

BULLETIN



BRITISH SOCIETY OF RHEOLOGY

1976, Vol. 19, No. 1

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Hon. Editor:

M. CAMINA,

Paint Research Association,

Waldegrave Road,

Teddington,

Middlesex.



FOREWORD

Once again the time has come to say farewell to a retiring Editor of the Bulletin. The work Dr. J. M. Hobbs has done for the Society deserves our thanks. All his Council colleagues and members of the Society wish to acknowledge his efforts. Fortunately, he still remains on the Council.

At the start of a new editorship it is appropriate to try to ascertain the type of Bulletin that members would like. Surely, the present format, with emphasis on future meetings and reasonable up to date news items is acceptable. Reports of conferences, symposia and meetings are also useful for those unable to attend. Perhaps the Bulletin should also summarise the current thinking in particular branches of rheology for those members who have only a peripheral interest in the subject.

As it has been difficult to retain a reasonable flow of technical articles I shall reiterate the pleas of past editors for comments, news, informative articles such as interpretative reviews and annotated bibliographies, and any other material that would keep the Bulletin interesting.

OFFICERS AND MEMBERS OF COUNCIL 1975-76

President: PROFESSOR K. WALTERS, Department of Applied Mathematics, University College of Wales, Aberystwyth.

Secretary: MR. F. N. COGSWELL, I.C.I. Ltd., Plastics Division, Welwyn Garden City.

Treasurer: DR. D. R. OLIVER, Department of Chemical Engineering, University of Birmingham, Birmingham B15 2TT.

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Abstracts Editor: DR. D. MARSHALL, Institute of Polymer Science, Loughborough University of Technology, Loughborough.

Bulletin Editor: MR. M. CAMINA, Paint Research Association, Teddington, Middlesex.

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DR. K. M. BEAZLEY, 44 Brockstone Road, Boscoppa, St. Austell PL25 3DP.

DR. D. C-H. CHENG, Warren Spring Laboratory, Stevenage.

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MR. A. EVANS, Department of Surgery, Royal Victoria Infirmary, Newcastle-upon-Tyne NE1 4LP.

DR. J. FERGUSON, Department of Fibre Science, University of Strathclyde, Glasgow G1 1XW.

DR. J. M. HOBBS, National Engineering Laboratory, East Kilbride, Glasgow.

APPOINTMENT

APPOINTMENT OF DIRECTOR AND MANAGEMENT COMMITTEE FOR THE POLYMER ENGINEERING PROGRAMME

The Science Research Council have now appointed the Director and the Management Committee for the important programme of research and post-graduate training in polymer engineering which is being undertaken in cooperation with the British Plastics Federation and the British Rubber Manufacturers Association. Dr. A. A. L. Challis has been appointed Director of Polymer Engineering in the Science Research Council, and took up his appointment full-time on 1 February 1976, but, after he returns to the U.K. later this year, will devote part of his time to the Polymer Engineering Programme.

The members of the Polymer Engineering Management Committee are: Mr. R. Lewis (GPG Holdings)—Chairman, Professor G. Allen (Imperial College of Science & Technology), Dr. A. K. Gupta (Department of Industry), Mr. G. K. Johnston (Bone Craven), Dr. D. G. Marshall (Dunlop Rubber Company), Professor R. K. Penny (Liverpool University), Dr. W. Watson (Rubber and Plastics Research Association), Professor W. L. Wilkinson (Bradford University), and ex officio, the Director.

CALLS FOR PAPERS

Mixing of Disperse non-Newtonian Systems

The Institution of Chemical Engineers (North-West Region) intends to hold a one-day meeting on "Mixing of disperse non-Newtonian systems" (provisional title), in December 1976. The emphasis should be on practical experience with the operation of all sorts of blending devices and their design and the rheological fundamentals should be kept at minimum. The disperse non-Newtonian material can be anything from polymer composites, latexes, solid-liquid and liquid-liquid dispersion in the food processing, cosmetics and pharmaceutical industries, slurries, pastes and paints.

Enquiries to:

Professor J. Ulbrecht,
Department of Chemical Engineering,
University of Salford,
Salford.

