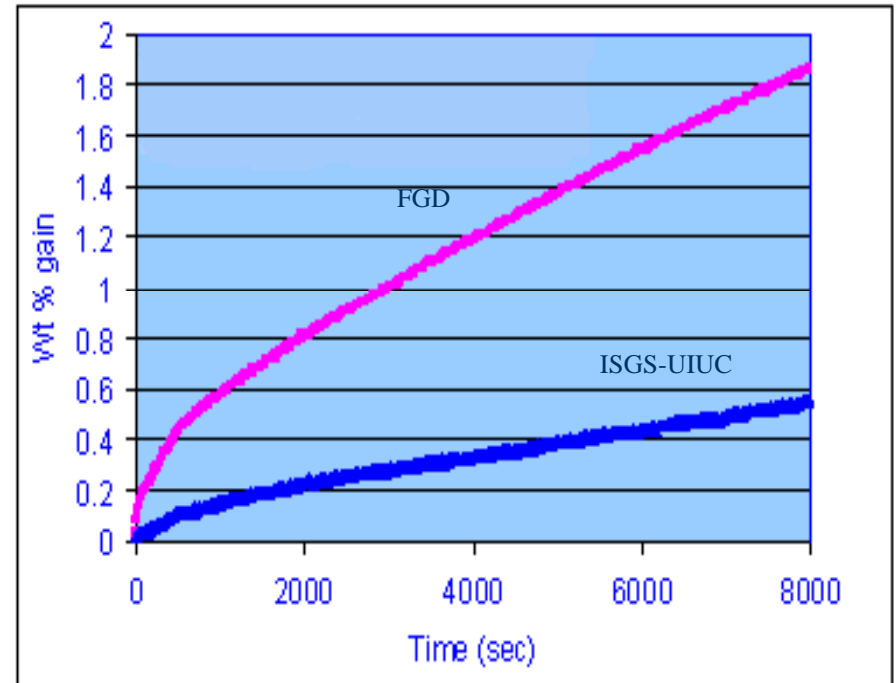
DOE SBIR Award

Teamed with the Dr. Massoud Rostam-Abadi at the Illinois State Geological Survey and University of Illinois Urbana-Champaign (ISGS-UIUC)

The objective of the program is to perform research on sorbent behavior in high acid gas flue gas streams. Development of “acid tolerant” sorbent materials capable of retaining mercury capture performance in the presence of high concentrations of SO_2 and SO_3

DOE SBIR Award

Previous research efforts by Dr. Massoud Rostam-Abadi have shown promising sorbent materials with selectivity to mercury over SO_2



DOE SBIR Award

Program Schedule

- Initial sorbent development and screening testing conducted iteratively during first 1-3 months
- Laboratory feasibility testing conducted on best candidates
- Best performing materials subjected to extensive characterization testing and final material optimization
- Final feasibility testing conducted on actual coal boiler flue gas using the PoCT system

DOE Cooperative Funding Award

Advanced Mercury Sorbents with Low Impact on Power Plant Operations

Objective:

To evaluate advanced sorbent materials for removing mercury from coal combustion flue gas with minimal impacts on balance of plant operations. Sorbent technologies to achieve 70% or greater mercury capture at 25% or less of DOE baseline cost.

DOE Cooperative Funding Award

Team Members

- Apogee Scientific, Inc
- EPRI
- URS Group
- Southern Company Services
- Calgon Carbon Corporation
- ISGS-UIUC
- Southern Research Institute
- Tennessee Valley Authority
- TXU
- TDA Research, Inc

DOE Cooperative Funding Award

Development Group	Sorbent	Unique Features
UIUC-ISGS	Chemically passivated and halogen impregnated activated carbons	<ul style="list-style-type: none"> • Chemically passivated to decrease impact on AEA use during concrete preparation • Enhanced mercury adsorption capacity
UIUC-ISGS	Expanded Activated Carbons	<ul style="list-style-type: none"> • Larger overall particle size distribution with the high surface area-to-volume ratio of small particles • Able to be mechanically separated from fly ash • Potential for sorbent reuse • Reduced impact on PCD performance
UIUC-ISGS	Non-carbon sorbents	<ul style="list-style-type: none"> • Minimal effect on concrete preparation due to non-carbon-based substrate • Micropore surface increases surface area • Chemical impregnation enhances mercury adsorption capacity
Calgon	Magnetic Carbon	<ul style="list-style-type: none"> • Magnetic properties allow it to be efficiently separated from fly ash, allowing the bulk of the fly ash to be used in concrete preparation • Recovered carbon can be re-utilized
TDA	Non-carbon sorbent	<ul style="list-style-type: none"> • Minimal effect on concrete preparation due to non-carbon-based substrate • Performs well at high temperatures

