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Preliminary Reservoir Simulation for Selection of a Pilot Site for CO₂ Sequestration: Effect of Reservoir Properties and Operational Parameters

Potential sites for a carbon sequestration pilot are assessed based on geological and engineering considerations, CO₂ injection capability, and CO₂ retention. The objective of the screening study was to evaluate and rank potential sites and geologic strata to select a site for a small-scale pilot. Producing and depleted gas reservoirs, and saline aquifers were considered.

Computer simulation is an important design tool and virtually all reservoir development decisions consider simulation results. Consequently, simulations were performed for CO₂-well injectivity optimization, for brine and gas production, and for a variety of reservoir characteristics and operational parameters that could be useful for maximizing sequestration capacity.

Simulations were run with a compositional simulator for saline aquifers and depleted gas reservoirs with high water saturation. Both vertical and horizontal injector wells were considered. For the saline aquifer case, a two-dimensional vertical cross section of the reservoir was modeled with a stochastic permeability field due to the lack of information about permeability heterogeneity. CO₂ propagation and breakthrough, pressure distribution, and saturation of different phases were visualized. The computations show that injectivity is very sensitive to absolute permeability and formation thickness.

An inverted 5-spot well pattern was used as a pilot test model for the depleted gas reservoir case. The base well-pattern consisted of one vertical or horizontal well in the center of the square and vertical producers in the four corners. Reservoir properties such as permeability, porosity, brine saturation, and degree of anisotropy were modified to approximate different types of gas reservoirs. Variation of operational parameters such as well completions, well length, injection and production well pressure were used to evaluate injection and production plans for each reservoir type.

The findings of this study will be useful in selecting carbon sequestration pilot sites, and evaluating potential sequestration efficiencies and enhanced natural gas production.