LOCAL ANALYSIS OF AXISYMMETRIC BUBBLE PINCH-OFF AT HIGH REYNOLDS NUMBERS

J. M. GORDILLO* AND M. PÉREZ-SABORID *

* Area de Mecánica de Fluidos
Escuela Superior de Ingenieros de Sevilla
41009, Sevilla, Spain
jgordill@us.es, psaborid@us.es

The description and measurement of the final stages previous to pinch-off of axisymmetric bubbles at high Reynolds numbers has recently aroused a great interest as shown in recent publications (see [1-5]). In this work we extend the previous analysis presented in [3] in order to describe not only the time evolution of the bubble minimum radius close to pinch-off, but also the radius of curvature of the interface in the case of symmetric breakup of axisymmetric bubbles (see [3]). For this purpose we have analyzed the structure of the irrotational flow near the minimum radius. We recover the asymptotic time evolution for the minimum radius, $R_0(t)$, found in [3] ($t \propto R_0^2 \sqrt{-log\, R_0^2}$) and that the interface is locally described, for times sufficiently close to pinch-off, by: $F(z,t) = R_0(t) - [1/(3\, log(R_0))]\, (z/R_0)^2$. However, we also find that, due to the weak character of the attractor of this system, these asymptotic solutions are only reached for times so close to pinch off that the continuum approach breaks. Therefore, bubble pinch-off strongly depends on initial conditions [5] and this fact may throw light on the existing controversy concerning the time scaling of the minimum radius during the final stages previous to pinch-off. We will also present results by including the inner fluid inertia and extract conclusions about the differences between bubble and drop pinch-off at high Reynolds numbers.

References

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