

Oman university uses an Equilibar back pressure regulator to simulate bottomhole pressure in EOR studies

Background

In Oman, many crude oil reservoirs have reached production peak and the primary methods of recovery are no longer useful. At this stage, an Enhanced Oil Recovery (EOR) method can help boost crude oil production in these reservoirs to extend their useful life.

Dr. Adel Mohsenzadeh, Petroleum Engineer and Faculty Member at University of Technology and Applied Sciences (UTAS), studies the performance of current EOR methods and researches new techniques to improve EOR. In his department, researchers study different methods to implement that will increase the reservoir recovery percentage in the oilfield. Their focus is on chemical injection methods to improve heavy oil recovery.

A core flooding system is a mandatory device to study the performance of EOR methods in the lab before utilizing them in the real oilfield. For his research, Dr. Mohsenzadeh built a core flooding system.

Challenge

Core flooding tests use rock and fluid samples from the reservoir to predict performance. The results of core flooding tests will indicate the expected recovery factor (how successful the method is) and the best injection scenario to be applied in the field.

To realistically study the performance of a new chemical for EOR applications, the test should apply the same temperature and pressure conditions in the lab as are found in the reservoir. Typically, the oil wells produce at a constant pressure condition called bottomhole pressure. To apply this condition in a core flooding test system, a back pressure regulator (BPR) with no fluctuation is required.

Originally Dr. Mohsenzadeh used a traditional spring-type BPR in his core flooding system design, but the pressure fluctuations made it difficult to collect precise data for the study. The challenge was to find a BPR to maintain a smooth production pressure to produce crude oil from core plug. Dr. Mohsenzadeh's research determined that a

dome-loaded BPR would be a better option, but he needed one that could control crude oil, brine and gases at very low flow and a range of high pressures.

Solution

Dr. Mohsenzadeh contacted Equilibar to find a BPR that could maintain control at the needed minimum and maximum range of pressure setpoints. Equilibar application engineers recommended a stainless steel Equilibar[®] U10L BPR with Kalrez O-rings and a stainless steel diaphragm for the core flooding apparatus. The BPR will be used at pressures up to 10,000 psi and temperatures up to 300 °C.



Figure 1: Equilibar U10L

The U10L is one of Equilibar's Research Series BPRs that are designed for a variety of gas, liquid and mixed phase applications where precision performance is critical. The U10L model is used where ultra-low flow rates and high pressure control are desired.

Equilibar Research Series BPRs are used in applications that involve 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.

Equilibar BPRs are controlled by a pilot regulator which provides the process setpoint. This setpoint regulator can be manual or electronic. Dr. Mohsenzadeh is using an N2 cylinder with a manual high pressure regulator to provide the setpoint to the U10L. This setup controls the back pressure very precisely up to 200 bar. To apply higher pressure, he is planning to use a gas booster and surge cylinder.

"I liked Equilibar's prompt follow up starting from their technical advice to issuing a quote and shipping the package overseas. In all steps of technical and commercial, they acted very professionally."

- Dr. Adel Mohsenzadeh

Application details:

The schematic of the core flooding apparatus is shown below in figure 3 with an Equilibar BPR at the exit of the core holder (top right box) keeping precise pressure for the testing.

Dr. Mohsenzadeh installed the Equilibar BPR successfully and improved the pressure control of the core flooding system. After several months of use, he reports that the BPR is working as expected with no maintenance required.



