METHANE HYDRATE
ONSITE RESEARCH FACILITIES

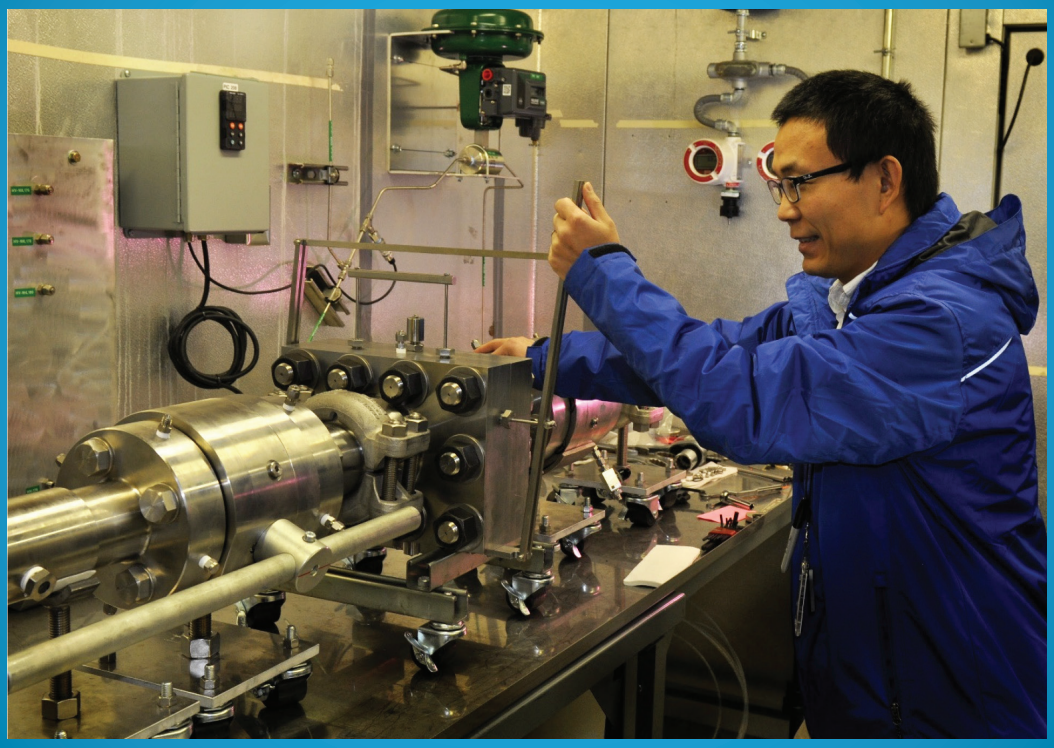

Figure 1. Methane hydrate research specialist, operating the pressure core cutting chamber, which is one components of the pressure core characterization tools (PCCT), being developed at NETL. This specialized cutter is designed to cut core samples while maintaining in situ pressure conditions up to 4500 psi.

NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

BACKGROUND

Methane hydrate represents a potentially vast natural gas resource for the United States (U.S.) and the world. Once thought to be rare in nature, methane hydrate deposits are now known to occur in great abundance in association with arctic permafrost and in sedimentary deposits found along continental shelves. Recent estimates suggest that the gas hydrate abundance contains more organic carbon than the world's coal, oil, and gas combined. One objective of the DOE NETL is to develop the knowledge base and facilities to support development of gas hydrate resources.

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INTRODUCTION

NETL's Methane Hydrate research team is working to build and maintain a world-class methane hydrate research laboratory. NETL's onsite facilities are designed to accommodate bench-scale experimental work on gas hydrate specimens collected with specialized pressure coring equipment and maintained at in situ subsurface pressures. Facilities under development include: (1) a multi-property characterization chamber (MPCC) and mini-MPCC for real-time sample observation with a micro- computed tomography (CT) scanner and (2) a multi-component pressure core characterization tool (PCCT).

PROJECT GOAL

The goal of the Methane Hydrate project is to develop onsite research facilities that can be used for state-of-the-art laboratory testing on methane hydrate samples collected in the field and preserved under pressure. This goal is well aligned with the NETL objective to obtain high-quality information on gas hydrates that will inform models and methods for predicting the behavior of gas hydrates in their natural environment and in realistic production scenarios.

