

Experimental Study on the Effect of Deep Eutectic Solvents on Enhancing Heavy Oil Recovery in Carbonate Reservoirs

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Abstract

Deep Eutectic Solvents (DES's) have recently been investigated and showed potential results for heavy oil recovery enhancement in sandstone formation. In this work, the potential of the DES on enhancing heavy oil recovery was further investigated using Carbonate cores from one of the Omani oil fields.

Two DES's (Choline Chloride + Glycerol and Choline Chloride + Urea) with 1:2 molar ratio were tested. The potential of the DES's diluted in brine in enhancing the heavy oil recovery was investigated through: IFT measurements, wettability alteration measurements (contact angle measurement and spontaneous imbibition tests), six coreflooding experiments and possible formation damage caused by the DES's. The effects of DES concentration diluted in brine and brine salinity on wettability alteration and oil recovery enhancement using coreflooding tests under reservoir conditions (1200psi and 45C) were also investigated.

Coreflooding experiments showed promising results where additional 10-32% of the residual oil was recovered by DES injection (as tertiary stage) after brine flooding with better performance by both DES's at higher concentrations and salinities. Furthermore, the DES's showed no indication of a caused damage to the formation. Viscous forces and wettability alteration of the DES solutions (from oil wet to water/neutral wet) were found to be the main mechanisms of the oil recovery enhancement.