Evolution of a Pressure-Induced Risk Management Strategy for CO_2 Injection in Deep Saline Aquifers

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Various boundary conditions can be employed to simulate injection of CO_2 in deep saline aquifers. Oruganti *et al*, 2009 demonstrated ways of quantifying the risk due to pressure buildup in an aquifer with a constant pressure boundary. However aquifers suitable for storage are likely to be infinite-acting, unless extraction wells are active. In this case, the constant pressure boundary condition underestimates risk. To analyze better the risk of overpressure due to CO_2 injection in an infinite aquifer, we develop an analytical solution for pressure profile in the aquifer, using the classical Van Everdingen and Hurst solution to the radial diffusivity solution, as applied to the case of an infinite aquifer. In this solution, the storage aquifer is assumed to be surrounded by an infinite aquifer, referred to as the "bounding aquifer". The pressure profile from the analytical solution matches well simulations that account for the full physics of the injection. As the permeability of the bounding aquifer increases, the infinite aquifer scenario approaches the constant pressure boundary case. Simulations with partially sealing aquifer boundary, and for different angles of the bounding aquifer are shown to illustrate the effect of no-flow boundaries on pressure-induced risk.

We use the notion of Contour of Overpressure (CoP) as a proxy for pressure-induced risk. Strategies for managing this risk include adjusting the flow rate of CO_2 such that a critical CoP, say +50 psi, does not extend beyond a critical radius. Given a sufficiently large aquifer drainage radius, the rate of injection can be sufficient enough to put away CO_2 on the order of amounts generated from a typical 500 MW coal-fired power plant.

Addressing overpressure risks during geologic CO_2 storage plays a pivotal role in accurately estimating the project risk. Through the above study, we have aimed at introducing elements of geologic realism into the problem, thus laying the groundwork for effective risk management strategies in CO_2 storage projects.