Abstract Submitted
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Turbulent crude oil jets in crossflow: holographic measurements of droplet size distributions[1] XINZHI XUE, DAVID MURPHY, JOSEPH KATZ, Johns Hopkins University Department of Mechanical Engineering — Buoyant, immiscible jets and plumes are created by subsurface oil well blowouts. In this experimental study, high speed visualizations and digital holography follow vertical crude oil turbulent jets of varying Reynolds and Ohnesorge numbers, all falling in the atomization range, while being towed in a towing tank generating 'crossflows' at varying crossflow-to-exit speed velocity ratios. The droplet size distributions are measured using a submerged miniature holographic microscopy system, enabling comparison between the plume behavior and the droplet size distributions. Due to variations in rise-velocity with droplet size, the shape and dispersion rate of the plume depends on the interfacial tension. Hence, the crude oil plume rises faster than a 'control' miscible oil analog with the same density and viscosity. Premixing the oil with dispersant (Corexit 9500A) at dispersant to oil (DOR) ratios of 1:100 and 1:25 reduces the oil-seawater interfacial tension by up to two orders of magnitude, promoting formation of micro-droplets. Hence, the plume rises at a slower rate, with the large droplets rapidly escaping, leaving smaller ones behind. Furthermore, for the DOR 1:25 case, some of the microdroplets are entrained into the vortices prominent in the wake region under the plume.

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David Murphy
Johns Hopkins University Department of Mechanical Engineering

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