Grace Neal

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BA (Hons)

Grace is an EngD Research Engineer sponsored by Unilever and based at Unilever Research and Development in Port Sunlight.

She came to Birmingham after completing an undergraduate degree in Natural Sciences at the University of Cambridge in 2005.

Her project looks at the mixing in vessels with a rising free surface, typical industrial examples include those where colourants are added to paints at the point of sale and in vending machines where hot water is added to a cup and the concentrate needs to be fully dispersed solely on the basis of the water addition.

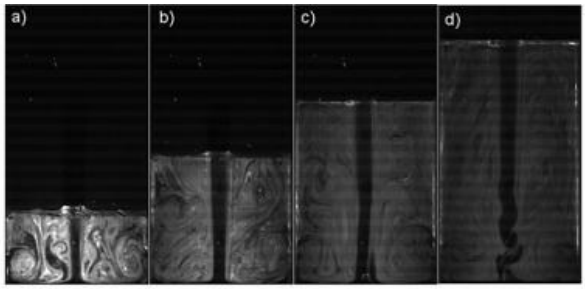
The study of such processes provides a number of experimental and modelling challenges in that start-up effects account for a significant proportion of the mixing time. There can be large disparities between the properties and ratio of the materials being added, the level of the free surface changes and the entrainment of air makes visualization difficult.

This project consists of three main objectives: firstly, to develop characterization techniques able to access the length and time-scales associated with the mixing in model bench scale geometry and which can produce accurate and reproducible results when the free surface is moving. Secondly, to explore the impact of material properties (e.g. viscosity ratio), process variables (e.g. injection rate, ratio of ingredients) and geometry (e.g. vessel size, inlet position) on mixing rate. Thirdly, to design new mixing systems which give efficient mixing when used with multiple streams of ingredients.

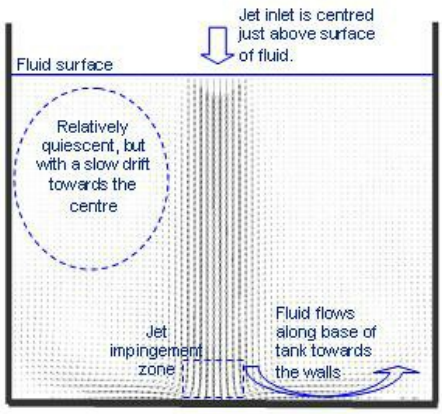
The techniques being used to achieve these objectives are Planar Laser Induced Fluorescence (PLIF), Particle Image Velocimetry (PIV) and Computational Fluid Dynamics (CFD).

Publication:

G. Neal, M.J.H. Simmons, J.A. Hough, P.J. Fryer, Criteria for measuring mixing performance in a vessel with a rising free surface. Experiments in Fluids 2008, (in press)



Evolving concentration fields at different fill heights for the 8 mPa.s fluid at (a) h = 2.2 cm; (b) h = 4.7 cm; (c) h = 7.3 cm; (d) h = 10.3 cm at a flow rate Q = 3.33 × 10-



An example of the velocity profile in a vessel showing the features present in all cases