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# Modeling Subsurface Hydrogen Storage With Transport Properties From Entropy Scaling Using the PC-SAFT Equations of State

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Hydrogen is a promising alternative to carbon based energy carriers and may be stored in large quantities in subsurface storage deposits. We investigate the impact of static properties, which are density and phase equilibria, as well as the impact of dynamic properties, being viscosity and diffusion coefficients, on the pressure field during the injection and extraction of hydrogen in the porous subsurface. In a first step, we derive transport properties for water, hydrogen and their mixture using the Perturbed-Chain Statistical Associating Fluid Theory (PC-SAFT) equation of state in combination with an entropy scaling approach and compare model predictions to alternative models from the literature. Our model compares excellently to experimental transport coefficients and models from literature with a higher number of adjustable parameters, such as GERG2008, while also showing a clear improvement over empirical correlations for transport coefficients of hydrogen. In a second step, we determine the effect of further model reduction by comparing our model against a much simpler model applying empirical transport coefficients from the literature. For this purpose, hydrogen is periodically injected into and extracted out of a dome-shaped porous aquifer under a caprock. Our results show that density and viscosity of hydrogen have the highest impact on the pressure field, and that a representative thermodynamic model is essential for modeling the storage aquifer while keeping the model's number of coefficients at a minimum. In diffusion-dominated settings such as the diffusion of hydrogen through the caprock, our developed diffusion coefficients show a much improved dependence on temperature and pressure, leading to a more accurate approximation of the diffusive fluxes.

## Participation

In-Person

## References

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