

INVESTIGATIONS INTO THE GEOMECHANICAL RESPONSE OF A PROPANE STORAGE CAVERN REGARDING ITS ANTICIPATED TIME-DEPENDENT GROWTH

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Abstract

The purpose of this paper is to present the results of the detailed geomechanical analysis of a cluster of salt caverns in the North Tees site, which are currently operated by SABIC UK Petrochemicals as a storage facility that functions by employing a brine displacement process.

The goal of the geomechanical studies undertaken was to investigate the anticipated growth of a propane storage cavern, regarding its structural interaction with the adjacent caverns concerning the potential loss of integrity of the cavern and the likelihood of ground subsidence at the surface.

To assess the geomechanical stability of the investigated salt caverns the geological structures were numerically modelled by employing a three-dimensional finite difference analysis. The geological materials that exhibit creep were modelled by employing a combination of the Norton power creep law and the Mohr-Coulomb elasto-plastic model. The shear strength characteristics of the remaining encountered geological materials were replicated by employing the Mohr-Coulomb elasto-plastic model.

Examination of the identified distribution of the stress concentrations at the roof of the caverns and the vertical cross sections, that correspond to the shortest distances between adjacent caverns, indicated that as long as the caverns are kept at halmostatic pressure no failure occurs in the ZG3 Boulby Halite which surrounds the caverns or in the layer of the ZG4 Carnallitic Marl which is situated above the caverns' roof.

Furthermore, the ground subsidence anticipated to develop above the investigated caverns, over a period of 50 years, was modelled by using the Salt_Subsid software. Examination of the three-dimensional distribution of the vertical displacements indicated that the subsidence predicted to occur in 50 years is practically negligible.

Key words: Caverns for Gas Storage, Computer Modelling, Rock Mechanics, Subsidence, United Kingdom