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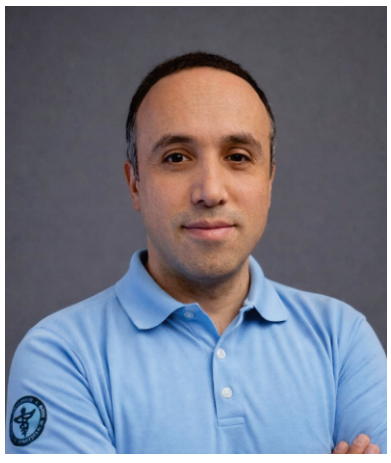
Hydrodynamic Features of Elastoviscoplastic Fluid Flow Through Random Porous Media

Yield-stress fluids flowing through porous structures appear in many engineering and geophysical processes such as subsurface transport, filtration, and energy systems. In this presentation, we investigate the hydrodynamics of yield-stress fluids in randomly generated porous media using direct numerical simulations.

The porous medium is constructed from randomly distributed, non-overlapping circular obstacles with different porosity levels. Two rheological models are considered: the Saramito elastoviscoplastic (EVP) model and the Bingham viscoplastic model. A wide range of Bingham numbers and Weissenberg numbers is examined to understand the combined effects of yield stress and elasticity.

Results show that pressure drop increases with both the Bingham number and the solid volume fraction of the obstacles. The role of elasticity, however, is more complex. At low Bingham numbers, elasticity increases flow resistance compared with viscoplastic fluids, while at high Bingham numbers, elasticity can lead to drag reduction. Near the yield limit, elastic stresses promote yielding by helping the fluid overcome the yield-stress barrier at smaller pressure gradients.

The simulations further reveal that increasing elastic effects can destabilize the flow, leading to unsteady dynamics and potentially chaotic flow regimes. These findings provide new insight into the transport mechanisms of elastoviscoplastic fluids in porous structures and highlight the importance of elasticity in yield-stress fluid flows.



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Dr. Saeed Parvar is a researcher in computational fluid dynamics specializing in complex and non-Newtonian flows. His work focuses on the numerical simulation of viscoelastic and elastoviscoplastic fluids, multiphase flows, and transport phenomena in porous media. He has been affiliated with institutions including FEUP, INEGI, Imperial College London, and KTH Royal Institute of Technology. His research combines high-performance computing, advanced rheological modeling, and direct numerical simulation to investigate flow physics relevant to engineering and energy applications.

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às 13h00 horas

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Maiores informações:
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