Solution Mining Research Institute Fall 2021 Technical Conference

19 – 22 April 2021

The Geological Barrier – A Key Component of a Comprehensive Integrity Assessment

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Abstract

Salt cavern facilities for various purposes have been operated in many countries for several decades. In order to maintain the integrity and functionality of these facilities, appropriate measures have already been taken in the past; hence the aim to maintain a safe storage operation is not new to the cavern industry. Nevertheless, the long-term integrity of an underground storage or solution mining facility is a key factor, since it has a major impact on operational safety and economic viability. For those reasons, the integrity assessment of the technical equipment of wells is standard. On the other hand, however, there is no comparable systematic approach to the assessment of the integrity of geological formations acting as barrier elements.

The entire system needs to maintain its integrity throughout the operational lifecycle and beyond - this applies in particular to the underground barriers. Furthermore, integrity requirements of the barrier can change over time if the usage of the storage is changed (e.g. hydrogen storage). Therefore, an integrity assessment should not only be limited to the borehole and its technical installations, but should also include the cavern(s) itself and the surrounding formation.

In this paper, a systematic approach for assessing the barrier function of geological formations will be presented. On the first level, two main categories were defined for the barrier assessment of the geological formation: “geological barrier” (storage formation) and “secondary geological barrier” (e.g. overburden sequence). The category “geological barrier” is subdivided into four different influencing factors which in each case are subdivided into a further assessment level in which different characteristics are assessed regarding their impact on the geological barrier.

The final evaluation of the two main categories (geological barrier and secondary geological barrier) can be used in order to identify recommendations for actions to improve the storage integrity or to identify weaknesses in the barrier system.

Finally, the result of the assessment of the geological barrier system can be combined with the integrity assessment of the borehole, which would result in an overall comprehensive integrity assessment of the salt cavern facility. Such an overall assessment provides a very convenient planning basis for the final abandonment phase or for potential conversions of a cavern, specifically with regard to hydrogen storage.

Key words: salt cavern, storage integrity, integrity assessment, geological barrier