1st Announcement

JOINT MEETING OF THE BRITISH, DUTCH AND ITALIAN SOCIETY OF RHEOLOGY

PISA, Italy, 13th-15th April, 1977

Deadline for submission—October 31st, 1976

The submission of contributed papers (title and 1-page abstract only) is open to members and non-members of the 3 Societies. Suggested topics for the meeting include:

1. Influence of processing on structure in polymers;

2. Mechanical properties and their measurement.

The use of English as the meeting language is recommended. The abstracts should be sent to the scientific secretaries of the Societies to the following addresses:

UNITED KINGDOM—F. N. Cogswell, 67 Daniells, Welwyn Garden City, Hertfordshire AL7 1QT.

THE NETHERLANDS—H. C. Booi, D.S.M. Research and Patents, P.O. Box 18, Geleen.

ITALY—D. Acierno, Istituto di Ingegneria Chimica, Viale delle Scienze, Palermo.

The host organization is the Italian Society of Rheology. Professor E. Butta of the University of Pisa will act as the chairman of the organizing committee.

PISA

Pisa is much more than the Leaning Tower. It is a city of sculpture and architecture, characteristically in the Romanesque style, and extending its influence into the surrounding region. The most effective example is probably the group of cathedral, baptistry, campanile and camposanto in the central piazza. Pisa is a magnificent city for exploration on foot; Roman remains (sarcophagi in the camposanto, the thermal baths), and mediaeval palaces and churches are everywhere.

One of the pleasantest institutions of Italian city life is the evening passeggiato, when the streets are given over to strollers, and vehicular traffic discouraged; try joining in along the Borgo Stretto and Corso d'Italia, lined with bookshops, cafes and restaurants. By day you can walk beside the Arno, or visit the many fascinating buildings Santa Maria della Spina, for example, a gem of Pisan Gothic.

If you have the opportunity, other beautiful cities are within reach: Lucca, Florence, Siena and the gay and bustling seaside town of Viareggio.

Pisa is memorable because it is Tuscan and because it is Italian. The city of Galileo Galilei! What more appropriate a place for a scientific congress!

FUTURE MEETINGS

DEFORMATION, YIELD AND FRACTURE OF POLYMERS

March 29th-April 1st, 1976

This is the third International Conference on this topic to be held at Churchill College, Cambridge, and should live up to the high standards of its predecessors. Section headings are: "Creep and Yielding", "Fracture", "Crazing", "Rubbers and Selected Topics", "Selected Topics" and "Crystal Deformation".

A new feature this year is more emphasis on selected topics which give prominence to really new research in the area covered by the Conference title. A total of 32 papers will be presented, including review papers by Professor A. S. Argon (M.I.T.), Dr. C. E. Turner (Imperial College), Professor L. R. G. Treloar (U.M.I.S.T.) and Professor A. Keller (Bristol). The programme is truly international, with a large number of eminent scientists from the U.S.A., Continental Europe and Australia.

The fee with residence is £45 (£25 without residence), and for research students £30 (£15 without residence).

Further details can be obtained from the Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL.

RHEOLOGY OF COLLOIDS

An informal discussion on the rheological properties of colloidal systems, arranged jointly by the British Society of Rheology and the Colloid and Interface Science Group (Faraday Division—Chemical Society) will be held at the School of Chemistry of the University of Bristol on April 8th and 9th, 1976. Overnight accommodation has been arranged at Hiatt Baker Hall, University of Bristol.

The provisional programme is as follows:

Thursday, April 8th, 1976

1.00 p.m. Lunch

First Scientific Session—School of Chemistry
Disperse Systems I

2.15 p.m. Introductory Lecture
Professor I. M. Krieger
Case Western Reserve University, U.S.A.

