

Core Flood Systems



Quality Engineered Solutions
Based on Proven Technology

A core flood system flows a fluid (gas or liquid) through a core sample at simulated reservoir conditions and measures flow parameters.

These systems are used for:

- Stimulation studies
- Diversion of stimulation fluids
- Flow distribution in multi-layered reservoirs
- Steady state permeability measurement
- Relative permeability measurement
- Formation damage tests
- EOR tests and research
- Acidization studies
- Water flooding
- Drilling mud invasion

Customized to Your Requirements

Because of the wide variety of tests that might be conducted in a core flood system, our equipment is typically customized to meet the exact requirements of a specific customer application. The systems below illustrate the wide range of options that can be incorporated into a core flood system.



System designed for multi-phase flow in low permeability materials. Multiple syringe pumps and associated piston separators allow multiple fluids to flow simultaneously. System includes an ultra-high resolution quartz transducer differential pressure manifold.



Four different fluid separators allow multiple fluids to flow through the core. Air-operated, zero-volume valves are computer controlled for remote separator selection and flow path configuration. A fraction collector collects fluid samples of the fluid produced.



Dual core holders allow flow through two cores in series or in parallel, in both forward and reverse directions. Multiple pressure taps along the length of the core allow pressure profile along the flow path to be monitored. A separator fill system allows the separators in the oven to be refilled without opening the oven and disturbing the environment. Core holders include a triaxial loading piston.

Core Flood Test Systems

Oven with dual triaxial core holders with multiple pressure taps.



Oven with single pivot-mounted core holder. Core holder can be pivoted outside the oven to simplify core insertion and removal.



Core Holder(s)

The core holder encloses the core sample and subjects it to simulated reservoir conditions. Typically the core holder is a Hassler sleeve holder, allowing for rapid installation or removal of core samples. Some of the options that are available in a core flood system include:

- Single or dual core holders
- Pivoting mount frame for horizontal or vertical orientation
- Roller-supported mount frame for easy movement and maintenance
- Pivoting mount to move from inside to outside oven for sample loading.
- Radial confining pressure or triaxial loading capability
- Range of core diameters (1 ½" typical)
- Core lengths up to 12"
- Multi-tap pressure ports along the core length
- Drilling mud invasion

Upstream Flow System

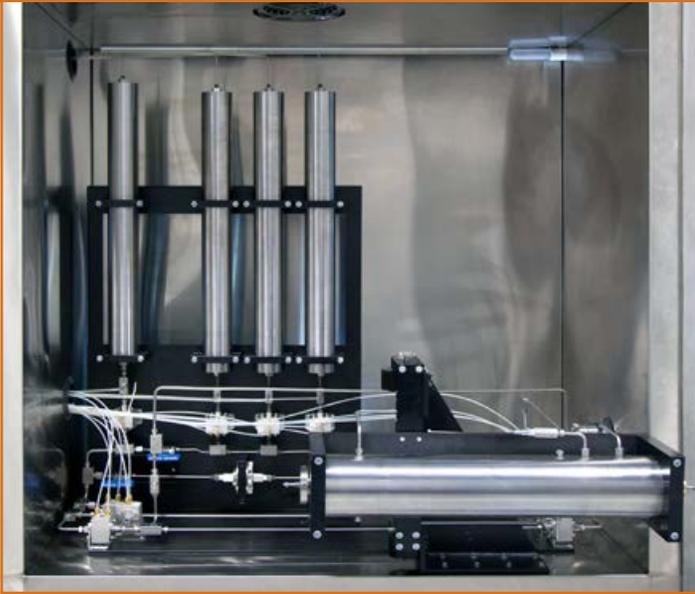
DCI has designed a family of dual piston syringe pumps (VPA) specifically for core flood applications. These pumps use special algorithms to provide pulse-less flow to drive fluid separator accumulators. Some of the features that can be selected to meet specific test requirements include:

- Pressure range and flow rate for the VPA(s)
- Multiple VPA's to allow simultaneous multi-phase flow
- Flow path forward or reverse, or in parallel or series through multiple core holders
- Wetted parts: Stainless steel or Hastelloy C 276
- Tubing size: 1/8" or 1/4"
- Gas injection system

Oven

A custom designed, stainless steel oven typically contains the core holder(s) and fluid separators. This allows core flooding tests to be conducted routinely to 300 °F. With special seal materials and other modifications to components housed in the oven, tests to 350° F, and even 400 °F are possible.

Four fluid separators mounted inside the oven behind the core holder. Core holder rotated out for ease of core sample loading.



Fluid Separator System

A bank of piston-type accumulators is mounted in the oven to allow multiple fluids to flow through a core sample in sequence or simultaneously. A bank of air-operated valves, also in the controlled temperature environment, allows the active separator(s) to be selected and allows the accumulators to be filled without disturbing the temperature environment. The separators are driven by one or more VPA's. The separators provide capability to flow highly corrosive fluids through the core sample(s) without putting the corrosive fluid in contact with the VPA. Typical specifications for the fluid separators are:

- Wetted parts: Hastelloy C 276, Teflon and PEEK
- Volume: 1000 ml
- Pressure: 10,000 psi

Pressure control cart to control confining and axial pressure in two core holders as well as provide capability to refill fluid separators in the oven.



