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SUBSIDENCE AND FRACTURES CAUSED BY THERMO-MECHANICAL EFFECTS

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Summary

The purpose of this paper is to present the results of a comprehensive study on the interpretation of in situ measured thermally induced fracturing in a well instrumented mine shaft. The validated prediction model has been applied to solution mined caverns in order to calculate, to discuss and to assess the relevance of temperature effects.

The model computations on temperature induced fractures resulting from cold intake air fluxes were in sufficiently good agreement with the measured temperature and stress distribution in the rock. An orthogonal network of fractures developing with time has been calculated. Horizontal and vertical fractures with a spacing of about 2 - 3 m have been observed.

Computations on cavern convergence and surface subsidence have been carried out considering transient temperatures and thermal expansion. Compared to computations without taking into account these effects, the predictions resulted in lower cavern convergence but higher surface subsidence.

The computations on temperature induced fractures in a gas storage cavern in case of a blow-out accident resulted in rather promising output. Although the temperature decrease may be rather large, only a small range of the adjacent rock will be influenced. A dense fracture network has been calculated. The extension of fractures into the adjacent rock, however, is limited to the near cavern wall.

Introduction

Solution mining of salt has mainly replaced conventional salt mining in Europe. The volume of single caverns has reached extraordinary size. Caverns for the storage of fluids and gases also increase in size. Despite the grows of cavern use, only limited monitoring procedures are available for the safe design and economical development of these caverns. Therefore suitable and reliable prediction models for cavern stability, cavern convergence and surface subsidence are indispensable.

Cavern convergence and corresponding surface subsidence caused by creep behavior of rock salt is adequately well understood. This profound knowledge forms the basis for respective cavern design computations. Although it is known that the mechanical behavior of rock salt is very sensitive to temperature, temperature impact and coupled thermo-mechanical effects on the performance of solution-mined caverns are often still insufficiently investigated, rarely measured, and sometimes even neglected in model computations.

Problem