ROCK MECHANICS ASPECTS OF NATURAL GAS STORAGE IN DOMAL SALT

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INTRODUCTION

Changes in natural gas market and regulatory environments have created a significant demand for large capacity storage facilities with capability for flexible gas storage. Much of the recent demand for natural gas storage is being addressed through the planning and development of solution-mined storage caverns in Gulf Coast salt domes in Alabama, Mississippi, Louisiana, and Texas.

Solution-mined caverns in salt domes have been used for liquid hydrocarbon storage since the early 1950's [Jacoby and Paul, 1974]. The technology for development and testing of these caverns is well established. Natural gas storage caverns are being developed from newly mined caverns or as conversions from existing liquid storage or brine production caverns. In this paper, rock mechanics studies for a newly mined storage project and a conversion project are discussed. The newly mined storage project is the Warren Petroleum Well No. 6 project in the Petal salt dome near Hattiesburg, Mississippi. The conversion project involves Dow Wells No. 13 and No. 14 in the Napoleonville salt dome south of Baton Rouge, Louisiana.

The rock mechanics aspects of liquid storage caverns are well established. Utilization of solution-mined caverns for natural gas caverns, however, introduces a relatively new challenge to the rock mechanics profession[1]. The purpose of this paper is to discuss some of these challenges through the presentation of two case histories of natural gas storage development.

The internal pressure in a cavern used for natural gas service can vary considerably throughout the lifetime of the cavern and is directly related to the amount of gas in the cavern. The stresses and deformations in the salt surrounding a natural gas storage cavern can be significantly different from the stresses and deformations surrounding a liquid storage cavern. Therefore, cavern stability during brine mining (or development solutioning) and/or liquid hydrocarbon storage does not guarantee stability during natural gas storage. The natural gas storage pressures must be evaluated in concert with the salt properties and cavern geometric characteristics to determine the allowable pressure range that will ensure cavern stability and product containment.

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[1] Although the high demand for natural gas storage caverns is relatively recent, the first cavern development occurred over 20 years ago in the Eminence salt dome in Louisiana.