Abstract Submitted
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Designing shear-thinning[1] ARIF Z. NELSON, RANDY H. EWOLDT, Univ of Illinois - Urbana — Design in fluid mechanics often focuses on optimizing geometry (airfoils, surface textures, microfluid channels), but here we focus on designing fluids themselves. The dramatically shear-thinning "yield-stress fluid" is currently the most utilized non-Newtonian fluid phenomenon. These rheologically complex materials, which undergo a reversible transition from solid-like to liquid-like fluid flow, are utilized in pedestrian products such as paint and toothpaste, but also in emerging applications like direct-write 3D printing. We present a paradigm for yield-stress fluid design that considers constitutive model representation, material property databases, available predictive scaling laws, and the many ways to achieve a yield stress fluid, flipping the typical structure-to-rheology analysis to become the inverse: rheology-to-structure with multiple possible materials as solutions. We describe case studies of 3D printing inks and other flow scenarios where designed shear-thinning enables performance remarkably beyond that of Newtonian fluids.

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