- 3.15 p.m. Paper by Professor A. Watillon
University of Brussels
- 3.55 p.m. Tea
- 4.20 p.m. Some Theoretical Considerations of the Second Electro-
viscous Effect
Dr. E. J. Hinch
University of Cambridge
- 5.00 p.m. Effects of Particle Size in the Rheology of Dilute
Disperse Systems
Dr. J. W. Goodwin
University of Bristol
- 5.40 p.m. Close Session
- Overnight Hiatt Baker Hall, Parry's Lane, Stoke Bishop, Bristol
- 7.00 p.m. Symposium Dinner

Friday, April 9th, 1976

Second Scientific Session—School of Chemistry

Disperse Systems II

- 9.20 a.m. The Effect of Adsorbed Polymer on the Rheology of
High Volume Concentration Dispersions
Dr. D. Eagland
University of Bradford
- 9.55 a.m. Non-Linear Viscoelastic Behaviour in a Concentrated
Aqueous Dispersion—Comparison of Macroscopic and
Microscopic Properties
Dr. R. J. Akers and A. Ayub
Loughborough University of Technology
- 10.30 a.m. The Determination of the Size of Colloidal Aggregates
Produced by Shear Field Forces
B. A. Firth
Royal School of Mines, Imperial College
- 11.05 a.m. Coffee
- 11.30 a.m. The Shear Thickening Effect in Concentrated Disperse
Systems
Dr. J. Strivens
Imperial Chemical Industries, Slough
- 12.05 p.m. Time Dependent Rheological Studies of Non-Aqueous
Systems
J. Helsen, G. Schoukens, A. J. B. Spaull and Professor
J. Mewis
Brunel University and Katholieke Universiteit, Leuven,
Belgium
- 12.40 p.m. Lunch

Third Scientific Session—School of Chemistry

Interfacial Rheology

- 2.00 p.m. Paper by Dr. M. van den Tempel
Unilever Research, Vlaardingen, The Netherlands
- 2.40 p.m. The Rheological Properties of an Interface not in
Thermodynamical Equilibrium
Dr. P. Joos
University of Antwerp, Belgium
- 3.20 p.m. The Surface Rheology of Interfacial Layers of Macro-
molecules
Dr. B. Warburton
School of Pharmacy, University of London
- 4.00 p.m. Tea

THE WEATHERING OF PLASTICS AND RUBBERS

The Building and Construction Group of the Plastics and Rubber Institute is to hold a major international symposium in London on June 8th and 9th, 1976 with the object of creating a dialogue between research workers, raw material suppliers, manufacturers, specifiers and users, on original work and specific aspects and problems concerned with the weathering of plastics and rubber materials. The programme will be considering simple outdoor weathering problems anywhere in the world and how these might be overcome.

The symposium, to be opened by Dr. P. J. Bakker, Director of the Plastics and Rubber Research Institute in Holland, is divided into the following five main sessions (details of papers attached):

- A Processes of weathering
- B Measurement of conditions
- C Techniques of studying weathering
 - (a) Weathering
 - (b) Polyesters
- D Effects of weathering and their prediction
 - (a) Polyvinylchloride
 - (b) Elastomers
 - (c) Adhesives/coatings
- E Stabilization of polymers
 - (a) Polyolefins
 - (b) Fire retardants
 - (c) Rubber protection
- F Developments and applications

An Open Forum, to discuss future prospects, will conclude the programme.

Further information and registration forms from Mr. D. H. Cohen, The Plastics and Rubber Institute, 11 Hobart Place London SW1W 0HL (Telephone: 01-245 9555).

WORLD CONGRESS ON CHEMICAL ENGINEERING

Chemical Engineering in a Changing World

Amsterdam, 28th, 29th, 30th June and 1st July, 1976

Sponsored by The European Federation of Chemical Engineering (165th event) and The Interamerican Confederation of Chemical Engineering.

Organized by The Royal Institution of Engineers in the Netherlands (K.I.V.I.) and The Royal Netherlands Chemical Society (K.N.C.V.).

Scientific Programme

Monday, June 28th, 1976

Opening Address by K. R. Westerterp and W. J. Beek.

SESSION 1: NEW ADVANCES IN CHEMICAL ENGINEERING

Chairman: W. J. Beek, The Netherlands.

—P. Grassmann, Switzerland:

Unit operations.

—R. Byron Bird, U.S.A.:

Rheological aspects of transfer.

