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Channelization of viscoplastic flow in a rough Hele-Shaw cell DUNCAN HEWITT, DAMTP, University of Cambridge, NEIL BALMFORTH, Department of Mathematics, University of British Columbia — The flow of viscoplastic fluid down slender conduits or through porous media has application in a range of industrial and geophysical settings, from the plumbing of mud volcanoes to the transport of proppant slurries in hydraulic fracturing. The yield stress can cause the fluid locally to clog up, which can significantly affect the flow patterns. Flow of a viscoplastic fluid in a Hele-Shaw cell that has randomly "roughened" walls is investigated, both numerically and using analogue laboratory experiments. Fluid injected into the centre of the rough cell, which is initially full of the same fluid, show pronounced channelization: above a critical pressure drop (below which there is no flow and all the fluid is unyielded and stagnant), one or more thin conduits of yielded, flowing fluid develop. At larger pressure drops, more channels of yielded fluid develop. The quantity and width of the channels, and the value of the critical pressure drop, depend on the amplitude of the roughness of the walls of the cell. If this roughness is known, the locations of the first channels to flow and the corresponding pressure drop can be predicted by an optimization algorithm.

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