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# NEW RESULTS ON CAVERN SEALING AND PERMEATION PROCESSES

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**Abstract:**

AKZO NOBEL and DOW Chemicals have funded a comprehensive research project on coupled thermo-mechanical / hydro-chemical permeation processes related to the sealing of abandoned brine-filled caverns. Progressive pressure build-up in a sealed cavern and the possible brine permeation into the rock has been studied by means of laboratory and in situ investigations. These experimental investigations were supported by numerical computations on macro and micro scale taking into account salt solubility, creep and dilatant thermo-mechanical behavior of rock salt and hydro-mechanical coupling, respectively.

The different processes involved in the brine permeation are discussed in the paper. Important results from this research study are:

- The technical and scientific basis for safe sealing has been developed by means of investigating the coupled thermo-mechanical / hydro-chemical processes and the underlying principles.
- The pressure build-up in a sealed cavern is mainly governed by creep and thermal expansion processes in the rock salt and in the brine.
- Computations show that the permeation of brine into the adjacent rock is not induced by damage and associated dilatancy. The permeation process starts when rock salt becomes permeable after brine pressure has approached overburden stresses at depth.
- The calculations demonstrate that during slow pressure build-up no stress state will occur that will lead to damage or even failure.
- The results of this R&D program will be used in praxis for the safe abandonment of caverns.

## Introduction

Abandonment and sealing of caverns has been subject of many investigations in recent years. By contract of AKZO NOBEL and DOW Chemicals the Federal Institute for Geosciences and Natural Resources, Hannover, has just finished a comprehensive research study on coupled thermo-mechanical / hydro-chemical permeation processes related to the sealing of abandoned brine-filled caverns. This research has been done in co-operation with the International Center for Computational Engineering Sciences (ICCES), University Hannover, and the Institute for Rock Mechanics (IfG), Leipzig.

## Problem

After sealing a brine-filled cavern, the brine pressure inside the cavern will increase (Bérest, P. and Brouard, B.,1995, Wallner, M., 1986). The pressurization rate is decreasing with time. Due to the pressure build-up in the cavern the deformation is stabilized. Convergence of the cavern and surface