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Unstable miscible displacements in Hele-Shaw cells: Three-dimensional Navier-Stokes simulations[1] RAFAEL OLIVEIRA, ECKART MEIBURG, UC Santa Barbara — We simulate unstable miscible displacements in Hele-Shaw cells based on the three-dimensional, variable viscosity Navier-Stokes equations coupled to a convection-diffusion equation for the concentration field. The simulations exhibit the formation of individual, quasisteady fingers whose properties are characterized as a function of the viscosity ratio and the Peclet number. We observe both traditional tip splitting events, as well as a novel inner splitting mechanism that has not yet been reported in the literature. This tip splitting is associated with fluid transport perpendicular to the plane of the Hele-Shaw cell, and hence cannot be reproduced by gap-averaged approaches. It has the effect of splitting the trailing sections of the finger longitudinally, while the finger tip can largely remain intact.

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