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# Microbiological impacts of hydrogen injection into underground storages

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As the integration of wind and solar energy increases, so does the need for large-volume and efficient storage to balance fluctuations in power generation and demand.

In order to meet this demand, the proportional injection of renewable hydrogen into the natural gas grid or directly into underground storage facilities (UGS) is already being investigated in several pilot studies. Large-scale hydrogen storage, especially in salt caverns, is considered to have great potential in the context of carbon-free energy supply. From microbiological studies of numerous cavern and porous storage facilities, it is known that most UGS are already colonized with microorganisms that can use hydrogen as their sole energy source.

The results of several research projects and analyses of numerous underground storage facilities with regard to the stimulation potential of existing microorganisms give clear indications of associated risks. The results of these studies also contradict the widespread assumption that saturated brine in caverns generally provides sufficient protection against microbial colonization.

Long-term analyses with over 70 active cultures enriched from different underground storage and reservoir samples and tests with original formation waters show significant hydrogen consumption even in saturated brine with simultaneous $H_2S$ formation by SRB. Carbonates from the minerals of the rock matrix can be used as a necessary carbon source. For a practical simulation of hydrogen storage, in addition to microcosm experiments, numerous high-pressure tests were carried out at storage-relevant conditions over several months with original brine and core samples from different storage types. In some cases, considerable hydrogen conversions and sulfide formation rates were found.

In addition to the influence of hydrogen injection on microorganisms in storage facilities, two projects are also investigating dedicated biological methanogenesis in 11 porous UGS. Presence of microorganisms was detected in almost all reservoirs. Active methanogenic archaea were enriched from three facilities and their ability for methanogenesis was studied and confirmed under different conditions (pressure, temperature, salinity). However, microorganisms with competing metabolic pathways were also detected (e.g. sulfate reducers and acetogens).

The presentation summarizes the results of microbiological investigations on storage and reservoir samples from more than 10 years and gives an overview of relevant microbial processes

and their potential impact on technical operations.