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ON THE CONTROLS OF MIXING OF INJECTED FRESH WATER JETS WITH BRINE IN SALT CAVERNS: SCALED FLOW VISUALIZATION EXPERIMENTS

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Abstract

Mixing of injected fresh water with saturated brine in U.S. Strategic Petroleum Reserve salt caverns governs the shape and rates of change of cavern walls due to leaching. Non-uniform and irregular leaching is a major concern of field operations. Oil withdrawal operations normally involve injection of fresh water into brine near the bottom of a cavern to displace the overlying oil out of the cavern. Of special interest are the factors that control well-mixed conditions below the oil-brine interface or possible movement of poorly-mixed fresh water upward that may form an upper bank of fresh water and concomitant leaching. We investigate factors controlling mixing using laboratory scaled-tank experiments with shadowgraph flow visualization. Parameters varied include: momentum via the flow rate of injected fresh water; degree of injected jet impingement on base of tank via placement of injection nozzle; and detachment of upward-traveling fresh water from the injection string. Initial results presented herein compare the relative strength of controls on mixing, especially with regard initial jet spreading and boundary-layer detachment effects from the injection string of the upward-moving fresh water plume.

Key words: Cavern Operation, Cavern Hydraulics, Cavern Dissolution Experiments