

Professor Peter Fryer MA PhD FEng FICHEM FIFST

Professor of Chemical Engineering

[School of Chemical Engineering \(/schools/chemical-engineering/index.aspx\)](http://schools/chemical-engineering/index.aspx)

Contact details

Telephone **+44 (0) 121 414 5451** (tel: **+44 121 414 5451**)

Email p.j.fryer@bham.ac.uk (mailto: p.j.fryer@bham.ac.uk)

School of Chemical Engineering
The University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK



Qualifications

- MA, MEng Chemical Engineering, Jesus College, Cambridge, 1981
- PhD: Dept. of Chemical Engineering, Cambridge, 1986

Research

The aim of research is to apply the principles of chemical engineering to the problems of the food industry. The food industry differs from the conventional process industries in that:

(i) Product safety is as important as process safety: for example, we study the hygienic design of processes and the ways in which sterility of products can be assured. We have developed (with Prof Z Zhang) a novel probe for measuring the forces needed to clean surfaces; work is underway to use this understanding to define better cleaning procedures. We are also looking at how to assess safety, using enzyme measurements, and how to build mathematical models for processes. Currently a large (£3.6 million) project is underway, supported by Cadbury, Unilever, Scottish and Newcastle Brewery, GSK, Bruker, Ecolab, Alfa Laval and GEA is underway to design ways of cleaning plant which is more environmentally friendly.

(ii) Materials have a complex texture and structure which must be perceived by the consumer as attractive: projects have studied how food structure is developed through processing, for example in chocolate (funded by Cadbury and others), gels (funded by Unilever) and biscuits (a LINK scheme with Campden and Chorleywood Food RA).

Much of the basic design data is unavailable; we are using both conventional and tomographic techniques to study how food materials flow through process plant and respond to heating and cooling, supported by LINK and BBSRC funding as well as wholly-funded work from industry. Taste and texture result from processing; we have studied how flavours are developed in grain roasting, in work funded by Brewing Research International. Much of the work involves very close links with industry in the UK and elsewhere: currently students are funded by Cadbury and Unilever, and work has been supported by Campden Food RA, Marlow Foods, and others.

Many of the students work as part of the Engineering Doctoral Scheme in Formulation Engineering. This enables researchers to work between industry and academia on research projects, giving them a unique understanding of how research is done for industrial benefit.

We run courses in Food Manufacture: the aim of this course is to train engineers and food scientists in each others disciplines, and to develop the profession of chemical engineering within this important subject area. These modules can be accessed as part of the Advanced Chemical Engineering Masters Course.

Other activities

- Council Member, BBSRC
- Editor, "Food and Bioproducts Processing", Transactions of the Institution of Chemical Engineers Part C
- Member of the Editorial Board, "Journal of Food Engineering", Innovative Food Science and Emerging Technologies, Soft Matter
- IChemE representative, International Conference on Engineering and Food

Publications

Yong, YP, Emery AN and Fryer, PJ. Heat transfer to a model dough product during mixed regime thermal processing, Transactions of the Institution of Chemical Engineers Part C, 80, 183-192, 2002.

Christian, GK, Changani, SD and Fryer, PJ. The effect of adding minerals on fouling from whey protein concentrate: development of a model fouling fluid for a plate heat exchanger. Transactions of the Institution of Chemical Engineers Part C., 80, 231-239, 2002.

Liu, W, Christian, GK, Zhang, Z and Fryer, PJ. Development and use of a novel method for measuring the force required to disrupt and remove fouling deposits. Transactions of the Institution of Chemical Engineers Part C., 80, 286-291, 2002.

Cox, PW and Fryer, PJ. Heat transfer to foods: modelling and validation. Journal of Thermal Science, 11, 320-330, 2002.

Miri, Y, Cox, PW and Fryer, PJ. In-situ visualisation of hyphal structure and arrangement in mycoprotein pastes, Biotechnology Letters, 25, 295-300, 2003.

Barigou, M., Fairhurst, PG Fryer, PJ and Pain, J-P. Concentric flow regime of solid-liquid food suspensions: theory and experiment, Chemical Engineering Science, 58, 1671-1686, 2003.

Robbins, PT and Fryer, PJ. The spouted-bed roasting of barley: development of a predictive model for moisture and temperature, Journal of Food Engineering, 59, 199-208, 2003.