PROJECT OBJECTIVES

Objectives of this project are to (1) develop the MPCC and mini-MPCC for real-time sample observation with a micro-CT scanner and (2) complete development of a multi-component PCCT.

PROJECT DESCRIPTION

This project is aimed at developing a suite of laboratory tools for experimental work on methane hydrate-bearing samples collected in the field and preserved under in situ pressures. These tools include the MPCC, mini-MPCC, and PCCT. Together, these tools allow for core-scale and pore-scale analysis of geophysical, geomechanical, and hydrological properties of natural hydrate specimens, in pressurized chambers designed to maintain in situ sample conditions.

NETL CAPABILITIES

MULTI-PROPERTY CHARACTERIZATION CHAMBER (MPCC)

The MPCC is a core-scale analysis chamber used for testing and imaging of hydrate-bearing sediments. It is designed to perform geophysical, mechanical, and hydrological measurements on standard, 2.5-inch diameter core samples. The MPCC apparatus at NETL is capable of measuring sample permeability, saturation, acoustic velocities, and mechanical properties, including material strength, strain, and stiffness. NETL is also developing a mini-MPCC for pore-scale testing of hydrate-bearing sediments on a much finer scale. This instrument is designed for testing 0.25-inch diameter core specimens.

The MPCC and mini-MPCC are mounted on carts and can be moved to one of NETL's CT scanners for real-time imaging during experimental steps. The MPCC is designed to be compatible with NETL's industrial and medical CT scanners, which are capable of image resolution down to 50 micrometers. The mini-MPCC, compatible with NETL's micro-CT scanner, is capable of scanning and imaging processes occurring at the pore scale, with image resolution to 1 micrometer.

PRESSURE CORE CHARACTERIZATION TOOLS (PCCT)

The PCCT is an advanced laboratory apparatus designed to retrieve, transfer, cut, sub-core, and characterize natural samples of hydrate-bearing sediments at PT conditions. Operation of the PCCT occurs in a cold room, with pressure in the assembled unit maintained with high-precision pumps. It is designed to be operated at NETL, using core delivered from sampling sites in pressurized cylinders. The PCCT can also be deployed to the field for onsite testing of hydrate-bearing specimens during active drilling and coring activities.

Key components of the PCCT include a core manipulator (for temporary storage of core extracted from a pressure core cylinder), core cutter (a chamber in which core specimens can be cut without losing pressure), sub-coring device (for cutting smaller core specimens from larger core samples), and multi-property testing chamber. The testing chamber is equipped to measure seismic wave velocity, geomechanical properties, and multi-directional permeability of hydrate-bearing samples. The PCCT also includes a CT-scanning chamber for high-resolution imaging of hydrate-bearing

samples. Most components of the PCCT have been completed. The last component being manufactured is a transport chamber, designed to preserve specimens at in situ conditions for transport to other methane hydrate research laboratories.

Figure 2. The effective stress chamber (ESC), pictured above, is a critical component of the pressure core characterization tools (PCCT). This chamber is used to measure acoustic. mechanical, and hydraulic properties of pressure core specimens while maintaining in situ pressure and temperature conditions.

PROJECT BENEFITS

Research facilities developed by the NETL Methane Hydrate research team are designed to support experimental work that will lead to a better understanding of methane hydrate properties and pore-scale behavior. In addition, these facilities will help establish NETL as a world class laboratory for fundamental research on methane hydrate samples. The ability to conduct research at in situ pressure and temperature conditions is critical and will ultimately lead to more realistic scenarios for producing gas from hydrates, as well as better strategies for minimizing environmental impacts of naturally occurring hydrates.

ACCOMPLISHMENTS/SUCCESSES

The NETL Methane Hydrate research team completed the design and fabrication of the PCCT apparatus, including the core manipulator, core cutter, sub coring device, and multi-property testing chamber. Additionally, the design and functional shakedown for gas-fluid relative permeability test setup utilizing MPCC was completed.

Research Partners

U.S. Geological Survey
Georgia Institute of Technology
University of Pittsburgh
Rensselaer Polytechnic Institute
West Virginia University

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