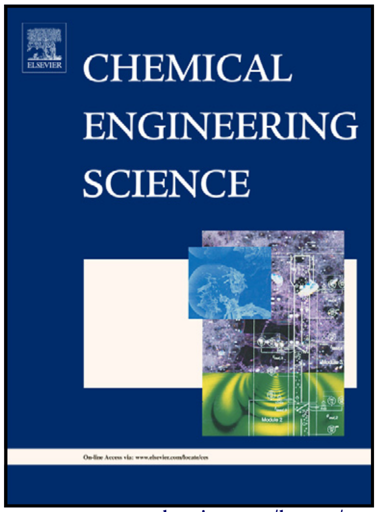

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Sandra Orvalho, Marek C. Ruzicka, Giuseppe Olivieri, Antonio Marzocchella

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Bubble coalescence: effect of bubble approach velocity and liquid viscosity

Sandra Orvalho[a]*, Marek C. Ruzicka[a], Giuseppe Olivieri[b,c], Antonio Marzocchella[b]

[a]Department of Multiphase Reactors, Institute of Chemical Process Fundamentals, Czech Academy of Sciences, Rozvojova 135, 16502 Prague, Czech Republic, www.icpf.cas.cz

[b]Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli "Federico II", P.le V. Tecchio, 80 – 80125 Napoli, Italy

[c]Bioprocess Engineering – AlgaePARC – Wageningen University, PO BOX 16, 6700 AA, Wageningen, the Netherlands

*Corresponding author: orvalho@icpf.cas.cz

Abstract

The goal of this study is to present new experimental data on the effect of the bubble approach velocity and liquid viscosity on pairwise bubble coalescence. Measurements were performed to investigate the dynamics of bubble coalescence under well-defined laboratory conditions. Air and pure aqueous solutions of alginate (no surfactants) were the phases. The bubbles were formed from two vertical capillaries, under constant flow conditions. The coalescence process was recorded with a fast video and then image analysed, to evaluate the bubble growth, bubble expansion rate, the first bubble touch, bubble contact time T, bubble coalescence efficiency E. Three control parameters were tested. The bubble size D on contact was set by the spacing between the capillaries (D = 1 and 1.5 mm). The bubble approach velocity V was controlled by the gas input (V = 0.031 - 39 mm/s). The liquid viscosity μ was adjusted by the alginate content (μ = 1.2 - 10.3 mPa.s). It was found that the bubble contact time T monotonously increases with the liquid viscosity, passing through three stages: initial rise (low μ, coalescence), then jump (intermediate μ, transient region), and finally forming a plateau (high μ, non-coalescence). In the coalescent regime, the bubble contact time monotonously decreases with the bubble approach velocity obeying a power law, which for a typical 1 mm bubble reads: $T \sim V^{-0.85}$. The difference in the bubble size did not change the coalescence pattern qualitatively, but only quantitatively in a modest manner.

Keywords: bubble coalescence, bubble approach velocity, liquid viscosity, transition regime

1. Introduction

The important phenomenon of coalescence of dispersed particles is inherent to the hydrodynamics of multiphase systems. In gas-liquid systems, like bubble column contactors and reactors, the