Abstract

The thesis presents a detailed study on the accuracy of the water spray numerical simulations, concerning the statistical error that is induced by the number of Lagrangian particles (N_p), which is prescribed to represent the water spray pattern. A wide variety of nozzles that produce water droplets with mean diameters ($Dv_{0.5}$), ranging from 35 to 1000 μm, have been used to conduct a series of numerical simulations (experiments) with the Fire Dynamics Simulator (FDS). The simulation results were analyzed to derive prediction models that allow for the estimation of the appropriate number of particles that eliminates the statistical error (critical N_p or $N_{p,cr}$). The effect of the computational mesh on the $N_{p,cr}$ is also investigated. The N_p, as a simulation parameter, significantly affects the simulation results. In addition, the study proves that the FDS default value $N_p = 5 \times 10^3 s^{-1}$ fails to accurately represent any water spray within the aforementioned range and suggests a power law relation between the $N_{p,cr}$ and the $Dv_{0.5}$, which confirms the proportionality of the statistical error and the quantity $1/\sqrt{N_p}$, and reveals a homogeneous behavior of the $N_{p,cr}$ for $Dv_{0.5}$ higher than 400 μm. Finally, the present work illustrates that the CPU time increases either linearly or exponentially, as the N_p increases.