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Steady-State Liquid Permeability Measurements in Ultra Tight Rock Samples

Thursday, 3 June 2021 20:00 (1 hour)

Matrix permeability is one of the most important characteristics of reservoir rocks yet its accurate measurement is often challenging for ultralow permeable shale and tight formations. Permeability of these reservoirs is in the range of micro-Darcy to nano-Darcy and depends on several factors including confining stress, pore pressure, pore fluid, and temperature. Hence, determination of permeability values in these rock samples is prone to errors where some inconsistencies exist in reported permeability values in the literature. In permeability measurements of tight and shale rock samples, transient methods are preferred over steady-state approach due to their time efficiency. Transient techniques, such as pulse decay permeameters, rely on using gases on measuring permeability requiring additional assumptions and parameters, hence, inaccuracies in the measurement arise especially when the flow path sizes are comparable with the mean free path of gas molecules. The use of steady-state methods, which provides an accurate and reliable estimation of rock permeabilities in conventional reservoir rocks, is limited for ultra-tight samples due to the long run-times. The presence of a small dead volume in the apparatus, comparable to the pore volume of tight samples, also contributes to uncertainties of measured permeability. However, unlike transient methods, liquids can be used as the flowing fluids in steady-state approaches with much confidence. Herein, we present the results of a custom-built liquid permeameter, based on the steady-state approach that can accurately measure permeabilities in the range of micro and nano Darcy. A core flooding apparatus is custom-built to nearly zero dead volumes and minimum upstream volume which consequently speeds up the steady-state measurements. Experiments are done with dodecane as the measuring fluid and different tight rock types including carbonate, sandstone as well as shale rock samples with permeabilities in the range of 10 µD to 10 nD. The new permeameter generates repeatable permeability values with maximum error of 5%. The experimental run time is less than one week for samples with the permeability above 1 µD and maximum three weeks when the permeability is below 1 µD.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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