Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Stability of Viscous Fingering in Uniport and Multiport Lifted Hele Shaw Cell[1] SACHIN KANHURKAR, PRASANNA GANDHI, Department of Mechanical Engineering, Indian Institute of Technology Bombay, AMITABH BHATTACHARYA, Department of Applied Mechanics, Indian Institute of Technology Delhi — Lifted Hele-Shaw cells typically display viscous fingering of liquids, which in turn leads to branched fractal patterns in the absence of any anisotropies. Recently, experiments involving parallel lifted Hele-Shaw cells with holes in the cell plates, also termed as "multi-port lifted Hele-Shaw cells (MLHSCs)", have been used to generate more regular mesh-like patterns in the liquid film. Although such patterns promise usefulness in several applications, their spatio-temporal evolution needs to be understood for better synthesis. As a first step therefore, we examine the stability of fingers evolving from a single hole by focusing on the flow of an annular film of liquid placed in a lifted Hele-Shaw cell. To validate the results, we also perform resolved numerical simulations of the setup via an in-house solver based on lubrication theory, which uses the front tracking method to evolve the interface in time and space. Using our numerical solver, we also have been able to evolve anisotropies in the Hele-Shaw cells in the form of multiple holes in the liquid film. The proposed theoretical analysis and insights obtained through numerical simulations, thus provide a framework for accurately predicting and experimentally realizing stable fluid patterns in a multi-port Hele-Shaw cell.

[1]This work was carried out under joint funding from the MHRD and DST through IMPRINT1 program under Grant No. DSTIMC002

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Date submitted: 03 Aug 2020 Electronic form version 1.4