PROJECT
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U.S. Department of Energy
National Energy Technology Laboratory

Sequestration

08/2002

Oceanic Sequestration

Background

Stabilization of rising levels of atmospheric greenhouse, primarily CO_2, may require the use of non-atmospheric carbon sequestration options in addition to maximizing improvements in energy conversion, end-use efficiencies, and fuel switching to lower-carbon or carbon-free energy sources. One potential large-scale sequestration option is to directly inject CO_2 into the ocean at depths greater than 1500m where it should be effectively sequestered for hundreds of years or longer. Generally, the deeper the CO_2 can be deposited, the longer the residence time in the ocean.

The current effort is directed at determining the fate of CO_2 introduced into the deep ocean and how the icelike CO_2 hydrate impacts the process. The experimental work is carried out in two facilities: a High-Pressure, Variable-Volume View-Cell (HVVC) and a High-Pressure Water Tunnel Facility (HTWF). In addition, a Low-Pressure Water Tunnel Facility (LWTF) capable of being chilled has been constructed and used to test various configurations of flow conditioners and section divergence angle and length.

Primary Project Goal

The objectives of the research are to obtain information useful both for assessing the technical feasibility of oceanic CO_2 sequestration and for developing optimal methods of introducing the CO_2 into the ocean.

Objectives

- Determine hydrate formation and dissolution conditions as a function of dissolved CO_2 content, temperature, and pressure, especially at higher levels of dissolved CO_2.
- Characterize the flow patterns possible in the water tunnel test sections and develop predictive tools for designing the internal geometries necessary for optimum stability of CO_2 (or any fluid particle) over an anticipated range of simulated ocean depths.
- Initiate CO_2 drop injection experiments in the HWTF to investigate depth of injection and initial dissolved CO_2 content effects on the fate of CO_2.

PRIMARY PARTNERS

National Energy Technology Laboratory

University of Pittsburgh

DOE FUNDING PROFILE

Prior FY's	$ 0
FY2002	$ 475,000
Future FY	TBA

TOTAL ESTIMATED COST

DOE	$ 475,000

CUSTOMER SERVICE

800-553-7681

WEBSITE

www.netl.doe.gov

NETL

OCEANIC SEQUESTRATION

Accomplishments

A theoretical model that predicts formation conditions for CO_2 and other hydrate-forming gases was developed during FY2001 along with an initial set of experiments used to validate this model. Results show that under conditions of temperature and pressure planned for deep-ocean sequestration, the formation of hydrate from dissolved CO_2 may be in areas of elevated dissolved CO_2 concentration, such as near the injection site.

High-Pressure Water Tunnel Facility in newly renovated laboratory

The flow conditioning elements were tested in the LWTF to determine the design parameters needed for stabilization of a CO_2 fluid particle in the HWTF over the range of anticipated ocean injection conditions. The precision of the measurements was improved and now the entire procedure can operate without intervention and automatically collects sets of profiles for different flow rates. Additionally, a full 3-D finite element analysis of the flow through the conditioner was initiated.

During FY2002, renovations to the Oceanic Sequestration Laboratory in Building 84, Rooms 119 and 125 were completed and the HWTF and supporting facilities were constructed. The HWTF is now operational and observations of CO_2 drops under simulated deep-ocean conditions can be seen.

Benefits

This project will provide useful information and models for the development and storage optimization of CO_2 in our oceans. By injecting carbon dioxide into the ocean at depths greater than 1500m, the risk of unnecessary human contact is removed and the carbon dioxide is placed as far from the atmosphere as possible. Additionally, by capturing carbon dioxide and sequestering it, harmful emissions into the atmosphere are prevented that would further precipitate global warming.

CO_2 drop in the High-Pressure Water Tunnel at a simulated depth of 2000 m.

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