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Influence of oil field production life on optimal CO₂ flooding strategies: Insight from the microscopic displacement efficiency

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We investigate the influence of the microscopic displacement processes on optimal gas flooding strategies. We couple a 1-D compositional reservoir model with an economic model of the flooding to assess profitability of the strategies. In general, we aim at the net present value maximisation, although the oil recovery and CO₂ storage efficiencies are also estimated. Under certain assumptions, we reduce the number of parameters controlling selection of optimal strategy to just a few dimensionless quantities characterising both physical and economic processes. We show that the production life of oil fields should not be fixed in optimisation studies, especially at low oil prices. A significantly larger net present value can be achieved by varying the reservoir lifetime in addition to the injection rates and volumes and other well controls. Herewith, the optimal strategy can differ from that in the case of a presumed production time. We conclude that waterflooding is the optimal recovery method if the injection rate is low, whereas gas (WAG) flooding applied as a primary method and followed by waterflooding is most optimal for large injection rates. Gas flooding applied as the tertiary recovery method is most optimal for an intermediate range of the rates. In the latter case, gas injection should begin much earlier than water breaks through to producing wells. Finally, we investigate how oil price influences the range of parameters suitable for gas injection.

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