

How much paint is left on your brush? – A journey in the world of yield stress fluids

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Abstract: We commonly extract various objects from baths of yield stress fluids (mud, chocolate, cement paste, paint, cream, gel, etc) to coat the material layer remaining on the object over a solid surface (bread, wall, skin, etc). At first sight this operation seems trivial. For simple liquids this is the well-known dip-coating process whose result depends on the competition between viscous, capillary and gravity effects [see e.g. Derjaguin and Levi, 1964)]. But for yield stress fluids the situation is much more complex due to the specific nature of these materials. In particular the volume finally coated can vary from zero to a large value depending on the exact material behavior, the procedure (flow history), and the boundary conditions. Here we explore these different aspects, which gives us the opportunity to review and discuss the state of the art of various problems in the science of yield stress fluids such as: the fundamental rheological behavior of these fluids; the microstructural origin of this behavior; the impact, on flow in complex geometries, of solid-liquid phase coexistence and elasticity in the solid regime; the possibility of shear-banding; the impact and origin of wall-slip; the role and characteristics of thixotropy; and the fate of the material during drying.