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Compositional modelling of impure gas injection into saline aquifers with the MUFITS simulator

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We present a recent extension of the MUFITS reservoir simulator for numerical modelling of multicomponent gas injection into saline aquifers. The extension is based on the compositional module of the simulator that implements a conventional cubic equation of state (EoS) for predicting phase equilibria of reservoir fluids [1]. Now, the module is supplemented with a new library of EoS coefficients for accurate modelling of CO_2, N_2, CH_4, H_2, O_2, H_2S, and other hydrocarbon components solubility in NaCl brine. In general, we follow the approach proposed by Søreide and Whitson [2] for modelling aqueous solutions, which involves a different and dependent on brine salinity binary interaction coefficients for aqueous and non-aqueous phases. However, we also use several published modifications to the EoS coefficients that were originally proposed in [2] to improve prediction of the mutual solubilities.

The extension is validated against 3-D benchmark studies of pure supercritical CO_2 injection into saline aquifers. Also, we consider two more complicated injection scenarios to demonstrate potential applications of the new development. First, we simulate impure CO_2 injection into a saline aquifer. We show that even a small amount of air (N_2 and O_2) in the injected gas results in a significantly more rapid spreading of the gas plume. Second, we consider a 3-D study of CO_2 injection into subsurface natural gas storage aiming at the cushion gas substitution with supercritical CO_2. The mechanical dispersion in the porous medium is accounted for an accurate modelling of CO_2 and CH_4 mixing. We simulate the propagation of CO_2 in the storage by modelling several seasons of natural gas (CH_4) injection and extraction.

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References

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