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Experimental study of the contact angle of hydrogen-brine-rock for subsurface energy storage

Friday, 4 June 2021 14:30 (15 minutes)

Feasibility of underground hydrogen storage (UHS) as a promising large-scale energy storage has become an attractive subject in recent years. Geological formation such as aquifers, depleted oil and gas reservoirs and salt caverns provide giant capacities for hydrogen storage. Compared with salt caverns, geological porous rock reservoirs (including aquifers and depleted hydrocarbon reservoirs) provide much larger volumes. However, successful utilisation of porous reservoirs for hydrogen storage depends on accurate characterisation of hydrogen transport at pore-scale which is to a large extend unknown. The pore-scale characteristics, such as contact angle, play crucial role in determining upscaled parameters such as relative permeability and capillary pressure curves. These functions will be then used to perform modelling and optimisation at reservoir scale. In this study, for the first time, we characterise the contact angle of hydrogen in contact with brine and subsurface geological rocks at pore scale. We utilise a captive bubble method, which allows for controlled-injection of hydrogen at a given pressure and temperature; to form accurate bubbles in a fully saturated environment. The experiments are conducted in a hydrogen-brine-sandstone system close to UHS in-situ conditions. More precisely, pressure is changed between 0 –100 bars and temperature between 20 –50 ℃. Also, an axisymmetric drop shape analysis-profile (ADSA-P) method is used to measure contact angles. First, we validate the setup for the published results in the literature for N2 gas, and then introduce H2 and report the accurate contact angles along with quantified errors and uncertainty range. The study is the first of its kind and will result in accurate Kr and Pc curve definitions for reservoir-scale analyses of hydrogen storage in subsurface formations.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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