Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Flow Analysis of a Rising Crude Oil Micro-Droplet Affected by Attached Microbial Streamers[1] MATTHEW AMARO, ANDREW WHITE, MARYAM JALALI, JIAN SHENG, Texas A&M University-Corpus Christi — Microfluidic experiments show bacteria flowing past a pinned crude oil droplet produce microbial aggregates and streamers on the oil-water interface. High speed DIC microscopy at 1000 fps for 1 sec with a sampling interval of 10 min captures the evolving flow and bacterial motility as well as adhesion, aggregation and streamer events. With bacteria as tracers, velocity measurements are acquired with in-house PIV-assisted PTV software. Flow fields with spatial resolution 2.5 μm are measured around an O(100) μm drop in a 700$\times$700 μm window. Full budgets of the 2D Navier-Stokes equation are faithfully resolved to determine pressure gradients by performing the balance over a control volume enclosing the droplet. Pressure gradients are integrated over the border of the control region to obtain pressure profiles at the leading and trailing edges. A momentum balance can be used to determine the drag induced by the drop and any attached streamers. Cases with and without streamers and their differing flow features are presented. Additionally streamers produce nonzero curl in the pressure gradient field providing a tool for identifying the position of otherwise invisible streamers. Ongoing experiments and future applications of the tools presented here will be discussed.

[1]Funded by GoMRI, NSF, ARO

Andrew White
Texas A&M University-Corpus Christi

Date submitted: 01 Aug 2017 Electronic form version 1.4