Solution Mining Research Institute Fall 2017 Technical Conference
Münster, Germany, 25 - 26 September 2017

Subsidence Modelling for the Zuidwending Cavern Field

Dr. Dirk Zander-Schiebenhöfer
KBB Underground Technologies, Baumschulenallee 16, Hanover, Germany

Patrick J.P. Roordink
N.V. Nederlandse Gasunie, P.O. Box 19, 9700 MA Groningen, The Netherlands

Sebastiaan Robertus
Akzo Nobel Industrial Chemicals B.V., P.O. Box 25, 7550 GC Hengelo, The Netherlands

Abstract

Subsidence is a sensitive issue in The Netherlands, because the ground elevation is low and water management is a challenging task. Therefore, subsidence induced by mining has to be thoroughly monitored, checked and predicted.

In the Zuidwending area AkzoNobel and Gasunie are operating salt caverns that are located in the Zuidwending salt dome. While AkzoNobel produces brine out of the caverns, Gasunie uses caverns for gas storage. Beside the fact that subsidence monitoring is mandatory, the individual share of the gas caverns on the overall subsidence is limited. Furthermore, gas production from the Groningen gas field also influences surface subsidence in the Zuidwending area.

Therefore, Gasunie and AkzoNobel needed a subsidence model that provides the capability to differentiate the contribution of the individual caverns/cavern types to the overall observed subsidence.

The established model incorporates the state of the art in subsidence modelling (e.g. SMRI's SaltSubsid software, EICKEMEIER's and SROKA/SCHOBER's approach on subsidence modelling). Additionally it provides some special features in order to match with the field conditions. These are:

- determination of the growth of the brine production by mass balancing based on production data,
- calculation of the cavern convergence volume based on daily cavern pressure values while applying an analytic creep formula of the Norton/Hoff creep law,
- consideration of the cavern field development over time,
- verification of the subsurface part of the model by history matching of the cavern development of every cavern individually based on sonar measurements (matching of cavern volume development over time),
- applying a time dependent concept for the angle of draw,
- verification of the surface part of the model on surface measurements (levelling, GPS) and their interpretation (history matching at benchmarks).

By history matching – first at subsurface and afterwards on surface – two independent verification levels were established. As observations from the measurements contain further contributions to subsidence, such as due to gas production, water management or ground compaction, these contributions had to be evaluated, before finally the modelled results for cavern induced subsidence could be checked against surface measurements.

The described stages of model verification enabled a satisfactorily match of the model with the observations and measurements.

The following subsidence prediction for the expected lifetime of the caverns clearly showed that over the intended lifetime of the gas storage caverns the produced subsidence will stay within permitted limitations.

Key words: subsidence modelling and prognosis, different cavern types with changing cavern operations, history matching, and interpretation of surface levelling data.