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The Impact of Gas Impurities on CO_2 Storage in Depleted Oil Field with Carbonate Reservoirs

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Abstract

The carbon dioxide capture and storage (CCS) is considered as a promising technology for carbon dioxide emission reduction. High-purity CO_2 mixture gas is separated from the flue gas and pumped into underground for a long-term storage. The impurities of gas can affect the trapping mechanisms. Various research studies about how impurity changes permeability were carried out. However, the effect of impurities in long-term trapping mechanisms is still unclear. This research studies the effects of H_2S, SO_2, and NO_2 in CCS for a long-term period of 2000 years using a PHREEQC geochemical simulator. The simulation presents formation water and rock samples from the previous research and the mixture gas groups to emphasis the effect of each impurity. The simulation contains two parts: the equilibrium block and the kinetics block. The former is to simulate the reversible reaction between the pure phases and the aqueous phase, which is defined by the equilibrium constant and dependent on the temperature. The latter is to simulate how phases react by time defined by kinetics rate, which is defined by the Arrhenius equation and depends on the pH, temperature, surface area and other reaction condition constants. Firstly, the gas and formation water are input into the equilibrium block to get CO_2 enriched solution and remaining gas components. Then, the remaining gas and solution and mineralogy are put into the kinetics block. Results indicate a shift from mineral trapping to solubility trapping in the presence of impurities, with a significant decrease in pH affecting CO_2 storage ratios. Furthermore, the changes in each mineralogy and the effects of each impurity are discussed.

Keywords: CCS; carbonate reservoir; gas impurities; PHREEQC; simulation