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Experimental Characterization of Temperature Dependence of Salt Dissolution Rate

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Abstract

The dissolution rate of salt walls is a crucial parameter in developing models of salt wall evolution during formation and operation of the salt caverns that make up the U.S. Strategic Petroleum Reserve. Several series of experiments were performed to quantify the relation between salt dissolution and the temperature, salinity, and flow velocity of the brine in contact with the salt. The experiments used a continuous flow facility to expose the walls of cylindrical salt samples to brines over a range of temperatures (24 to 50°C), salinities (0 to 90% of saturation), and velocities (0.4 to 4 cm/s). Both pressed salt and salt core samples were tested. The mass loss per unit time was measured, in addition to changes in the density of the flowing brine, while monitoring the brine temperature and flowrate. The data show that under these low velocity, laminar conditions the flow speed is not a dominant parameter. Statistical analysis of the data provides an empirical relation between salt dissolution rate, brine saturation and brine temperature. In addition, both the present work and prior work in the literature show that the dissolution rate is affected by salt surface roughness characteristics. The effect of roughness could not be quantified in the present work, but differences in dissolution rates between salt samples with "smooth" and "rough" dissolution were clear. A review of the existing literature is provided as well as a comparison of the current data to those in the literature. Suggestions for future work include more carefully controlled roughness experiments and extension of flows into the turbulent regime.

Key words: Salt Dissolution Experiments, Caverns for Liquid Storage, Salt Properties, Strategic Petroleum Reserve.