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# Professor Mike Adams PhD, CEng, FIChemE, CChem, FRSC, CPhys, FinstP, FREng

Professor of Product Engineering and Manufacturing

**School of Chemical Engineering (/schools/chemical-engineering/index.aspx)**

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## About

Mike Adams is Professor of Product Engineering and Manufacturing.

He has published over 170 scientific papers, book reviews, book chapters on particle technology, and co-edited four books on *Tribology in Particulate Technology*, *Theoretical and Computational Methods in Tribology*, *Solid-Solid Interactions* and *Dynamics of Complex Fluids*. He has co-ordinated major grants from the TSB and the EU including a current **FP7 project. (http://nanobiotouch.org/)** He is the Programme Coordinator for the **MSc course in Advanced Chemical Engineering. (/postgraduate/courses/taught/chemical-engineering/advanced-chemical-engineering.aspx)** As an Academic Lead for the **Science City Research Alliance (http://www.birminghamsciencecity.co.uk/)** he is responsible for a laboratory that has specialist facilities to study advanced materials and biomaterials. It supports research across the University and provides a research service to industry.

He is a committed advocate of supradisciplinary research and innovation in products and processes, which involve national and international collaborations with academic institutions and industrial companies.

## Qualifications

- Fellow of the Royal Academy of Engineering, 2003
- Fellow of the Institution of Chemical Engineers, 1998
- Fellow of the Royal Society of Chemistry, 1994
- Fellow of the Institute of Physics, 1994
- PhD Molecular Acoustics, 1974
- Grad RSC, 1969

## Biography

Mike qualified with a Grad RSC in 1969 and was awarded a PhD in 1974 for research in the field of molecular acoustics at the University of Essex. He was subsequently employed as a research scientist by Unilever R&D in their London laboratory. In 1979 he transferred to their Port Sunlight laboratory where he developed his interest in process engineering and materials science including areas such as powder technology, complex fluids, interfacial engineering and tribology. Collaboration with academic institutions was an important component of his role as a Senior Scientist. He was appointed a Visiting Professor in the Department of Chemical Engineering & Chemical Technology at Imperial College (1995-2003) and an Honorary Professor in the Department of Chemical Engineering at The University of Birmingham (2000-2003). He was also actively engaged with the activities of professional institutions, for example, he was the Chairman of the Institute of Physics Tribology Group in the period 1995 - 1998. He has continued to develop these research interests with his appointment in the School of Chemical Engineering at the University of Birmingham in 2004.

Mike was awarded the Donald Julius Groen Prize by the IMechE in 1999 for outstanding contributions to interfacial engineering. As a result of his research in particle technology, he was invited by the IChemE to present the Lesley J Ford Lecture in 2003. His industrial and academic research activities were recognised in 2003 by his election as a Fellow of the Royal Academy of Engineering.

## Teaching

- 3MS
- Colloids and rheology
- Powder handling
- Food flavour

## Postgraduate supervision

For a full list of available Doctoral Research opportunities, please visit our **Doctoral Research programme listings. (http://www.bham.findaphd.com/?es=y&apl=y&aplt=&show)**.

## Research

**RESEARCH THEMES**

**Particle Technology**

Roll compaction, granulation, tabletting, milling, powder characterisation, blending, mechanical properties of particles, granules and compacts, caking, liquid bridge forces, FEM, DEM.

**Tribology**

Friction, lubrication, wear, adhesion, contact mechanics of polymers, mammalian skin (*in vivo* and *in vitro*), particles, powders, coatings and fibres.

**Complex fluids**

Pastes, emulsions, dispersions; squeeze, orifice, capillary and confined flows; tack; elastoviscoelastic and non-linear viscoelastic material models; wall slip; high throughput rheometery; FEM.

**Taction**

Tactile sensors, relationship with the biotribology of skin, tactile displays, modelling.

**Process engineering**

Screw extrusion, ram extrusion, roll milling, upsetting, forming, cleaning

**RESEARCH ACTIVITY**

**Liquid bridges**

There are many examples for which the adhesion associated with liquid junctions between solid surfaces is important such as granular materials, hard disk drives, nanotribology, nanolithography processes, and in the interaction of particles within the lungs. The focus of his work has been on developing theoretical models such as the effects of wetting and gravity on the capillary forces and the influence of non-Newtonian rheology including power law, elastoviscoplastic and non-linear viscoelastic flow.

**Complex fluids**

Multiphase and structured fluids occur widely as products and intermediates or fouling materials in processing. He has investigated experimental methods to determine the properties of such fluids as a basis for developing models of processing operations and product usage. They includes methods such as orifice, capillary and squeeze flow for establishing material models including characterising the substantial changes in the rheological properties that are observed at length scales of less than one or two orders of magnitude greater that the microstructural length scale, which may be important in product usage and the cleaning of processing equipment, for example. He has also studied methods for establishing the wall traction boundary conditions. The diffusion of moisture into these fluids is another important property and he has developed a procedure for measuring the diffusion coefficient as a function of water activity that takes account of finite time and finite area corrections.

