

ABSTRACT

FRISIA extracts salt from the deepest salt mine in the world at a depth between 2500-3000 meters. Near the processing plant in the province of Fryslân (Friesland) in The Netherlands the salt layers can only be found at this depth. The processing vacuum plant is favourably situated from a logistics point of view. Solution Mining from such depths is unique regarding aspects of leaching operations, cavern behaviour and well maintenance.

The in-situ salt temperature is over 100 °C due to the large depth and the cavern brine-hydrostatic pressure is some 270 bars below the lithostatic pressure. As a result, the salt has a strong tendency to flow towards the cavern, resulting in a full balance between cavern convergence and dissolution rates. At an extraction rate of about 0,5 mio tons per year per cavern the cavern volume remains constant at about 300,000 m³, only mildly shape shifting during production. The governmentally imposed limit on the cavern diameter will never be reached due to this convergence. Only build up of insolubles in the sump and subsidence effects at the surface limit the production lifetime of a single cavern.

Well maintenance requires special attention, since the pressure build up after shut in is high. Operations require either high pressure equipment (used in the gas and oil industry) or a sophisticated “killing” (outflow suppression) of the well. By applying a high-density mud in the well, the cavern pressure is insufficient to eject the mud column within a certain period of time. Since the heavy mud has to float on brine, special care is taken to prevent the density driven exchange of mud and brine.

The present rate of subsidence amounts to about 4 cm per year, correlating to the rate of extraction and the convergence of two caverns, which are only 500 m apart. A smooth bowl of Gaussian shape is the result, with 21 cm subsidence at the deepest point (latest levelling survey of 9-2001). Frisia is presently planning to drill two additional wells at larger distance from each other and from the present wells, to be able to distribute the subsidence over a larger area. This will increase the possible salt extraction capacity from a single cavern since subsidence is limited by permit. Since surface-water management and salt-water migration from the sea through shallow strata are important local issues, the magnitude of final subsidence is a strongly debated issue. The subsidence in the old concession area will be limited to 35 cm.