# EPSRC supported EngD:

Transforming the sustainability of formulated product manufacture in stirred vessels with CFD and AI-based models.

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Unilever (Port Sunlight)

Tax free bursary of £ 25,737 per annum plus fees paid.

**Project Description:**

This project focusses on the uses of engineering simulations and ML/AI to accelerate the development of the manufacturing process for formulated liquid products and their implementation in factories. The industrial sponsor, Unilever, is a global company focused on consumer goods, including food (Hellmans), cleaning products (Persil), and personal care products (Dove). Digital transformation is crucial for Unilever to innovate, enhance sustainability, engage consumers, and improve operational efficiency.

These products have a rapidly-evolving property called rheology where the thickness (viscosity) changes over time and with movement. Examples include slurries which are then spray dried into granules, surfactant structured liquids, paints and coatings, inks and adhesives. Here, the in-process microstructural development, and thus rheology, is so rapid that it cannot be captured by measurements offline. This hampers scale-up calculations for new formulations from lab (litre) to process scale mixers (tonnes) because the material properties are not known, driving extensive experimental trials that generate material waste and use energy and detrimentally impact the sustainability targets on reducing GHG emissions.

This project will tackle this challenge by developing and testing of in silico modelling approaches, ultimately applying them as experimental surrogates, to relate bulk process parameters to the material in-process parameters. During manufacture the viscosity & rheology evolves so the process can move through turbulent, transitional and laminar flow regimes. Computational Fluid Dynamics (CFD) is very efficient at modelling turbulent and laminar flows but modelling transitional flows remains a major challenge. The research will thus tackle (i) testing of CFD closure models for turbulent flow to resolve transitional flows, validated against existing experimental flow data for non-Newtonian mixing in stirred tanks, (ii) optimisation of simulation speed and accuracy using the latest developments in running CFD on GPU based computers and AI optimisation of closure models and (iii) testing of the capability of open-source and proprietary AI tools to interrogate simulations to relate observed process phenomena (e.g. torque) to material parameters (rheology).

Funding Details:

To be eligible for EPSRC funding candidates must have at least a 2(1) in an Engineering or Scientific discipline or a 2(2) plus MSc.

To apply please email your cv to [cdt-formulation@contacts.bham.ac.uk](mailto:cdt-formulation@contacts.bham.ac.uk).

Open to UK nationals only due to funding restrictions.

For details on the Engineering Doctorate scheme visit the [homepage](http://www.birmingham.ac.uk/schools/chemical-engineering/postgraduate/eng-d/index.aspx).

**Deadline:**

17th January 2025