DESIGN CRITERIA FOR PREVENTION OF CREEP RUPTURE FOR GAS CAVERNS IN SALT ROCK MASS

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ABSTRACT: When dimensioning caverns in salt rock for compressed natural gas storage, the specification of the minimum permissible internal pressure during operation plays an important role. In addition to the absolute value of the minimum internal operation pressure, the pressure reduction rate and the times under these pressure conditions are crucial in terms of rock mechanics.

The pressure reduction rates influence the size of the stress concentrations in the peripheral cavern zone. After a constant minimum pressure is reached these stresses are redistributed into the rock mass due to the viscous properties of the rock salt, leaving only a residual stress level. The time under minimum pressure conditions produces relatively large strain rates within the rock zone surrounding the cavity. To prevent creep rupture occurences, such as spalling in the cavern wall zone, the time during which a deep rock salt cavern remains under low internal pressure must be limited.

The results of calculations based on the finite element method show the effect of the pressure reduction rates

and the depth range of the cavern on the specific time dependent parameters in the rock mass.

The criteria for the evaluation of the calculated stress and strain distributions are described and discussed, on the basis of examples, in terms of their influence on cavern design.

The results from the rock mechanical laboratory tests form the basis for determining the material parameters required to describe the time dependent deformation and strength properties of the rock salt encountered.