Solution Mining Research Institute Spring 2023 Technical Conference

Detroit, Michigan, USA, 24-25 April 2023

Experiences from the first H2-MITs in Northern Europe Review of design, operational experience and results

René Buzogany and Ingo Meinecke

DEEP.KBB GmbH, Hannover, Germany

Abstract

In the course of the energy transition, the development of storage facilities for hydrogen is crucial in order to ensure security of supply. Hydrogen storage in salt caverns has been intensively researched and has been identified as a promising solution. Recently, the implementation of different pilot projects for underground hydrogen storage in Northern Europe has been launched.

In one of the aforementioned projects - the first demonstration project HyStock in the Netherlands - N.V. Nederlandse Gasunie (Gasunie) developed together with DEEP.KBB GmbH (DEEP.KBB) a strategy and procedure to test the cavern borehole ZWA8A at the location of Gasunie's subsidiary EnergyStock in Zuidwending, The Netherlands, with regard to related system requirements as well as safety aspects concerning hydrogen storage operation.

The aim of the second pilot project H2CAST-Ready at the STORAG ETZEL site in Germany is to develop a demonstration plant for the underground storage of hydrogen at large scale. Two salt caverns at the Etzel site, which were previously intended for natural gas storage, shall be converted for hydrogen storage for testing purposes. This is accomplished by the operator STORAG ETZEL in a consortium with GASUNIE Energy Development, Hartmann Valves, SOCON, DLR, Technical University of Clausthal and DEEP.KBB.

An elementary part of the testing process of a cavern system with regard to the storage of hydrogen is the proof of borehole tightness and hence its integrity. In both demonstration projects, a two-step-procedure consisting of first a mechanical integrity test (MIT) with nitrogen and a second test with hydrogen was applied.

The two-step execution of the integrity test was chosen mainly for two reasons: Firstly, for safety reasons, the tightness of the storage system should first be tested with an inert gas to minimize risks in case of leakage. Furthermore, a subsequent measurement with the later storage medium hydrogen creates comparability between the two tests. In this way, valuable findings can be obtained as to whether the results of a nitrogen test can in principle be transferred to hydrogen storage. This is also important with regard to the conversion of natural gas caverns, whose tightness has already been confirmed with a nitrogen test.

This "combined MIT" (coMIT) approach was successfully executed on a completed borehole in The Netherlands and on a full-scale cavern in Germany. Both wells were initially planned for natural gas storage. The comparison of the operational framework conditions and results of the tests on the two independent wells provides valuable insights for future hydrogen applications and will also help to assess at an early stage how promising it will be to convert existing natural gas storage caverns to hydrogen storage.

Therefore, the design parameters, the gathered operational experience and the MIT results are discussed within this paper with the aim to provide first insights for the basis and development of a standard procedure and acceptance criteria for mechanical tightness tests of hydrogen storage caverns especially with regard to the transferability of the standard test with nitrogen.

Key words: Salt Cavern, Storage Cavern, Hydrogen, mechanical integrity test (MIT), HyStock, H2CAST