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# Benchmark Study of Underground Hydrogen Storage in Eclipse

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## Abstract

In terms of energy transition, underground hydrogen storage (UHS), delivers a promising solution for large scale energy storage. The hydrogen is produced by renewable energy driven electrolysis, which converts water into hydrogen and oxygen. This process is referred to as "POWER-to-GAS".
In UHS, the viscosity and density induced effects during multiple storage cycles and therefore the efficiency have to be determined and assessed. For this purpose, a numerical benchmark model has been developed to investigate and predict the impact of injection/production rates, schedule times, storage gas compositions and well setups.
A semi-synthetic rectangular reservoir model with a single-well and a multi-well setup was used. The model is based on real geological data. In the single-well case, the well was placed centrical. For the multi-well setup, four wells were placed circular in the distance of 850 to 950 meters around the centrical well. The reservoir was initialized with a dry gas composition and a gas saturation of 80%. Four storage cycles per case were simulated. The pressure of the depleted gas reservoir has been lifted previously by injecting storage gas in four two-month periods. As storage gas, three different compositions have been introduced. A series of 24 simulation cases were performed and evaluated, to get a better understanding of the interaction.
Results of the simulations are presented by charting and assessing bottom-hole pressures, storage gas recoveries, compositions of the production streams and gravity/viscous force induced effects, due to different cycle duration, rates, and compositions.

The developed benchmark model, as well as a detailed review, will be published on the website of the Institute of Petroleum Engineering of Clausthal University of Technology. The user can either modify the input parameters for the application to other underground gas storage scenarios or re-simulate the obtained results with other simulators to assess the induced deviations.