Fachbereich 4
Produktionstechnik
Maschinenbau &
Verfahrenstechnik

CENTER OF
APPLIED SPACE TECHNOLOGY
AND MICROGRAVITY
ZARM

Fluids and Space Engineering Seminar

Date: Thursday, April 27, 2023 at 14:15 h
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Application of Screen Channel Liquid Acquisition Devices for Phase Separation in Microgravity

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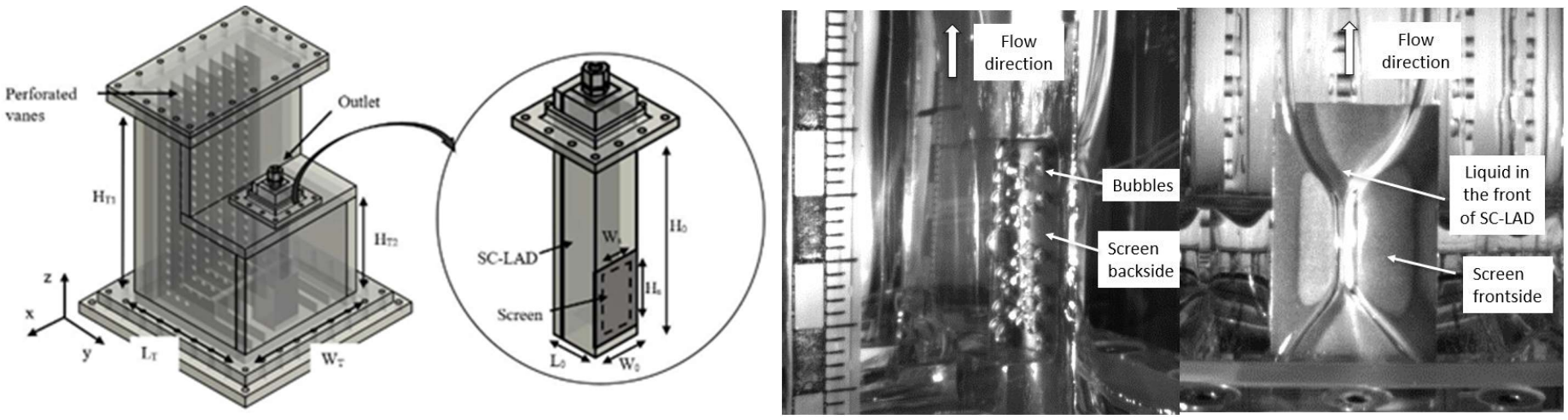

Figure 1: Experiment tank CAD model and sample drop test results showing ingested bubbles after the bubble point breakthrough.

Phase separation is critical for the supply of gas-free liquid propellant from the tank outlet to the engine of a spacecraft. In a microgravity environment, surface tension and contact angle become the governing mechanism for phase separation and dictate the position of the liquid-gas interface. Liquids with zero-degree contact angle tend to adhere to the tank wall, and gas stays in the center. Therefore, to maintain a constant supply of liquid to the outlet of the tank, a liquid acquisition device (LAD) is essential.

In this project, the experiment was designed to investigate the phase separation in a microgravity environment with the help of a screen channel liquid acquisition device SC-LAD. For this purpose, a supply tank was designed with a SC-LAD inside it. The screen used in the SC-LAD is DTW 200x1400. The liquid was removed from the supply tank through the SC-LAD at a fixed flow rate. The analysis of the sensor data and the images obtained by the high-speed cameras shows a successful separation of phases through the SC-LAD in subcritical conditions and ingestion of bubbles at the critical condition. The phenomena observed during the experiment are reorientation of the free surface under microgravity, capillary rise of liquids between parallel plates, flow through screen pressure loss due to applied removal flow rate and bubble point breakthrough of the screen. In this talk, the experiment setup, observations and results from the drop tower experiment campaign will be discussed.