Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Viscous Fingering in Viscoelastic Fluids: Numerical Simulations and Experiments POOJA JANGIR, RATAN MOHAN, PARESH CHOKSHI, Indian Institute of Technology Delhi (IIT) — Polymer additives are widely used to alter the viscous fingering instability attributed mainly to the shear-rate dependent viscosity and elasticity. Present study aims to examine the role of these two rheological properties on the instability, simultaneously. The flow systems considered are: viscoelastic displacing Newtonian fluid (VN) and Newtonian displacing viscoelastic fluid (NV). Numerical simulations are performed using spectral method and Adams-Bashforth technique. To incorporate shear-thinning viscosity and elasticity, the White-Metzner model is adopted. Evaluation of concentration, mixing length and contact area shows that shear-thinning feature has a destabilizing effect while elasticity always stabilize the flow, irrespective of the flow system. In the experiments, polyethylene oxide (PEO) of different concentrations and molecular weights are used to incorporate non-Newtonian features. The VN system shows wider and less fingers as concentration of PEO increases while ramified fingers are observed in the NV system. The instability is further intensified for high molecular weight PEO, for similar viscosity contrast. The strong shear-thinning and elastic features contribute to the formation of ramified patterns and create locally stable/unstable regions in the flow field.

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Date submitted: 01 Aug 2020 Electronic form version 1.4