Dispersion of a suspension plug in oscillatory pressure-driven flow
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Brown University — We investigate the dispersion of suspension plugs in a micro-
capillary as they are sheared in periodic pressure-driven flows. To study this novel
configuration, a new experimental method was implemented to observe the shear-
induced evolution of semi-infinite suspension plugs consisting of non-colloidal spherical
particles (90-μm mean diameter) at dilute and high concentrations for various
values of applied strain. In this cyclic shearing flow, irreversible particle migration
arises from numerous unpredictable hydrodynamic interactions between particles
and walls. Although the periodic velocity profiles do not lead to any significant
increase in plug length, significant streamwise particle migration was observed near
the walls of the capillary, becoming more pronounced with increasing strain amplit-
tude γ₀. This experimental outcome agrees with the results of numerical simulation,
which produces analogous behavior for a suspension sheared between parallel walls.
Calculating dimensionless particle diffusivities $D_z$ for various $γ₀$ allows us to deter-
mine a cutoff point demarcating regimes of reversibility and irreversibility.

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