DOE Cooperative Funding Award

Sorbent	Mercury Capacity ($\mu\text{g/g}$) as Hg^0
UIUC-ISGS Passivated Carbon	1.3 – 1.9 Times Base Carbon (750 – 1800)
UIUC-ISGS Large Particle Carbon	1313
UIUC-ISGS Clay Based Micropore	75
TDA Non-Carbon Catalytic	162
Calgon Magnetic Carbon	>1200
Norit FGD-Hg	1282

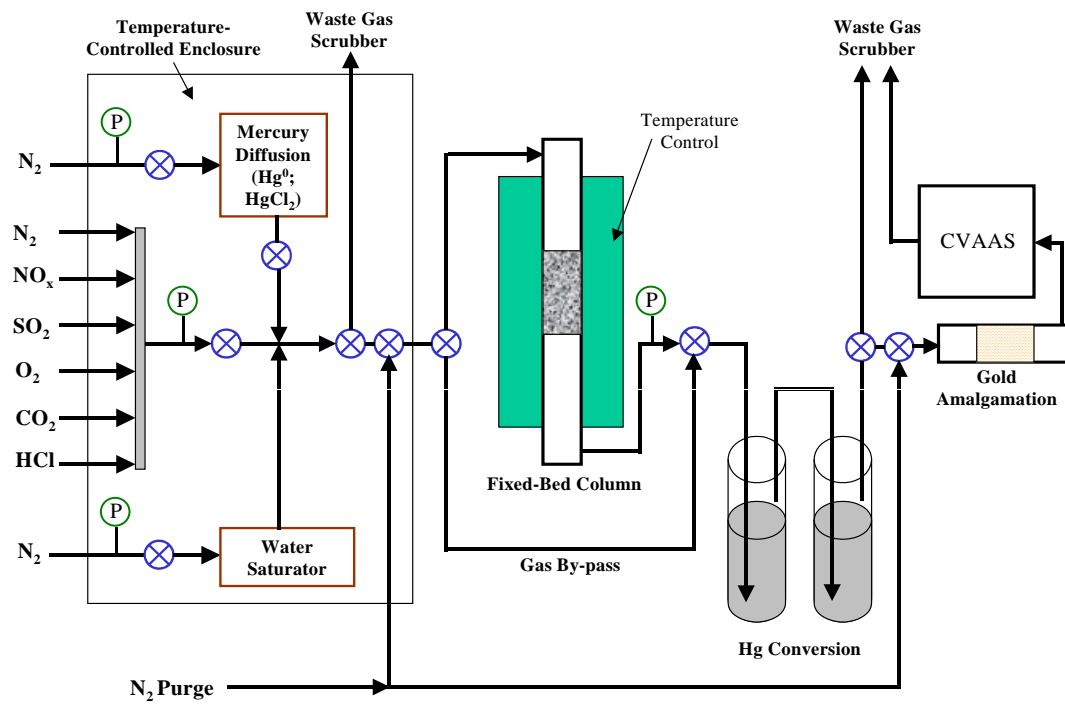
DOE Cooperative Funding Award

Project Schedule

- Sorbent Preparation and Optimization – Materials are prepared and tested in an iterative method to select formulations with best possible mercury capture capabilities
- Laboratory Screening Tests – Characterize mercury adsorption of multiple formulations using fixed bed test apparatus
- Slipstream Evaluations – Best performing materials tested using the EPRI PoCT system at three different host sites encompassing distinct coal types (PRB, EB, and Texas Lignite)
- Pilot-Scale Sorbent Evaluations – Materials evaluated on 1-5 MW Pilot facilities at Southern Company's Plant Miller and Mercury Research Center

