Influence of electrolyte on velocity of the bubbles rising in solutions of sodium n-alkylsulfates (C8, C10, C12)

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Surfactants can diminish velocity of the rising bubble even by over 50% when fluidity of the bubble surface is completely retarded. As a result of viscous drag exerted by continuous medium on the moving bubble interface an uneven distribution of adsorbed surfactants, called Dynamic Adsorption Layer (DAL), is established when the bubble floats with its terminal (constant) velocity. The DAL formation means that adsorption coverage is lowered on the upstream part and increased at the rear part of the rising bubble. This induced gradient of the adsorption coverage means an appearance of a surface tension gradient, which retards fluidity of the bubble surface. Minimum adsorption coverage needed for complete retardation of the bubble surface fluidity is different for different surfactants and in the case of ionic surfactants can be strongly affected by an electrolyte presence in their solutions, because surface activity of ionic surfactants can be enhanced in electrolyte presence.

The contribution presents results of studies on influence of electrolyte (NaCl or KCl) addition and pH variation on bubble velocity in solutions of sodium n-octylsulfate (SOS), n-decylsulfate (SDS) and n-dodecylsulfate (SDDS). The electrolyte concentration was varied from 0.0001 to 0.05M, while pH from 3 to 12. Profiles of the bubble local velocity, i.e. the velocity variation with distance from a point of the bubble formation, and terminal velocities were determined, as well as the dynamic and equilibrium surface tensions of the solutions. In low concentrations of sodium n-alkylsulfates the bubbles, after the acceleration stage, reached a maximum followed by a deceleration stage tending to attain their terminal velocity. The maximum disappeared at high SOS, SDS and SDDS concentrations. Electrolyte alone did not change the bubble velocity. However, addition of even small amounts of the electrolyte into sodium n-alkylsulfates solutions lowered the bubble velocity. Increasing electrolyte concentration affected the bubble motion parameters in a similar way as increasing concentration of sodium n-alkylsulfates, what shows that due to the electrolyte presence the degree of adsorption coverage over the bubble surface was increased. Higher adsorption coverage means an increased retardation of the bubble surface fluidity and lower bubble velocity. The effect was especially significant at low concentrations of the surfactants studied. For example in 1x10⁻³M SDS and 3x10⁻⁵M SDDS solutions the bubble terminal velocities were lowered from 24.1±0.7cm/s and 31.4±0.6cm/s to 15.2±0.5cm/s and 14.6±0.5cm/s, respectively, when the electrolyte concentration was changed from 0 to 0.05M NaCl.