TRANSIENT ANALYSIS FOR THE MULTIMECHANISM-DEFORMATION PARAMETERS OF SEVERAL DOMAL SALTS

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ABSTRACT

Use of Gulf Coast salt domes for construction of very large storage caverns by solution mining has grown significantly in the last several decades. In fact, a nationally important Strategic Petroleum Reserve (SPR) storage occurs in large cavern arrays in some of these domes. Although caverns have been operated economically for these many years, these caverns have a range of relatively poorly understood behaviors, involving creep closure fluid loss and damage from salt falls. It is certainly possible to postulate that many of these behaviors stem from geomechanical or deformational aspects of the salt response. As a result, a method of correlating the cavern response to mechanical creep behavior as determined in the laboratory could be of considerable importance. Recently, detailed study of the creep response of domal salts has cast some insight into the influence of different salt origins on cavern behavior. The study used a simple graphical analysis of the limited non-steady state data to give a bound, or an approach to steady state, as an estimate of the steady state behavior of a given domal salt. This permitted the analysis of sparse creep databases for domal salts. It appears that a shortcoming of the steady state analysis was in masking some of the salt material differences. In an attempt to overcome the steady state analysis shortcomings, a method was developed based on the integration of the Multimechanism-Deformation (M-D) creep constitutive model to fit the transient response. This integration process essentially permits definition of the material sensitive parameters of the model, while those parameters that are either constants or material insensitive parameters are fixed independently. The transient analysis method has proven more sensitive to differences in the creep characteristics and has provided a way of defining different behaviors within a given dome. Creep characteristics, as defined by the transient analysis of the creep rate, are related quantitatively to the volume loss creep rate of the caverns. This type of understanding of the domal material creep response already has pointed to the possibility of establishing various distinct material spines within a given dome. Furthermore, if the creep databases for domal salts can be expanded, one could expect additional definition of domal geology and structure.

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