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Experimental Evaluation of the Impact of Induced Fractures on Cyclic Solvent Injection Performance in Low-permeability Hydrocarbon Reservoirs

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Abstract Text:

Recovery factors associated with primary recovery schemes applied to low-permeability hydrocarbon reservoirs are often small (<5-10%). As a result, cyclic solvent injection (CSI) schemes, using CO_2 and produced gas, are currently being considered as a method for enhanced hydrocarbon recovery. Fracture networks generated during hydraulic fracture stimulation affect both primary and enhanced recoveries by increasing the surface area contacted with the low-permeability reservoir matrix. However, experimental studies of the impact of induced (hydraulic) fractures on CSI performance are sparse, particularly those that provide a realistic representation of the hydraulic fracturing process by inducing fractures under “in-situ” stress conditions. Therefore, the primary objective of this proof-of-concept work is to develop a lab-based methodology for evaluating the effect of fracture properties (e.g., surface area) on CSI performance, as applied to ‘ultra-tight’ (nanodarcy permeability) reservoirs.

An in-house core-flooding methodology, that combines ‘in-situ’ fracturing and cyclic gas injection, was used herein. The experimental procedure includes: 1) performing multiple cycles of lean gas (i.e., 80% C_1 + 20% C_2) injection on an oil-saturated intact core plug until reaching maximum oil recovery, 2) artificially fracturing the core plug under stress, 3) repeating multiple cycles of lean gas injection on the artificially-fractured core, under similar experimental conditions as those used for the intact core, until reaching maximum oil recovery, and 4) measuring the fracture permeability. A well-characterized tight siltstone sample obtained from the Canadian Montney Formation was analyzed as an example.

Experimental results (**Fig. 1**) indicate that 1) fracturing under stress causes a 4-fold increase in surface area and a 5 orders of magnitude increase in permeability and 2) the recovery factor is enhanced by ~18.5% after fracturing, increasing from ~4.6% to ~23.1%. This study provides a proof-of-concept experimental approach for evaluating the impact of fracture parameters (i.e.

surface area/fracture permeability) on CSI performance in tight rocks.

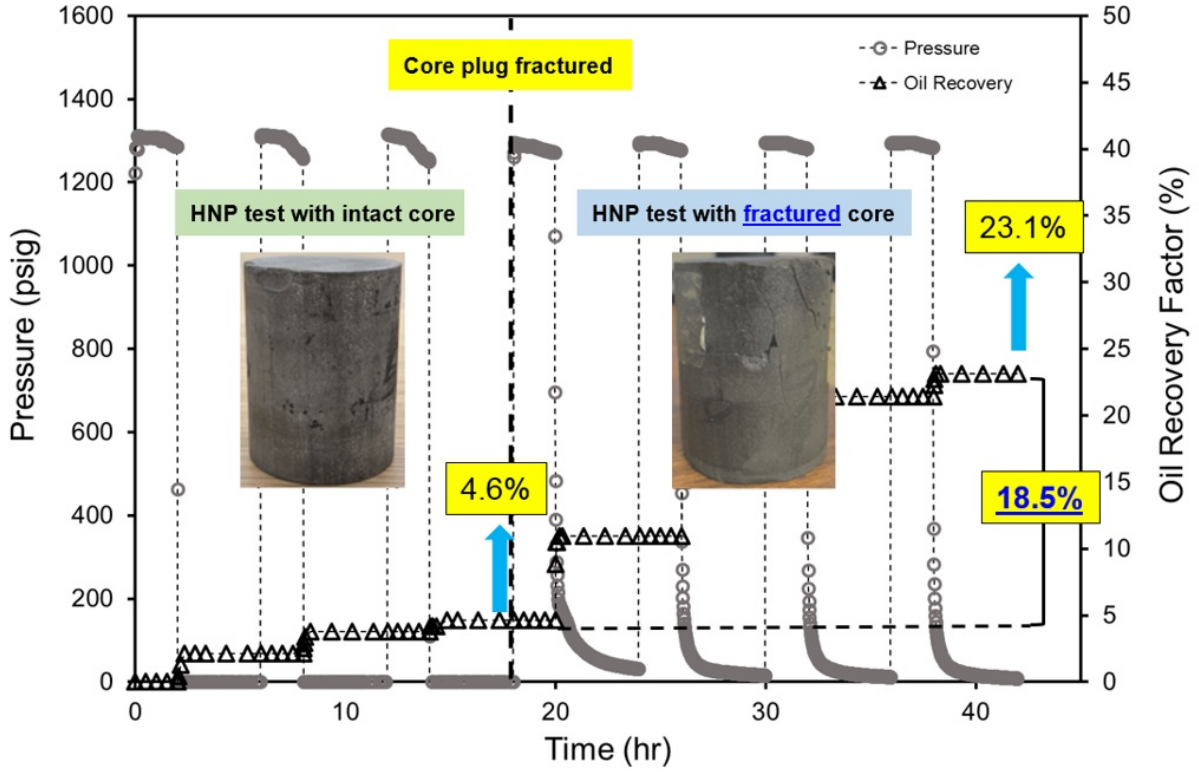

Fig 1. Cyclic lean gas injection testing with intact and artificially-fractured core plug samples

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