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# MODELING AND EXPERIMENTAL DETERMINATION OF CO2 – CRUDE OIL MINIMUM MISCIBILITY PRESSURE (MMP) FOR CO2-CRUDE OIL SYSTEMS

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## Abstract

Miscible gas injection processes as secondary recovery methods can be applied to a huge number of mature reservoirs to improve the trapped oil displacement. Miscible gas injection processes like $CO_2$ flooding are recommended to be carried out at minimum miscibility pressure (MMP) for effective enhanced recovery of trapped oil. There are several methods for MMP determination, but slim tube and vanishing interfacial tension (VIT) are the deployed experimental techniques in this study. Five crude oil samples (A, B, C, D and E) from different production fields were utilized for oil - $CO_2$ MMP determination. Slim tube experiments were conducted at lower injection rate of 0.1 cc / min to ensure stable displacement processes for reliable MMP determination.

Displacement efficiency is greatly affected by the interfacial tension (IFT), existing between injected gas and reservoir oil, which is a function of both injection pressure and injected gas composition. Therefore, miscibility will develop between the two phases when IFT approaches zero. Therefore, experimental IFT measurements had been carried out for mentioned crude oil - $CO_2$ systems at different pressures using the aforementioned VIT technique. Vanishing interfacial tension (VIT) was the deployed technique for IFT measurement. In it, pendent drops of oil were introduced in the vicinity of injection gas inside the optical cell at various pressures and respective constant reservoir temperature. Using the Axisymmetric drop shape analysis (ADSA) technique, the Laplace capillary equation was iteratively solved to match real against theoretical oil drop shape for IFT determination.

The pressure corresponds to zero IFT was found by IFT versus injection pressure plot extrapolation, which is termed as MMP. VIT technique measured MMP values were found to be in close agreement with slim tube measured MMPs for same crude oil- $CO_2$ systems. PVT software predicted MMPs show unacceptable potential deviation from slim tube determined MMP vallues. Evaluation of a number of crude oil – $CO_2$ MMP correlations (9 Nos.) resulted in unreliable calculated MMP values.

For the considered field reservoir oils and $CO_2$ miscibility investigation, this study recommends the VIT technique as a reliable, economic and less time consuming method for MMP determination, compared to the more expensive and more time consuming slim tube technique.