THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF LIQUID JET STABILITY FOR APPLICATION TO FLASHING

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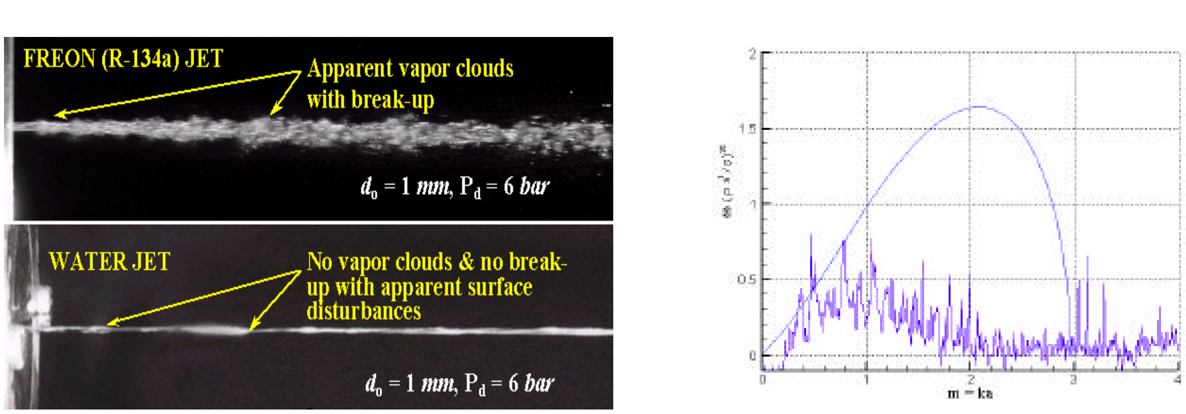
The hazards associated with accidental release of pressure-liquefied gases have become important in consideration of safe storage and handling as well as the development of mitigation methods. Flashing is known to involve rapid vaporization under dynamic release conditions that under certain conditions can become explosive.

The purpose of these investigations is to characterize the phenomenon of flashing from a stability perspective. As a necessary first step, the hydrodynamics are considered through application of theoretical stability analysis. To test the theory, a laser-based technique was developed for measurement of interfacial surface disturbances and corresponding amplifications or growth rates of unstable disturbances.

Each of the nozzles used for on-going flashing experiments were tested using the existing VKI water spray facility to determine nozzle hydraulics (measured as discharge coefficients), jet dispersion characteristics (measured as droplet diameter and velocity distributions downstream of the jet breakup location), and stability characteristics (predicted using linear stability theory and measured as disturbance growth rates using the laser extinction method). Stability characteristics were then related to dispersion characteristics by comparison of most unstable disturbance wavelengths with droplet diameters in the dispersed two-phase flow region. Ultimately the methods developed under this project may be extended to flashing jets by further consideration of thermodynamic instability and application of the laser extinction method to future Freon R-134a experiments being conducted here at the VKI.



(a) *(b)*

Figure 1 : Comparison of flashing and non-flashing jets discharged from a 1-mm nozzle (a) and comparison of theoretically predicted and measured disturbance growth rate spectra (b)