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Huff & Puff EOR in the Liquids-Rich Portion of the Montney Play: Effect of Solvent Composition

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Summary

Excluding thermal recovery, where energy in the form of heat is introduced into the reservoir, most Enhanced Oil Recovery (EOR) processes rely on injecting displacing fluids in the reservoir. The displacing fluids typically serve two purposes: (i) to increase the energy in the reservoir through pressure support; and (ii) to mobilize the hydrocarbons (with or without miscibility) from the pore space towards producing wells. In unconventional reservoirs that rely on hydraulic fractures for production, displacement EOR methods are not feasible since the injected fluids cannot flow through the formation towards producing wells. This leaves cyclic methods, also known as huff-and-puff as one of the few possible alternatives for improving recovery in these types of reservoirs.

In this work, we use numerical reservoir simulation to explore the feasibility of using cyclic gas injection to enhance recovery of liquids in gas condensate reservoirs in the Montney formation. We study the effects of the composition of the solvent injected as well as the optimum schedule of injection, soak and production periods.

Theory / Method / Workflow

A reservoir geomodel of a typical Montney gas condensate reservoir was constructed using publicly available data. Rock mechanics data was integrated into the model alongside completion and pumping schedule information to predict non-planar hydraulic fracture propagation and geometries that are representative of the typical the stimulated volumes in Montney. A compositional numerical reservoir simulator was then used to forecast liquid recovery under different scenarios involving cyclic gas injection. Sensitivities to study the effect of the injected gas composition were carried out alongside an optimization study to determine the length of the injection and production cycles to maximize recovery.

Results, Observations, Conclusions

Modelling results showed that the composition of the injected solvent has a strong influence on the success of any cyclic injection process. The injection pressures and volumes also affect the amount of additional condensate that can be recovered. The results also suggest that there is a time window to start applying the EOR process; starting too early can hinder liquid production and too late might leave some unrecoverable condensate behind.

Novel/Additive Information

Recent literature has reported simulation studies related to this subject, however, all of them are based on simplified planar fracture models. We aim to test huff-and-puff using a complex fracture model that takes into consideration the detailed rock fabric characteristics and geomechanical properties, the in-situ stress field and realistic treatment schedules. By using a more rigorous fracture description we should able to better investigate the feasibility of these recovery processes in a full-well study and not only in an element of symmetry such as a half or quarter planar fracture.

As unconventional operators consider optimizing their operations, single-well EOR processes like huff-and-puff promise not only to increase recovery on a per-well basis, but also to arrest the rapid decline observed in these wells. This translates in lower capital expenditures (by reducing the need for drilling) as operators can maintain production with a lower number of wells.