

Measurement of interfacial parameters of single Taylor bubbles rising in closed vertical and slightly inclined tubes using ultrasonic and visualization techniques

M. B., de Azevedo¹, J. L. H., Faccini¹, D., Santos³,
N. N., Araujo³, P. A. M., Vinhas³, J., Su²
e-mail: bertrand@ien.gov.br,
faccini@ien.gov.br

¹ SETER, IEN

² PEN/COPPE, ³ Poli/UFRJ

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The present work reports an experimental study of single Taylor bubbles rising in water-glycerin mixtures in vertical and slightly inclined tubes filled partially with the liquid mixtures to leave an air pocket of length L_0 at the top end, [1]. A Taylor bubble was formed by the inversion of the tube (Fig.1). The velocities and lengths of the rising bubbles were measured by using a pulse-echo ultrasonic technique and a high speed video camera. The bubble profiles and the thicknesses of the liquid films around the bubbles were measured by the ultrasonic technique. The inclination angles studied were 0° , 2.5° , 5° , 7.5° , 10° and 15° from the vertical position. It was observed, for all liquids studied, that the bubble velocity U_b decreased (Fig.2) and the film thickness increased (Fig.3) with increasing viscosity. Furthermore, the bubble velocity increased with increasing inclination angle and the influence of the inclination angle on velocity tends to decrease when the liquid viscosity increases (Fig.2). The measurements also indicated that for lower viscosity liquids, the inclination angle has no influence on the length of bubbles generated from the same air volume. However, for higher viscosity liquids, it was observed a tendency of the bubble length to decrease when the inclination angle increases (Fig.4).

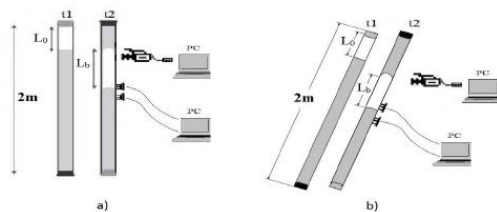


Figure 1. Schematic of the stagnant liquid column:
a) Vertical and b) Slightly inclined.

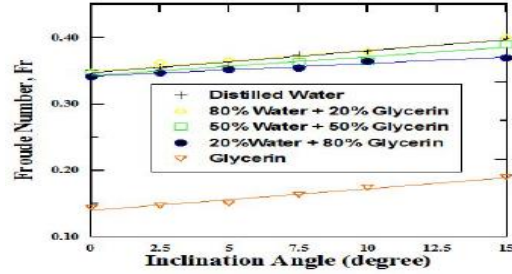


Figure 2. Variation of Fr with the inclination angle for the different liquid mixtures used.

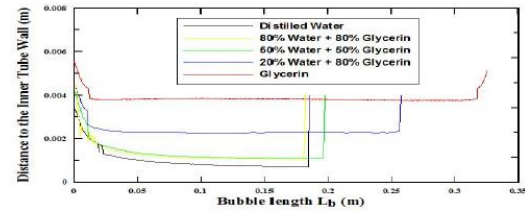


Figure 3. Liquid film profiles of bubbles generated from an air pocket length $L_0 = 0.15$ m rising vertically in liquids with different viscosity.

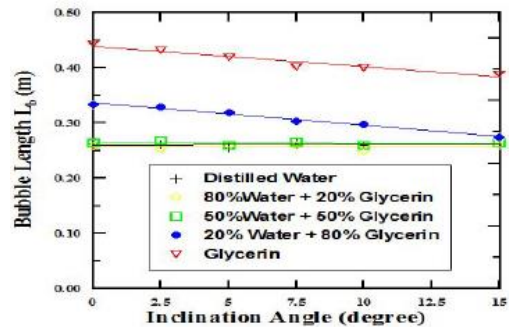


Figure 4. Variation of the bubble length L_b with the inclination angle for the different liquids used.

References

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