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Water entry of hydrophilic spheres through fabric-fluid interfaces

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University of Central Florida — The vertical impacts of solid projectiles with the free surface of a deep aqueous pool are traditionally investigated with respect to impactor shape, entry speed, and surface roughness. Free surface alteration in some cases, may be more readily achieved for the modulation of splashes. In this combined experimental and theoretical study, smooth, free-falling, hydrophilic steel spheres impact penetrable and non-penetrable fabrics resting atop the fluid surface for Weber numbers in the range of 430-2700. Penetrated fabrics remain near the free surface, suppressing the splash crown, but allowing passage of a Worthington jet whose height increases with the depth of the trailing cavity. Non-penetrable fabrics create deep seal cavities by veiling the descending impactor, generating higher Worthington jets, and pronounced splash crowns. Some fabrics, both penetrable and non-penetrable reduce drag with respect to clean surface impacts by providing the drag-reducing benefits of flow separation while not offering a high inertial penalty. Such observations augur well for military and industrial applications where splashes warrant control to mitigate damage to life and property.

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