the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

Novel High-capacity Oligomers for Low-cost CO_2 Capture

Background

The mission of the U.S. Department of Energy's (DOE) Existing Plants, Emissions, & Capture (EPEC) 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 and reuse is focused on advancing technological options for the existing fleet of coal-fired power plants in the event of carbon constraints.

One area of interest in post-combustion CO_2 capture is the use of solvent-based systems, which involves chemical or physical sorption of CO_2 from flue gas into a liquid carrier. Solvent-based systems are being used today for scrubbing CO_2 from industrial flue gases and process gases; however, scaling this type of CO_2 capture system to the size required for processing the large volumes of flue gas produced by a pulverized coal (PC) plant has not been achieved. DOE is funding research to develop low-cost and efficient, solvent-based CO_2 capture technologies that can significantly reduce CO_2 emissions from existing PC power plants.

Description

GE Global Research, in collaboration with GE Energy and the University of Pittsburgh, is working to develop a novel oligomeric solvent and process for post-combustion capture of CO_2 from coal-fired power plants. An oligomer is a short chain polymer with relatively few repeating units that can be synthesized with varying chain lengths and a wide variety of functional groups. Both the chemical and physical CO_2 absorption/desorption properties can be adjusted to achieve optimal CO_2 capture performance (high CO_2 carrying capacity, low heat of absorption, thermal and chemical stability).

Researchers will utilize both computational and laboratory methods to identify and produce oligomeric solvents for post-combustion capture of CO_2. Molecular modeling will be employed to identify oligomeric solvents having potential for high CO_2 capture capacity under low energy usage conditions. Researchers will use

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

David Lang
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4881
david.lang@netl.doe.gov

Teresa Grocela-Rocha
Principal Investigator
GE Global Research
1 Research Circle
Niskayuna, NY 12309-1027
518-387-6220
grocela@ge.com

PARTNERS

GE Global Research
GE Energy
University of Pittsburgh

PERIOD OF PERFORMANCE

10/1/2008 to 9/30/2010

COST

Total Project Value
$3,091,452

DOE/Non-DOE Share
$2,473,162 / $618,452

U.S. DEPARTMENT OF ENERGY

advanced synthetic methods to synthesize and modify the solvents and determine their ability to absorb and desorb CO_2 using high throughput screening (Figure 1).

In order to determine the overall feasibility of the proposed process, a rigorous model of the solvent absorption-desorption system will be developed and combined with an existing power plant model. The combined model will use a cost of energy (COE) analysis based on existing power plant operational models to optimize the integrated system for minimum capital and operational cost with maximum CO_2 capture.

Primary Project Goal

The primary goal of this project is to develop a novel oligomeric solvent and process for post-combustion capture of CO_2 from coal-fired power plants with 90 percent capture efficiency and less than a 35 percent increase in COE.

Objectives

Specific objectives of this project are to:

- Develop process models to predict solvent performance on a large scale and aid in the solvent design.
- Develop an integrated system model that predicts the overall plant performance with the designed CO_2 capture system and aid in the economic and technical optimization.
- Develop a strategy for the synthesis of candidate solvents.
- Develop solvents that are engineered to have an improved CO_2 absorption capacity, low volatility, and high thermal stability.

Benefits

This project proposes the use of non-aqueous, functionalized, liquid oligomeric solvents with a flexible backbone integrated in a retrofittable CO_2 capture process to meet DOE program goals. The development of this technology will provide extensive benefits for existing plants requiring new CO_2 capture technology to meet expected government regulations for CO_2 emissions. For retrofit applications, the flexibility of the proposed solvent and process makes the system appropriate for capturing CO_2 from PC-fired plants.

Planned Activities

This 2-year project is divided into two phases. In Phase I, emphasis will be placed on model development, screening, and selection of solvent classes for CO_2 capture, synthetic strategy development, and synthesis of Generation 1 solvents. The models will be used to determine the COE for these solvents.

During Phase II, research will be centered on solvent optimization and synthesis of Generation 2 solvents, bench-scale testing of the most promising solvents, degradation testing, model refinement, and prediction of solvent and overall plant performance.

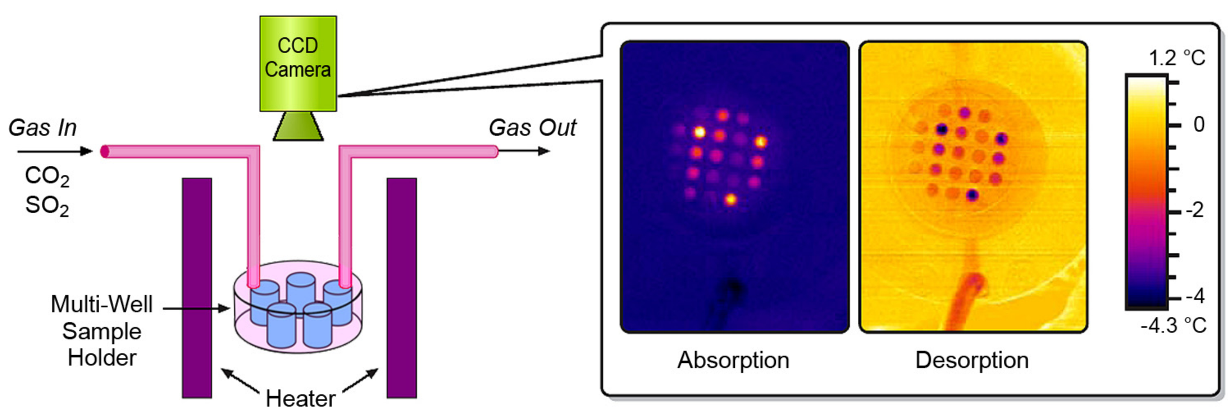

Figure 1. High throughput screening detail and schematic of a system for initial screening of potential solvents