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EXPERIMENTAL AND NUMERICAL STUDY OF IMPINGING BUBBLY JETS IN MICROGRAVITY CONDITIONS

Abstract

A study of bubbly jet impingement in microgravity conditions is presented in this work. The impinging jets configuration brings two jets flowing along the same axis in opposite direction into collision. As a result, a narrow zone (the impingement zone) in which coalescence events between bubbles can be enhanced, is created. Experiments have been carried out at ZARM Drop Tower through the ESA Education Drop Your Thesis! programme. Filtered air bubbles in distilled water as a carrier liquid are generated using a capillary T-junction ($d = 1$ mm inner diameter), in which a regular slug-flow is created prior to injection. Within this method, the size and velocity of the bubbles can be controlled via the gas and liquid flow rates. Variations of the separation between jets have been also considered, ranging from 5 mm up to 100 mm. Results on the global structure of the impinging jets and the individual behavior of bubbles are presented. In particular, the velocity field, bubble size distribution, and the spatial distribution of coalescence events are obtained, and compared with the results obtained in normal gravity conditions. The velocity field is highly perturbed by the presence of the opposing jet in the impingement zone. The conical aperture angle and the bubble mean size decrease as the momentum flux is increased. Coalescence events occur mainly near the nozzles and in the collision zone. A higher number of coalescences have been observed in microgravity than in the normal gravity case, due to the absence of buoyancy forces: in reduced gravity,the bubbles move passively within the liquid flow field, while in normal gravity the bubbles quickly rise after leaving the inertial region of the jets. Therefore, the relative velocity between bubbles is lower in microgravity than on ground. Good qualitative agreement between CFD simulations and experiments have been obtained.