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Emulsion viscosity reduction

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Deepwater production of crude oils may be challenged by viscous emulsions in seafloor pipelines from the wellhead to the platform. This is problematic because the emulsion viscosity at high water cuts can be several orders of magnitude greater than that of the crude oil. This becomes more severe with higher water cuts and lower temperatures. Viscosity reducing additives have been found to be effective in reducing emulsion viscosity.

Centrifugation of the dead oil was found to have a significant effect on emulsion viscosity; both with and without additives. This was in spite of only a small percentage of the material being removed by centrifugation. The role of this material is under investigation.

To simulate live oil, isooctane was added to the dead oil. The amount of isooctane to add was determined by matching the viscosity of the live oil. The simulated live oil was used to make emulsions at various water cuts and temperatures to determine the viscosity profile. At higher water cuts and lower temperatures, the emulsion would sometimes be a gel that was too viscous to measure.

Emulsions were generated either batch-wise with a bottle shaker, paddle wheel, or in a flow-loop. The viscosity was determined in the former two cases with a Brookfield couette type rheometer and in the latter case by measurement of pressure drop across a length of capillary tube. The emulsions were further characterized by NMR restricted diffusion for drop size analysis and MRI for profiling during separation. Microscopy using hydrophobic slide and cover-slip was used for visual observation.

The additives were proprietary chemicals or demulsifiers supplied by major oilfield chemical companies. These chemicals were characterized by observing the phase solubility between water and *n*-octane.

Experimental protocol was important for ensuring reproducible results. In addition to temperature and water cut, this included method of making emulsion, shear rate, dosage of chemical, time after addition, and order of mixing.

The characteristics and rheological effects of the chemical additives were evaluated. The results ranged from increase in emulsion viscosity to reduction in viscosity to less than that of the oil phase.