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MODELING OF COLLISIONAL SURFACE PRODUCTION/DESTRUCTION TERMS WITHIN THE Σ-Y EULERIAN SPRAY ATOMIZATION MODEL

Dominik Eichler[§], Philipp Pischke, Reinhold Kneer
Inst. Heat and Mass Transfer, RWTH Aachen University, Germany
[§] Correspondence author. Email: eichler@wsa.rwth-aachen.de

ABSTRACT The Σ-Y Eulerian spray atomization model is suited for CFD simulations of high Weber and Reynolds number sprays. In this model, the spray is assumed to behave like a single phase turbulent flow. Two additional transport equations are introduced to describe the flow: A transport equation for the liquid mass fraction Y and another one for volumetric interfacial area Σ. Among others, collisions of liquid droplets lead to production and destruction of Σ. In the work presented here, an expression for the collisional production term is derived by means of a numerical experiment featuring turbulent droplet collisions: Generic droplet populations, described by an initial mean Weber number and the shape of the initial droplet distribution are subject to turbulent velocity fluctuations leading to turbulent droplet collisions. A stochastic droplet collision modeling algorithm is used to trigger collisions. The outcome of a collision is determined by the comprehensive collision model proposed by Munnannur and Reitz. Results show that a collisional production term can be obtained featuring the same form proposed in the literature but which was hitherto postulated, but not demonstrated. Since different approaches exist for the modeling of τ_{coll} and Σ_{eq}, CFD simulations employing the Σ-Y model are performed showing the influence of the value of τ_{coll} and Σ_{eq}. The results indicate that production of Σ is fast compared to numerical time steps typically used in CFD spray simulations. Thus, Σ is limited by its local equilibrium value Σ_{eq}.