Improving oil recovery by injecting alcohol-treated CO_2

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Abstract. Oil recovery during CO_2 injection is higher for near-miscible and miscible conditions compared to immiscible condition. In case of the depleted oil reservoir, reservoir pressure is not sufficient to achieve miscible or near-miscible condition. This paper investigates the impact of alcohol-treated CO_2 (CO_2 equilibrated with alcohol at reservoir Pressure and Temperature) on miscibility pressure and respective oil recovery.

Injection experiments were performed on a Bentheimer sandstone for two sets of fluid pairs (1) CO_2 and oil, and (2) alcohol-treated CO_2 and oil. A mixture of 35% Hexane and 65% Decane was used as oil. Alcohol-treated CO_2 prepared by mixing of 4% Ethanol in scCO_2 at the experimental pressure and temperature. All experiments were performed at a constant temperature of 70 ^oC and two different pressures (1300 and 1700 psi). Literature studies show that 1300 psi represents immiscible condition and 1700 psi represents near-miscible condition for the selected oil and CO_2. To characterize the fluid pairs used in this study, we performed capillary rise experiments to measure interfacial tension (IFT) between (1) CO_2 and oil, and (2) alcohol-treated CO_2 and oil at experimental conditions. Oil recovery, differential pressure, and compositions are recorded during injection experiments.

Experimental observations reveal that alcohol-treated CO_2 is more effective than pure CO_2 for reducing IFT and miscibility pressure. Approx. 10 to 20 % oil recovery increases with the addition of 4% ethanol in CO_2. However, the increase in oil recovery with alcohol-treated CO_2 is more dominant at immiscible condition. Although it also shows some improvement at near miscible condition, its efficiency is greatly reduced.

The generated data provides a direct quantitative measurement of the reduction in miscibility pressure and improvement in oil recovery. The proposed methodology has the potential to enhance the feasibility of CO_2 sequestration in oil reservoirs.