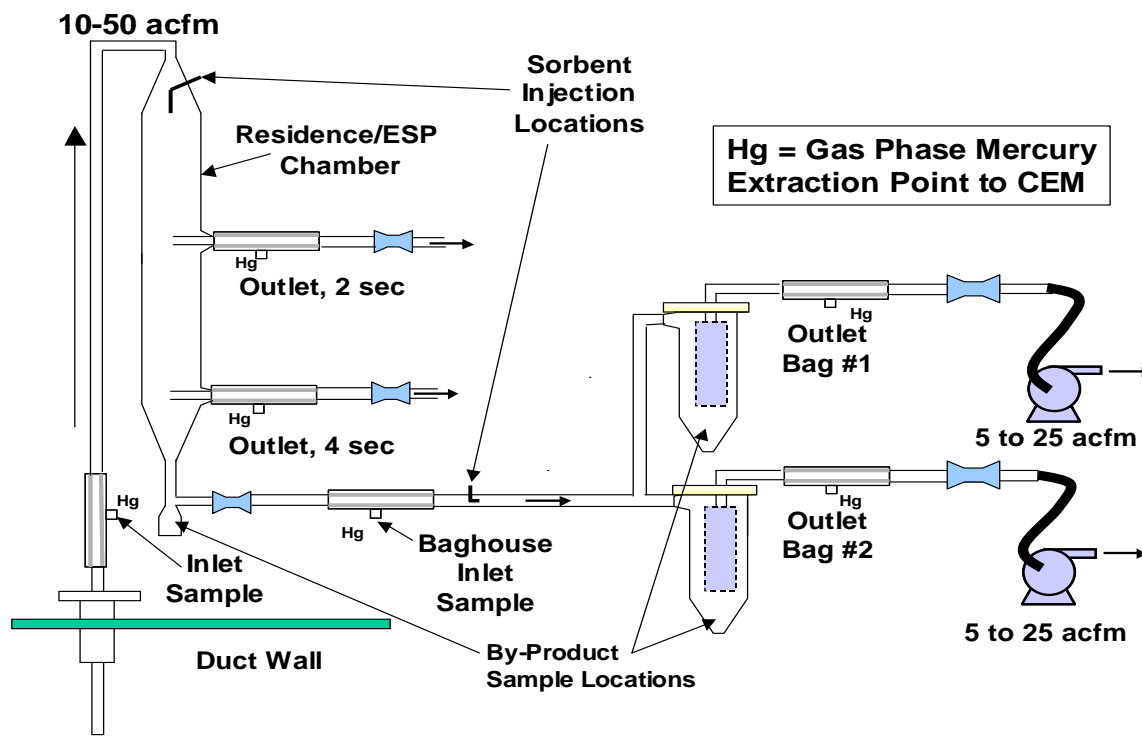
DOE Cooperative Funding Award

Laboratory Fixed Bed Test Apparatus – URS Group



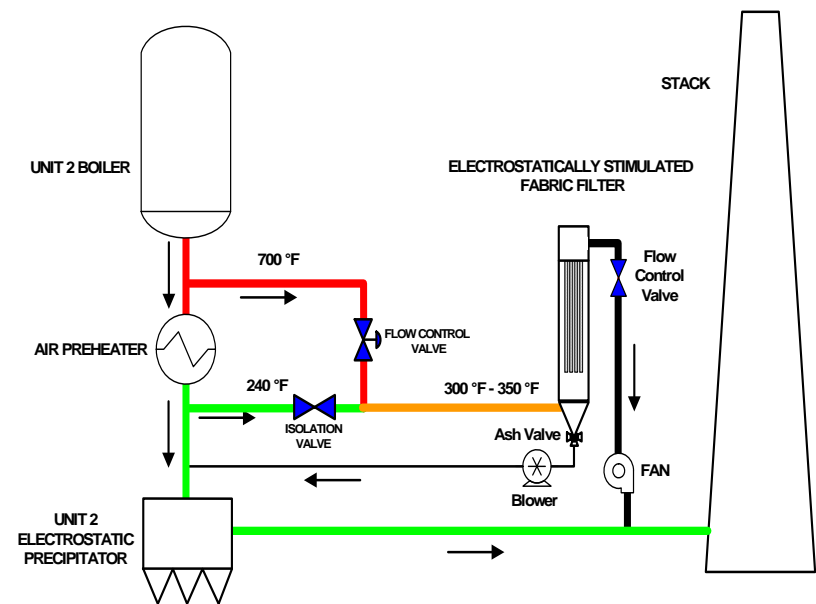
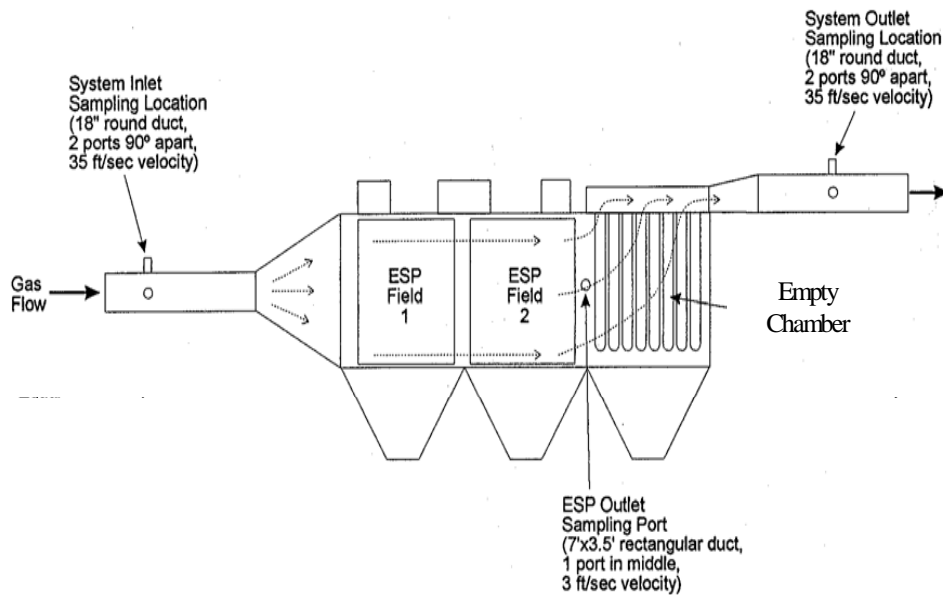
DOE Cooperative Funding Award

