School of Energy Resources
Hydrogen Energy Research Center

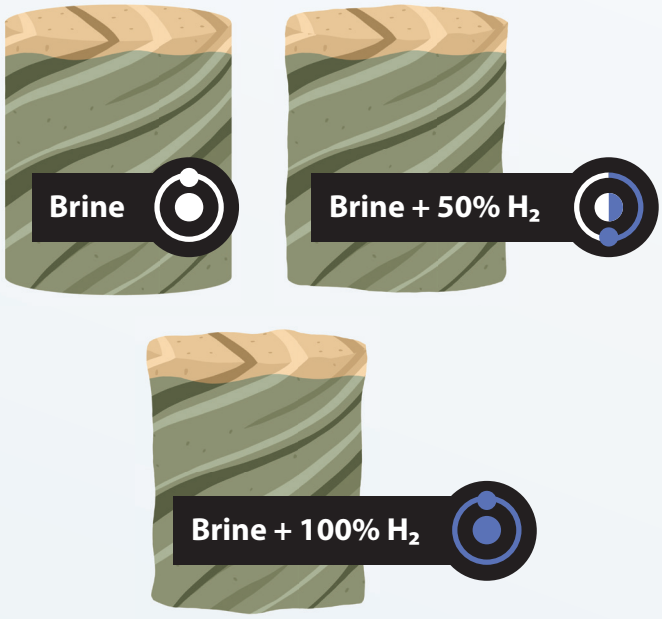
Experimental Study on the

Effect of Hydrogen on the Mechanical Properties of Hulett Sandstone

What This Study Was About

This study investigated the effect of hydrogen treatment on the mechanical properties of sandstone samples from Hulett member of Sundance Formation, a potential underground hydrogen storage host in Wyoming, USA.

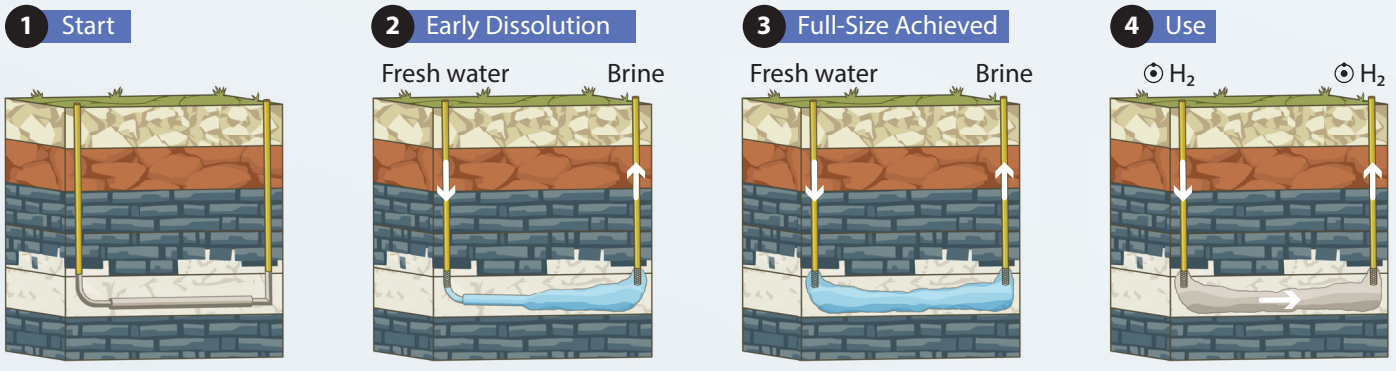
How it was conducted: Cylindrical specimens were treated with brine, brine + 50% H_2, and brine + 100% H_2 for two weeks at a pressure of 15 MPa and a temperature of 83 °C. X-ray diffraction (XRD), scanning electron microscope (SEM), Brunauer-Emmett-Teller (BET), uniaxial compression, and triaxial compression tests were conducted on specimens.



Why This Study Was Needed

Hydrogen and hydrogen-based fuels could offer potential solutions to meet the projected increase in energy demand and consumption. However, as an important surplus energy, hydrogen needs to be stored for later use. Geological storage is an efficient and low-cost option for storing large volumes of hydrogen. Among the geological storage options, saline aquifers are considered the most cost-effective for underground hydrogen storage (UHS).

Hydrogen Storage



One of the challenges of storing hydrogen in saline aquifers is the possible geochemical reactions between host rock, formation solution, and hydrogen. Ensuring that the high stability and integrity of the storage formation is preserved following any geochemical interactions is an important safety consideration for long-term hydrogen storage and cycling.

What the Researchers Found

Overall, the researchers concluded that with increased volumes of hydrogen, there was a higher frequency of geochemical interactions, and a reduction in rock strength.

Observed results shows

Hydrogen-treated specimens showed an increase in pore space, and pores with larger volumes and smoother surfaces

Specimens treated with 50% H_2 and 100% H_2 show 31% and 80% smaller maximum volumetric strains than that of the specimen treated with 0% H_2

Hydrogen treatment resulted in a reduction of dolomite and clay minerals in the rocks

At higher principal stress (Pd), the effect of hydrogen on the peak strength of specimens is more pronounced

The specimens treated with hydrogen show more ductile behavior than the specimens treated with 0%H_2

What Does This Mean?

This pioneering study investigating the effects of hydrogen's interaction with saline solutions and host rocks, will aid future researchers in understanding the interrelated nature of geochemistry and a rock's mechanical strength, and help with identifying the optimal conditions for UHS.

To learn more about the testing and results, read the full study.

Read The Study
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