

Gas Injection in Lower Cretaceous Reservoirs: Findings from Experimental and Simulation Studies

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Most oil production in the Danish part of the North Sea is from low permeable chalk reservoirs that are produced by natural depletion or water flooding. The Valdemar field, with an average permeability lower than one mD, has been developed solely by depletion, projected to give a low ultimate recovery. A research project has been carried out to study the potential of increasing the oil recovery with hydrocarbon gas injection in Lower Cretaceous reservoirs. The research involves comprehensive efforts covering PVT experiments and modeling, flooding tests and history matching, and compositional simulation of different injection scenarios. The experimental studies served as the basis for the subsequent compositional simulation analysis. In addition, findings from these experimental studies provide direct engineering implications for gas injection. The flooding data were history matched using a compositional model. It was found that the local equilibrium assumption could result in excessive vaporization and must be somewhat corrected. The final simulation was performed using a small sector from the Valdemar field. A model with two parallel horizontal wells, one as injector and another as producer, was constructed using the average petrophysical properties selected for each layer in the Lower Cretaceous formation. Sand-propped fractures were defined in both wells. The simulation showed that hydrocarbon gas injection could significantly increase oil recovery as compared to natural depletion. For comparison, injection scenarios with other gases, like CO₂ and flue gas, were also simulated, with CO₂ giving the highest recovery and flue gas a lower one. For CO₂ and flue gas, we also discussed the implications for CO₂ storage.



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