Karin Mehauden

Evaluation of the thermal and mixing performance of an agitated vessel for processing of complex liquid food

Miss Karin Mehauden
PhD student
Sponsors: EPSRC and Giusti

Karin Mehauden studied Food Science and Technology degree in France. She then did an MSc in Food Quality Management. In January 2005, she joined the Fluid Mechanics group and the Food Research group at the University of Birmingham to start a PhD project. Her PhD project involved working in close relationship with the two groups.

PhD research (01/2005-date)

- Research sponsored by T Giusti/Briggs of Burton Plc – Process engineering specialists and equipment manufacturers for the Food, Brewing & Distilling, Health & Beauty and Pharmaceutical markets – Burton on Trent, United Kingdom.
- Use of Time Temperature Integrators to measure the thermal treatment efficiency in a Giusti vessel.
- Use of PIV (Particle Imaging Velocimetry) and PEPT (Positron Emission Particle Tracking) to investigate mixing within a Giusti food processing vessel.
- PhD work part of a LINK project (DEFRA) on the exploitation of Time Temperature Integrators. This project involved several food companies that manufacture appertised products (e.i. soup).

Current Research: Evaluation of the thermal and mixing performance of an agitated vessel for processing of complex liquid food

In the food industry, heating and mixing of food products is often performed simultaneously. Ostensibly, these processes seem very easy to evaluate, however, the fluids commonly encountered in food processing routinely possess complex rheology. When this is the case, it is very difficult to evaluate the efficiency of the process, since it is essential that each phase receives the minimum heat treatment to ensure the food is safe to eat. The determination of heating and mixing efficiency is essential in order to have a better understanding and to improve the design of processes.

Thermocouples are commonly used to measure heating efficiency, but for many products it is not feasible to use them. Time-temperature indicators (TTIs) are small particles containing a reactive species that can be passed through a process and then assayed to measure the process effects.

TTIs are used almost exclusively without consideration of their location in fluid systems. In industry, vessels (such as Giusti's vessel pictured left) used to process food are heated from the bottom and in some cases steam is injected towards the centre of the vessel. Therefore, according to the path that TTIs take inside the vessel, the measured thermal efficiency will be different.

Figure 2. Normalised velocity and Occupancy plot
of the reduced scale version of the Giusti's vessel

It is therefore essential to have an understanding of the fluid flow and the location of the TTIs during the process. This project was carried out by using flow visualisation techniques such as PIV (Figure 1) and PEPT (Figure 2). Understanding the fluid flow inside vessels is essential in order to validate the use of TTIs to determine thermal process efficiency.

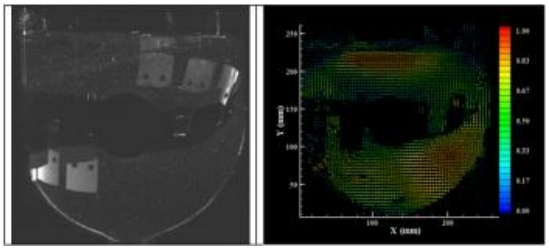
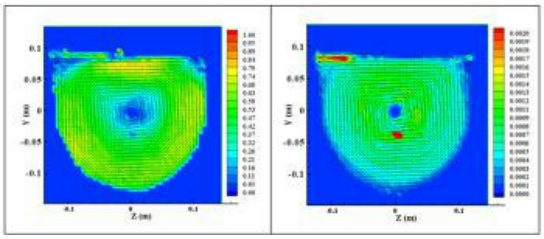


Figure 1. Fluid flow normalised velocity measured inside the reduced scale version of the Giusti's vessel



Publications

Journals

Validation of Thermal Processing Using Time-Temperature Indicators as Process Probes
P.J. Fryer, M.J.H. Simmons, K. Mehauden and S. Bakalis
Japan Journal of Food Engineering, Volume 9, Issue 1, 2008

Use of Time Temperature Integrators for Determining Process Uniformity in Agitated Vessels
K. Mehauden, S. Bakalis, P.J. Fryer and M.J.H. Simmons
Innovative Food Science & Emerging Technologies, Accepted for Publication November 2007

A novel method to evaluate the applicability of time temperature integrators to different temperature profiles
K. Mehauden, P.W. Cox, S. Bakalis, M.J.H. Simmons, G.S. Tucker and P.J. Fryer
Innovative Food Science & Emerging Technologies, Volume 8, Issue 4, December 2007, Pages 507-514

Evaluating the Applicability of Time Temperature Integrators as Process Exploration and Validation Tools
S. Bakalis, P.W. Cox, K. Mehauden P.J. Fryer
Book Chapter in I.D.L. Bogle, J. Žilinskas (Eds.)(2006) Computer Aided Methods in Optimal Design and Operations. Series on Computers and Operations Research, Vol. 7, World Scientific, ISBN 981-256-909-X.

Conferences

Verification of the reliability of Time Temperature Integrators made from the α-amylase of the Bacillus amyloliquefaciens for assuring the safety of various thermal processes
K. Mehauden, P.W. Cox, S. Bakalis, M. Simmons and P.J. Fryer

IAFP (International Association for Food Association) - Calgary (Canada) -August 2006

Validation of thermal processing of foods in large agitated vessel
K. Mehauden, P.W. Cox, S. Bakalis, G. Cure, G. Tucker, M.J.H. Simmons, P.J. Fryer
IUFoST (International Union of Food Science and Technology) - Nantes (France) - September 2006

Time Temperature Integrators: An alternative technique to determine the heat treatment efficiency of large agitated vessels
K. Mehauden, P.W. Cox, S. Bakalis, M.J.H. Simmons, P.J. Fryer
IFT (Institute of Food Technology) - Chicago (US) - July 2007