Master Thesis

Call for Application

Parameterization and Optimization of Stirrer Geometries for Stirred Tank Bioreactors Using CFD-Coupled Iterative Algorithms

Problem Description:

Stirred tank bioreactors rely on efficient stirrer designs to ensure proper mixing, mass transfer, and shear conditions critical for bioprocess performance. Traditional stirrer geometries are often fixed and may not optimize these factors for various applications. CFD simulations enable detailed analysis of flow and mixing but manually refining stirrer designs based on CFD results is time-consuming. An automated, iterative optimization approach that parametrizes stirrer geometry and uses CFD outputs to guide improvements can accelerate and improve design. However, optimized stirrers must be experimentally validated to confirm simulation accuracy and practical performance.

Objective and Scope of Work:

This thesis aims to develop stirrer design parameterization and CFD-based iterative optimization framework for stirrer geometries in stirred tank bioreactors. Tasks include:

- Defining geometric parameters representing stirrer features
- Performing CFD simulations to evaluate gas holdup for each design.
- Implementing an optimization algorithm to update parameters based on CFD results, targeting gas holdup and power consumption.
- Identifying best performing stirrer designs for prototype fabrication and pilot plant testing.
- Verifying CFD predictions by experiments in a 30L stirred tank reactor.

The guidelines available at the Institute for Multiphase Flows for the preparation of theses must be observed.

Hamburg, 07.04.2026

Contact:
Christoph Wigger, M.Sc., Room N 1.083
Noah von Schnitzler, M.Sc. Room O.3018

Focus: **Simulative, Experimental**
Start: **from 06/2026**