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Interactions between evaporating droplets in a monodisperse stream

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Abstract

A numerical simulation of the evaporation in a monodisperse droplet stream is conducted, taking into account the interactions between droplets. A code solving the Navier-Stokes equations in the liquid phase is coupled to the calculations of the external flow using commercial CFD software. The transient stage of the evaporation, and the non-uniform transfer parameters on the droplet surface are taken into account. The results are validated with the experimental measurements of the vapor mole fraction field and with empirical correlations on the transfer parameters. This investigation emphasizes the strong interaction effects between closely spaced droplets in a dense spray, reducing significantly the transfer parameters. The Marangoni force in the droplet becomes more significant than the viscous force, driving the internal motion of the droplet and affecting the temperature field. Finally, a better understanding of the evaporation phenomenon with closely spaced droplets will help to refine existing models used in dense sprays.

Key words: spray, evaporation, interactions, wake, Marangoni, monodisperse

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