Comparing CO2 Injection Practices to Low-Salinity and High-Salinity Wastewater Injection Practices Into Deep Saline Aquifers in Kansas

Esmail Ansari[1], Yevhen Holubnyak[1], Franciszek Hasiuk[2], Jennifer Hollenbach[2]
[1]University of Kansas; [2]Kansas Geological Survey

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Abstract

CO2 injection into deep saline aquifers is offered as one solution to mitigate global warming. Deep saline aquifers have been used safely for wastewater disposal for more than seven decades across Kansas. However, recently large injection rates from low-salinity injection wells (EPA Class I wells) and high-salinity injection wells (EPA Class II wells) have markedly increased subsurface pressure and seismicity rates in Southern and Central Kansas. Deep saline aquifers in Western Kansas may have the potential for CO2 storage because they have experienced low injection volumes and almost no historical pressure change. This work compares CO2, low-salinity and high-salinity injection practices to understand their similarities and differences in diffusing pressure in the aquifer and its hydraulically connected basement, where it has been suggested that most seismicity in Kansas occurs. We use simple yet representative numerical models to simulate the pressure evolution for each practice. We then use Sobol sensitivity analysis and tornado charts to find the important geological factors controlling pressure evolution around the wellbore and in the reservoir. Finally, we offer simple regression models to estimate pressure build-up for each case. Our results show that pressure buildup is higher at the top of the reservoir and lower at the bottom of the reservoir that is in close proximity to the basement when injecting CO2 compared with wastewater injection. In both cases, the CO2 plume and the salinity plume occupy smaller footprints than the overpressure plume, which extends into a larger area. This result is particularly valid for high-permeability carbonate aquifers, in which gravity forces dominate viscous forces and move the CO2 and

overpressure plume towards the top of the reservoir. We also find that CO2 injection creates a larger pressure build-up than low-salinity and high-salinity wastewater, when injected at similar mass, primarily because CO2 has lower density and occupies more pore space. In addition, when injecting CO2, the CO2 plume expands at the top of the reservoir, moving the native formation brine across the hydraulic gradient in the aquifer or down into the basement. This study could be used to establish the safety protocols for injecting CO2 into deep saline aquifers.