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Impact of capillary pressure hysteresis on Underground Hydrogen Storage

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The decarbonization of energy mainly requires the substitution of fossil fuels with low-carbon alternatives. Heavy industries require high-temperature heat that cannot be supplied through electricity. Moreover, the production of renewable electricity requires a storage medium to compensate for their intermittent behaviour. Hydrogen is a favorable medium for storing the excess low-carbon electricity and can accommodate the high temperature requirements. Subsurface hydrogen storage provides the mean to safely store and re-use the hydrogen gas. A successful storage project requires accurate modeling of the hydrogen movement and the extent of its loss.
Flow of hydrogen in porous media containing water is affected by hysteresis in flow properties, mainly relative permeability and capillary pressure. This hysteretic behaviour is a consequence of changes in contact angle and capillary trapping of non-wetting phase in porous media. As a result, the amount of hydrogen trapped in underground increases overtime, causing significant hydrogen loss. Most of the available literature have only considered the hysteresis in relative permeability and have not studied the path dependency of capillary pressure. Moreover, studies focused on the impact of hysteresis on hydrogen storage and hydrogen loss due to trapping is still scarce.
The overall aim of this study is to model the hysteresis effect during the two-phase flow of hydrogen-brine. The outstanding contribution of this work would be considering the capillary pressure hysteric behaviour through generating the full scanning curves during the injection/production cycles for each grid cell. At the next stage, we will look into the relative permeability hysteresis to investigate their individual and mixed influence on the hydrogen trapping in subsurface. Finally, we aim to perform a sensitivity analysis on the controlling parameters (rates, shut-ins and so on) to derive the most optimized scenarios for a successful storage operation. Due to the cyclic nature of the system, we speculate hydrogen loss because of increased trapped hydrogen during the consecutive cycles. We also expect the capillary pressure to be a less contributing parameter compared to relative permeability as the field-scale nature of the system is less affected by capillarity [1].

Participation

In-Person

References

1. Juanes R, Spiteri EJ, Orr Jr FM, Blunt MJ. Impact of relative permeability hysteresis on geological CO2 storage. Water resources research. 2006 Dec;42(12).

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