# Rheology of magnetic capillary suspensions

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Capillary suspensions are prepared by adding an immiscible secondary fluid to a *conventional* suspension, typically formed by solid particles dispersed in a liquid carrier. The secondary fluid becomes a third phase that induces bridges between the particles and generates a network that dramatically affects the stability and mechanical properties of the suspension [1, 2].
Magnetorheological (MR) fluids [3] are suspensions of relatively large (d ~ 0.5-10 mm) magnetizable particles in a liquid carrier. Upon the application of a uniaxial magnetic field, the magnetic interaction between particles prevails and leads to their aggregation and the formation of columnar aggregates. This structuration is the origin of the so-called magnetorheological effect: a large reversible increase in the viscosity of the suspension, and sometimes the emergence of a yield stress, upon the application of the field. The fact that the mechanical properties of suspensions can be dynamically controlled with an external stimulus (the field) makes them attractive for numerous applications, such as dampers, clutches, or brakes [4].
In this work we studied the rheology and structure of magnetic capillary suspensions, i.e. suspensions prepared with magnetizable particles (carbonyl iron) and two immiscible liquids (mineral oil and water). The presence of the secondary liquid mitigated particle sedimentation but also resulted in a non-negligible elastic modulus and yield stress even in the absence of a field (the off-state), which could be detrimental to some applications. The on-state behavior of the suspensions was dominated by the magnetostatic interactions. More interestingly, the suspensions showed a rich rheological behavior with a strong influence of the preshear history. Differences of up to an order of magnitude in the yield stress were observed under various preshear protocols.

**Keywords:**
Capillary Suspensions, Magnetorheological Fluids, Magnetic Fluids, Yield Stress

**References:**

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