Abstract Submitted
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Numerical investigation of multi-stability in the unstable flow of a polymer solution through porous media[1] MANISH KUMAR, SOROUSH ARAMIDEH, Purdue University, CHRISTOPHER BROWNE, Princeton University, SUJIT DATTA, Princeton University,, AREZOO ARDEKANI, Purdue University — The flow of viscoelastic polymeric fluids through porous media is common in industrial applications such as oil recovery and groundwater remediation. Polymeric stresses can lead to an elastically induced instability of the flow. Here, we numerically study the flow of a polymeric fluid in a channel consisting of multiple diverging and converging physical constraints, mimicking the pore bodies and throats of an ordered porous medium. The inertial effects are negligible due to small Reynolds numbers and the flow characteristics are determined by the Weissenberg number, a dimensionless ratio of elastic to viscous forces. At small Weissenberg numbers, stable eddies appear on the top and the bottom of each pore. Conversely, at large Weissenberg numbers, strong flow fluctuations due to high polymeric stresses lead to stretching and relaxation of the polymeric chains inside the pores. The stretched polymeric chains inside the pore facilitate eddy formation, whereas relaxed chains lead to eddy free regions. The eddy formed by stretched chains and eddy free region induced by relaxed chains lead to multiple distinct unstable flow structures inside a pore. We quantify the eddy area and correlations between the flow patterns of different pairs of pores, as well as polymeric stress and pressure drop across the tortuous channel to better understand the mechanism behind the observed flow patterns.

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