Pressure Control System

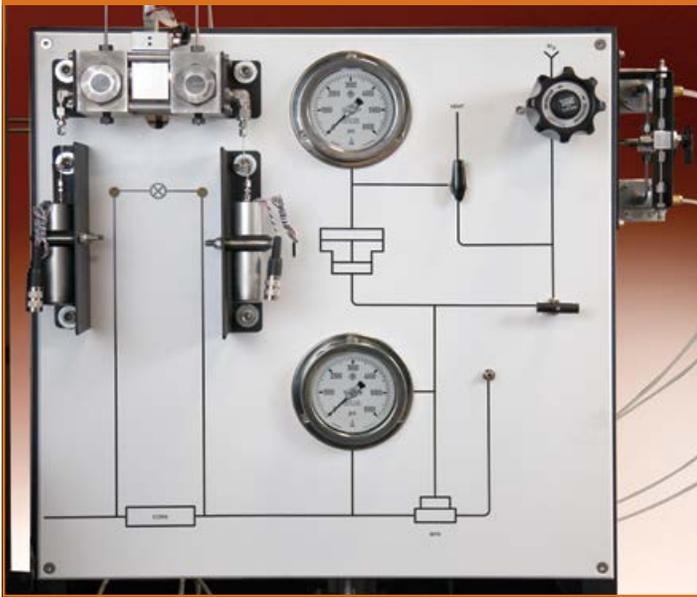
The pressure control system controls the confining pressure around the core sample and, if applicable, the axial pressure applied to the core sample. Some options to consider include:

- 10,000 or 15,000 psi
- "Passive" pressure control with isolation valves
- "Active" pressure control with back pressure regulator or VPA
- Separate axial pressure control

Differential Pressure Measurement Module

Accurate differential pressure measurement is the key to accurate permeability and other flow parameter calculations. These measurements include differential pressure measurements over the length of the core and between ports on core holders with multi-tap pressure ports. Selecting the optimum differential measurement transducer(s) depends on the differential pressure to be measured as well as the system pressure rating. DCI engineers can help select the optimum differential pressure transducers for a specific application. A proprietary DCI design uses dual quartz pressure transducers with one part per billion resolution capability and an air-operated shorting valve between the two transducers to provide extremely accurate and stable differential pressure measurement.

Back pressure control cart with integrated quartz transducer differential pressure module.



Back Pressure Control System

The back pressure control system controls the pore pressure in the system and provides a means of measuring flow rates of fluids flowing through the core(s). This includes measuring different flow rates through two different core samples in dual core flood systems, as well as the relative flow volume of two different fluid phases flowing out of a core. Options include:

- VPA in pressure mode to control back pressure and measure volume.
- Dome-loaded back pressure regulator with direct gas pressure control or electronic controller to control dome pressure.
- Coriolis mass flow meter. Measures mass flow rate and density allowing flow of two different fluid phases to be measured and differentiated.

Fluid Sampling System

Options include valves and porting that allow fluid samples to be extracted from the face(s) of the core sample(s) and an automated fluid sampling systems (fraction collector) that allows many sequential samples to be taken from the fluid produced.

Touch screen monitor allows operator to set system valves to control flow configuration as well as monitor and acquire data.



Data Acquisition and Test Control System

Data is acquired automatically from each transducer in the system. This PC-based system allows the operator to specify which data are collected for a specific test as well as the data collection rate. The same PC program provides test control capability for the system.

A touch-screen interface allows the operator to set the flow configuration, the back pressure control mode, the active fluid separator, the oven temperature, the VPA control mode and parameters and other test parameters. The flow configuration and other test parameters are displayed graphically to the operator. Other screens allow for functions such as individual control of automated valves for maintenance purposes, entry of transducer calibration values, and more. This data acquisition and test control software is typically customized to each specific test system.

Core Flood Systems

VPA Syringe Pumps



DCI's VPA syringe pumps form an essential element in core flood systems designed and built by DCI. Some of the features of these pumps include:

- Servo-motor/encoder, precisely controlled with state-of-the-art digital electronics, provides the smoothest possible drive performance with nano-liter volume resolution.
- High-speed positive feedback control loops that allow for precisely controlled constant flow rate, or accurate pressure control.
- Air-operated, zero-volume valves to allow pulse-free switching between cylinders.
- Compact integrated manifold integrates all four valves required for a dual cylinder VPA into a single manifold.
- Large ports in valves and cylinder connections allow pressure control to be unaffected by small particles in the fluid.
- A touchscreen operator interface allows the operator to set VPA control in a few simple steps.
- LabView drivers allow the VPA to be controlled from a remote PC over a LAN connection.
- A small footprint conserves valuable laboratory space.



**Quality Engineered Solutions
Based on Proven Technology**

982 North 675 West

North Salt Lake, UT 84054

Tel: 801 298 4899

Fax: 801 298 4875

sales@dcitestsystems.com

www.dcitestsystems.com