

To characterize the dense regions at an early stage of atomization process in simplex swirl injector: two-photon laser-induced fluorescence technique

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Abstract

The primary objective of the present work is to capture n-heptane hollow cone spray at the initial phase of its atomization process in industrial pressure swirl injector. To visualize such optically dense regions, we have adopted a high-contrast imaging technique called two-photon laser-induced fluorescence (2p-LIF). This technique diminishes the multiple scattering events and associated issues of dense zones. Therefore, it became convenient to meet our second objective of estimating droplet size distribution (DSD) from the morphology of initial spray liquid structures. It is accomplished by analyzing the 2p-LIF data to determine liquid-gas interfaces and calculate their surface curvatures by employing a new analysis technique proposed in [1, 2]. The droplet size distribution and Sauter mean diameter (SMD) are calculated from the surface-interface-curvature analysis of the dense phase and compared with those obtained from the phase Doppler anemometry (PDA) measurements performed in the dispersed phase. It is shown that the dense spray carried footprints of the dispersed phase. Thus, the morphology/surface density of the initial spray structure is correlated with the final droplet size. Overall, this work belongs to a more global initiative that aims to characterize the dense zone of the spray to finally provide better input spray conditions that can be used for numerical simulations of spray flames. Result of the dense spray zone will then be analyzed in terms of consequences for further combustion simulations.

Keywords: 2p-LIF, SMD, size distribution, surface-curvature, simplex atomizer

References

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