the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

Evaluation of Solid Sorbents as a Retrofit Technology for CO_2 Capture from Coal-fired Power Plants

Background

Retrofitting the current fleet of pulverized coal (PC)-fired power plants for the separation and sequestration of carbon dioxide (CO_2) is one of the most significant challenges for effective, long-term carbon management. Post-combustion CO_2 capture using solid-sorbent based technologies is a potential resolution to this challenge that could be appropriate for both new and existing PC-fired power plant configurations. However, as development is in the early stages, it is necessary to address the most critical challenges facing this application using an efficient, proven approach to expedite the development process.

Description

More than 20 sorbents will be tested on simulated flue gas in a fixed-bed contactor. The most promising of which will then be tested on actual flue gas and characterized for key adsorption and handling properties. Sorbent developers identified from the public literature will be invited to provide samples for screening and joining the sorbents developed by the project team. A slipstream moving-bed contactor will be fabricated during lab-scale tests, with the testing to be conducted at three field sites: Southern Company and Alabama Power's E.C. Gaston Station, Luminant's Martin Lake Station, and a yet to be determined Xcel Energy plant.

Process equipment performance and scale-up will be evaluated in parallel with sorbent testing. Technology issues and critical obstacles will be identified and addressed and a technology survey will be completed to identify existing process equipment that may be relevant for sorbent-based CO_2 capture. Detailed capital and operating costs will be determined with a final result of cost per ton of CO_2 removed. A conceptual design for the integration of CO_2 capture into a 500-megawatt (MW) plant will be completed and a 1-MW pilot unit will be designed to provide the next step.

CONTACTS

Jared P. Ciferno
Technology Manager
Existing Plants, Emissions & Capture
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-5862
jared.ciferno@netl.doe.gov

Andrew O'Palko
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4715
andrew.opalko@netl.doe.gov

Sharon M. Sjostrom
Principal Investigator
ADA-ES, Inc.
8100 SouthPark Way, Unit B
Littleton, CO 80120
303-339-8856
sharons@adaes.com

PARTNERS

ADA-ES, Inc.
Adsorption Research Inc.
Ameren
American Electric Power
Electric Power Research Institute
Jenike & Johanson
Luminant
North American Power
Reaction Engineering International
Southern Company
Stantec
Xcel Energy

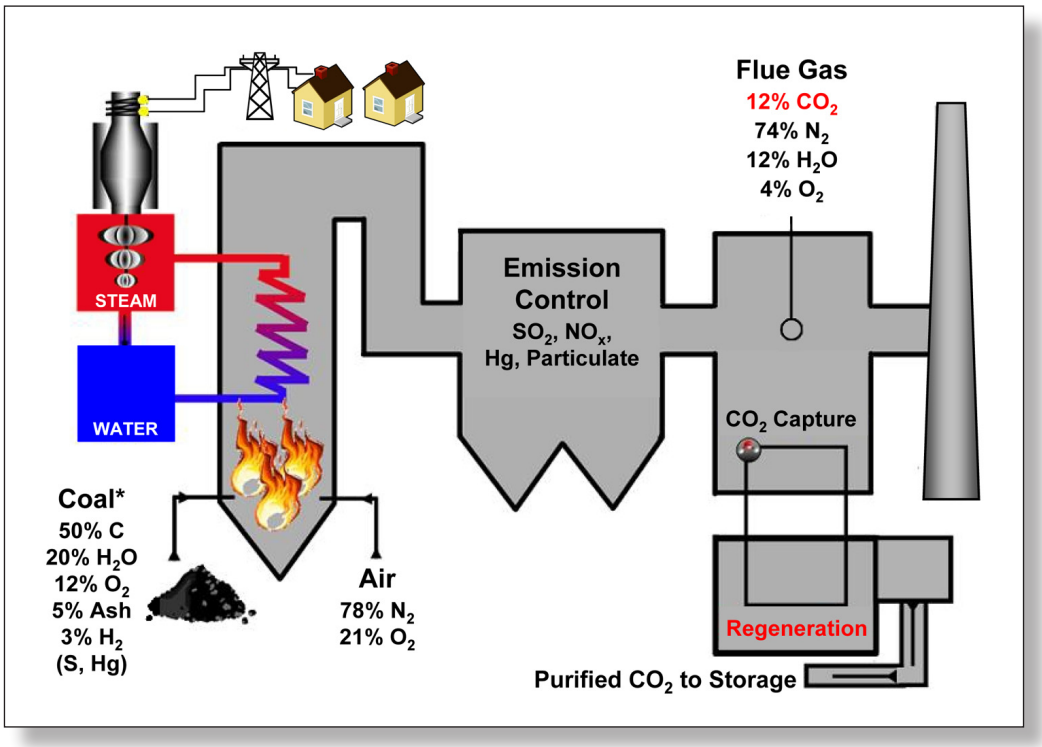
PERIOD OF PERFORMANCE

9/30/2008 to 12/31/2010

COST

Total Project Value
$3,199,725

DOE/Non-DOE Share
$1,999,725/$1,200,000



Post-Combustion Capture

Primary Project Goal

The primary goal of this project is to evaluate the feasibility and expedite the development of solid sorbent-based CO_2 capture technologies that can be retrofit to conventional PC-fired power plants.

Objectives

The objectives of this two-phase project are to exhibit long-term 90 percent CO_2 removal from actual flue gas while limiting the increase in the cost of electricity (COE) for capture and sequestration to less than 35 percent.

Benefits

A key attribute of CO_2 sorbents is that less water (H_2O) is present, compared to solvent-based systems, thereby reducing the sensible heating and stripping energy requirements. Test results from evaluating sorbents at laboratory- to bench-scale for their performance in a CO_2 capture process will aid in the development of the conceptual design for integration of the sorbent system into a PC-fired power plant.

This project is uniquely suited to advance the development of sorbent-based CO_2 capture to meet the U.S. Department of Energy's (DOE) goal of obtaining pilot-scale results by 2013.

Planned Activities

The two general families of sorbents, supported reactants and molecular sieves, will be evaluated for the application of CO_2 capture using temperature swing adsorption (TSA). Between 20 to 30 sorbents developed by the project team members, as well as those identified from public literature, will be tested on simulated flue gas in a fixed-bed contactor, with the most promising sorbents later being tested on actual flue gas in the same apparatus. A maximum of 10 sorbents will then be selected for characterization for key adsorption and handling properties.

Sorbents will also be evaluated on the following criteria: 1) availability of raw material; 2) manageable disposal costs (low toxicity); 3) CO_2 working capacity; 4) interaction with flue gas constituents (sulfur oxide [SO_X] and nitrogen oxide [NO_X]); and 5) sufficient hardness to mitigate attrition. The sorbents displaying the most promising properties will be evaluated in a bench-scale moving bed contactor and tested parametrically to identify the optimal range of operation.