Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Stabilization of miscible viscous fingering by a step-growth polymerization reaction[1] PATRICK BUNTON, SIMONE STEWART, DANIELA MARIN, William Jewell College, MICHAEL TULLIER, Louisiana State University, ECKART MEIBURG, University of California at Santa Barbara, JOHN POJMAN, Louisiana State University — Viscous fingering is a hydrodynamic instability that occurs when a more mobile fluid displaces a fluid of lower mobility. Viscous fingering is often undesirable in industrial processes such as secondary petroleum recovery where it limits resource recovery. Linear stability analysis by Hejazi et al. (2010) has predicted that a non-monotonic viscosity profile at an otherwise unstable interface can in some instances stabilize the flow. We use step-growth polymerization at the interface between two miscible monomers as a model system. A dithiol monomer displacing a diacrylate react to form a linear polymer that behaves as a Newtonian fluid. Viscous fingering was imaged in a horizontal Hele-Shaw cell via Schlieren, which is sensitive to polymer conversion. By varying reaction rate via initiator concentration along with flow rate, we demonstrated increasing stabilization of the flow with increasing Damkohler number (ratio of the reaction rate to the flow rate). Results were compared with regions of predicted stability from the results of Hejazi et al. (2010). When the advection outran the reaction, viscous fingering occurred as usual. However, when the reaction was able to keep pace with the advection, the increased viscosity at the interface stabilized the flow.

[1]We acknowledge support from NSF CBET-1335739 and NSF CBET 1511653

Patrick Bunton
William Jewell College

Date submitted: 27 Jul 2017 Electronic form version 1.4