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Hengelo Brine Field:
'FE Analysis of Stability and Integrity of Inline Pillars'

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Abstract

The Hengelo Brine Field of Akzo Nobel Chemicals bv consists of about 200 caverns. Up to now, the total production amounts about 2.0 Mio. tons of salt. Actually, Akzo Nobel plans to expand the brine field south east from the existing field. In the new part of the field only single well caverns will be mined by solution mining. The new caverns will be arranged in rows with distinct main pillar widths to guarantee stability. BGR carried out FE calculations to determine the allowable minimum main pillar width between cavern rows as a function of cavern diameter and cavern height. For reasons of simplification two-dimensional FE models were developed considering only the main pillars between cavern rows and neglecting the inline pillars. In the 2D FE models an infinite number of parallel cavern rows were analyzed like brine filled 'drifts'. The results of this work were already presented at the SMRI Fall Meeting 2004 in Berlin, Germany (EICKEMEIER & PAAR & HEUSERMANN 2004).

In addition to the design of the main pillars, the tightness of the inline pillars had to be analyzed in case of cavern 'work over' operation. To this aim, different 3D models had to be developed considering different cavern diameters and different main pillar widths. The minimum inline pillar width was defined to be 20 m. During operation and 'work over' periods different specific weights of brines were considered in the FE calculations to simulate a fictive different degree of saturation of the brine in two adjacent caverns. During operation an over-pressure of 2 MPa in the caverns was assumed. During 'work over' periods no over-pressure in the affected cavern was considered. Stability of the inline pillar and integrity of the rock salt at the cavern contour were verified by checking the state of stress compared to the allowable stress intensity index η and by means of the frac criterion. The results show that especially the pressure build-up after several 'work-over' periods may lead to potential frac initiation into the rock salt at the wall, but not at the roof and the bottom of the cavern. This phenomenon of possible fracturing is only related to the contour of the caverns. It is not related to inline pillars and is independent of the width of the inline and main pillars.