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Mixing Behavior of 45° Inclined Dense Jets in Currents

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Abstract:

In the present study, we experimentally investigated the mixing behavior of 45° inclined dense jets in unbounded co-flowing and counter-flowing currents using the Planar Laser Induced Fluorescence (PLIF) approach. The experiments were conducted in a towing flume, and the test conditions included a wide range of Densimetric Froude number (Fr) and Nominal Densimetric Froude number ($NFr > 0$ for co-flowing and < 0 for counter-flowing currents). The results showed that the mixing behavior can be categorized into dense-jet-dominated and current-dominated regimes. Within $|NFr| < 1.0$, the dense jet trajectories mainly depended on the source discharge characteristics, and the ambient currents had little effects. The dimensionless coefficients, including the centerline peak height z_m/FrD and dilution S_m/Fr at the centerline peak, were all nearly independent of NFr . Outside this range, however, the mixing became dominated by the currents, and the characteristics mainly depended on the value of NFr instead. The influence of currents on the jet spreading and concentration decay along the jet trajectories were quantified in details based on the experimental results. In particular, in counter-flows, the non-dimensional centerline penetration depth x_{cp}/FrD and the dilution at the centerline penetration depth S_{cp}/Fr were found to be strongly correlated with NFr .

Keywords: Inclined dense jets; Co-/Counter-flowing currents; Jet trajectory; Dilution.

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