THE CONSIDERATION OF THE LEACHING PHASE IN THE STUDY OF THE EVOLUTION OF GAS STORAGE CAVERNS IN ROCK SALT

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1 - PROBLEM OVERVIEW

When studying the stability and the evolution of underground structures (tunnels, storage cavities, mines, etc.), it is important to bear in mind the "memory-effect" behaviour (elastoplasticity, elastoviscoplasticity, etc.) of the rock surrounding the cavities. For this reason, we need accurate background data on the way the cavities were excavated. However, for the purposes of numerical simulation (using the finite element method, for instance), it proves highly inconvenient to model the actual excavation scenario: modelling (by mesh removal) is cumbersome to implement, penalizes computation time, and can jeopardize the accuracy of the numerical results. Instead of modelling the excavation scenario as such, it is therefore commonplace to implement a simpler process that considers the final shape of the underground structure, i.e. upon completion of excavation work.

The excavation phase is thus simulated in terms of appropriate background data describing the "external forces" acting on the cavity walls. These forces are accurately known both at the start of the excavation process (forces due to geostatic stress) and upon completion of the excavation process (forces applied at the start of the operational phase). However, we have no way of knowing how these forces progress as excavation work proceeds; indeed, to determine this, we would need to model the excavation process using the same cumbersome method that we initially sought to avoid.

In this paper we take a simple example (a spherical cavity excavated by dissolution in rocksalt) to show that the progression of the external forces acting on the cavity walls will depend on the progression in the cavity radius (dissolution law) and on the rheology of the rock being excavated (elasticity, rigid-viscoplasticity, elastoviscoplasticity). However, cavity behaviour during the operational phase can be accurately simulated by representing the dissolution phase in terms of a force that shows a linear response over time between the two limiting points, these two limit force values being necessarily known.