Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Pinch-off dynamics of a liquid column pulled by a sphere settling through an interface[1] JACQUES MAGNAUDET, IMFT/CNRS/University of Toulouse, JEAN-LOU PIERSON, IMFT and IFFEN — We study the dynamics of the liquid column that forms past a settling sphere as it crosses the horizontal interface separating two immiscible liquids. Depending on the viscosity contrast between the two fluids, on the fluid and sphere-to-fluid density contrasts, and on the Bond number, the primary pinch-off is found to be either shallow or deep, i.e. taking place either close to the initial interface or close to the sphere. We rationalize these observations through simple scaling laws predicting that, if the sphere velocity stays constant during the breakthrough, the transition from shallow to deep pinch-off takes place when the Bond number exceeds a critical value depending on the sphere-to-fluid density contrast. However, the viscosity contrast frequently results in large sphere accelerations or decelerations. We show that their influence is similar to a (negative or positive) buoyancy effect and may be accounted for via a modified expression of the critical Bond number; this approach allows us to predict correctly the observed tendencies. We finally compare scaling laws and mechanisms controlling pinch-off dynamics in the present situation, where inertia is comparable in the two fluids, with those involved in the case of air cavities created by an an impact at a free surface.

[1]partly supported by Direction Generale de l'Armement

Jacques Magnaudet
IMFT/CNRS/University of Toulouse

Date submitted: 21 Jul 2017 Electronic form version 1.4