EPRI's PoCT System



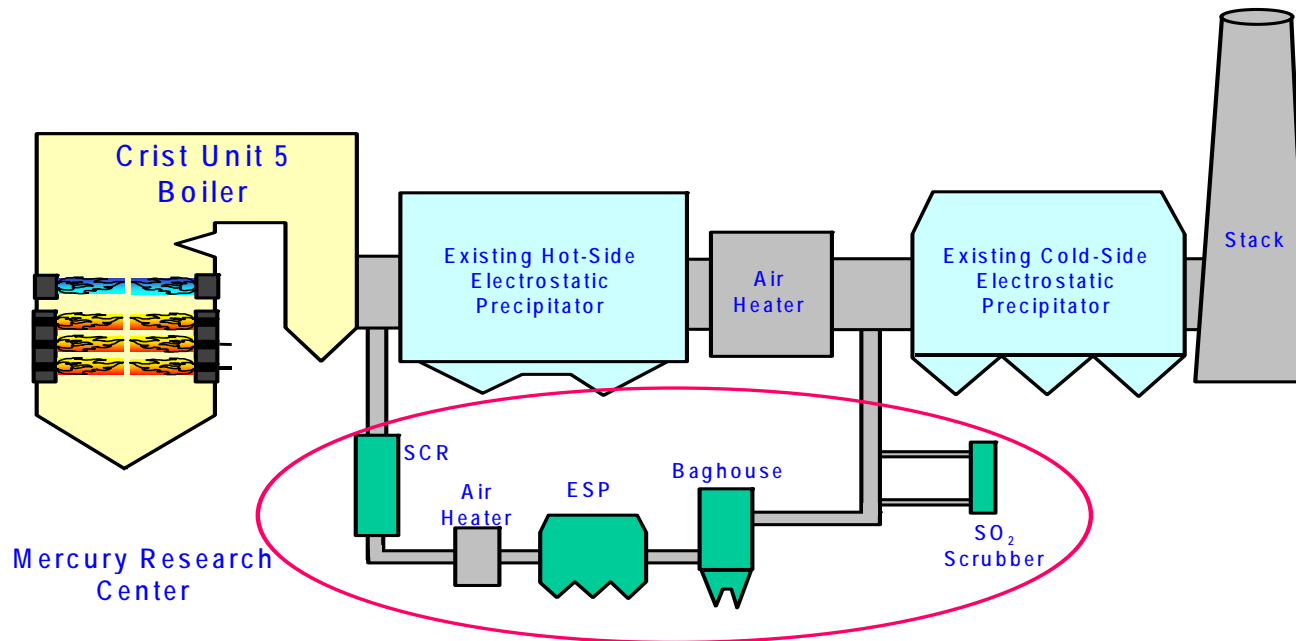
DOE Cooperative Funding Award

Southern Company's Plant Miller Pilot Facility



DOE Cooperative Funding Award

Southern Company's Mercury Research Center



Questions

