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A BENCHMARKING OF THE NUMERICAL APPROACHES FOR THE STRESS-DILATANCY-PERMEABILITY RELATIONSHIP IN EDZ OF ROCK SALT

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Abstract

Excavation in a geological repository for establishing a cavern to dispose the wastes results in deviatoric stress conditions due to the disturbance of the in-situ static stress equilibrium. For crystalline and salt rocks this deviatoric stress condition causes the opening of the discontinuities lying between the grains following an elastic compression. Previous studies indicate that the dilatancy boundary in which a transition from the compression to dilatancy takes place is a critical point for the opening and/or formation of the microcracks in a crystalline rock submitted to deviatoric stresses. The pore volume and permeability decrease firstly at the compression phase and take a minimum value at the dilatancy boundary. After the dilatancy boundary the permeability increases rapidly and reaches a characteristic value for the rock material studied under determined minimum stress components (confining-normal stress). After this value moderate increases can be observed with increasing deviatoric stresses. The prediction ability of the numerical attempts to couple this unconventional hydraulic behaviour to mechanical changes remained limited. Empirical formulations are mostly case specific and therefore not applicable for universal statements. The percolation theory seems to be appropriate for modelling the rapid increase of the permeability induced by the dilatancy that is a result of the changes at deviator.

This study offers an overview, evaluation and comparison of the numerical approaches for predicting the stress-dilatancy-permeability relationship in EDZ's of rock salt. The phenomenological description of the crack initiation is summarized based on recent studies. The prediction ability of some representative approaches are compared and the results are discussed.

Key words: Cavern Operation, Caverns for Waste Disposal, Rock Mechanics, Rock Salt and Potash Mining (Shaft), Salt Properties