November 29, 2024

Chemical Engineering Science
Professor Wei Ge, Editor

Dear Prof. Ge,

Please find enclosed the revised version of our manuscript (CES-D-24-01867): "Numerical Simulation of Bubble Deformation and Breakup under Simple Linear Shear Flows". We thank the reviewers for their comments and thoughts regarding improvement of our paper. We believe that we have addressed all of the reviewers' concerns; the changes are itemized in detail below.

NOTE: all references to equations and figures below are with reference to the numbering scheme of the revised version of the paper, not the original version. Also, changes are hi-lighted in red.

Changes made in response to comments of Reviewer 4:

1. The investigated ranges of density ratio (λ) and viscosity ratio (η) could be expanded to encompass lower values, which would be applicable to various gas-liquid systems, including molten metal processes and slurry bubble columns.

   Response:
   Thank you for your kind comments. In the revised paper, we have completely modified the "Introduction" and improved the motivation for our research.

2. Additional details regarding the computational tools/code and algorithms employed would enhance the reproducibility of the results presented in this study.

   Response:
   Thank you very much for your suggestions. Please see the top of section 3.2 which now references our past work on the algorithm that is employed in this paper.

3. The authors should elucidate the rationale behind constraining the viscosity ratio to values below 10^{-3}.

   Response:
   In the paper, we already described physical properties (density, viscosity, surface tension) set in the computations:

Bubble: $\rho_\mathrm{b} = 1.2$ kg/m^3 and $\mu_\mathrm{b} = 1.8 \times 10^{-5}$ Pa·s
Liquid: $\rho_\mathrm{m} = 1000$ kg/m^3 and μ_m = a changeable value corresponding to Ca [Pa·s]
Surface tension : $\sigma = 2.5 \times 10^{-2}$ N/m.
Then, μ_m had $2.0 \times 10^{-2} \sim 6.0 \times 10^{-2}$ Pa·s and V had about $1.1 \sim 1.3$ m/s for the range of Ca and Re in our computaions.
When $\mu_\mathrm{m} = 2.0 \times 10^{-2} \sim 6.0 \times 10^{-2}$ Pa·s, we have $\eta < 1.0 \times 10^{-3}$.
We have added the range of μ_m and V used in this study.

4. While gravitational effects were not considered in this investigation, a brief discussion of the potential influence of the Froude number (Fr) on bubble breakup dynamics would provide valuable context.

   Response:
   We agree with the reviewer's comment.
   In our computations, we set $g = 0$ because we wanted to isolate only the effects of the density and viscosity ratios and wanted to compare previous studies dealing with the deformation and breakup of a drop with $\lambda = 1$ and $\eta = 1$. When the gravity is considered, we obtain Fr (Froude number) $\left(= \frac{\Gamma R}{\sqrt{gR}}\right) = 1.7$ ($Re = 93$ and $Ca = 0.3$) and 1.9 ($Re = 43$ and $Ca = 0.8$).
   Although the values of Fr are not so large, the effect of gravity (bubble rise motion) may not be completely negligible in terms of Fr. However, bubbles for both conditions reach the breakup at t = about 0.5 s. Accordingly, it is expected that the effect of gravity (bubble rise motion) can be negligible to the behavior of bubble deformation and breakup around critical Re number conditions. In the revised paper, we have described these explanations.

   Please see line 181 in section 2 (the definiton of Fr) and the remark in section 2.

On behalf of the authors,

Mitsuhiro Ohta