Solution Mining Research Institute Fall 2016 Technical Conference
Salzburg, Austria, 25 - 28 April 2016

Time-dependent behavior of rock salt - Improved approaches for Lab determination and modelling

Brückner, D., Günther, R.-M., and Salzer, K.

Institut für Gebirgsmechanik GmbH, Friederikenstraße 60, 04279 Leipzig, Germany

Abstract

Actual problems in the geotechnical design of underground openings such as high pressure gas storages require sophisticated constitutive models and consistent parameters for rock salt to facilitate reliable prognosis of stress-dependent deformation from the initial excavation to long times.

Fortunately, in the long term the response of the rock salt masses is governed by its steady state creep behaviour. However, because in experiments the time necessary to reach true steady creep rates can last long periods up to years, depending on stress and temperature conditions. Extensive experience in performing creep tests in connection with dimensioning of storage caverns resulted in new methods. Therefore, an innovative but simple creep testing approach can be suggested. Generally, this kind of tests focus on the determination of the secondary creep rate, a feature necessary for the prognosis of cavern convergence, surface subsidence and a long-term usability of the storage. With the new method we suggest a series of multi-step creep tests with loading and un-loading cycles allow a more reliable estimate of stationary creep rates in a reasonable time schedule. As a further method the relaxation test, i.e. a creep test under decreasing load will be introduced. The results of both methods are compared in order to extrapolate creep rates at low stresses or stresses established at low deformation rates.

Finally, the advanced material approaches with the visco-elastic core or the strain-hardening like developed at the IfG are used to describe all relevant deformation properties of rock salt, e.g. creep and relaxation. The capability of the combination of improved testing procedures and accompanied modelling is demonstrated by recalculating different test types at variable loading and temperature conditions. Thus reliable extrapolations relevant to in-situ creep rates (10^{-9} to 10^{-13} s^{-1}) become possible.

Key words: rock salt, rock mechanics, gas storage, salt caverns, cavern abandonment,