In Situ Testing for Rock Salt Characterization

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1 INTRODUCTION

Design of underground facilities requires reliable assessment of pertinent mechanical properties to predict salt behavior during development and storage operations and after wards whether the cavern is used for waste disposal or just permanently sealed and abandoned.

Designers have realized that a comprehensive site characterization is uniquely suitable to in situ testing because of the relatively localized volume affected by the cavity and because the lack of representativeness associated with typical samples tested in laboratory.

In fact, even if laboratory test samples appear often necessary and effective, therefore they are not sufficient because their "representativeness" don't cover the entire proper simulation of in situ structure, temperature and stress conditions, even because the large probability of serious sampling disturbance.
In situ testing enhances significantly the "representativeness" of the "samples" tested and also allows assessment of diverse mechanical properties, such as strength, short and long term (creep) compressibility and permeability of the host materials, with a single test.

Data collected during drilling (water losses, rate of penetration) and casing cementation (volume of cement) as well as during subsequent logging operations can provide valuable information regarding the stratigraphy of the overburden materials, their relative permeability and bulk ratios as well as their susceptibility to erosion. Evaluation of core samples taken at strategic elevation identified prior or during drilling can be effectively used to validate the information above. Salt cores also are taken to assess the grade of salt materials, the percentage of insolubles and the potential dissolution rates.

Tests can be performed in the well after cementation to obtain the mechanical properties of the salt mass. In-situ creep tests (Fernandez, 1983) can be performed at various levels of deviatoric stress by varying the internal well pressure in stages maintaining the pressure constant at each stage for appropriate periods of time, while the discharge in brine volume is measured at regular intervals.

In addition short-term increases in well pressure combined with measurement of corresponding changes in brine volume can be performed to evaluate the elastic properties of the salt mass, the tightness of the well and casing seat and to obtain a lower boundary value of in-situ stress ratios.

Large, short-term reductions of well pressure can also be carried out to approximate the dilatancy of the materials around the well.

Results obtained from additional in-situ characterizations, including seismic velocity measurements between wells can be used in combination with the data obtained from the wells to define a reliable stratigraphic model of the salt formation.

A discussion of the results of a series the in situ tests[1] carried out in Belvedere Spinello Brinefield to evaluate pertinent short and long term mechanical properties of the host rock is presented in this paper using the framework presented above.