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Impact of pure CO_2 and carbonated water injection to enhance recovery of heavy oil

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Performance of CO_2 and hydrocarbon (HC) gas injection into a heavy crude oil was investigated at high pressure/temperature condition, using high permeable well-sorted original reservoir sandstone. Complete series of PVT and slime tube tests were followed by vertical and horizontal gas floods to study the impact of injection rate, injectant type and reservoir pressure. Dimensional analysis was performed to study the involved mechanism and forces. Sometimes direct injection of CO_2 may not be practically and economically possible. In addition, in plans for CO_2 storage, CO_2 as a free phase in a reservoir is coupled with a significant leakage risk that prevents the scenario of direct injection. Therefore, in the second part, the enhancement of heavy oil recovery was tested by the carbonated water injection. The results of the first part of core flooding experiments demonstrated that gravity and solubility are the most effective mechanisms in oil recovery. The reduction in oil recovery in horizontal flooding for HC gas injection is higher due to the smaller difference between the densities of CO_2 and oil compared to HC gas/oil systems. Furthermore, a small increase of oil recovery after breakthrough (BT) during N_2 injection proves the importance of the solubility mechanism. Therefore, In this case, more precise analysis could be performed by applying the dissolution number instead of capillary and/or bond number. For the second part of the experiments, the results obtained demonstrate that the capability of carbonated water to enhance oil recovery for both secondary and tertiary flooding is significantly greater than that for water flooding. The creation of a low resistance flow channel and low oil recovery in water flooding is compensated by CO_2 diffusion and subsequent viscosity reduction and oil swelling in heavy oils.

Figure 1: Experimental design and dimensional analysis scheme during high pressure gravity assisted flow.

Biography

Behzad Rostami is an Associate Professor of Petroleum Engineering in the Institute of Petroleum Engineering (IPE) at University of Tehran, Iran. His research interests involve gas injection based methods of enhanced oil recovery, foam injection and carbonated water injection, CO2 sequestration in saline aquifers and depleted hydrocarbon reservoirs, gravity drainage and multi block interaction in fractured media. He has authored more than 40 technical papers in international journals and has also guided more than 30 graduate students.

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