EPSRC supported EngD: Computational modelling of drag reduction agents (DRAs) in pipe flow.

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

Project Description:
Drag-reducing agents (DRAs) are chemicals for improving transport when pumping fluids of high Reynolds numbers, which consumes 10 to 25 percent of the global energy demand (*Napierala (2022) Energies 15(3), 799*). Being introduced at the upstream of a pipeline, DRAs can reduce the drag up to 80%, leading to a significant energy reduction (*Xi (2019) Phys. Fluids 31, 121302*), utilising less infrastructure, and decreasing the corresponding carbon footprint. The design principle of DRAs is to produce molecules with exceptional chain length. However, they undergo performance degradation due to the scission of their polymeric chains when they are subject to high turbulent shearing in the pipeline. The aim of this project is to develop a computational platform to simulate DRAs in a turbulent pipe flow to analyse the shear stress effects on the performance of DRAs along the pipeline.

This project will investigate the effect of different DRAs in improving flow behaviour in pipe flow by developing a turbulent model for a straight pipe. The turbulence model will be based on a robust Reynolds-Averaged Navier-Stokes (RANS) (*Niazi et al. (2024) Chem. Eng. Sci., 285, 119612*) or a Large-Eddy Simulation (LES) (*Li et al. (2020) Comp. Mod. Eng. Sci. 125, 541*) model. We will develop and validate the model for Newtonian fluids and commercially available DRAs such as poly alpha olefins (PAOs). Subsequently, we will expand the model to non-Newtonian fluids using appropriate constitutive models to match rheological properties. In the next step, we will develop our model to include more complex geometries and components such as bends, reducers, expansions, etc. under different operating conditions. Finally, we will develop a mathematical model to correlate the shear stress with the available DRA performance at different pipe sections.

It is expected that developing a computational tool for modelling drag-reduction in turbulent flow could reveal the underpinning mechanisms for the scission of polymeric chains of DRAs and inform our industrial collaborators with an in-depth understanding on the role of turbulence shear on DRA efficiency to design and formulate more effective and sustainable solutions.

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.

Open to UK nationals only due to funding restrictions.

For details on the Engineering Doctorate scheme visit the homepage.

Deadline: Friday 17th January 2025