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High-Pressure Visual Experimental Studies of Oil-in-Water Dispersion Droplet Size

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The formation of oil-in-water dispersions is a critical step during the blowout of coastal and deepwater oil and gas production systems, and is a determining factor in the vertical and lateral migration of oil through the associated adjacent water column. In this study a high-pressure sapphire visual autoclave apparatus was used to measure the size of crude oil droplets that were saturated with gas and dispersed in an aqueous phase as a function of mixing speed. Oil-in-water droplet size distributions were measured at pressures of 11 MPa, for autoclave stirring rates of 200-1000 RPM ($1076 \leq Re_{stirred\ vessel} \leq 5378$). Arithmetic mean droplet diameters decreased monotonically from 344 to 125 μm over this range, with maximum droplet sizes decreasing from 708 to 441 μm . A model tuned to the measured oil-in-water data was used to predict a mean droplet size on the order of 80 μm for Deepwater Horizon conditions; when incorporated into far field blowout simulations, this droplet size data enables quantitative assessment of the impact of dispersant injection at the blowout site.

Keywords: droplet size, mixing, deepwater blowout, multiphase flow

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