Figure 2. Photo of core flooding system with core holder and U10L

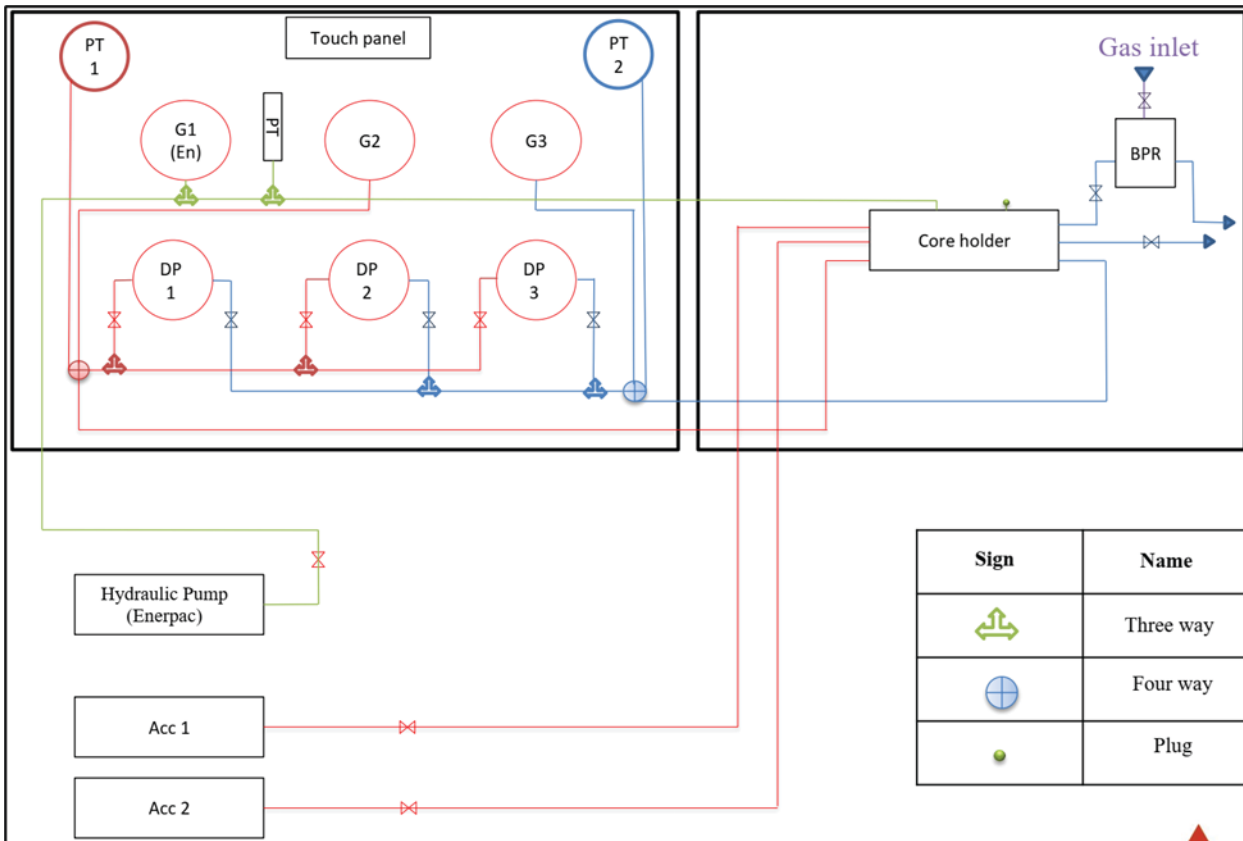


Figure 3. Schematic of the core flooding apparatus with a U10L at the exit of the core holder

About University of Technology and Applied Sciences

The University of Technology and Applied Sciences in Muscat is the second largest higher education institution in Oman with more than 13,000 students studying in various programs. It is one of seven colleges under the Ministry of Manpower in the Sultanate. The Engineering Department offers 12 specializations: Architectural Engineering, Civil Engineering, Land Surveying, Quantity Surveying, Draftsman, Computer Engineering, Electrical Power Engineering, Electronics & Communications Engineering, Air Conditioning & Refrigeration, Chemical Engineering, Mechanical Engineering and Oil & Gas.

Contact Equilibar

Equilibar is a provider of unique and innovative fluid control solutions based in Fletcher, North Carolina. Equilibar's patented back pressure regulator technology is used in a wide array of processes including catalyst, petrochemical, sanitary, supercritical, vacuum and other industrial applications. For more information, please contact an Equilibar applications engineer at inquiry@equilibar.com or 828-650-6590.

About the Authors



Dr. Adel. Mohsenzadeh earned his Ph.D. in Petroleum Engineering from Sultan Qaboos University College of Engineering - Chemical and Petroleum Engineering Department - in Oman in 2016. His thesis title was "Novel Application of Deep Eutectic Solvents for Enhancing Heavy Oil Recovery." He is Currently a faculty member of University of Technology and Applied Sciences (UTAS, previously named HCT) in the Oil and Gas Engineering program. He continues his research area in EOR methods such as chemical injection, heavy oil recovery, steam injection, thermal methods and gas injection. He designed and assembled a core flooding system for his studies.



Diane Jacober is a Technical Marketing Specialist 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 marketing@equilibar.com or 828-650-6590.