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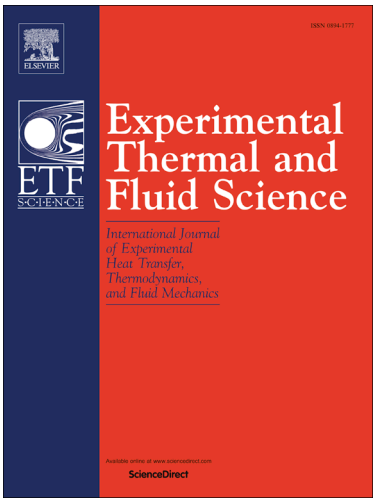

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ACCEPTED MANUSCRIPT

Shapes of single bubbles in infinite stagnant liquids contaminated with surfactant

Shohei Aoyama, Kosuke Hayashi, Shigeo Hosokawa, Akio Tomiyama *

Graduate School of Engineering, Kobe University, 1-1, Rokkodai, Nada, Kobe 657-8501, Japan

**Corresponding author: tomiyama@mech.kobe-u.ac.jp, Tel/Fax: +81-78-803-6131*

Keywords: Contaminated bubble, Aspect ratio, Surfactant, Correlation

H I G H L I G T S

· Effects of surfactant on bubble shape are experimentally investigated.

· Triton X-100, 1-octanol, SDS and 1-decanol are used for surfactant.

· A correlation of aspect ratio is proposed based on experimental data.

A B S T R A C T

Aspect ratios of ellipsoidal bubbles in clean and contaminated systems were measured to investigate the effects of surfactant on the bubble aspect ratio. The bubble diameter ranged from 0.80 to 5.8 mm. Air was used for the gas phase and the glycerol-water solutions were used for the liquid phase. The experimental ranges of the Morton number, M, the bubble Reynolds number, Re, the Eötvös number, Eo, the Weber number, We, and the Tadaki number, Ta, were as follows: $10^{-7} < M < 10^{-3}$, $3.6\times10^{-1} < Re < 1.7\times10^{2}$, $1.1\times10^{-1} < Eo < 5.9$, $5.0\times10^{-3} < We < 3.7$ and $5.3\times10^{-2} < Ta < 3.6$. Triton X-100 and 1-octanol were used for surfactant. The terminal velocities of bubbles were confirmed to be independent of the surfactant concentration, and therefore, the bubbles were fully-contaminated from the point of view of the terminal velocity. By making use of the aspect ratio data, the applicability of available aspect ratio correlations was examined and an empirical correlation was proposed. The applicability of the proposed correlation was also examined for sodium dodecyl sulphate (SDS) and 1-decanol. As a result, the following conclusions were obtained: (1) the aspect ratio database, which is of use for validating and developing shape correlations, was obtained, (2) the available aspect ratio correlations are not applicable to the present data for fully-contaminated ellipsoidal bubbles, (3) the aspect ratios are well correlated in terms of a combination of the Eötvös and bubble Reynolds numbers, which proves that

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