ICLASS 2009, 11th International Annual Conference on Liquid Atomization and Spray Systems, Vail, Colorado USA, July 2009

Drop Fingering on Oblique Impact: Part 2—Modeling

Alexander L. Brown* and Richard A. Jepsen
Sandia National Laboratories
PO Box 5800
Albuquerque, NM 87185-1135

Abstract

Recently acquired data for oblique drop impacts provides the background for the development of a model to help describe the fluid behavior of such events. Part 1 of this paper series presents data from impact events of various scales with water. Fingers are particularly evident in portions of the results, and have therefore been quantified for the range of experimental conditions.

The fingering data have been analyzed to develop a predictive model that can appropriately distribute the fingers given the initial direction of travel of the incoming drop and the angle of inclination of the drop to the obstacle surface. This is managed through an empirical distribution function. The distribution function has been empirically determined from the dimensionless data, and is a function of two constants and a dimensionless velocity. The model is found to result in reasonable fit for the range of conditions that involve between 0.4 and 10 cm diameter drops, velocities ranging from about 1-20 m/s, and impact angles from 90º to 45º (from horizontal). Coefficients of determination are presented for the existing data. Because the distribution function only provides a weighting, we also make comparisons with the data involving a total finger model. The fit remains acceptable with the added uncertainty of the total finger model.

This model provides the basis for an oblique impact splashing model that has been implemented in a dilute spray CFD code. We make the assumption that the splashing drops are distributed proportionally according to the fingering distribution. This is an excellent approximation for some splashes, and may be reasonable for others. This model represents a pragmatic improvement to the predictive behavior of a general model for drop impacts.

Key words: Impact angle, instabilities, fingers, pressure, droplet

* Corresponding author, albrown@sandia.gov