PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Sequestration

03/2006

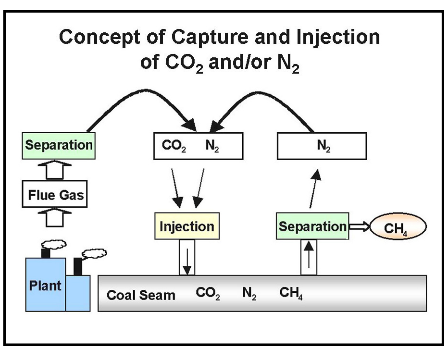
Unminable Coalbeds and Enhancing Methane Production Sequestering Carbon Dioxide

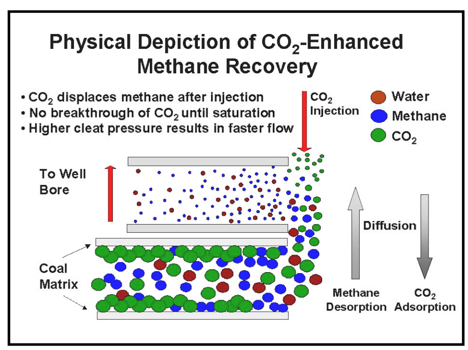
Background

One method for sequestering carbon dioxide (CO_2) is to store it in natural geological formations, such as unminable coal seems. Most of the gas present in coal seams is stored on the internal surfaces of the organic matter. Because of its large internal surface area, coal can store 6 to 7 times more gas than the equivalent volume of a conventional gas reservoir. Most coal seams contain methane; the gas content generally increases with coal rank, depth of the coalbed, and reservoir pressure. Unmineable coalbeds are attractive targets for sequestration of CO_2 because they have a large storage capacity and the sequestered CO_2 can enhance the recovery of natural gas by displacing the methane that is present in the coalbeds.

Oklahoma State University led an effort to investigate and test the ability of injected carbon dioxide to enhance coalbed methane production. The specific focus of this project was to investigate the competitive adsorption behavior of methane, CO_2, and nitrogen on a variety of coals. Measurements were focused on the adsorption of the pure gases, as well as mixtures. Data was taken from coals of various physical properties at appropriate temperatures, pressures, and gas compositions to identify the coals and conditions for which the proposed sequestration applications are most attractive.

Mathematical models were developed to describe accurately the observed adsorption behavior. The combined experimental and modeling results were generalized to provide a sound basis for performing reservoir simulation studies. These studies evaluated the potential for injecting CO_2 or flue gas into coalbeds to simultaneously sequester CO_2 and enhance coalbed methane (CBM) production.





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

Dawn Deel
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507
304-285-4133
dawn.deel@netl.doe.gov

Khaled Gasem
Principal Investigator
Oklahoma State University
423 Engineering North
Stillwater, OK 74078
405-744-9498
gasem@che.okstate.edu

PARTNERS

Oklahoma State University

Penn State University

Geo-Environmental Engineering
State College, PA

COST

Total Project Value
$876,175

DOE/Non-DOE Share
$820,649 / $55,526

ADDRESS

National Energy Technology Laboratory

1450 Queen Avenue SW
Albany, OR 97321-2198
541-967-5892

2175 University Avenue South
Suite 201
Fairbanks, AK 99709
907-452-2559

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

One West Third Street, Suite 1400
Tulsa, OK 74103-3519
918-699-2000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

Primary Project Goal

The overall goal of this project was to develop accurate prediction methods (models) for describing the adsorption behavior of gas mixtures on coal over a complete range of temperature, pressure, and coal types.

Accomplishments

Completion of this project has contributed the following knowledge to the field of adsorption of coalbed gases for CBM production and CO_2 sequestration:

- Significantly expanded database for adsorption, including valuable data on:
  - A variety of pure, binary, and ternary gas mixtures
  - Eight different coal matrices and activated carbon
  - Effects of moisture on adsorption behavior for selected systems
- An adsorption modeling capability based on theory, including development of:
  - Several state-of-the-art models for representing adsorption equilibrium of pure fluids and mixtures within their experimental uncertainties
  - Generalized and matrix-calibrated models to provide accurate predictions within one to three times the experimental uncertainties
- Improved models to estimate coal capacity for coalbed gases based solely on readily accessible coal characterizations parameters
- Improved computational capabilities, including robust algorithms for solving adsorption equilibrium for a variety of models
- An improved pure-fluid and mixture compressibility factor EOS model which is required for CBM adsorption measurements
- Dissemination of the above accomplishments to the scientific and engineering community through a series of technical reports, presentations, and journal publications.

Objectives

The objective of this effort was to develop, test and investigate the ability of coal to enhance coalbed methane production while sequestering carbon dioxide by adsorption on the surface of various U.S. coals.

Benefits

This project significantly enhanced the understanding of multilayer adsorption of near critical and supercritical components on heterogeneous surfaces. The data and models developed permitted evaluation of the ability of coal to sequester CO_2, a major greenhouse gas, and simultaneously increase the supply of methane, a clean-burning energy source, and provide a sound basis for commercial implementation of this technology.