521

NUMERICAL ANALYSES OF LINING SYSTEMS FOR A FUTURE GERMAN REPOSITORY IN CLAYSTONE BASED ON A TIME-DEPENDENT NON-LOCAL CONSTITUTIVE MODEL

TOPIC 10: Technological operations and performance assessment of components

P. Herold [1], E. Simo [1], M. Manica [2].
[1]Bge Technology Gmbh (Germany), [2]Institute Of Engineering, National Autonomous University Of Mexico (Mexico)

Abstract

The R&D project "Support of Underground Openings in a HLW/SF Repository in Claystone - AGEnT" was carried out jointly by BGE TECHNOLOGY GmbH (BGE TEC) and DMT GmbH & Co. KG (DMT). Within the project, fundamental information on the influence of the geotechnical conditions on the design, operation, and on support concepts and materials for a repository in German claystone formations was gained. DMT in parallel presents the parameter variations, geotechnical modelling as well as the formulations of suitable low-pH concrete. BGE TEC's work included the evaluation of the interaction of corrosion and mechanical properties during the post-closure phase as well as detailed numerical analyses of the HM-behaviour of a representative drift. This abstract focuses on the latter aspect.

A concrete-based support structure made of wedge blocks, combined with a compressible material in the extrados was identified as the preferred support structure. It is known that the specific configuration and extent of the excavation damaged zone (EDZ) depends on many factors such as the rock properties, the initial stress state, the geometry of the opening, the excavation method and duration as well as the characteristics of the support structure. Thus, a series of fully coupled hydro-mechanical finite element analyses of the main drift was prepared to address the time-dependent behaviour of the compressible grout. The work provides qualitative insights into the behaviour of the support structure and its interaction with the host rock.

The potential of the compressible grout to moderate the behaviour between the host rock and the lining was demonstrated. It can limit the load transferred to the lining and, therefore, can significantly reduce the internal forces in the concrete blocks. However, the latter causes further relaxation of the claystone resulting in a larger EDZ. Displacements in the ground are not controlled by the bulk deformation of the claystone but by the configuration of localised deformations, where areas enclosed by the shear bands tend to move as rigid blocks. If the magnitude of creep

deformations in the rock is large enough to exhaust the compression capacity of the grout, its stiffness will rapidly increase, in turn increasing the internal forces in the lining. Since the latter does not occur in all the grout simultaneously, load increases will tend to be anisotropic and can thus particularly increase shear forces and bending moments. If the repository design involves a compressible grout to limit deformations and internal forces in the lining, it should be guaranteed that the time-dependent deformation of the rock will not exhaust the compression capacity of the grout during its service life. Otherwise, the originally estimated internal forces can easily be exceeded. The time-dependent behaviour of the grout, which includes the increase of the yield pressure and the increase of the stiffness during hardening, brought about by the hydration processes of the binding agent, has a limited effect on the behaviour of the drift, mainly during the excavation process. However, the lower stiffness of the grout in such early stages can significantly increase its deformation and eventually exhaust its compression capacity.