

Validation of computational fluid dynamics in biotechnologically relevant fluids

PhD-student: Rik Volger
e-mail: r.volger@tudelft.nl

Co-Promotor/

Supervisors: Dr. Cees Haringa

Promotors: Dr. Adrie Straathof

Project term: March 2022 – February 2026



Description

Most validation of computational fluid dynamics (CFD) simulations has been performed with water-air systems. However, fermentation broth in industrial biotechnological processes exhibit significant differences from water, leading to inaccuracies in computational predictions. In my project, we aim to validate CFD simulations for biotechnological processes with fermentation broth, or fluids closely resembling fermentation broth. I will use a combination of fiber probes and advanced optical and radiation-based techniques such as x-ray tomography to characterize the behavior of the gas phase and liquid phase, including e.g. the bubble size distribution. I will use machine learning to investigate these distributions and the three-dimensional flow patterns in opaque liquids, and to make the translation from experimental findings to hydrodynamic models.

Second, I will investigate the impact of surfactants and salts on the oxygen transfer rate and the mechanisms behind that. Last, I will tune CFD simulations to explain broth fluid behavior obtained by experimental data.