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Ganglia mobilization by purely elastic instability

Monday, 30 May 2022 11:35 (15 minutes)

The flow of viscoelastic polymer solutions and their use as displacing agents in porous media are important for industrial applications, such as enhanced oil recovery and soil remediation. Complexity of flow and high elasticity of conventionally used viscoelastic polymer solutions can lead to purely elastic instability in porous media. In this work, we study the impact of elastic instability on displacing oil ganglia at low Reynolds numbers using a microfluidic approach. Our unique design consists of a single-capillary entrapment connected to two symmetric serpentine channels. This design excludes the effect of viscous forces and allows a direct focus on displacement driven solely by elastic forces. After the onset of purely elastic instability, an unstable base flow is observed in the serpentine channels. We argue that the pressure fluctuations caused by this unstable flow create an instantaneous non-equilibrium state between the two ends of the oil ganglia. This provides the driving pressure to overcome the capillary threshold pressure and eventually displace the entrapped oil. In our geometry, we observe that the displacement coincides with the emergence of a fully developed elastic turbulent state.

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Online

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