- Tse, KL., Pritchard, AM, and Fryer, PJ. The rate and extent of fouling in a single-tube wort boiling system. *Transactions of the Institution of Chemical Engineers Part C.*, 81, 13-22, 2003.
- Tse, KL., Boswell, CD., Nienow AW and Fryer, PJ. Assessment of the effects of agitation on mashing for beer production in a small scale vessel, *Transactions of the Institution of Chemical Engineers Part C.*, 81, 3-12, 2003.
- Cox, PW, Bakalis, S, Ismail, H, Forster, R, Parker, DJ and Fryer, PJ. Visualisation of three-dimensional flows in rotating cans using Positron Emission Particle Tracking (PEPT), *Journal of Food Engineering*, 60, 229-240, 2003.
- Bakalis, S, Cox, PW, Wang-Nolan, W, Parker, DJ, and Fryer, PJ. Use of Positron Emission Particle Tracking (PEPT) technique for velocity measurements in model food fluids, *Journal of Food Science*, 68, 2684-92, 2003.
- Bakalis, S, Parker, DJ and Fryer, PJ. Measurement of velocity distributions of viscous fluids using Positron Emission Particle Tracking (PEPT), *AIChE Journal*, 50, 1606-1613, 2004
- Christian, GK, and Fryer, PJ. The balance between chemical and physical effects in the cleaning of milk fouling deposits, in *Heat Exchanger Fouling and Cleaning: Fundamentals and Applications*, ed P Watkinson and H Muller-Steinhagen, at <http://services.bepress.com/cgi/viewcontent.cgi?article=1022&context=eci/heatexchanger>, 2004
- Liu, W, Zhang, Z, Christian, GK, and Fryer, PJ. Direct measurement of the forces required to disrupt and remove fouling deposits, in *Heat Exchanger Fouling and Cleaning: Fundamentals and Applications*, ed P Watkinson and H Muller-Steinhagen, 2004
- Loret, C, Meunier, V, Frith WJ, and Fryer, PJ. Characterisation of maltodextrin gels under small deformation, *Carbohydrate Polymers*, 57, 153-163, 2004.
- Loret, C, Frith WJ and Fryer, PJ. Mechanical properties of maltodextrin gels: small and large deformation. In *Gums and stabilisers for the food industry 12*, Williams, PA. & Phillips, GO., The Royal Society of Chemistry, 116-123, 2004
- Loret, C, Stephan Schumm, S, Pudney, PDA, Frith, WJ and Fryer, PJ. Phase separation and molecular weight fractionation behaviour of maltodextrin /agarose mixtures, *Food Hydrocolloids*, 19, 557-565, 2005.
- Wong, DCY, Adams, MJ, Seville, JPK, and Fryer, PJ. A computational model of flavour deposition onto food surfaces, *Trans. IChemE C*, 83, 99-106, World Congress of Chemical Engineering special issue, 2005.
- Edmondson, PT, Grammatika, M, and Fryer, PJ. Modelling of heat transfer, mass transfer and flavour development in chocolate crumb, *Trans. IChemE C*, 83, 89-98, World Congress of Chemical Engineering special issue, 2005.
- Miri, T, Barigou, M, Fryer, PJ and Cox, PW. Flow induced fibre alignment in mycoprotein paste, *Food Research International*, 38, 1151-1160, 2005.
- Fryer, PJ and Robbins, PT. Heat Transfer in Food Processing: Ensuring Product Quality and Safety, *Applied Thermal Engineering*, 25, 2499-2510, 2005.
- Mousavi, R, Miri, T, Cox, PW, and Fryer, PJ. A novel technique for ice crystal visualization in frozen solids using X-ray micro-computed tomography, *Journal of Food Science*, 70, E437-E442, 2005.
- Liu, W, Christian, GK, Zhang, Z and Fryer, PJ. Direct measurement of the force required to disrupt and remove fouling deposits of whey protein concentrate, *International Dairy Journal*, 16, 164-172, 2006.
- Bakalis, S, Cox, PW, Russell, AJ, Parker, DJ and Fryer, PJ. Development and use of Positron Emitting Particle Tracking (PEPT) technique for velocity measurements in viscous fluids in pilot scale equipment, *Chemical Engineering Science*, 61, 1864-1877, 2006.
- Mackey, BM, Kelly, AF, Colvin, JA, Robbins, PT and Fryer PJ. Predicting the thermal inactivation of bacteria in a solid matrix: Simulation studies on the relative effects of microbial thermal resistance parameters and process conditions, *International Journal of Food Microbiology*, 107, 295-303, 2006.
- Norton, IT, Fryer, PJ, and Moore, SR. Product/Process integration in food manufacture - Engineering sustained health, *AIChE J*, 52, 5, 1632-1640, 2006.
- Fryer, PJ, Christian, GK, and Liu, W. How hygiene happens; the physics and chemistry of cleaning, *International Journal of Dairy Technology*, 59, 76-84, 2006.
- Yang, Z, Parker, DJ, Fryer, PJ, Bakalis, S and Fan, X. Multiple-particle tracking \diamond an improvement for positron particle tracking, *Nuclear Instruments and Methods in Physics Research Section A*, 564, 332-338, 2006.
- Liu, W, Zhang, Z, Fryer, PJ. Identification and modelling of different removal modes in the cleaning of model food deposits, *Chemical Engineering Science*, 61, 7528-7534, 2006.
- Liu, W, Fryer, PJ, Zhang, Z, Zhao, Q, Liu, Y. Identification of cohesive and adhesive effects in the cleaning of food fouling deposits, *Innovative Food Science and Emerging Technologies*, 7, 263-269, 2006
- Loret, C, Frith, W, Fryer, PJ. Mechanical and structural properties of maltodextrin/agarose gel composites. *Appl. Rheol.* 16, 248-257, 2006.
- Christian, GK, and Fryer, PJ, The effect of pulsing cleaning chemicals on the cleaning of whey protein deposits, *Trans. IChemE C*, 84, 320-328, 2006.
- Hooper, RJ, Liu, W, Fryer, PJ, Paterson, WR, Wilson, DI and Zhang, Z, Comparative studies of fluid dynamic gauging and a micromanipulation probe for strength measurements, *Trans. IChemE C*, 84, 353-358, 2006.
- Bakalis, S, Cox, PW, Mehaudan, K, and Fryer, PJ. Evaluating the applicability of time-temperature indicators as process exploration and validation tools, pp 187-196 in *Computer Aided Methods in Optimal Design and Operations*, eds IDL Bogle and J Zilinskas, World Scientific, Singapore, 2006. [presented at British/Lithuania bilateral workshop, Feb 2006, and published after review.]
- Liu, W, Ab. Aziz, N., Zhang, Z., and Fryer, PJ. Quantification of the cleaning of egg albumin deposits using micromanipulation and direct observation techniques, *Journal of Food Engineering*, 78, 217-224, 2007
- Simmons, MJH, Jayaraman, P and Fryer, PJ. The effect of temperature and shear rate upon the aggregation of whey protein and its implications for milk fouling, *Journal of Food Engineering*, 79, 7517-528, 2007.
- Kemp, MR and Fryer, PJ. Enhancement of Diffusion through Foods Using Alternating Electric Fields, *Innovative Food Science and Emerging Technologies*, 8, 143-153, 2007.
- Tucker, GS, Brown, HM, Fryer, PJ, Cox, PW, Poole, FL, Lee, H-S and Adams, MWW. A Sterilisation Time-Temperature Integrator based on Amylase from the Hyperthermophilic Organism *Pyrococcus furiosus*, *Innovative Food Science and Emerging Technologies*, 8, 63-72, 2007.
- Norton, IT, Moore, SR, and Fryer, PJ. Understanding food structure and breakdown: engineering approaches to obesity, *Obesity Reviews*, 8, 83-88, 2007.

