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Viscoplastic flow in a Hele-Shaw cell NEIL BALMFORTH, University of British Columbia, DUNCAN HEWITT, University of Cambridge — A theoretical study is presented of the flow of viscoplastic fluid through a Hele-Shaw cell that contains various kinds of obstructions. Circular and elliptical blockages of the cell are considered together with step-wise contractions or expansions in slot width, all within the simplifying approximation of a narrow gap. Specific attention is paid to the flow patterns that develop around the obstacles, particularly any stagnant plugged regions, and the asymptotic limits of relatively small or large yield stress. Periodic arrays of circular contractions or expansions are studied to explore the interference between obstructions. Finally, viscoplastic flow through a cell with randomly roughened walls is examined, and it is shown that constructive interferences of local contractions and expansions leads to a pronounced channelization of the flow. An optimization algorithm based on minimisation of the pressure drop is derived to construct the path of the channels in the limit of relatively large yield stress or, equivalently, relatively slow flow.

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