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I'll Huff and I'll Puff and I'll – Recover more Oil? Part 1: The Rock

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Summary

Typical decline curves observed in unconventional reservoirs are enough to scare most conventionally minded operators and explorationists away, nevermind getting your head around nanodarcy permeability. However, these unconventional reservoirs have dominated the playbooks across North America for the last decade or so. These reservoirs have enormous reserves attached to them and with the surge in horizontal and fracing technology, it has made it possible to move that reserve to resource. That recoverable resource is but a fraction, a very small fraction, of what we know is there – so the question now is – how can we increase recovery rates and still remain economical?

Conventional enhanced oil recovery (EOR) methods have been around for decades including water/fire/polymer flooding in the carbonates of southeast Saskatchewan, sandstones of the Cardium and thermal injection in heavy and oil sand plays. The problem with these methods is that the rock has to be somewhat porous and permeable to be effective. The challenges that face the unconventional shale world is their often heterogeneous nature and ultra-low permeabilities. Moreover, the permeability decay associated with increased pressure, i.e. closure stress, drawdown, open choke, etc., is inelastic in these reservoirs, culminating in steep decline curves.

Recent advances in EOR methods to specifically handle these ultra-low permeability reservoirs are coming to fruition with lab and field testing being refined by the day. Gas Cycling or 'Huff and Puff' EOR is proving successful with operators seeing anywhere between ~10-60% increase in OOIP. This presentation will focus on the rock and rock fabric of these plays – defining parameters in which we can start to benchmark for this type of EOR method. Looking at the rock-gas interaction and relationship is also important – what is happening as we let each gas cycle soak in the reservoir and is there a difference between the condensate and black oil window?

Lastly, this presentation will look at what implications this has on the Canadian oil and gas scene, particularly the Montney and Duvernay Formations. Very different reservoirs in their own right – is this Gas Cycling 'Huff and Puff' method appropriate? And what should you expect for returns?