

**Minimum Miscibility Pressure
for
Trinidad Crudes / CO₂ Systems**

Tennyson Jagai

Minimum Miscibility Pressures (MMP) for Trinidad crudes/CO₂ systems were determined by theoretical and experimental methods.

Two theoretical methods were used. In the first, empirical correlations published in the literature, were used to calculate the MMP of 123 local crudes comprising separator liquids, recombined fluids and stock tank oils. The gravities of the separator liquids ranged from 17.6 API to 37.6 API giving miscibility pressures ranging from 11.12 MPa (1613 psia) to 52.86 MPa (7666 psia). The recombined fluids ranged in gravities from 17.6 API to 60.0 API with miscibility pressures ranging from 8.65 MPa (1254 psia) to 62.55 MPa (9072 psia). These calculations showed that each correlation gave a different value of MMP for the same crude. The difference between the largest and smallest for any one crude was of the order of

thousands of psi. This work has shown that the MMP determined by these correlations should not be used for final design of a CO₂ miscible flood.

The second theoretical method used the ternary diagram. The Peng-Robinson Equation of State (PREOS) was used to generate data for construction of the ternary diagrams. The ternary diagrams could not be used for determining MMP because the data for tuning the PREOS was not available.

A slim tube displacement research rig was designed and built at a cost of less than half the market price. It was tested to 34.47 MPa (5000 psig), calibrated and used to carry out displacements up to 20.68 MPa (3000 psig) in determining the MMP of 10 local crudes, using carbon dioxide as the displacement gas. The crudes ranged in gravities from 28.0 API to 35.6 API with the measured MMP ranging from 12.89 MPa (1870 psig) to 20.55 MPa (2980 psig).

Electronic detection of displacement phases with a photocell was developed. A chart recorder was incorporated in the design.

The effect of flow rate on percentage recovery was studied using this rig. This was used to establish an injection rate schedule for slim tube displacements, as it was found that flow rates published in the literature were inadequate.

The effect of temperature on percentage recovery was also studied with this rig. The higher recoveries obtained with increasing temperature were found to be consistent with published data.

The solvent mixture 70% methanol, 15% acetone, 15% benzene suggested in the literature, was found to be inadequate in removing asphaltenes which were deposited in the coil. Dichloromethane, and trichloroethane were found to be more effective in removing these deposits.

This work has shown that :-

1. The MMP determined with the above two theoretical methods should be used as preliminary estimates only.
2. A fully operational slim tube rig now exists and should be used for determining MMP.
3. The measured MMPs are well within the reservoir pressures of many local reservoirs, thereby establishing the fact that the CO_2 miscible process is an EOR technique now available to the local industry for increasing the oil recovery from Trinidad reservoirs.