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Understanding and Monitoring of Cavern Migration in the Hengelo Cavern Field, the Netherlands

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Abstract

The Hengelo Cavern Field has been developed in five phases with increasing technical knowledge and higher safety standards.

Most of the 42 caverns in phase 1 (drilled between 1933 and 1958) migrated, in five cases leading to significant surface subsidence. Currently AkzoNobel prepares abandonment of the last open wells in the phase 1 area. In order to prove long term safety after closure, the caverns were examined, simulated, reconstructed, and modelled. By analysing the available data and scrutinizing a few caverns where extensive migration occurred, the cavern migration behaviour and its influential parameters were identified. This paper clarifies how the caverns have been reconstructed and how the maximum potential migration is determined with the model.

During the phase 1 development some of the wells were positioned close to each other, intentionally allowing interconnections. The motive was to complete these wells as doublets, while the other wells were designed as single completion caverns. Despite these intentions, the leaching during this phase was performed in a less controlled manner compared to current best practice. The majority of the caverns in the phase 1 area established unintentional connections after which leaching continued from the connected caverns. Due to this lack of control over mining occurred at most of these caverns. As a result most of the caverns have migrated upwards through the overburden.

Since the amount of measured data about the phase 1 caverns is scarce, the caverns needed to be reconstructed to allow a comprehensive analysis. In order to reconstruct the cavern development and final dimensions, the caverns were simulated based on their historical production, on interpretations of the geology and on data from logbooks. After cross-correlating the dimensions with the available data, the dimensions are used in an analytical model. Considering multiple influential parameters the post-production 'residual' volume and dimensions of the caverns were deduced. Thereafter, the maximum potential migration was determined using a migration model.

By using the remaining open phase 1 boreholes to extract more data, the migration model can be developed further. When completed, the model will be used to predict possible future migration in the phase 2 area of the cavern field, where potentially instable and not intrinsically safe caverns occur.

Key words: cavern migration, cavern simulations, reconstruction, migration modelling, subsidence.