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**Physical Behavior of Oil Field (Class II) Waste in a Sealed Disposal Cavern –
Insights from a Study of Cored Drilling Mud Recovered from a Re-entered
Well Located on the Texas Gulf Coast**

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ABSTRACT

Disposal of oil field (Class II) waste in salt caverns is generally accepted to be both economical and to pose little environmental risk during operation or after closure. The general assessment that there is little long-term risk from this disposal method is justified by reports (Veil, 1996; Tomasko, 1997) that summarize qualitatively the experience of experts in the field of cavern operation and stability. The goal of the current study is to augment this assessment with additional quantitative insight into the long-term physical behavior of mud-laden waste that would be deposited in a cavern.

At final closure, a disposal cavern will be approximately 90% full of oil-field waste slurry, with the upper 10% filled with saturated brine, and accumulated residual hydrocarbon plus the oil blanket. This report includes a re-examination of a previously published (Pearce, 1993) analysis of cored mud samples from an oil well that had been plugged for 29 years. This slurry of drilling mud and cuttings was considered to be a useful analog to the contents of a waste-filled cavern. Recovered mud samples flowed from the coring assembly during transfer to the sample container, but quickly gained gel strength when left quiescent. This suggests that waste will self-level in a cavern and will not be piled near the point of injection. Profiles of density and gel strength for mud in the depth interval from 60 to 731 feet indicated that some settling of the largest particles may have happened despite development of substantial gel strength. Gel strength re-developed over hours, suggesting that settling of small particles produced during the slurry process, and density segregation of waste, will be limited to a short period after deposition in a cavern.

Insight may be gained from these results by comparing this behavior to that of saturated brine used to fill the majority of caverns at closure. This comparison is, initially, a useful basis for

long-term projections because there is an increasing number of empirical studies and modeling analyses for brine-filled caverns (SMRI bibliography, et seq.; Bérest et al., 1999).

Gelling of slurried waste will inhibit settling of all but the largest solid waste particles, will have essentially no significance in opposing cavern convergence, and will slow or eliminate free-convective exchange of energy and chemical constituents between the waste mass and the salt, leaving only exchange by conduction and diffusion.

An example of the consequences of this is that heat transfer coefficient at the cavern wall (free convection in a representative brine-filled cavern, versus heat conduction in an immobile gel) will be reduced by two orders of magnitude for the waste-filled cavern, when compared to the brine-filled cavern. Thus, overall heating and thermal expansion of the cavern contents would take place at this reduced rate. Thermal expansion in a sealed brine-filled cavern is potentially a dominant cause of pressurization in a closed brine-filled cavern during the early months after closure. If heating toward the geothermal gradient is 100-fold slower in a waste-filled cavern, then initial pressure buildup upon closure would be similarly slowed. This would provide additional assurance that long-term, slow permeation of brine into the salt (Bérest et al., 1999) could be sufficient to avoid excessive pressurization.

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