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Impact of Viscous Fingering on Fluid Mixing JANE CHUI, MIT, PIETRO DE ANNA, Universite de Lausanne, RUBEN JUANES, MIT — Viscous fingering is a hydrodynamic instability that occurs when a less viscous fluid displaces a more viscous one. Instead of progressing as a uniform front, the less viscous fluid forms fingers that vary in size and shape to create complex patterns. Understanding how these patterns and their associated gradients evolve over time is of critical importance in characterizing the mixing of two fluids, which in turn is important to applications such as enhanced oil recovery and microfluidics. Mixing relies on the presence of concentration gradients. In this work, we determine the concentration field experimentally during the injection of a fluid into a circular Hele-Shaw cell to displace a more viscous fluid. We use a fluorescent tracer with the injected fluid to obtain high-resolution concentration fields, from which we determine the concentration gradients for different fluid injection rates and various viscosity ratios. Areas where gradients are present constitute the mixing zone, which can be characterized by its length and its thickness. We develop quantitative models of the dynamics of the interface length (previous work) and mixing zone thickness, and propose a scaling theory for the growth of the mixing zone and the overall impact of viscous fingering on mixing.

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