ECBM RESEARCH WITHIN THE DUTCH CATO PROJECT

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Abstract

The CATO project is a 25.4 M€ integrated research program sponsored by the Dutch government in the area CO_2 capture, transport, storage, risk analysis, environmental impact and societal acceptance. The project is participated by a large consortium formed by industry, research institutes, universities and environmental organizations. One of the largest work packages within the CATO program is dedicated to CO_2 storage in coal fields (3.2 M€).

The objective of the project is to determine the technical and economical feasibility of ECBM as a way to geologically sequester CO_2. A number of field projects are taking place and much laboratory work has already been done, but still there is little or no fundamental understanding of the physics behind exchange reactions and swelling behavior. CATO is trying to address this knowledge gap so that CO_2 injection for ECBM and CO_2 storage purposes can become a reality in the near future.

Introduction

In the wake of the Kyoto protocol, reduction of CO_2 emissions to control the level of greenhouse gases in the atmosphere has become a major goal. In this kind of environment, the challenge is to find cost-effective solutions, profitable if possible, that will reduce the release of CO_2 into the atmosphere.

Enhanced Coalbed Methane (ECBM) has been identified as a potentially economic sequestration method having the capacity to store years of global CO_2 emissions. Additionally the injection of CO_2 in coal enhances methane production yielding a double positive effect.

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The objective of the project is to determine the technical and economical feasibility of ECBM as a way to geologically sequester CO_2. To date, few experimental ECBM/CO_2 field pilots have been realised worldwide. A micro-pilot test is taking place in Canada set-up by the Alberta Research Council while the world's first large-scale ECBM pilot using CO_2 injection is operated by Burlington resources in the San Juan Basin in the U.S. In Europe, the first field experiment with ECBM/CO_2, the RECOPOL project, is currently starting at the Upper Silesian Basin in Poland.

However, although field projects are taking place and much laboratory work has already been done, there is little or no fundamental understanding of the physics behind exchange reactions and swelling behavior. CATO is trying to address this knowledge gap so that CO_2 injection for ECBM and CO_2 storage purposes can become a reality in the near future.

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Research questions

Experiments and modeling will address the main questions to be answered:

- Volumes: is there enough potential in terms of production and sequestration? How much CO_2 can be exchanged with CH_4 for different coal types?

- Productivity/Injectivity: is there enough permeability and can this be kept to provide with high enough production rates? How fast do the adsorption/desorption and diffusion processes take? What is the effect of water on the exchange rates? What is the effect of CO_2 on permeability, mechanical swelling/shrinkage and electrical conductivity? What is the effect of injection and production rates on deformation, permeability and fracturing?

- Environment: does the CO_2 remain sequestered? Is there a risk of CO_2 leakage at high injection rates?

Activities

Within the project framework, activities are distributed over the different participants.

TU Delft

TU Delft is currently the only lab in the world which can handle high pressure static/dynamic experiments with large cores. Activities will be conducted using the infrastructure of the Dietz Laboratory and the High Pressure Laboratory. The activities undertaken at TU Delft include:

1. Experiments to determine coal storage capacity for different gases on different coal types. Gases looked into include CH_4, CO_2, N_2, flue gas and CO.

2. Flooding experiments to determine gas diffusion with and without water.

3. Experiments to determine CO_2 effects on swelling/shrinkage, transport properties and possibly on the mechanical properties of coal and their stress dependency. This work will be conducted on large cores looking at volume effects and permeability changes.

4. Development of models at scales from maceral to seam level, as an input for modeling work.

5. Petrological/petrophysical description/visualization of the multi-pore behaviour of coal. A study on the relation of the cleat system to maceral content and degree of coalification.

University of Utrecht – TNO

The focus of their activities is the microscopic behaviour of CO_2-CH_4 interactions with coal. Activities will be conducted using the infrastructure of the High pressure and Temperature Laboratory at Utrecht University. The activities undertaken at Utrecht include:

1. Experiments to determine adsorption mechanisms at the microscopic/maceral level making use of infrared microspectroscopy.

2. Experiments to determine CO_2 and flue gas effects on swelling/shrinkage, transport properties and possibly on the mechanical properties of coal and their stress dependency. This work will be conducted on ground, homogenized, core samples and will address coupled CO_2-adsorption/deformation effects and their influence on permeability and electrical conductivity.

3. Development of modeling capabilities in SIMED.

4. Electrical properties of coal for monitoring purposes. The experiments will consist primarily of 1-D compaction/dilation experiments, with flow-through of CH_4 and CO_2, gas sampling and steady state permeability measurement. Simple electrical conductivity measurements will be made by using impedance spectroscopy. The mechanical and permeability data obtained will be used to test and parameterise constitutive models. The experimentally derived electrical conductivity data will serve as input for evaluation of monitoring methods by TNO.

Shell Exploration and Production

The focus of their activities is the integration of experimental results in the development of modeling capabilities for ECBM. The activities undertaken at Shell include:

1. Development of modeling capabilities in MoReS. Integration of existing experimental results into simulators and validation with field data.

2. Analysis of well count, well pattern, need for fracturing, conformance control, etc.

Results

The CATO project runs from 2004 through to 2008. Activities have already commenced and first results will be available by the end of 2004. Results, as available, will be presented at the GHGT-7meeting.

References

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