Loret, C, Frith, WJ, and Fryer, PJ. Mechanical and structural properties of maltodextrin/agarose microgels composites, *Appl. Rheol.*, 17, 31412-(19 pages), 2007.

Mousavi R, Miri T, Cox PW, Fryer PJ, Imaging food freezing using X-ray microtomography, *International Journal of Food Science and Technology*, 42, 714-727, 2007.

Yang, Z, Fryer, PJ, Bakalis, S, Fan, X, Parker, DJ, and Seville, JPK. An improved algorithm for tracking multiple, freely moving particles in a Positron Emission Particle Tracking system. *Nuclear Instruments and Methods in Physics Research Section A*, 577, 585-594, 2007.

Yang, Z, Fan, X, Fryer, PJ, Parker, DJ, and Bakalis, S. Improved multiple-particle tracking for studying flows in multiphase systems, *AIChE J*, 53, 1941-1951, 2007.

Knoerzer, K, Juliano, P, Gladman, S, Versteeg, C, and Fryer, PJ. A Computational Model For Temperature and Sterility Distributions in a Pilot-Scale High-Pressure High-temperature Process, *AIChE J*, 53, 2996-3010, 2007.

Mehaudan, K, Cox, PW, Simmons, MJH, Bakalis, S, Tucker, GR and Fryer, PJ, A novel method to evaluate the applicability of Time Temperature Integrators to different temperature profiles, *Innovative Food Science and Emerging Technologies*, 8, 507-514, 2007.

Leadley, C, Tucker, GS and Fryer, PJ. A comparative study of high pressure sterilisation and conventional thermal sterilisation: quality effects in green beans, *Innovative Food Science and Emerging Technologies*, 9, 70-79, 2008.

[Privacy](#) | [Legal](#) | [Cookies and cookie policy](#) | [Accessibility](#) | [Site map](#) | [Website feedback](#) | [Charitable information](#)

© University of Birmingham 2015

