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PRECISION PRESSURE CONTROL

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# Major Australian University uses Equilibar® Back Pressure Regulator for High Pressure Core Flooding Experiments

## *Background*

Core flooding experiments are routinely performed in hydrocarbon reservoir engineering to investigate multiphase flow characteristics of rock-fluid systems. For such experiments, representative rock and fluid samples for a hydrocarbon reservoir are collected. The fluids are then injected through the rock under high pressure and high temperature in a laboratory setting. The results of core-flooding experiments are useful in forecasting the outcome of various injection/production processes that a hydrocarbon reservoir may undergo.

A major university in Australia recently partnered with Equilibar to improve the accuracy and efficiency of their active core-flooding experiment program.

## *The Challenge*

Core-flooding experiments are done under high pressure and high temperature conditions representative of the conditions that exist in deep (e.g. 3000 meters) hydrocarbon reservoirs. During an experiment, as the fluids are injected (e.g. crude oil, natural gas/$CO_2$ , water) through a cylindrical rock sample, a data set is recorded over time. A back pressure regulator (BPR) is used to maintain the fluid pressure inside the rock and is therefore located at the exit end of the rock sample. Originally, the university was using a traditional spring loaded BPR for this purpose.

One particular type of data collected by the university is the differential pressure across the rock sample as the fluids are passed through it. Minimizing fluctuation and pulsation in the pressure data is critical to collecting valid, meaningful results from the experiments. This is achieved in part by using pulsation-free positive displacement syringe pumps. However, even with this type of pump in place, pressure fluctuations were occurring with the traditional spring-loaded BPR.

## *Customer System Configutation*

The schematic below shows the outline of a typical core flooding setup. Fluids are injected into the core sample using syringe pumps and are passed through the BPR downstream of the sample before their volumes and flowrates are measured. The particular configuration shown in the diagram below is best suited for a liquid-liquid type of flooding where the produced liquids are collected in a graduated cylinder. For a liquid-gas flooding, a gas meter is also used to measure the amount and flowrate of the gas produced over time.

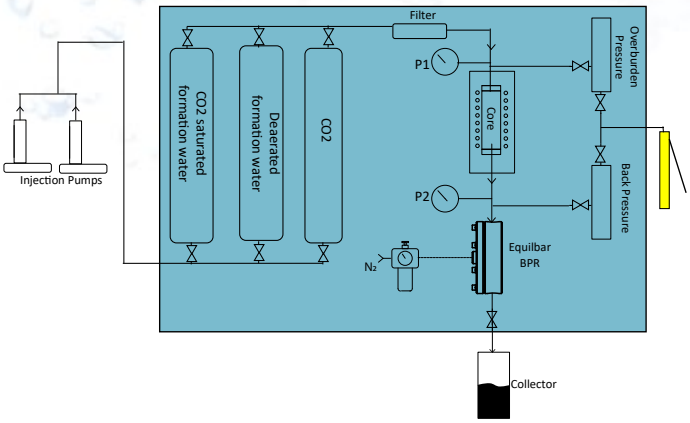


Figure 1: Typical core flooding setup for liquid-liquid type

## *The Solution*

To reduce pressure fluctuations, Equilibar application engineers recommended a stainless steel U10L regulator with Kalrez® O-rings and stainless steel diaphragm for the university's application. The U10L is part of Equilibar's Ultra Low Flow Series BPRs, specifically designed for a variety of gas, liquid and mixed phase applications at very low flow rates. The UL series uses a single outlet orifice design, as compared to other Equilibar Research Series designs that use multiple orifices. It is a good fit for certain ultra-low flow applications including core-flooding experiments. The UL Series is offered in pressure ranges up to 3000, 6000, and 10000 psi (200, 415 and 690 bar).

Figure 2: Stainless Steel Equilibar U10L BPR

320 Rutledge Road • Fletcher, North Carolina 28732
(828) 650-6590 office • (801) 504-4439 fax

www.equilibar.com

## *Customer Feedback*

The U10L was installed into the core-flooding test system as a replacement for a standard spring-loaded BPR to resolve the fluctuating data. The Equilibar® BPR, with its dome-loaded design and sensitive diaphragm, can maintain constant core pressure no matter how the flow rate of fluids through the rock sample is changing. The Equilibar's unique operation allows the unit to minimize pulsation and fluctuations in the data, resulting in useful experimental results.

Below is a graph comparing the performance of the Equilibar BPR used in core-flooding experiments to that of a traditional spring-loaded BPR manufactured by a prominent vendor. The Equilibar BPR is a significant improvement for this application.

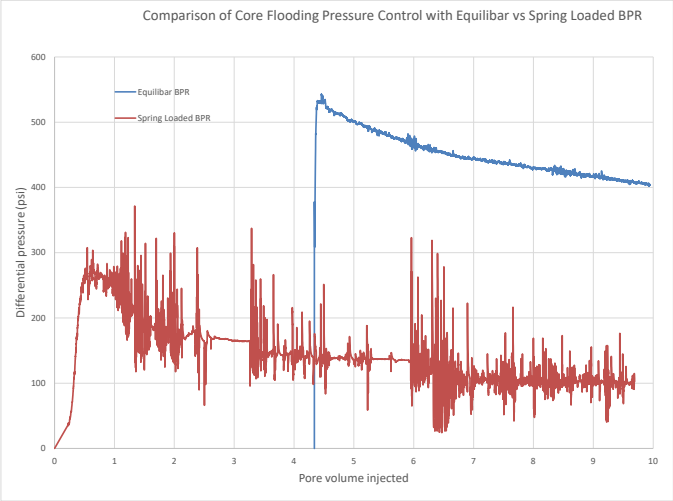


Figure 3: Graph of differential pressure at various injection volumes with an Equilibar U10L vs a traditional unit

Equilibar Research Series BPR applications include low flow rates, extremely high pressures and other challenging laboratory scenarios. By using unique combinations of diaphragm and O-ring materials, Equilibar regulators are able to perform with high accuracy even in the harshest environments, including those with high temperatures and aggressive chemicals.

## *Contact Equilibar*

Equilibar, LLC is a provider of unique and innovative pressure control solutions based near Asheville, NC. Equilibar's patented back pressure regulator technology is used by researchers and engineers worldwide in a wide array of processes including catalyst, petrochemical, supercritical and other industrial applications. For more information please contact an Equilibar application engineer at http://www.equilibar.com or 828.650.6590.


## *About the Author*

*Diane Jacober is a Technical Content Creator at Equilibar, LLC, provider of high precision pressure control solutions. She has B.S and M.S degrees in engineering and has worked as a process engineer, project engineer and technical marketing specialist in several industries. Diane can be reached at dianejacober@equilibar.com or 828-650-6590.*