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Turbulent drag reduction using biopolymers and bio-inspired superhydrophobic surfaces[1] ANOOP RAJAPPAN, GARETH H. MCKINLEY, Massachusetts Institute of Technology — Skin friction accounts for over 50% of the total drag on ships, and its effective mitigation can yield significant savings in fuel, operating costs, and emissions. Despite considerable promise as an effective drag reduction strategy, high molar mass additives have been largely precluded from commercial use due to the high cost of synthetic polymers. In this context, we investigate the aqueous mucilage extracted from seeds such as flax, chia and psyllium as viable, cost-effective and eco-friendly alternatives to synthetic water-soluble polymers. Using frictional drag measurements performed in a bespoke Taylor-Couette apparatus, we show that aqueous mucilage displays comparable drag reduction efficacy as polyethylene oxide, a common synthetic polymer, at a much lower cost. We study the effects of salinity and shear-induced chain scission, and explore the use of cross-linking agents to augment the drag reduction performance of the dissolved chains. Finally, we investigate the use of scalable, randomly rough superhydrophobic walls (inspired by the natural texture on the leaves of the lotus and other plants) as a passive means to mitigate turbulent skin friction, and its synergistic use in conjunction with dilute polymer solutions to enhance the overall reduction in frictional drag.

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