Chair of Aerodynamics and Fluid Mechanics
TUM School of Engineering and Design
Technical University of Munich

Experimental Study of Liquid Aluminum Secondary Atomization

Semester's Thesis / Master's Thesis

Contact: Leopold Winter
Mail: leopold.winter@tum.de
Phone: 089 289 16393
Start date: As of now

Motivation

In powder-based additive manufacturing of metal parts, high-quality metal powder is essential. The powder's shape and size significantly affect the quality of the final product. Typically, metal powders are produced through atomization of a liquid metal jet in a gas atomizer. A crucial stage in this process is secondary atomization, wherein individual droplets break down into multiple smaller fragments. Previous experiments at the Chair of Aerodynamics and Fluid Mechanics explored droplet breakup using both liquid metals and water. These experiments involved generating single droplets, atomizing them in a shock tube, and capturing the breakup process with a high-speed camera. The next phase of research aims to analyze the impact of varying experimental conditions on the breakup process of liquid aluminum.

Objectives

The primary objective of this thesis is to conduct experiments with liquid aluminum using the shock tube. The facility for these experiments is already established, and preliminary tests with aluminum have yielded promising results. The process involves melting single aluminum spheres and subsequently exposing them to a controlled flow generated within the shock tube. Experiments will be captured using a high-speed camera, and various pressure and temperature sensors. Following the experiments, a detailed analysis will be performed, utilizing both the recorded pressure signals and the high-speed imagery. This analysis aims to study the mechanisms and characteristics of liquid aluminum breakup. The ultimate goal is to derive conclusions about the breakup behavior of liquid aluminum droplets, and compare these to other liquids.

Additionally, as a secondary objective, there is a plan to design an enhancement for the current experimental setup. This modification will enable the conduction of experiments in an inert atmosphere.

Requirements

- Knowledge of general gasdynamics
- Experience in practical lab work
- Knowledge in MATLAB
- Knowledge in CAD

What you learn during this thesis

- Planning and conducting experiments
- Practical work with a shock tube
- Gaining insights into multiphase flow phenomena and their applications

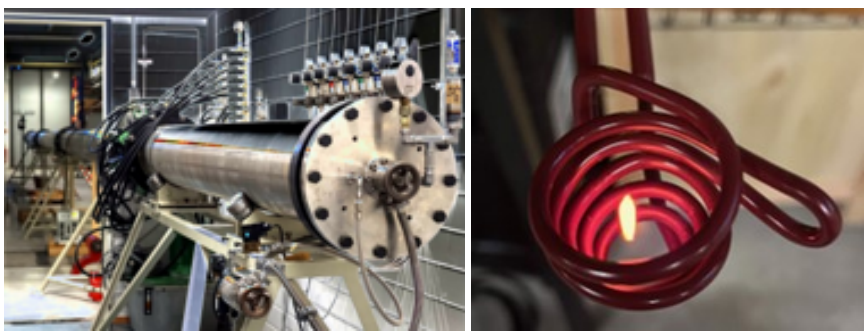

Figure 1: Left: Experimental facility, shocktube at the AER. Right: Levitating and melting aluminum inside an induction coil