Contribution ID: **248** Type: **Oral Presentation**

The role of birefringent strands on the stability of viscoelastic flows through porous media

Monday, 30 May 2022 10:50 (15 minutes)

We consider the flow of dilute polymer solution through model porous media consisting of an array of cylinders. Our recent results (Mokhtari et al. 2022) demonstrate that birefringent strands are key in understanding viscoelastic effects in such systems. These strands act as a distribution of tangential forces that reduce the velocity in their vicinity and induce a complete reorganization of the flow on large scales within porous structures.

While being simple, arrays of cylinders have proven useful in capturing many important mechanisms inherent to viscoelastic flows past obstacles and have recently attracted a lot of attention (Walkama et al. 2020; Haward et al. 2021). Walkama et al. (2020) showed that introducing disorder in a staggered geometry locally reduces polymer stretching and enhances flow stability with a delay in transition to chaos. Haward et al. (2021) showed a very different arrangement of the strands in staggered and aligned geometries and demonstrated instead that stagnation points control this transition, independently from the disorder. This raises the question of the role of the strands in the transition to chaos: Could it thus be that birefringent strands also control the transition to chaos in porous structures?

Here we use numerical simulations to study the role of the birefringent strands on the flow stability through crystalline structures of cylinders. Our approach combines a recently developed numerical scheme for viscoelastic models of dilute polymer solutions (Mokhtari et al. 2021) with high performance computing. We find that the strands yield an angle between the direction of the imposed pressure gradient and the average flow, favouring certain flow directions. This causes a hysteresis of the flow angle and multistability, which may be fundamental to understand experimental results and transition to chaos.

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References

Haward, S. J., Hopkins, C. C. & Shen, A. Q. 2021 Stagnation points control chaotic fluctuations in viscoelastic porous media flow. Proceedings of the National Academy of Sciences 118 (38).

Mokhtari, O., Latché, J.-C., Quintard, M. & Davit, Y., 2022 Birefringent strands drive the flow of viscoelastic fluids through porous media (in preparation).

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Walkama, D. M., Waisbord, N. & Guasto, J. S. 2020 Disorder suppresses chaos in viscoelastic flows. Physical Review Letters 124 (16), 164501.

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

In person

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Session Classification: MS21

Track Classification: (MS21) Non-linear effects in flow and transport through porous media