PRELIMINARY ASSESSMENT OF THE DRAG COEFFICIENT OF SINGLE BUBBLES RISING IN WATER–IONIC LIQUID MIXTURES

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Abstract. The increasing concentration of atmospheric greenhouse gases, especially CO_2, is a key contributor to climate change, with a large portion of emissions coming from industrial activities. As a result, CO_2 capture has gained significant attention in recent years. Ionic liquids (ILs) have emerged as promising solvents for CO_2 absorption due to their negligible vapor pressure, high thermal stability, and tunable physicochemical properties [1].

Bubble columns are widely used for gas–liquid absorption because of their simple design, low maintenance, and efficient heat and mass transfer [2]. However, their operation involves complex multi-scale flow phenomena. For IL-based systems, the fluid dynamics and mass transfer mechanisms are still not well understood, and experimental studies remain limited. In systems involving ILs, the hydrodynamics and interfacial behaviour can differ significantly from those in conventional liquids, and the underlying fluid dynamics remain poorly understood. Therefore, fundamental studies using air bubbles in water–IL mixtures are essential to characterize bubble dynamics independently of reactive or mass-transfer effects, and experimental data for such systems remain limited.

In this study, we experimentally investigated the drag coefficient of a single bubble rising in deionized water–IL mixtures. Calibrated bubbles with diameters between 3 mm and 10 mm were injected at the bottom of a rectangular bubble column (L = 0.15 m; W = 0.04 m; H = 1 m), and their terminal velocity was determined from high-speed videos. Two ionic liquids were considered, namely 1-butyl-3-methylimidazolium tetrafluoroborate (Bmim[BF_4]) and 1-ethyl-3-methylimidazolium acetate (Emim[Ac]), and different concentrations (10% and 20% by mass) were studied. The results were systematically compared with measurements in pure deionized water and with widely used drag correlations from the literature.

Keywords: *Ionic liquids, single bubble, drag coefficient*

References

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