



Breaking a Paradigm: Can Oil Recovery from Shales be Larger than Oil Recovery from Conventional Reservoirs? The Answer is Yes

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Summary

Oil recovery worldwide from conventional reservoirs vary significantly from case to case, but it is sometimes presented at an approximate average of 30 % of the original oil in place, including primary and secondary recovery. This study shows that proper implementation of huff and puff gas injection in shales can lead to larger percent oil recoveries. Explaining the reasons for this controversial and out of the box conclusion is the key objective of this paper.

Method

This research starts by investigating flow units and pore throat sizes of shales, and by demonstrating the separate 'upside-down' or inverted vertical containment of natural gas, condensate and oil in shale reservoirs. Once vertical containment is demonstrated with data from the Eagle Ford shale in Texas, the research moves to investigating huff and puff gas injection in hydraulic fractured horizontal wells. The investigation is carried out by considering theoretical, core, laboratory, and petrographic data; and a simulation match and economics of an Eagle Ford huff and puff gas injection pilot.

Results, Observations, Conclusions

Results, dramatic and that no doubt will become highly controversial, lead to the out of the box conclusion that oil recovery with correctly-performed huff and puff gas injection can lead to oil recoveries even larger than oil recoveries from conventional reservoirs, reaching levels of up to 40%+ of the OOIP from the oil container. The finding is important as oil recoveries from shales have been reported up to this point in the literature to be very low ranging between approximately 5 and 10 %.

The term "container" is not used generally in petroleum engineering, but proved of significant value in our research. A container is "a reservoir system subdivision, consisting of a pore system, made up of one or more flow units, which respond as a unit when fluid is withdrawn" (Hartmann and Beaumont, 1999).

Although this investigation is carried out only for the Eagle Ford shale of Texas, preliminary scoping studies indicate that a similar potential might exist in other tight and shale reservoirs such as the Duvernay, Montney and Doig reservoirs in Canada, and Vaca Muerta in Argentina.

Novel/Additive Information

The key contribution of this paper is highlighting the extraordinary potential of huff and puff gas injection in shale petroleum reservoirs, which can increase oil recoveries to even higher levels than the recoveries commonly achieved in conventional oil reservoirs. Economic benefits as a result of huff and puff gas injection in shales are included in the paper.