EXPERIMENTAL CHARACTERIZATION OF A FLASHING TWO-PHASE JET

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In the industrial environments some liquids, as butane or propane, are stored under high pressures. Sometimes, hazardous situations can happen in case of accidental release caused by equipment or operator failure. In this case the high pressured liquids face on sudden depressurization and this leads to a non-equilibrium in the state of the material (highly flammable) ending up in vapor explosions which is known as “Flashing”. This project will focus on an understanding of the source processes with emphasis on rapid spray droplet evaporation after the formation of a two-phase flashing jet.

The purpose of this study is to develop a physical model that describes the flashing process immediately after the release. In this project optical techniques are used to characterize a spray of droplets of Freon 134a. Measurements of the droplet velocity were taken using PIV.

The model that was developed for 1D spray showed that the droplet diameter and velocity decrease with the time and the behavior of the droplet changes for different initial diameters. This means that the smaller is the droplet diameter, the faster is the evaporation and the velocity decrease. An other important point was the calculation of the droplet temperature. It was show that the temperature decreases very fast and goes to a value -57.5^{0}C lower than the boiling point (-26.7^{0}C). Decreasing the ambient temperature the droplet temperature decreases.

Except the numerical approach, PIV measurements were performed in the centre-line of the jet in different positions downstream of the nozzle (different diameter and angle of it). There were many problems to face on, as in the flow there was liquid, the seeding close to the nozzle was too dense and the conditions inside the bottle were not controlled. From the photos below these problems are showed. From the velocity profile it was observed that the velocity decrease depends on the nozzle diameter, which means bigger nozzle diameter corresponds to higher velocity. Moreover, the different nozzle angle influences the evolution of the velocity, i.e. the smallest is the nozzle angle the higher is the velocity. Finally, comparison between the experimental results for this flashing jet and normal air jet showed that there is no similarity.

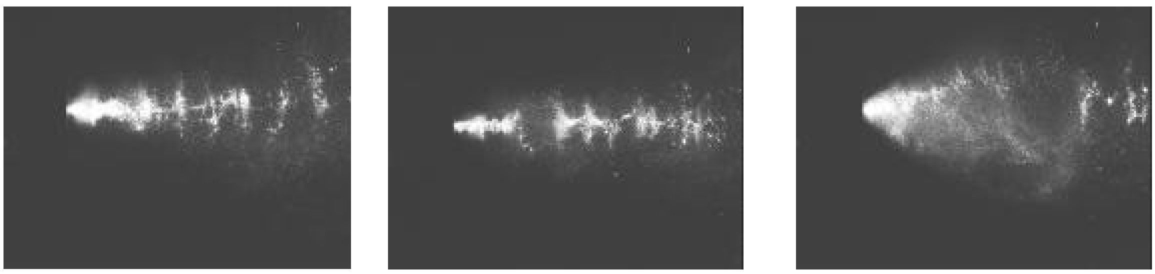

Figure 1: Instantaneous images of a flashing jet R134a