CFD analysis of dilute sprays using the Euler-Lagrange modeling.

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Abstract

The presented work is about Computational Fluid Dynamics (CFD) modeling of dilute sprays – both non-evaporating and evaporating. For this purpose the newly developed Euler-Lagrange solver in OpenFOAM 1.6 will be used. The results obtained with the Euler-Lagrange solver in OpenFOAM 1.6 will be compared against the commercial Euler-Lagrange solver of ANSYS FLUENT 12.1.

The spray configuration considered here has been experimentally studied through Laser- (LDA) and Phase-Droppler Anemometry (PDA) measurements by Nijdam et al. [1]

The spray nozzle has an aerodynamic profile (long, tapered and sharp-edged), which was designed for preventing recirculation at the nozzle exit. The nozzle has an inside diameter of 9.8 mm and a length of 240 mm. The spray has an exit velocity of 23 m/s and a turbulence intensity of 1.4 %. The gas temperature at nozzle exit is 0 °C. The co-flow has a velocity of 2.4 m/s with an air flow temperature of 16 °C. The droplet sizes range from 1 µm to 90 µm.

The Euler-Lagrange model in OpenFOAM will be used for prediction of dilute non-evaporating (turpentine) and evaporating (acetone) sprays. Both models will be validated against the experimental studies of Nijdam et al. [1] and the Euler-Lagrange simulation models of Nijdam et al. [2,3], which had been developed using the commercial CFD software CFX 4.4.

Keywords

CFD, OpenFOAM, Multiphase flow, Euler-Lagrange, Evaporating spray

References

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