UNIVERSITY OF BIRMINGHAM

PhD position on modelling bubble-particle in multiphase systems for advanced sustainable separation techniques

Location: School of Chemical Engineering, University of Birmingham

Supervision: Dr. Thomas Abadie and Prof. Mark Simmons

About the project

Microplastics pose a significant threat to aquatic ecosystems and human health. Bubbly flows—widely used in flotation and water treatment processes—offer a promising solution for their removal. However, the complex interactions between bubbles, particles, and contaminants present challenges in optimising these processes for real-world applications. This PhD project, in collaboration with Prof. Kristian Waters (McGill University, Canada), will explore bubble-particle dynamics to enhance the efficiency of flotation-based separation methods. While froth flotation has been widely used in mineral processing, its potential for environmental applications—such as microplastic removal, battery recycling, and microalgae harvesting—remains underexplored. Through a combination of **experimental visualisation, interfacial property measurements, CFD modelling and data-science**, this research will pave the way for more sustainable and resource-efficient flotation technologies.

Key Research Areas

- **Bubble-Particle Interactions:** Investigating how bubbles interact with microplastics and other particles in multi-phase systems.
- **Experimental Analysis:** Using high-speed imaging, PIV (Particle Image Velocimetry), and PEPT (Positron Emission Particle Tracking) to capture and analyse bubble and particle trajectories.
- **Computational Modelling:** Developing and refining **3D CFD simulations** (using OpenFOAM or Basilisk) to model bubbly flows with particles, incorporating surfactant dynamics and non-Newtonian effects.
- **Sustainable Surfactants & Energy Efficiency:** Evaluating the role of plant-based surfactants and polymers to optimise flotation processes and minimise water, chemical, and energy usage.
- **Multi-Scale Approach:** Bridging small-scale experimental and modelling insights with large-scale numerical models to guide the design of more effective flotation systems.

Why Join This Project?

- **Interdisciplinary & Collaborative Research:** Work at the intersection of fluid dynamics, environmental engineering, and computational modelling.
- **International Collaboration:** Conduct research in partnership with **Prof. Kristian Waters** at **McGill University, Canada**, with the opportunity for a research placement in his lab.
- **Cutting-Edge Techniques:** Gain expertise in advanced experimental methods and computational fluid dynamics, using open-source tools like OpenFOAM and Basilisk.
- **Impact-Driven Research:** Contribute to tackling global environmental challenges, from microplastic pollution to resource-efficient recycling and water purification.
- **Supportive Research Community:** the School of Chemical Engineering runs the Centre for Doctoral Training in Formulation Engineering, and the project will build on the EPSRC PREMIERE programme grant, a leading programme in numerical modelling and data-driven methods with researchers from the University of Birmingham, University College London and Imperial College.

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Applicant:

Applicants should have a first-class degree or good 2:1 (or equivalent) in Chemical Engineering, Mechanical Engineering, Computing, Mathematics, or related areas. We welcome applications from candidates with a strong background in **engineering, physics, fluid mechanics, computational modeling, or related fields**. Experience with CFD, experimental fluid mechanics, or interfacial science is beneficial but not essential. A passion for sustainability and problem-solving is key!

Due to funding restraints, the position is only open to UK rate students. To be eligible for a fully funded UK home studentship you must be a UK national resident in the EEA, Switzerland, the UK or Gibraltar for the last three years. Candidates with settled status (having lived in the UK for five years) and pre-settled status (having lived in the UK/EEA/Gibraltar/Switzerland for a minimum of three years) are eligible for funding. Candidates with indefinite leave to remain or enter are also eligible for funding. Self-funded students are also welcome to apply.

Deadline: The position will be filled as soon as a suitable person has been found; hence you are encouraged to apply as soon as possible (by email to t.abadie@bham.ac.uk or online https://www.birmingham.ac.uk/study/postgraduate/subjects/chemical-engineering-courses/chemical-engineering-phd).