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Measurement of the Mean Droplet Size in Horizontal, Isothermal Air–Water and Air–Viscous Liquid Free Jets in Quiescent Ambient S. AL-RABADI, Fluid Mechanics Dept., Tech. Univ. of Hamburg–Harburg, Germany, A. AL-SALAYMEH, Mechanical Engineering Dept., Univ. of Jordan, Jordan, L. FRIEDEL, Fluid Mechanics Dept., Tech. Univ. of Hamburg–Harburg, Germany — In a free jet where higher turbulence intensity than that of the ambient exists, the liquid phase fragmentation enhanced by aerodynamic forces that are associated with the co-flowed and entrained air is pronounced. Measurements using 2-D PDA as well as high-speed cinematography of air–water and air–viscous liquid in free jets at several nozzle exit pressures and nozzle outlet diameters have been conducted. It became evident that the mean droplet size decreases with increasing air–liquid phase mass flow ratio due to the increase of the shearing on the liquid phase. This leads to substantial liquid fragmentation (primary breakup) and, subsequently, to the formation of satellite droplets with small sizes. This trend becomes significant with increasing liquid viscosity. Higher liquid viscosity than that of water affects the droplet formation and breakup by reducing the rates of surface perturbations and consequently droplet distortions. The droplet velocity decreases with the downstream distance due to the continued air entrainment. The kinetic energy of the droplets is mostly dissipated during the collisions, which may induce further liquid fragmentation and hence formation of a number of relatively smaller droplets (secondary breakup), or the formation of comparatively larger liquid fragments that may rain out the free jet.

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