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High Pressure Cavern Analysis

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Abstract

In 2002 the SMRI research project “High Pressure Cavern Analysis” has been completed and the final report SMRI 2002-2 /13/ has been presented to the Cavern Sealing and Abandonment Advisory Committee during the SMRI fall meeting in Bad Ischl. The research work resulted in a geomechanical model that is able to generate the basic data for evaluating and/or assessing the conditions of an abandoned brine filled cavern in domal salt.

The main goal of the research project was to compare different cavern configurations and abandonment conditions and to describe the effects of these differences with respect to long-term behavior. The most important results of the research project can be summarized as follows:

- The permeability behavior of rock salt can be described dependent on the tangential effective stress. This means that a parameter is available, which enables the results of the laboratory and in-situ tests to be understood and interpreted.
- The same parameter, the tangential effective stress, can be used as a design parameter for the description of the state of a sealed cavern.
- The most important impact on the peak level of the tangential effective stress originates from the different thermal states of the brine and the rock mass at sealing. If the thermal balance between brine and the rock mass has to be achieved during plugging, an intermediate state of high tangential effective stresses and hence large zones where permeabilities are enhanced will develop. For the long-term behavior a more favorable state will be reached. This final state is equivalent to the case of a cavern where the brine is in thermal equilibrium with the rock mass at the sealing.
- Besides thermal aspects and with a focus on long-term conditions under plugging cavern height, cavern shape, material characteristics of the rock salt and primary rock

salt permeability are of major influence on the tangential effective stresses and the maximum cavern pressure reached after sealing.

- The simulation model of an abandoned cavern which has been developed is suitable for the long-term modeling of the infiltration process which starts after cavern sealing.
- The results of these simulations can be used as the basis of a concept for answering the question of whether a cavern can be abandoned under the project-specific local constraints.

Keywords: Cavern Abandonment, Computer Modeling, Salt Permeability,
Rock Mechanics