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Investigation of T-H-M-C processes on sealing systems in rock salt

THORSTEN MEYER, OLIVER CZAIKOWSKI AND KYRA JANTSCHIK

GRS

Presenting Author: thorsten.meyer@grs.de

In Germany, the disposal of radioactive waste is foreseen in deep geological formations. To ensure that radionuclides are isolated from the biosphere, shafts and drifts from mining activities need to be closed with sealings made from adequate construction material. Therefore, a sealing system consists of the sealing material itself, the excavation damaged zone (EDZ) and the contact seam between sealing material and EDZ.

In the context of the national research Project “THyMeCZ” (FKZ: 02 E11698), GRS is currently investigating sealing and backfilling materials for nuclear repositories in salt formations. The program aims at providing process understanding and experimentally based parameters needed for the long-term performance assessment of the sealing system.

The experiments focuse on the long-term sealing behaviour of the system under various conditions, e.g. contact with saline solutions, mechanical stresses and increased temperatures. The sealing system is simulated in laboratory experiments using hollow cylinders of rock salt filled with concrete sealing material.

The influence of thermal (T), hydraulic (H), mechanical (M) and chemical (C) impacts to the sealing performance of the lab-scale sealing system is systematically investigated:

- Percolation of the system with saline solutions: investigation of changes in fluid permeability, solution composition and the phase ensemble with time due to material deterioration/corrosion (HC).
- Exposition to various stress states with and without percolation of saline solutions: Determination of fluid permeability as well as changes in solution composition and the resulting phase ensemble (HMC).
- Percolation of the system with brines at elevated temperature: investigation of the influence of temperature on the hydraulic and chemical parameters with time (THC).
- Exposition to various stress states and percolation with saline solutions at elevated temperatures. A new experimental setup for these investigations is built, based on corrosion-resistant syringe pumps (THMC).

In order to understand the complex chemical interactions in the percolation/corrosion processes, a special long-term cascade experiment was applied for the investigation of the reaction path of the fluid-solid interactions. The results are compared with the results of the geochemical modeling and with results of the percolation experiments.

This paper will present selected results from laboratory experiments at GRS.