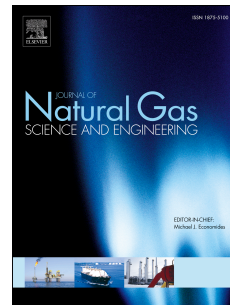


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Comparison of huff-n-puff gas injection and solvent injection in large-scale shale gas condensate reservoirs

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A Comparative Study of Huff-n-Puff Gas and Solvent Injection in a Shale Gas Condensate Reservoir

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Abstract

A compositional simulation approach is utilized to compare huff-n-puff gas and solvent injection in a shale gas condensate reservoir. Each injection process is analyzed in terms of the least cost, shortest payback period, smallest injected pore volume and maximized recovery of the condensate components.

Two gases (methane and ethane) and two solvents (methanol and isopropanol) are chosen for the comparison. The reservoir model is calibrated based on available published rock and fluid properties, and history matching is carried out with production data. The model consists of heterogeneities representative of a shale reservoir such as a stimulated rock volume (SRV) and a non-stimulated rock volume (NSRV) that is intersected by a network of natural fractures.

The reference model is used to understand and establish the basic recovery mechanisms of the four injection fluids while highlighting the principal differences between them. The effects of injection pressure, initial reservoir pressure, injection and production time, the gas-condensate composition and nanopore confinement are evaluated. Analysis of the performances of the four injection fluids are based on the total hydrocarbon recovery factors, combining the liquid and gas phases, calculated within the same operation time.

Results demonstrate ethane to be a superior injection fluid with a high recovery factor for most scenarios, accompanied by a relatively higher profit to investment ratio and shorter payback period. Ethane injection recovers the heavy condensate components more efficiently compared to methane and solvent injection for a given gas condensate composition. This advantage is complemented by ethane's capability to equally recover all of other hydrocarbon components from the reservoir. The recovery performance of solvent huff-n-puff for a leaner gas condensate fluid is significantly greater than that for the richer gas-condensate reservoir fluid. The main difference in the optimization of gas and solvent performance is highlighted. Gases require longer injection and production time, whereas solvents perform better with shorter injection time and longer production time.

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