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A High-Level Review of Microbial Activity in Salt Caverns

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Abstract

Industrial and government groups throughout the world have shown interest in hydrogen storage as they are aligning themselves to transition from a fossil fuel-powered economy to a hydrogen economy. Although hydrocarbons have been successfully stored in salt caverns for over many decades, storing hydrogen brings new challenges, such as microbial activity. Compared to hydrocarbons, hydrogen is more susceptible to microbial growth as it provides an easy source of electrons for biological and chemical reactions. Microbial activity has the potential to impact storage performance and result in asset loss through hydrogen loss, hydrogen sulfide formation, methane formation, and corrosion. Therefore, before siting and developing a large-scale hydrogen storage project, the potential for microbial activity to occur needs to be assessed for every salt cavern site.

Depending on the environment, there can be a few species that can grow and pose a threat to storage operations. Bacteria that use the metabolic pathways of acetogenesis, methanogenesis, and sulfate reduction constitute the greatest concern when storing hydrogen. Parameters that affect the variety and growth rate of bacterial species present in the cavern ecosystem include temperature, salinity, and pH. But unlike hydrogen storage in underground reservoirs, salinity and pH should not pose any microbial activity issue in salt caverns because the brine is close to fully saturated. Temperature is the dominant factor in analyzing microbial growth and affects the maximum rate of growth of a microbe.

Generally, temperatures above 55 °C are preferred to minimize microbial activity. Temperatures outside the range of enzymatic activity for a microbe can either halt growth or kill the microbe outright. In this paper, the authors comment on the parameters that have the largest impact on microbial activity in salt caverns and provide examples of the locations in North America where microbial activity can be expected.

Keywords: Microbial activity; hydrogen storage; salt caverns; energy storage; hydrogen economy