Influence of Nozzle-Flow Turbulence on the Primary Spray Breakup

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Abstract

This paper presents experimental investigations of the correlation between nozzle flow and spray in a pressure atomizer with a constant volume flux. The focus is placed on the influence of turbulence and the secondary flow field in the nozzle. For these studies a nozzle and an operation set point were chosen such that no cavitation occurs inside the nozzle. To obtain experimental data at the same geometries for different Reynolds numbers two kind of liquids were used. In addition, various nozzle geometries have been investigated for the liquid with the lower viscosity.

Inside the transparent nozzle the three-dimensional velocity and turbulence distributions in three different cross-sections were measured using a Laser Doppler velocimetry with a high spatial resolution. To obtain information about the spray near the nozzle exit, where the optical obscuration is high, an X-ray system was developed. This system makes it possible to estimate the three-dimensional density distribution using a tomographic reconstruction process in this spray region. In the boundary area of the spray near the nozzle exit a Dual Mode phase Doppler sys-tem was applied to measure the three-dimensional velocity and droplet diameter distribution. Finally, high-speed videos from the entire spray have been taken to gain a better understanding of the spray formation.

The experimental results show that the breakup of the two liquids at different Reynolds numbers is completely different. By comparing the different nozzle geometries the turbulence was identified as the main cause for breakup. The turbulence affects the spray width and the number of droplets but it has no effect on the droplet diameter.

Key words: Primary breakup, atomization

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