

Rock Mechanical Determination of the Maximum Internal Pressure for Gas Storage Caverns in Rock Salt

by

Reinhard Rokahr

Kurt Staudtmeister

Dirk Zander-Schiebenhöfer

Institut für Unterirdisches Bauen

Hannover University

Abstract

A new criterion for the determination of the maximum permissible internal pressure for gas storage caverns in rock salt has been developed on the background of the experience and scientific work of the past 20 years. The results of the research project, which was sponsored by the SMRI, demonstrate, that safety at maximum internal cavern pressure can be evaluated taking into account the various different influencing factors.

Safety at maximum internal cavern pressure state for gas storage caverns can be quantified by the criterion, that evaluates safety on the basis of a boundary condition for usability. The limiting state is equated to that point in time when the infiltration of the storage medium into the rock mass starts and can not be prevented from continuing. This is defined by a combined infiltration / safety criterion, describing the onset of infiltration qualitatively if the internal cavern pressure exceeds the level of one of the two components of the local stress state acting perpendicular to the spreading direction of the infiltration process. The quantitative measure is given by the minimum extent of a closed safety zone surrounding the cavern where the two stress components of the local stress state in the rock mass, that are acting perpendicular to the spreading direction of the secondary induced infiltration, exceed the internal cavern pressure by a certain level.

The paper presents the results of a sensitivity study for caverns in domal rock salt including the main influencing factors

- primary stress state (densities of the overlying rocks, depth of the cavern)
- the geometrical layout parameters (shape of cavern roof, height of the chimney between cavern roof and casing shoe)
- site location factors (pillar width)
- operating history conditions assuming a typical seasonal storage
- creep response of rock salt (material law and corresponding parameters)

on the rock mass state at maximum internal cavern pressure. The application of the criterion leads to a qualitative and quantitative measure for the specific state to evaluate. The main result is a classification of importance of the influencing factors with respect to safety at maximum pressure conditions.