Experimental investigation of evaporating bi-component droplets in a turbulent channel flow

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Abstract

The reduction of the pollutant emissions and the identification of new fuels can be achieved by a better understanding of the physical phenomena like fuel droplets evaporation and heat exchange. Mathematical modelling of these phenomena will find further its applicability in the simulation of the spray evaporation inside a combustion chamber.

The long term objective of this study is to experimentally investigate the influence of the turbulence on the multicomponent droplets evaporation. The experimental database will be used in the future to validate the numerical simulation developed in parallel at ONERA.

The short term objective is to investigate the coupling of the Global Rainbow Thermometry (GRT) and Phase Doppler Anemometry (PDA) techniques in a highly turbulent and confined flow and to characterize the droplet size, velocity and temperature evolutions in the channel. As liquid, a mixture of n-octane and 3-pentanone is used.

The experimental setup consists in a square cross-section channel flow with a very high level of turbulence intensity. An ultrasound atomizer disposed inside the duct allows the formation of a cloud of bi-component droplets of different sizes and velocities which are quickly dispersed in the carrier flow. The measurement techniques are described and the results are presented for different measurement positions in the channel flow.

Key words: spray evaporation, experimental investigation, rainbow thermometry, turbulent flow

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