Disposal of Nonhazardous Oil Field Wastes into Salt Caverns

John A. Veil (jveil@anl.gov; 202-488-2450)
Deborah Elcock (202-488-2451)
Mary Raivel (202-488-2433)
Dan Caudle (713-973-6085)
Robert C. Ayers, Jr. (713-664-0501)
Ben Grunewald (405-848-0690)

Argonne National Laboratory
955 L'Enfant Plaza, SW, Suite 6000
Washington, DC 20024

Abstract

Bedded and domal salt deposits occur in many states. If salt deposits are thick enough, salt caverns can be formed through solution mining. These caverns are either created incidentally as a result of salt recovery or intentionally to create an underground chamber that can be used for storing hydrocarbon products or compressed air or for disposing of wastes. This poster discusses research conducted by Argonne National Laboratory to evaluate the suitability, feasibility, and legality of disposing of nonhazardous oil and gas exploration, development, and production wastes (oil field wastes) into salt caverns.

In 1988, the U.S. Environmental Protection Agency (EPA) published a list of those oil field wastes that were exempt from regulation as hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA). EPA's Underground Injection Control (UIC) regulations allow those oil field wastes to be injected into Class II UIC wells. At the state level, only the Railroad Commission of Texas (TRC) has formally authorized disposal of oil field wastes into salt caverns. The TRC has issued permits for six facilities, but to date, only four of these are active. In April 1996, the TRC released draft proposed cavern disposal regulations. Ten other states were contacted about their interest in disposing of oil field waste into salt caverns. Many of these states were interested in following the TRC program to see how it worked, but at this time, only New Mexico has received a formal application for disposal of oil field wastes into salt caverns and Louisiana has received preliminary inquiries from companies interested in pursuing cavern disposal. There are no apparent regulatory barriers to the use of salt caverns for disposal of most types of oil field wastes at either the federal level or in the eleven states that were contacted.

Research sponsored by the U.S. Department of Energy, under Contract W-31-109-ENG-38 with Argonne National Laboratory, 9700 Cass Avenue, Argonne, IL 60439; fax: 630-252-9877.

The types of oil field waste that are planned for disposal in salt caverns are those that are most troublesome to dispose of through regular Class II injection wells, because they contain excessive levels of solids. The solids-containing oil field wastes most likely to be disposed of in salt caverns include used drilling fluids, drill cuttings, completion and stimulation waste, produced sand, tank bottoms, and soil contaminated by crude oil or produced water.

The location and design of waste disposal caverns play an important role in ensuring long-term waste isolation from the surface water or groundwater resources. Hundreds of caverns have been used safely for storing different types of hydrocarbons. The hydrocarbon storage industry has developed useful, detailed standards and guidance for designing and constructing storage caverns that are also appropriate for creating solution-mined caverns for other uses. Operators should be able to demonstrate that the caverns they plan to use - either new caverns developed specifically for oil field waste disposal, or existing caverns that are being converted - will remain stable in the future.

Disposal caverns act like large oil/water/solids separators. The solids in the incoming waste settle to the bottom of the cavern while the lighter oils and hydrocarbons rise to the top of the cavern, where they can be removed. Incoming waste displaces clean brine, which is either sold as a product or disposed of. Cavern pressure should be monitored and controlled before the cavern is filled with oil field waste, throughout the waste emplacement cycle, and optimally, for some period of time after waste emplacement has ended.

There is no actual field experience on the long-term impacts that might arise from salt cavern disposal of oil field wastes. The literature contains many theoretical studies that speculate as to what might happen following closure of a cavern. Although different authors agree that pressures will build in a closed brine-filled cavern due to salt creep (domal salt only) and geo-thermal heating, they do not specifically address caverns filled with oil field wastes. Caverns filled with oil field wastes having specific gravities greater than that of brine will have a lower likelihood of failure than caverns filled with brine. More field research on pressure buildup in closed caverns is desirable.

On the basis of this preliminary research, we believe that disposal of oil field wastes into salt caverns is feasible and legal. If caverns are sited and designed well, operated carefully, closed properly, and monitored routinely, they represent a suitable means of disposing of oil field wastes.

Acknowledgments

The authors wish to thank Nancy Johnson, DOE Headquarters, Office of Fossil Energy, and John Ford, DOE's National Petroleum Technology Office, for their support on this research over the past few years.