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ANALYSIS OF THERMAL INDUCED FRACTURES IN ROCK SALT

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Abstract

During a withdrawal phase the temperature within a gas storage cavern decreases which can lead to stress states in tensile regions. The occurrence of tensile stresses in the zone close to the perimeter of the cavity is particularly important as part of the stress evaluation. The tensile strength of rock salt is relatively low compared to its compressive strength. If the tensile strength is exceeded, it is likely that discrete fractures will occur orthogonal to the direction of the tensile stress. If fractures of this kind are created – whether vertical or horizontal – the gas will penetrate the fracture at the relevant pressure and further extend the length of the fractures under certain circumstances. There are currently no theoretical approaches describing the manner in which the fractures might propagate into the not by temperature changes influenced rock salt mass during repeated cyclic pressure changes. This aspect is topic of prospective research.

Salt caverns cannot be entered but only explored by sonar measurements, with which it is not possible to detect tensile fractures at the cavern wall. In Germany, with the Gorleben shaft one suitable example exists where temperature changes caused horizontal tensile fractures in the surrounding rock salt. These fractures have been well mapped while the temperature development in the shaft is well documented.

Within this paper, recalculations of the temperature distributions in the shaft and the resulting stress state in the surrounding rock salt mass are carried out under consideration of different salt properties. The results and the consequences for the dimensioning of gas caverns for high frequency loading are going to be discussed and assessed.

Key words: rock mechanics, gas cavern design, cyclic loading