Discharge and Dispersion in Water-Mist Sprays: Experimental and Numerical Analysis

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Abstract

The present study is aimed at modeling a high-pressure water-mist spray employing two classic numerical codes. To this end, an experimental campaign has been performed both to obtain the input data for the numerical approach and to serve as a validating tool to quantify the predictive capability of the proposed models. In particular, experiments have been conducted to determine volume-flux distribution, drop-size distribution, initial velocity and spray-cone angle. Advanced laser-based diagnostics (*Malvern Spraytec* and Particle Image Velocimetry) has been employed together with simple *ad hoc* built instruments to measure these parameters over a prescribed range of high operative pressures (50-90 bar). Specific measurement methodologies have been developed to gain a proper experimental evaluation of any subject of investigation. Then, a computational simulation of the water-mist spray has been implemented in Fluent and FDS (Fire Dynamics Simulator) codes. Characteristic drop size, velocity and cone angle have been introduced as input parameters, while volume-flux distribution has been employed to compare numerical results to experimental data as a final validating task. A good qualitative agreement has been gained: the spray physics appears to be properly expressed by the proposed models. However, intrinsic limitations characterize both the experimental tools and the computational codes and may explain some still-to-be-solved discrepancies from a quantitative point of view.

Key words: water mist, discharge, dispersion, experimental analysis, numerical models.

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