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Oil droplet behavior in a counterrotating vortex pair generated in a Langmuir cell tank SANJIB GURUNG, CARLOWEN SMITH, ADILA HOQUE, TRISTEN MEE, SHANKAR SINGH, MUMTAZ HASSAN, University of South Florida, Department of Mechanical Engineering, SEYEDMOHAMMAD-JAVAD ZEIDI, ANDRES TEJADA-MARTINEZ, University of South Florida, Department of Civil and Environmental Engineering, DAVID MURPHY, University of South Florida, Department of Mechanical Engineering — Langmuir circulation is a form of turbulence occurring in the ocean surface′s upper layer due to wind shear and surface waves. The resulting pairs of counterrotating vortices called Langmuir cells affect particle distribution in the water column. Buoyant particles such as oil droplets resulting from entrained oil slicks can be trapped by downwelling in Stommel Retention Zones (SRZ). Using a laboratory facility recreating some aspects of SRZ, we study the fate of such oil droplets, which is not well understood. The experimental facility consists of a $1 \times 0.2 \times 0.5$ m^3 tank in which a shear stress is applied on the side walls using conveyor belts, resulting in a counterrotating vortex pair of variable strength and turbulent kinetic energy. A turbulent oil jet may be repeatably injected downwards into this downwelling region. The resulting droplet size distribution is simultaneously characterized for 5 minutes after oil injection using brightfield imaging at 10 Hz within three fields of view horizontally distributed across the tank. The decrease in median droplet diameter over time for various belt speeds is rationalized using the Trapping Function, which is the ratio of outward to inward forces acting on a droplet at the elevation of the vortex center.

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