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Analytical Approach for Leakage Characterization in Carbon Sequestration in a Bounded Deep Saline Aquifer

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Abstract

One of the promising methods in CO₂ sequestration is CO₂ injection into deep saline aquifers. A challenging question in CO₂ storage in deep saline aquifers is how we can determine the leakage in a storage aquifer if its cap rock does not fully seal it. Numerous studies have been done to answer this question using different disciplines including numerical simulations, analytical modeling, and experimental investigations. Among these methods, leakage detection by monitoring pressure changes in a monitoring well has gained the most attention recently. In this study, we have developed a new analytical modeling method to monitor pressure changes in monitoring aquifers as a tool for leakage detection. Our developed analytical models are capable for bounded saline aquifers. To eliminate the effect of a size in our modeling, all the developed models are in dimensionless form. Pragmatic sensitivity analyses are performed to determine the effect of different parameters on a dimensionless leakage rate and a pressure change in a monitoring well and a pressure change in a storage aquifer due to both injection and leakage. Based on the results gained, the dimensionless pressure in the monitoring well depends on the well location and the thickness of the monitoring aquifer; however, it is independent of a leak location. The dimensionless pressure change in a storage aquifer highly depends on the

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