

SUBSURFACE EXPERIMENTAL LABORATORY

Autoclave and Core Flow Test Facilities



DESCRIPTION

Researchers at the National Energy Technology Laboratory (NETL) study subsurface systems to better characterize and understand gas-fluid-rock and material inter-actions that impact environmental and resource issues related to oil, gas, and CO₂ storage development. However, studying the wide variety of subsurface environments related to hydrocarbon and CO₂ systems requires costly and technically challenging tools and techniques. As a result, NETL's Experimental Laboratory encompasses multi-functional, state-of-the-art facilities that perform a wide spectrum of geological studies providing an experimental basis for modeling of various sub-surface phenomena and processes. This includes, but is not limited to, long term exposure of geological samples to specific conditions such as CO₂ saturation at elevated pressure and temperature and the study of geomechanical properties and behavior of fluids, including fluid-solid and fluid-fluid physical and chemical interactions. The laboratory has a wide range of tools and instrumentation to ensure a complete cycle of scientific studies from preparation of representative samples, through the preliminary measurements of basic properties, to the advanced investigation of the processes of interest under simulated subsurface conditions.

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CAPABILITIES

The High Pressure Immersion and Reactive Transport Facility utilizes standing stirred autoclave reactors equipped with carbon dioxide (CO₂), sulfur dioxide (SO₂), hydrogen sulfide (H₂S), methane (CH₄), oxygen and flue gas feed lines with pressure ratings of 5,000 psig at temperatures up to 482 °F. The lab also contains a set of rocking autoclaves for experiments at 7,250 psig and temperatures up to 662 °F in CO₂/brine environments. Test reactors are ideally suited to investigate gas/liquid or gas/slurry interactions.

The Geological Sequestration Core Flow Facility includes three flow-through test systems with the ability to measure permeability, CO₂-enhanced oil recovery, and CO₂-water-rock interaction of core samples under CO₂ sequestration conditions. Water-rock flow-through systems allow for measurement of relative permeability of various fluids to study fluid displacement in reservoir rocks under high pressure (up to 5000 psi) and temperature (up to 150 °C) conditions. These units can also be used to study flow-through fractured seal materials such as well-bore cements and caprocks.



Figure 1. Six fixed-head autoclave system with PC interface.

GOALS AND OBJECTIVES

Research aimed at monitoring the long-term storage stability and integrity of CO₂ sequestered in geologic formations is one of the most pressing areas that needs to be understood if geologic sequestration is to become a significant factor in reducing greenhouse gas emissions. The most promising geologic formations under consideration for CO₂ sequestration are active and depleted oil and gas formations, brine formations, and deep, unmineable coal seams. Unfortunately, the long-term CO₂ storage capabilities of these formations are not well understood.

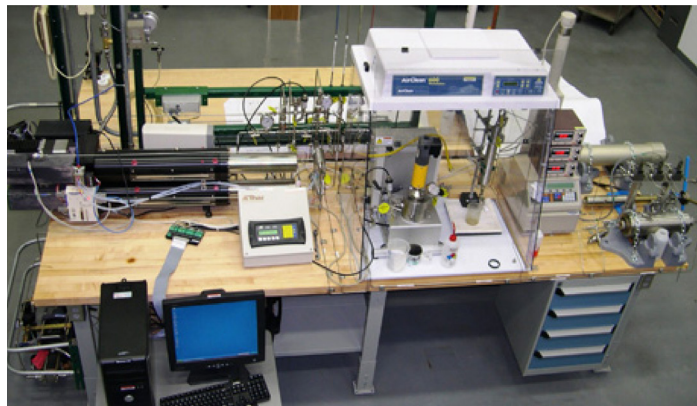


Figure 2. Flow-through unit for studying CO₂-enhanced oil recovery.

The laboratory's goal is to better simulate the conditions found in major potential geological sequestration sites. Information obtained from laboratory testing of various rock types under a variety of controlled conditions and environments will provide information on the geotechnical effects and chemical interactions that occur when CO₂ is injected into natural rock. This information will also be used to predict potential problems that might be encountered in field-scale investigations.

BENEFITS

To help meet a national strategic commitment to clean power generation, NETL is developing a technology base for tomorrow's highly efficient, near-zero-emissions power plants. Environmental and geosciences researchers perform laboratory-scale studies of solid, liquid, and gaseous flows and their interactions. These studies are aimed at understanding the suitability of flue gases for capture and storage in industrial wastes after release from coal fired power plants. Utilization and sequestration of greenhouse gases, such as CO₂, to mitigate global warming is a primary focus of NETL's research initiatives. The Autoclave and Geological Sequestration Core Flow Test Facilities will be instrumental in accessing the realistic potential of CO₂ geologic sequestration, as well as coalbed methane (CBM) production. Activities conducted at these test facilities will be instrumental in linking laboratory, field, and modeling activities, to ensure accurate test results while optimizing resources to achieve program goals.



Figure 3. CFS-839Z water-rock flow-through system.

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