Numerical study of co-flowing air-water plane sheets

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Bubble generation is a fundamental problem of scientific interest at the same time as an important application of many industrial processes. Thus, with the aim at exploring new geometrical configurations to generate air bubbles, a two-dimensional flow pattern given by a plane air sheet surrounded by a coflowing water stream discharging into stagnant air has been studied by direct numerical simulation using the Volume of Fluid technique (VoF) to describe the air-water interface. The problem is governed by the Weber number, $We = \rho_w u_w^2 h_a/\sigma$, and the water-to-air velocity ratio, $\Lambda = u_w/u_a$, where u_w and u_a are the velocities of the water and air streams respectively, ρ_w the water density and h_a the half-thickness of the air exit. For a constant Weber number, two different regimes have been observed: jetting (Fig. 1a) and bubbling (Fig. 1b). The bubbling frequency, the intact length and the bubble size have been computed and compared with experimental data. Finally, the transition curve $We - \Lambda$ from jetting to bubbling has been calculated, as well as the bubbling frequency as a function of Λ for different values of We.

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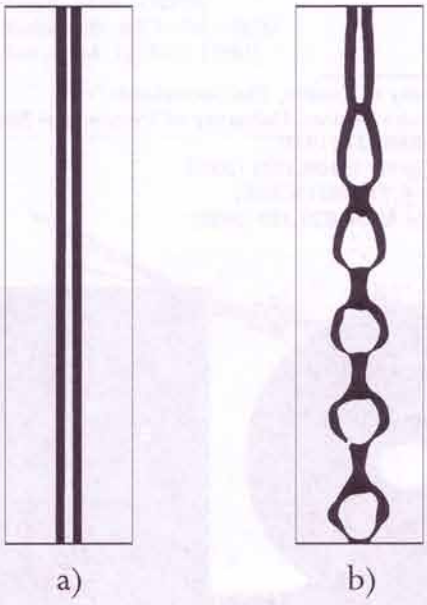

Figure 1: (a) Jetting regime at $\Lambda = 0.20$. (b) Bubbling regime at $\Lambda = 0.13$. $We = 13.86$.