the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

Evaluation of Solid Sorbents as a Retrofit Technology for CO_2 Capture

Background

The mission of the U.S. Department of Energy/National Energy Technology Laboratory (DOE/NETL) Existing Plants, Emissions & Capture (EPEC) Research & Development (R&D) Program is to develop innovative environmental control technologies to enable full use of the nation's vast coal reserves, while at the same time allowing the current fleet of coal-fired power plants to comply with existing and emerging environmental regulations. The EPEC R&D Program portfolio of post- and oxy-combustion carbon dioxide (CO_2) emissions control technologies and CO_2 compression is focused on advancing technological options for the existing fleet of coal-fired power plants in the event of carbon constraints. This project is one of six R&D carbon capture projects from the EPEC program that were selected by DOE to receive funding from the American Recovery and Reinvestment Act of 2009 (ARRA). These projects will accelerate carbon capture R&D for industrial sources toward the goal of cost-effective carbon capture within 10 years.

Pulverized coal (PC) plants burn coal in air to produce steam and comprise 99 percent of all coal-fired power plants in the United States. CO_2 is exhausted in the flue gas at atmospheric pressure and a concentration of 10–15 percent by volume. Post-combustion separation and capture of CO_2 is a challenging application due to the low pressure and dilute concentration of CO_2 in the waste stream, trace impurities in the flue gas (nitrogen oxides [NO_x], sulfur oxides [SO_x], and particulate matter [PM]) that affect removal processes, and the parasitic energy cost associated with the capture and compression of CO_2.

Sorbent-based technologies, which adsorb CO_2 onto a solid sorbent, have the potential to effectively reduce the energy penalties and costs associated with post-combustion CO_2 capture for industrial facilities, as well as for both new and existing PC-fired power plants.

Project Description

ADA-ES (ADA) and partners will design, construct and operate a 1 MW equivalent gas flow pilot-scale test unit to evaluate the performance and cost of an advanced solid sorbent CO_2 capture technology. Results will be used to prepare detailed designs and cost estimates for industrial- and utility-scale CO_2 capture applications.

The project will utilize progress on sorbent technology as demonstrated in bench-scale viability tests from a separate DOE project (DE-NT0005649) and will refine and optimize sorbent capture and regeneration processes through pilot testing and process modeling. Previous laboratory and preliminary field testing, engineering analyses, and physical modeling have shown that solid sorbent-based CO_2 capture is a promising alternative to solvent-based capture technologies and it has distinct benefits due to anticipated

CONTACTS

Shailesh D. Vora
Technology Manager
Existing Plants, Emissions & Capture
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-7515
shailesh.vora@netl.doe.gov

Bruce Lani
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-5819
bruce.lani@netl.doe.gov

Sharon Sjostrom
Principal Investigator
ADA-ES, Inc.
8100 South Park Way, Unit B
Littleton, CO 80120-4527
303-734-1727
sharons@adaes.com

PARTNERS

Stantec Consulting Ltd.
Shaw Energy & Chemicals, Inc.

PERFORMANCE PERIOD

Start Date	End Date
10/01/2010	12/31/2014

COST

Total Project Value

$18,750,000

DOE/Non-DOE Share

$15,000,000 / $3,750,000

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

AWARD NUMBER

FE0004343

lower regeneration energy requirements and higher CO_2 capacity. ADA has evaluated over 100 potential CO_2 sorbents from 20 developers in 6 countries to select sorbents for scale-up and has identified supported amines and activated carbon as the best performing candidates. Based on model and optimization studies of the solid sorbent technology process, the project will design, construct, and operate a 1 MW pilot plant on a slipstream of coal-fired flue gas for parametric studies and for a minimum two month period of steady state operation. The information gained from the project operation will be used to complete a technical and economic analysis of the process.

Goals

The project goal is to validate and optimize a solid sorbent-based CO_2 capture technology through pilot testing and process modeling. The project outcome is to define a path forward for achieving 90 percent post-combustion CO_2 capture at less than a 35 percent increase in cost of electricity (COE) for a sorbent-based technology which is applicable to industrial sources of CO_2 and that will be ready for demonstration testing in 2020 with potential commercial deployment beginning in 2030.

Objectives

Project objectives are to demonstrate the technical, economic, and energy benefits of a solid sorbent-based CO_2 capture technology. Specific objectives include developing performance data through the operation of the system on a slipstream of flue gas; assessing sorbent performance sensitivity to flue gas constituents and effectiveness for capture of other regulated pollutants; operating the test continuously for at least two months to identify operating and maintenance issues and assess system reliability; removing at least 90 percent of the incoming CO_2 from the flue gas; producing high purity CO_2; and conducting a techno-economic analysis of the commercial design.

Planned Activities

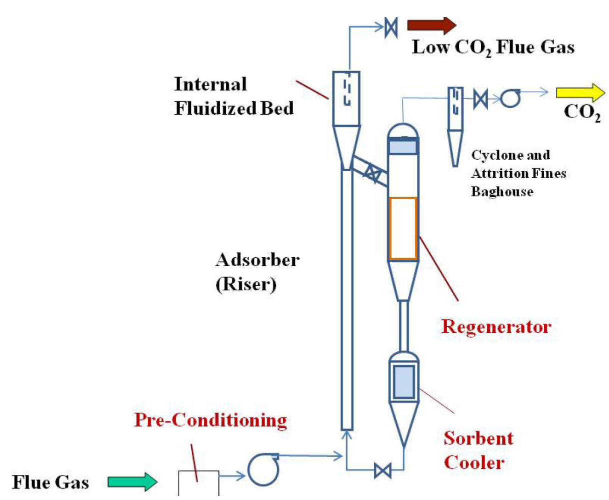
- The process design developed during the previous viability assessment will be scaled to a 500 MW commercial plant utilizing computational fluid dynamics and process modeling.
- A 1 MW pilot plant of the refined commercial concept will be designed, constructed, and installed at a coal-fired power plant site to evaluate the process design and characterize sorbent performance.
- Field testing with the 1 MW pilot plant will include parametric studies and up to two months of continuous pilot operation to validate pilot plant performance.
- Based on the test results, process models will be refined, a full-scale conceptual engineering design will be prepared, and the COE for a commercialized process will be determined.

Accomplishments

- Project awarded on 09/17/2010.
- Kick-off Meeting conducted on 12/03/2010.

Benefits

This project will advance a solid sorbent-based CO_2 capture process that has been validated through laboratory and field tests to a 1 MW slipstream pilot test to demonstrate the technology's potential to significantly reduce the energy penalty and costs compared to current state-of-the-art technologies. This work continues the evaluation and optimization of promising candidate sorbents on a slipstream testing level and increases the likelihood of developing an economical, commercial-ready CO_2 capture technology for industrial- and utility-scale applications.



Conceptual Pilot System