Flashing liquid jets and two-phase droplet dispersion
II. Scaled experiments for derivation of droplet atomisation correlations

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Abstract

This paper describes the results of the first stage of Phase III of a Joint Industry Project (JIP) on liquid jets and two-phase droplet dispersion. This stage included scaled experiments for water, gasoline, cyclohexane, butane and propane for a range of superheats (carried out at Cardiff University), although this paper will focus on the water and cyclohexane experiments to describe the model development. Moreover this stage provided recommendations for atomisation correlations in the regimes of mechanical break-up, transition to flashing, and fully flashing. See the overview companion paper I for a wider overview of the problem, implementation of the correlations into consequence models and subsequent validation against both the current scaled experiments and additional large-scale butane experiments.

The first experimental stage involved the following:

- Experiments for water including variation of superheat for the first time. These were required to further validate and possibly improve the SMD correlation as a function of superheat. Experiments (involving different orifice sizes) were carried out where droplet size measurements were taken across the full relevant range of superheats. These measurements were taken using new advanced PDA technology for dense sprays recently acquired from Dantec Dynamics.

- Additional experiments for other chemicals than water, e.g. cyclohexane (orifice sizes up to 2 mm). These are required to ensure that the derived droplet size correlations are also valid for other chemicals and hence different thermo-fluid properties (including refining of the correlation). This included measurement of flow rate, accurate characterisation of discharge and the atmospheric expansion zone, and added near-field downstream measurements (droplet distribution).

- Development of new correlations for SMD and droplet size distribution based on a best fit of the above experimental data. The new Phase III SMD correlation retains the tri-functional curve as function of superheat (including regimes for mechanical break-up, transition to flashing, and fully flashing) but includes considerable further refining accounting for the larger droplet sizes measured by the new PDA system.