Contribution ID: **400** Type: **Oral Presentation**

Evaluation of Relative Diffusivity of Hydrogen-Methane System for Underground Hydrogen Storage in a Depleted Gas Reservoir Using a Novel Pore-Scale Reactive Transport Model

Thursday, 16 May 2024 09:50 (15 minutes)

The depleted gas reservoir is considered as one of attractive ways for underground hydrogen storage (UHS). However, due to the chemical reaction during UHS, the diffusion coefficient of the H2-CH4 binary system is more difficult to evaluate. The objective of this paper is to establish a novel pore network model merging H2 reactive transport to evaluate the relative diffusivity of the H2-CH4 system for UHS in depleted gas reservoirs. Firstly, a stochastic pore network model was constructed based on the pore-throat diameter distribution of a depleted gas reservoir. Then, the concentration and rate functions were defined in the pore network model, in which the diffusion transport through porous media was expressed by the Fick's law. And a power-law chemical reaction equation for H2-rock was added as the source term. Finally, the curve of the relative diffusion coefficient vs. hydrogen concentration of the H2-CH4 binary system was obtained by solving the governing equations, which could be used to determine the impacts of diffusion during UHS in depleted gas reservoirs. The results show that the diffusion coefficient of the H2-CH4 system is related to H2 concentration, porosity, pressure, etc. The H2 diffusion coefficient is proportional to H2 concentration and pore-throat size but inversely proportional to pressure. The diffusion coefficient under low pressure is about 20 times that under high pressure. Under the temperature of 40℃ and the porosity of 0.247, the effective diffusion coefficient decreases from 2.4×10-7m2/s to 6.03×10-8m2/s when the pressure increases from 5MPa to 20MPa. Under the temperature of 40 ℃ and the pressure of 10MPa, the effective diffusion coefficient increases from 3.7×10-8m2/s to 1.21×10-7m2/s when the porosity increases from 0.2 to 0.32. Furthermore, under the temperature of 40℃, the porosity of 0.247 and the pressure of 10MPa, the H2 effective diffusion coefficient is about 5×10-9m2/s when the H2 concentration is 0.4, while the effective diffusion coefficient increases to 4×10-8m2/s when the H2 concentration is 0.6. In addition, considering the CH4 creation by the chemical reaction of H2, the H2 effective diffusion coefficient decreased due to the decreasing of H2 concentration and the increasing of CH4 concentration.
A novel pore network model merging H2 reactive transport was proposed in this paper to evaluate the relative diffusion coefficient of the H2-CH4 system during UHS in depleted gas reservoirs. The methodology could provide a reference for UHS in depleted gas reservoirs.

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

Country

China

Porous Media & Biology Focused Abstracts

This abstract is related to Porous Media & Biology

References

Conference Proceedings

I am not interested in having my paper published in the proceedings

Primary author: ZHANG, Qiuyue

Co-authors: Mr CAO, Renyi; Mr JIA, Zhihao

Presenter: ZHANG, Qiuyue

Session Classification: MS12

Track Classification: (MS12) Advances in computational and experimental poromechanics