CHARACTERIZATION OF FLASHING BREAK-UP OF SUPERHEATED LIQUID JETS

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When a pressurised liquefied gas is submitted to an instantaneous release to ambient conditions, the fluid becomes superheated and unstable. Part of the fluid disintegrates through violent evaporation using its internal energy and a two-phase mixture appears. As a result of the evaporation the remaining liquid is cooled to saturation temperature, which for liquefied gases is on the order of -30º C (even lower) at ambient pressure. This evaporation process, called *flashing*, can be very violent and some times explosive. The flashing phenomena has many areas of interest in current industrial environment such as injection systems in rockets and diesel engines, or safety aspects in failures of pressurized vessel in chemical and nuclear power plants.

This project has focused on two phase flashing jets. The main objective of this study was to model and characterize the break-up length of a R134a flashing jet, i.e. the distance from the nozzle outlet where the jet breaks-up into a spray. Two different approaches, theoretical and experimental, were used in the investigation.

In the theoretical approach, the variable temperature field inside the jet has been modelled, obtaining the temperature profile in the jet along its axis for different jet diameters. The results have been used as an input in a bubble growth model. Also the nucleation of bubbles in the flashing jet has been investigated. The results show that jets with larger diameters will nucleate more bubbles and they will grow much faster than in jets with smaller diameters. This could explain what it has been experimentally observed in previous investigations: when the diameter of the jet increases the break-up length decreases (Figure 1).

In the experimental approach, a laser extinction technique (LEM) was applied to detect bursts in the flashing jet (Figure 2). The basis of this technique is simple: a laser beam crosses the jet and a photodiode receives its signal at the other side of the jet. When explosions or bubbles pass through the beam, the photodiode signal is disturbed and these events are detected. High speed camera images of the flashing jet were analyzed and coupled with LEM to develop a burst detection algorithm to measure the number of flashing events and their rate. Microphone and piezoelectric sensors were also used to characterize the flow downstream and upstream of the nozzle were the jet originates.

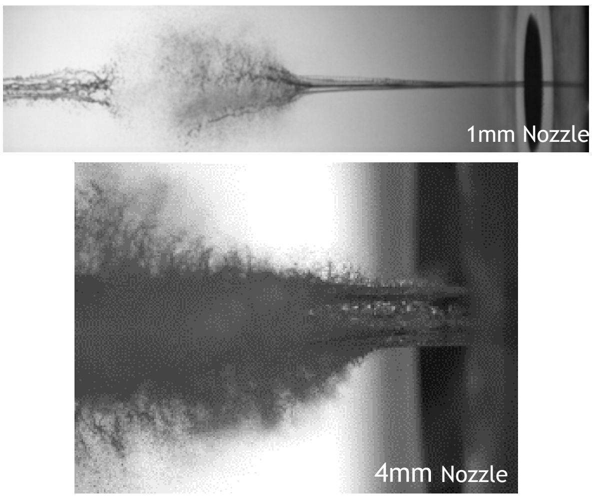

Figure 1: Decrease of the break-up length when the diameter of the jet increases (high speed camera imaging).

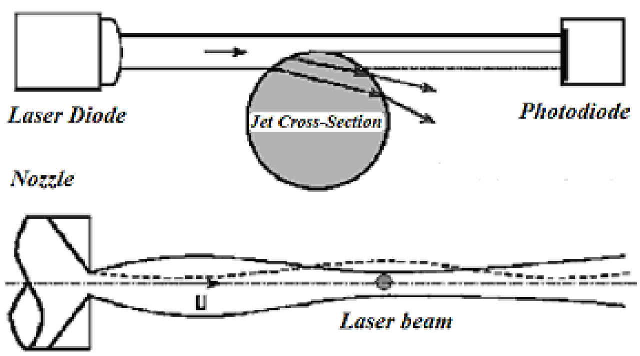

Figure 2: Schedule LEM technique applied to burst detection .