Scoping analysis of brine extraction/re-injection for enhanced CO2 storage

GCCC Digital Publication Series #12-11

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Keywords:
Brine extraction; Brine re-injection; CO2 sequestration; Formation volume factor

Cited as:
Hosseini, S.A. and Nicot, J.-P., 2012, Scoping analysis of brine extraction/re-injection for enhanced CO2 storage: Greenhouse Gas Sci Tehnol, 2: 172-184. GCCC Digital Publication #12-11.

Abstract:

Brine extraction from the CO_2 injection interval and re-injection into overlying shallower aquifers have been described as an active management tool at sequestration sites. They improve injectivity and reduce risks, and are a potential cost-saving measure. In this study, using analytical equations, we show that brine re-injection from the deep aquifer into a shallower saline aquifer increases CO_2 storage capacity relative to direct CO_2 injection into the two saline aquifers as a result of the CO_2 density change. Using generic models, we compare three different scenarios for CO_2 injection: (i) injection of CO_2 into the deep aquifer without the re-injection program, (ii) injection of CO_2 into both the shallow and deep aquifers, and (iii) injection of CO_2 into the deep aquifer and extraction/re-injection of the brine into the shallow aquifer. Volumetric calculations at different pressure and temperature conditions provide a simple analytical tool for studying CO_2 storage capacity in stacked saline aquifers. Numerical compositional simulations confirm results of the analytical derivations and prior assumptions. Depending on the size and depth of the shallower aquifer, brine re-injection can increase storage capacity by 30% or more, given a comparison of scenario 3 with scenario 1. However, when scenario 3 is compared with scenario 2, storage gain is generally less than 5%, although potential CO_2 leakage risks are reduced. Results of a sensitivity analysis to shallow-aquifer pore volume and geothermal-temperature gradient are also presented. In addition, brine re-injection from geopressured saline aquifers, when compared with that of normally pressured reservoirs, is twice as efficient.