Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Time Evolution and Effect of Dispersant on the Morphology and Viscosity of Water-in-Crude Oil Emulsions[1] DIEGO F. MURIEL, JOSEPH KATZ, Johns Hopkins University — This study examines the time evolution and effects of adding dispersant (Corexit 9500) on the microscopic morphology and bulk viscosity of salt water-in-crude oil (Louisiana) emulsions. Methods include rheology and microscopy, followed by a machine-learning-based analysis of the emulsion structure. Initially, the water droplets appear as a multi-scale lattice with mean diameter of 2.7 μm and polydispersity of 0.44, with small droplets aggregating around large ones. The bulk viscosity is one to two orders of magnitude higher than that of the crude oil. After 7 days, the number of submicron droplets increases and the nearest neighbor distance decreases, indicating preferential aggregation. At high shear rates (5-100 s^{-1}), the viscosity increases by 60-130% compared to the initial values. After 14 and 21 days, as the droplets coalesce and many of the clusters merge, the bulk viscosity decreases. These trends suggest that aggregation contributes to the increase in viscosity. Mixing the emulsion with dispersant accelerates the phase separation. The removed water fraction increases with dispersant concentration, reaching 77% for a 10^{-3} concentration. The remaining emulsion consists of fine droplets with Newtonian viscosity four times higher than that of the crude oil.

[1]MPRI. Multi Partnership Research Initiative, Canada.

Diego Muriel
Cornell University

Date submitted: 02 Aug 2020 Electronic form version 1.4