criteria for breakup of droplets

I. Sher*, E. Sher†

* School of Engineering
Cranfield University
Cranfield, Bedfordshire MK43 0AL
United Kingdom

† Department of Mechanical Engineering
Ben-Gurion University of the Negev
Beer-Sheva, Israel

Abstract

The problem of a liquid droplet in high speed trajectory through ambient gas is modelled. The fate of such a droplet is of importance to the prediction of overall spray characteristics, in the context of secondary breakup. This phenomenon poses some fundamental problems of transformation between different energetic states.

A theoretical analysis of the problem is presented, in which an overall energy balance is examined, that includes surface, kinetic and dissipation energies. Transformation between states, i.e. between a droplet and its breakup products, is a spontaneous process, under instantaneous trajectory conditions that include drag forces. Transformation involves the reversible surface and kinetic energy transitions, and the irreversible viscous dissipation energy. Results imply a bi-modal equilibrium. Thermal effects, as in the case of a hot ambient are also discussed.

* Corresponding author: i.sher@cranfield.ac.uk