the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Efficient Regeneration of Physical and Chemical Solvents for CO_2 Capture

Background

Increased attention is being placed on research into technologies that capture and store carbon dioxide (CO_2). Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and, in turn, mitigating global climate change without adversely influencing energy use or hindering economic growth.

Deploying these technologies in commercial-scale applications requires a significantly expanded workforce trained in various CCS specialties that are currently under-represented in the United States. Education and training activities are needed to develop a future generation of geologists, scientists, and engineers who possess the skills required for implementing and deploying CCS technologies.

The U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) has selected 43 projects to receive more than $12.7 million in funding, the majority of which is provided by the American Recovery and Reinvestment Act (ARRA) of 2009, to conduct geologic sequestration training and support fundamental research projects for graduate and undergraduate students throughout the United States. These projects will include such critical topics as simulation and risk assessment; monitoring, verification, and accounting (MVA); geological related analytical tools; methods to interpret geophysical models; well completion and integrity for long-term CO_2 storage; and CO_2 capture.

Project Description

NETL is partnering with the University of North Dakota (UND) to conduct research and training in evaluating the use of composite polymer membranes and porous membranes to recover CO_2 from CO_2-rich streams from coal gasification synthesis gas (syngas). In gasification combustion, fuel is converted into gaseous components by applying heat under pressure in the presence of steam. CO_2 can be captured from the syngas that emerges from the coal gasification reactor before it is mixed with air in a combustion turbine. Here the CO_2 is relatively concentrated and at a high pressure. Candidate membranes and solvent combinations will be tested in batch and continuous laboratory scale experiments using mixtures of CO_2 and hydrogen (H_2) to determine the rate of CO_2 removal and solvent regeneration as a function of temperature, initial reservoir pressure, and permeate pressure (Figure 1). The most promising membrane-solvent combinations will be tested using a synthetic gasification syngas stream that contains minor and trace impurities to determine the feasibility of CO_2 capture and solvent regeneration. This work will also be applicable to similar post-combustion carbon capture systems.

CONTACTS

Sean Plasynski
Sequestration Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-4867
sean.plasynski@netl.doe.gov

Andrea McNemar
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-2024
andrea.mcnemar@netl.doe.gov

Brian Tande
Principal Investigator
University of North Dakota
241 Centennial Drive Stop 7101
Harrington Hall Room 307
Grand Forks, ND 58202
701-701-3797
briantande@mail.und.edu

PARTNERS

None

PROJECT DURATION

Start Date
12/01/2009

End Date
11/30/2012

COST

Total Project Value
$300,000

DOE/Non-DOE Share
$300,000/$0

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

This technology has the potential to exceed the thermal energy requirement for regeneration of solvent based CO_2 separation and capture technology. Capture and separation account for 60 percent of the costs for CCS; the largest cost to the power cycle is associated with the steam used for solvent regeneration, as high as 3.6 to 4.5 million Btu/ton CO_2 recovered.

Goals/Objectives

The overall objective of the project is to utilize graduate and undergraduate students to determine the feasibility of using asymmetric polymer membranes and porous membrane contactors for the recovery of CO_2 from CO_2-rich solvent streams in which the solvent is used to absorb CO_2 from gasification syngas. These membrane systems have the potential to eliminate or reduce the thermal and/or pressure cycling requirements of traditional solvent regeneration systems because they facilitate CO_2 transport out of the solvent by increasing the interfacial contact area for mass transfer.

Benefits

Overall the results of the project will make a vital contribution to the scientific, technical, and institutional knowledge necessary to establish frameworks for the development of commercial-scale CCS. The technology produced by this research has the potential to exceed the thermal energy requirement for regeneration of solvent based CCS technologies. By reducing or eliminating the energy penalty, this technology has the potential to attain the DOE goals of achieving over 90 percent CO_2 capture at a less than 10 percent increase in the cost of electricity.

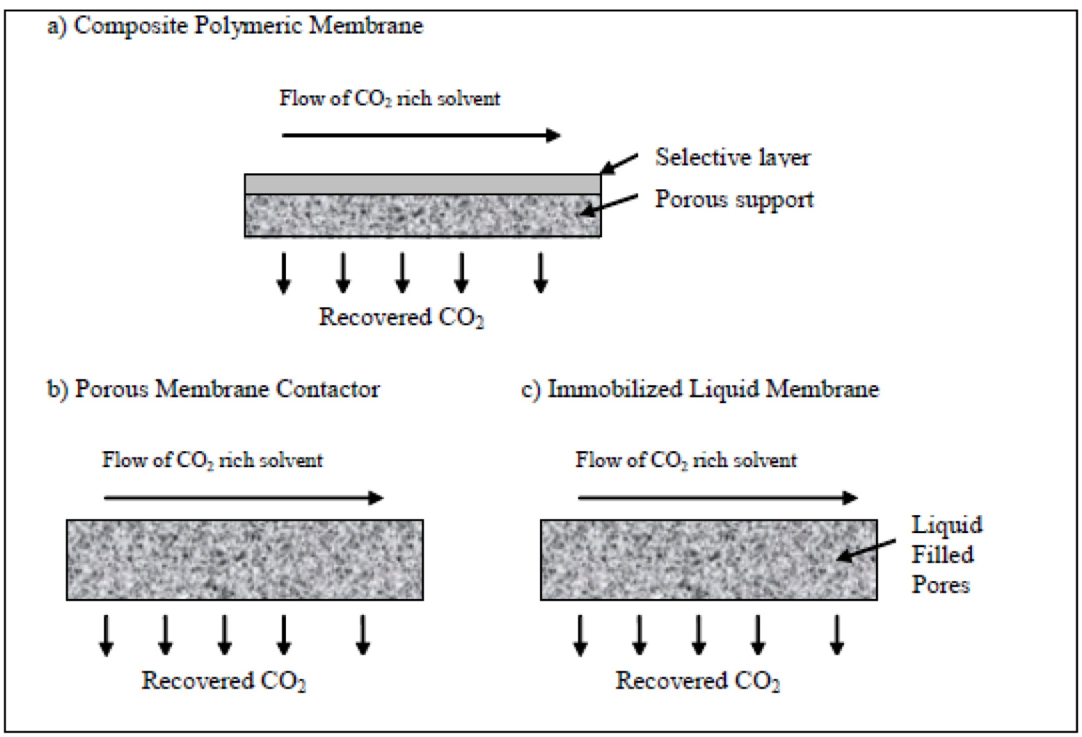

Figure 1 Membrane types that will be investigated in this study