SALT-CAVERN CLOSURE DURING AND AFTER FORMATION

F. Joseph Fischer
Bruce D. Light
Shell Development Company
Houston, Texas USA

Paul R. Paslay
Paslay, Incorporated
Houston, Texas USA

ABSTRACT

An analysis over time of the behavior of salt caverns used for oil and gas storage is presented. The cavern and surrounding salt mass are modelled axisymmetrically and generalized plane strain is assumed for the vertical (axial) direction. The internal pressure acting on the cavern boundary is varied as a piecewise linear function of time to accommodate brine and other fluids within the cavern. The outer cylindrical boundary of the salt mass is either restricted from radial motion (multiple cavern array) or the radial stress is specified (single, isolated cavern). The present analysis predicts stresses and displacements within the salt mass as functions of time for either instantaneous or sequential cavern formation.

The disadvantage of other formulations compared to the one presented here is that instantaneous cavern formation has usually been assumed. In practice, the dissolutioning process occurs over a period of one year or longer while time constants for the salt are frequently of the order of several days. Earlier analyses have predicted that, typically, over one-half of the long-term cavern closure occurs during the first year. The small time constants and sizable first-year closure are inconsistent with the assumption of instantaneous cavern formation. Predictions using the present formulation, which tracks simultaneous, time-dependent dissolutioning and cavern closure, are compared with corresponding instantaneous cavern formation results.