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Turbulent hydraulic jumps: Effect of Weber number and Reynolds number on air entrainment and micro-bubble generation[1] MILAD MORTAZAVI, ALI MANI, Center for Turbulence Research, Stanford University — Air entrainment in breaking waves is a ubiquitous and complex phenomenon. It is the main source of air transfer from atmosphere to the oceans. Furthermore, air entrainment due to ship-induced waves contributes to bubbly flows in ship wakes and also affect their performance. In this study, we consider a turbulent hydraulic jump as a canonical setting to investigate air entrainment due to turbulence-wave interactions. The flow has an inlet Froude number of 2.0, while three different Weber numbers (We = 1820, 729, 292), and two different Reynolds numbers (Re = 11000, 5500) based on the inlet height and inlet velocity are investigated. Air entrainment is shown to be very sensitive to the We number, while Re number has a minor effect. Wave breaking and interface collisions are significantly reduced in the low Weber number cases. As a result, micro-bubble generation is significantly reduced with decreasing Weber number. Vortex shedding events are observed to emerge at the toe of the jump in all of the cases. For high Weber number regimes, shedding of vortices is accompanied by engulfment of air pockets into the jump in a periodic manner, while for lower Webber number regimes such events are significantly suppressed. Reynolds number is shown to have a negligible effect on the air entrainment, wave breaking and micro-bubble generation, contrary to the previous assumptions in other studies.

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