Leakage characterization through above-zone pressure monitoring: 2-Design considerations with application to CO2 storage in saline aquifers

GCCC Digital Publication Series #12-07

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Keywords:
Modeling-Flow simulation, Monitoring-Design, Monitoring-downhole pressure, Risk-well integrity, Characterization

Cited as:
Zeidouni, M. and Pooladi-Darvish, M., 2012, Leakage characterization through above-zone pressure monitoring: 2 – Design consideratiosn with application to CO2 storage in saline aquifers: Journal of Petroleum Science and Engineering, v.98-99, p. 69-82. GCCC Digital Publication #12-07.

Abstract:

Deep saline aquifers are widely used for waste disposal and are the main candidates for storage of CO2 as a means of reducing greenhouse gas emissions to the atmosphere. Safety of disposal/storage projects highly depends on the containment of CO2 within the target aquifer. However, since the cap-rock overlying the aquifer may include leakage pathways that permit the injected fluids to leak to subsurface formations and/or to surface, detection and characterization of any such pathways from storage formations into overlying formations are required. A leakage test has been introduced in an earlier paper to characterize a leakage pathway through pressure monitoring in an overlying aquifer separated from the target aquifer by the cap-rock. A leakage pathway can be characterized by the leak transmissibility and location parameters, so a successful test should be able to provide sufficient confidence to evaluate the transmissibility and location parameters. In this work, different strategies are evaluated in order to achieve a successful test. The strategies include increasing the sampling frequency, use of pulsing, and increasing the number of monitoring/injection wells. The information provided by different strategies is evaluated, based on their effects on well-posing the inverse problem. The effects are studied based on information and correlation matrices, as well as the confidence interval. Locating the monitoring well is studied considering the requirements to ensure the safety of CO2 storage projects. Finally, we present a graphical method to obtain prior information on the leak based on the pressure derivative data. The graphical method is obtained based on deriving a new realtime analytical solution for the pressure at the monitoring zone.