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OPTIMIZATION OF SOLUTION STORAGE CAVERN CONSTRUCTION

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Abstract

To improve dissolution efficiency for storage cavern construction in salt, a group of laboratory experiments, theoretical analyses, and physical simulations were carried out. Dissolution experiments with large salt specimens under varying conditions demonstrate the impact of dissolution angle, solution concentration, and temperature on the salt removal rate. A set of coupled constitutive equations for storage cavern construction by solution mining is presented, accounting for liquid flux, salt dissolution, and mass transfer. With regard to the liquid flux effect on cavern construction, numerical simulations of liquid flux in salt caverns of specified geometry were performed, showing that the tubulars in the well, including the setting depths of the injection and withdrawal strings and the distance between the production and injection points, impact greatly the flow in the cavern, especially near the cavern wall where the flux rate (velocity) determines the salt dissolution rate. Using a physical simulation system developed by us, simulations of liquid flux under different tubing combinations in a vertical cylindrical cavern of large dimensions (ϕ = 3.5 m, h = 7 m) were performed in the laboratory and the observations and results are described. Finally, a group of optimized parameters for fast leaching of salt caverns is suggested for cavern storage construction and management.

Key words: Salt cavern, Oil and gas storage, Solution mining construction, Solution methods, Parameter optimization