Solution Mining Research Institute Fall 2011 Technical Conference

York, United Kingdom, 3–4 October 2011

GEOMECHANICAL PARAMETRIC STUDIES FOR A PROPANE STORAGE CAVERN IN NORTH TEES SALT FIELD IN THE UK

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Abstract

A series of numerical parametric studies were carried for Cavern 99 in the North Tees site, which is currently operated by SABIC UK Petrochemicals as a wet storage facility for propane, by implementing appropriate numerical analysis techniques to investigate the relevant factors that govern its long term geomechanical stability. The primary goal of the undertaken geomechanical modelling was to investigate, the potential of tensile failure at the roof of Cavern 99.

The geological conditions in the North Tees salt field, around the estuary area of the river Tees, are typified by the Boulby Halite which, due to tectonic faulting, is found locally at a depth of approximately 340 m and varies in thickness between 30 m and 45 m. Glacial Drift cover consists of sand and boulder and the underlying Triassic Sherwood Sandstone is overlying the Roxby Formation marls and the Sherburn Anhydrite which is underlain by the Rotten Marl.

The first stage of the applied parametric studies investigated the reduction and increase of the magnitude of the geomechanical properties of Sherburn Anhydrite, Rotten Marl and Boulby Halite, by introducing a ±40% change for Young's modulus and tensile strength and ±25% change for Poisson's ratio. In the second stage of the parametric studies, a series of incremental analyses were undertaken to determine the height of the brine column capable of introducing the onset of tensile stresses at the roof of Cavern 99.

The conclusion derived from the first stage of the parametric studies was that the investigated increase or reduction of the geomechanical properties (i.e. Young's modulus, tensile strength and Poisson's ratio) of the relevant geological materials had no identifiable influence in the least compressive stresses at the roof of Cavern 99 (i.e. the stresses capable of inducing tensile failure at the cavern roof). Furthermore, the second stage of the parametric studies has shown that as the height of the brine column (measured from the roof of the cavern) increases, the calculated tensile stresses at the roof of Cavern 99 were proportionally reduced. It was also possible to identify the threshold limit of the brine column above which no tensile stresses could develop at the roof of the cavern.

Key words: Bedded Salt Deposits, Cavern Design, Caverns for Gas Storage, Computer Modelling, Rock Mechanics, United Kingdom.