Contribution ID: **411** Type: **Poster Presentation**

Numerical study on the enhanced oil recovery by CO2 injection and CO2 storage in shale oil formations

Wednesday, 15 May 2024 16:10 (1h 30m)

A larger part of oil in shale formations in Sichuan Basin, China, is volatile oil, which has greater movability compared with other types of oil. However, the production practice showed that the oil production rate declined significantly at the primary production stage (produced by depletion). Therefore, measures of enhanced oil recovery (EOR) should be implemented to acheive effective shale oil production. Carbon dioxide (CO2) huff ‘n’puff has been widely used to improve the recovery efficiency of shale oil. Meanwhile, CO2 storage can be acheived by injecting CO2 in shale oil formations. In this study, a field-scale numerical model was established based on the real geological conditions and formation properties of the Sichuan Basin, China, and the model was validated by history match of shale oil production data. Molecular diffusion of CO2, confinement of nanopores, adsorption of CO2, and solubility of CO2 in water were considered in the numerical model. Effects of injection rate and time, time span of soaking, number of huff ‘n’puff cycles on the shale oil production were investigated by sensitivity analysis. Results showed that the molecular diffusion of CO2 and confinement of nanopores helps to increase the efficiency of huff ‘n’puff of CO2, The adsorption of CO2 on the surface of nanopores and the dissolution of CO2 in water and oil contribute to increase the amount of CO2 storage in shale oil formations. In addition, the earlier injection of CO2 leads to higher oil recovery, and five cycle CO2 huff ‘n’puff can enhance the oil recovery by 11.67%, with 40% of the injected CO2 stored in shale oil formations .When the time span of CO2 soaking time exceeds 30 days, the increase oil producution is not significant. This work provides an important guidence for the effective EOR of volatile oil by CO2 huff ‘n’puff in shale oil formations..
Keywords : Shale oil formations, CO2 huff ‘n’Puff, EOR of volatile oil, CO2 storage, numerical simulations.

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Session Classification: Poster

Track Classification: (MS01) Porous Media for a Green World: Energy & Climate