E U R O S A F E

Towards Convergence of
Technical Nuclear Safety Practices in Europe

Calibration and Improvement of Numerical THM Models for Rock Salt Repositories in the Frame of THERESA

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Objectives of THERESA WP3

The objectives of WP3 of the THERESA project are the evaluation and improvement of numerical modelling capabilities for assessing the perfor-mance and safety of nuclear waste repositories in rock salt, with particular regard to the long-term evolution of the excavation damaged zone (EDZ). The work plan is structured as follows.

- Evaluation of code capabilities and/or develop¬ment needs and compilation of relevant data
- Implementation in computer codes and testing of the calibrated models
- Definition and benchmark simulation of a test case (TC), with measured data from a large-scale lab test on coupled THM processes
- Expression of the applied process models in a compartment model and implementation in integrated PA codes to perform long-term predictions for a reference case (RC)

This poster deals with the first two of these items.

Experimental work

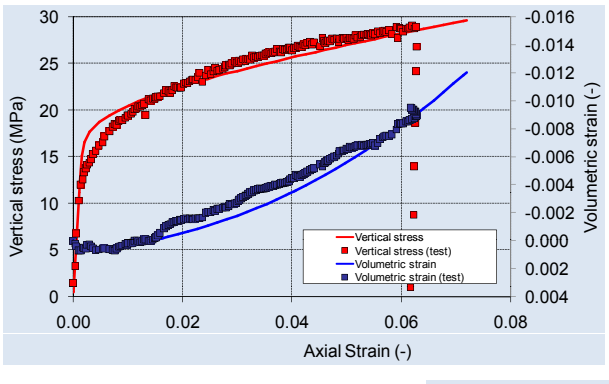
In order to increase the experimental data base regarding rock salt damage and dilatancy and to provide data for model validation, GRS performed combined damage and sealing tests on three salt samples in a triaxial apparatus with measurement of deformation and gas permeability under various stress conditions. Similar tests, but on higher permeable samples, were performed by BGR. The University of Utrecht as a contractor of NRG put great effort into the development of models describing the healing of damaged salt. This work is presented in Poster 45 by J. Hart et al.

Model calibration

The partners' different models were calibrated using laboratory data. Models are

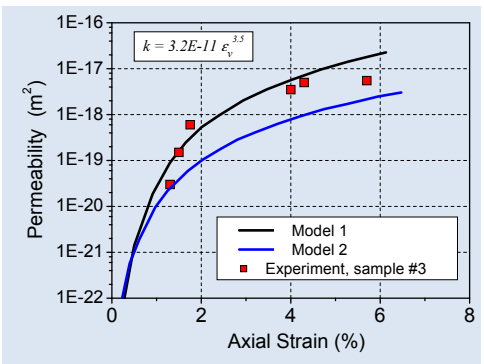
- A factorial stress dependent function for coupling deviatoric and volumetric strain (BGR)
- A modified Hein model (FZK, DBETEC)
- A modified viscoplastic law originally deve-loped for crushed salt (CIMNE, DBETEC)
- The Günther/Salzer constitutive law (IfG)
- The constitutive law of Hou/Lux with a porosity-permeability relation involving the minimum principal stress (TUC)

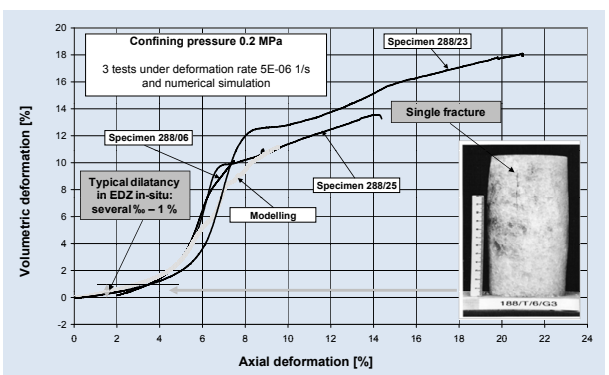
The codes used were JIFE (BGR), ADINA (FZK), FLAC^{3D} (DBE-TEC and TUC), CODE_BRIGHT (CIMNE), and FLAC (IfG).



Simulation of a triaxial test at 1MPa confining stress and $10^{-7}s^{-1}$ strain rate on a salt sample (CIMNE)

Permeability of the sample and calculated permeability evolution for two sets of material parameters (FZK)





Measurement results (thin lines) and numerical simulation (heavy line) of lab tests on rock salt dilatancy by IfG

Conclusions and future work

Most models have reached an advanced calibration state, but not all numerical and physical problems are solved yet. The different partners see improve-ment needs for

- Numerical robustness
- Volumetric strain evolution in the dilatant phase
- Coupling of permeability to mechanical state

The calibrated models have been applied to study the evolution of coupled thermo-hydro-mechanical phenomena in the laboratory benchmark test (Lecture of Heemann et al.). The long-term perme-ability evolution around an engineered barrier (a drift seal made of concrete) will be simulated and the consequences for the long-term safety of the repository will be assessed.

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