NUMERICAL STUDY OF MULTIPLE TANDEM JETS IN CROSSFLOW

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The mixing and merging characteristics of multiple tandem jets in crossflow are investigated using the Computational Fluid Dynamics (CFD) code FLUENT. The realizable $k \sim \varepsilon$ model is employed for turbulent closure of the Reynolds-averaged Navier-Stokes equations. Numerical experiments are performed for 2- and 4-jet groups, for jet-to-crossflow velocity ratios of $K = 4.6 - 11.2$. The computed velocity and scalar concentration field are in good agreement with experiments using Particle Image Velocimetry (PIV) and Laser-induced Fluorescence (LIF). The results show that the leading jet behaves similar to a single free jet in crossflow, while all the downstream rear jets have higher and very similar jet trajectories – suggesting a reduced ambient velocity for the rear jets. The concentration decay of the leading jet is greater than that of the rear jets. When normalized by the appropriate crossflow momentum length scales, all jet trajectories follow a universal relation regardless of the sequential order of jet position and the number of jets. Supported by the velocity and trajectory measurements, the maximum effective crossflow velocity ratio is computed to be in the range of 0.49 to 0.59.