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Pore-Scale Modelling of Hydrogen Transport in Porous Media

Tuesday, 31 May 2022 09:20 (1h 10m)

Hydrogen energy has enormous potential for playing an important role as a clean fuel in energy transition. We have studied hydrogen transport in a sandstone porous media pre-saturated with brine at pore scale. Volume of fluid method was used to study the transport of hydrogen in sandstone porous media under different wetting conditions. The main purpose of this study is to determine the effect of sandstone wettability on hydrogen transport process. Based on the hydrogen-brine-quartz contact angle data measured by Stefan et al. under different conditions, the fluids properties of this study were determined and the contact angle hysteresis were considered. Then, based on these parameters, we simulated the hydrogen storage and extraction processes during underground hydrogen storage, and the distribution, transport behavior and storage/extraction efficiency of hydrogen in porous media under different wetting conditions were investigated comprehensively. The results have showed that sandstone ensures safe storage of hydrogen in underground porous media. However, under the hydrophilic condition and extremely low capillary number (CA<90°, Ca<10-5), hydrogen clusters stored in sandstone with saturated brine cannot be mobilized efficiently, and extraction of hydrogen by injecting brine will result in significant high residual hydrogen saturation. The critical capillary number for mobilizing trapping hydrogen should be kept above the 10-5~10-4 to ensure the successful extraction of hydrogen.The extraction efficiency of hydrogen can be improved by injecting some gas with stronger wettability to the wall, such as nitrogen. Therefore, study suggested that hydrogen storage in sandstone porous media can ensure the safe storage of hydrogen. However, how to effectively reduce the residual hydrogen saturation during hydrogen extraction is the key to the effective implementation of this measure.

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References

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

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