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Experimental study on immiscible jet breakup using refractive index matched oil-water pair[1] XINZHI XUE, JOSEPH KATZ, Johns Hopkins University — A subsea oil well blowout creates an immiscible crude oil jet. This jet fragments shortly after injection, resulting in generation of a droplet cloud. Detailed understanding of the processes involved is crucial for modeling the fragmentation and for predicting the droplet size distribution. High density of opaque droplets near nozzle limits our ability to visualize and quantify the breakup process. To overcome this challenge, two immiscible fluids: silicone oil and sugar water with the same index of refraction (1.4015) are used as surrogates for crude oil and seawater, respectively. Their ratios of kinematic viscosity (5.64), density (0.83) and interfacial tension are closely matched with those of crude oil and seawater. Distribution of the oil phase is visualized by fluorescent tagging. Both phases are also seeded with particles for simultaneous PIV measurements. The measurements are performed within atomization range of Ohnesorge and Reynolds numbers. Index matching facilitates undistorted view of the phase distribution in illuminated section. Ongoing tests show that the jet surface initially rolls up into Kelvin-Helmholtz rings, followed by development of dispersed phase ligaments further downstream, which then break into droplets. Some of these droplets are re-entrained into the high momentum core, resulting in secondary breakup. As the oil layer and ligaments evolve, they often entrain water, resulting in generation of multiple secondary water droplets encapsulated within the oil droplets.

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