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Abstract

Salt caverns have a unique property among large scale storages: their tightness can be accurately tested. This stems from the invention of the so-called Nitrogen / brine interface “Mechanical Integrity Test”, developed in the US in the 1980s and that has since then imposed itself globally throughout the cavern storage industry, even if the practice and acceptance criteria still remains largely country and/or company-specific. To test the tightness of Hydrogen storage caverns, recent pilots HyStock (done in 2022), HyPSTER (2021-2024) and H2CAST (2022-2023) have all opted for first Nitrogen and then Hydrogen – brine interface tests while there is no technical obvious reason why a “standard” single Nitrogen test would not fit, as it does for a Methane cavern. It is likely due to the fact that MIT acceptance is largely experience-based which cannot be as strong for Hydrogen caverns, being only 6 caverns in a total of 2000 storage salt caverns. Available information from these pilots found no leak, whether it is with Nitrogen or Hydrogen. In order to assess the behavior in case of a leak, synthetic ones are assumed and modeled in this work. It aims to study the influence of the type of gas (Methane, Nitrogen and Hydrogen) on a leakage through the cementation of a casing by modeling the leak paths using three different approaches. The final objective is to compare leakage behavior with Methane, Hydrogen and Nitrogen, to support the standardization of testing protocols for Hydrogen caverns.

Key words: Mechanical Integrity Test, Hydrogen, Leak Path, Micro annulus, Salt Caverns