**Particle and granular mechanics**

The mechanical properties of particles, granules and powder compacts are important in storage, handling, processing and packaging. His work in this area has included: the use of fracture mechanics and discrete numerical simulation to understand the breakage behaviour of granules in both the wet and dry states; the application of finite element analysis and analytical models to examine the rebound behaviour of particles; the interpretation of the elastic, plastic and viscoelastic deformation using theoretical models.

**Tribology**

Tribology is concerned with the friction, lubrication and wear of materials. He has studied the tribological behaviour of a wide range of materials including particles, fibres and polymers. His recent work has focused on the *in vivo* friction and lubrication of human skin both on the inner forearm and also the finger pad, which is an extremely complex system due to the special characteristics of the contact mechanics associated with the fingerprint ridges and the large number density of sweat glands that are located on these ridges. The tribological behaviour of the finger pads is particularly important in tactile assessment and exploration as well as grip function.

**Process engineering**

The aim of process engineering is to assist in the selection of processing equipment and the optimisation of the design and operation of the equipment. The ideal approach is based on understanding the properties of the feed materials and the evolution of their properties and microstructure during the process as basis for developing quantitative models that avoid the need for uncertain scale-up rules. He has been involved in the study of a wide range of processing operations including extrusion, granulation and roll compaction

## Other activities

- Lead Assessor for Process Engineering, Royal Academy of Engineering Standing Committee for Research & Secondment Schemes (2005 -9)
- External Examiner for the Department of Mechanical Engineering, Brunel University (2000-2004)
- Member of the EPSRC Chemical Engineering College (1995-)
- Member of the Chartered Physicist Committee (1999 – 2002)
- Member of the Institute of Physics Surface Science and Technology Divisional Committee (1995 – 1998)
- Chairman of the Institute of Physics Tribology Group (1995 - 1998)
- Member of the UMIST Industrial Steering Committee for the MSc course in Geotechnical Engineering (1997 – 2000)
- Member of the Steering Committee for 'The Royal Society - Unilever Indo-UK Forums in Materials Science and Engineering' (1995 – 2000)
- Member of the IChemE Books Editorial Board (2011-)
- Member of the Editorial Advisory Board of Powder Technology (2005-)
- Member of the Editorial Advisory Board of Tribology International (1998-)
- Member of the Editorial Board of the Proceedings of the IMechE, Part E: Journal of Process Mechanical Engineering (2005-)

## Publications

Andrews JW, Yu S, Gururajan B, Reynolds G, Roberts R, Wu C-Y, Adams MJ. (2010) Analytical solutions for roll compaction of pharmaceutical powders. **Journal of Pharmacy and Pharmacology**, 62 1403-1404.

Bowen J, Cheneler D, Walliman D, Arkless SG, Zhang Z, Ward MC, Adams MJ. (2010) On the calibration of rectangular atomic force microscope cantilevers modified by particle attachment and lamination. **Measurement Science & Technology** 21 115106.

Yan Y, Zhang Z, Cheneler D, Stokes, JR, Adams, MJ. (2010) The influence of flow confinement on the rheological properties of complex fluids, **Rheologica Acta**, 49 255 - 266.

Muhammad HB, Oddo CM, Beccai L, Adams MJ, Carrozza C, Hukins D, Ward M. (2009) Design of a bimimetic MEMS based tactile capacitive sensor. **Procedia Chemistry** 1 124 -127.

Cheneler D, Ward MC, Adams MJ, Zhang Z. (2008) Measurement of dynamic properties of small volumes of fluid using MEMS. **Sensors and Actuators B: Chemical** 130 701-706.

Willett CD, Johnson SA, Adams MJ, Seville JPK. (2007) "Pendular Capillary Bridges". In Salman, A.D, Hounslow, M.J., Seville, J.P.K. (Eds), Handbook of Powder Technology Volume 11: Granulation, Elsevier (Amsterdam), pp 1317-1351.

Adams MJ, Briscoe BJ, Johnson SA. (2007) Friction and lubrication of human skin. **Tribology Letters** 26 239-253.

Basterfield RA, Lawrence CJ, Adams MJ. (2005) On the interpretation of orifice extrusion data for viscoplastic materials. **Chemical Engineering Science** 60 2599-2607.

Adams MJ, Lawrence CJ, Urso MED, Rance J. (2004) Modelling collisions of soft agglomerates at the continuum length scale. **Powder Technology** 140 268 -279.

Huang ZH, Lucas M, Adams MJ (2003) Study of ultrasonic upsetting under radial and longitudinal die vibration. **Modern Practice in Stress and Vibration Analysis Materials Science Forum** 440-4 389-396.

Kafui KD, Thornton C, Adams MJ. (2002) Discrete particle-continuum fluid modelling of gas-solid fluidised beds. **Chemical Engineering Science** 57 2395-2410.

Adams MJ, Johnson SA, Seville JPK, Willett CD.(2002) Mapping the influence of gravity on pendular liquid bridges. **Langmuir** 18 6180-6184.

Lian G, Xu Y, Huang W, Adams MJ. (2001) On the squeeze flow of a power-law fluid between rigid spheres. **Journal of Non-Newtonian Fluid Mechanics** 100 151-164.

Adams MJ, Mashelkar RA, Pearson JRA. (1998) Rennie, A.R. (eds), Dynamics of Complex Fluids, Imperial College Press - The Royal Society.

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