—P. B. Weisz, U.S.A.:

Energy processes.

SESSION 2: CO-OPERATIVE RESEARCH IN CHEMICAL ENGINEERING

Chairman: F. J. Zuiderweg, The Netherlands.

Tuesday, June 29th, 1976

SESSION 3: FOOD TECHNOLOGY

Chairman: H. A. Leniger, The Netherlands.

PARALLEL SESSIONS FOR SPECIALISTS

Subjects:

- * Routine programs and use of electronic computers in chemical engineering;
- * Information and documentation;
- * Loss prevention.

The scientific programs of these sessions are being prepared by the relevant Working Parties of the European Federation of Chemical Engineering.

Wednesday, June 30, 1976

SESSION 4: ENERGY AND RAW MATERIAL RESOURCES

Chairmen: J. Ciborowski, Poland, & E. Wicke, Germany.

PARALLEL SESSIONS FOR SPECIALISTS

Subjects:

- * Mechanics of particulate solids;
- * Non-newtonian liquid processing.

The scientific programs of these sessions are being prepared by the relevant Working Parties of the European Federation of Chemical Engineering.

Thursday, July 1st, 1976

SESSION 5: ENVIRONMENT AND HUMAN ACTIVITIES

Chairmen: S. D. Bhasin, India and G. Lindner, Sweden.

SESSION 6: EDUCATION IN SCIENCE AND TECHNOLOGY

Chairman: G. A. Dummett, United Kingdom.

CLOSING ADDRESS *by E. Bartholomé, Germany.*

**SECOND INTERNATIONAL SYMPOSIUM ON
POLYVINYLCHLORIDE**

5-9 Juillet, 1976

Lyon-Villeurbanne (France)

Details from Dr. Alain Michael, CNRS, Laboratoire de Chimie Macromoléculaire—39, Boulevard du 11 Novembre 1918—69626 Villeurbanne (France)—Telex CNRS Vilbr 900225.

**PRI's SECOND EUROPEAN CONFERENCE TO BE HELD
IN SEPTEMBER-OCTOBER 1976**

The International Rubber Conference planned for October 1976 in Spain was recently cancelled and the Belgian Section of the Plastics and Rubber Institute, will be holding the PRI's second European Conference of September 29th—1st October 1976. The subject will be 'The technology of plastics and rubber interface' and the venue will be the Sheraton Hotel, Brussels.

As at the first European conference, a MINiex exhibition will be held and small unit stands will be available for supplier and other companies to exhibit materials and developments.

The Sheraton Hotel in Brussels—home of the first European conference—provides excellent conference and exhibition facilities. A simultaneous translation service will be provided, and about five hundred delegates are expected to attend. A full social programme for delegates' wives and evening functions will also be arranged.

Further details will be available in due course from Mr. R. H. Craven at the Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL.

CONFERENCE PROCEEDINGS

'Polymer Rheology and Plastics Processing' Conference Proceedings Available

Papers presented at the Polymer rheology and plastics processing conference organised by the PLASTICS AND RUBBER INSTITUTE and the BRITISH SOCIETY OF RHEOLOGY on September 17th–19th, 1975 are now available from the PRI.

The international programme was developed to bridge the gap between theory and practice in polymer rheology and plastics processing by improving communications between industrial and academic workers.

The proceedings comprise the following sections:—

- (a) The different approaches—industry, technology, measurement and theory
- (b) Processing practice —large blow moulding, extrusion coating, extrusion for dielectric applications and injection moulding
- (c) Plasticisation and pumping
- (d) Calenders, dies and moulds
- (e) Flow phenomena
- (f) Stretching flows

This publication includes editorial comment by the Organising Committee and concludes with a report of the conference forum on attitudes to research in industry and the universities.

It was hoped that through the development of new processing technology to exploit the properties of plastics, and the systematic data collection and educated application of research, channels of communication will be improved between theory and practice to benefit everyone concerned in this major technological field.

Bound volumes of the 28 papers may now be purchased ONLY from the Plastics and Rubber Institute, 11 Hobart Place, London, SW1W 0HL, price £10.00 (PRI members) and £15.00 (Non-members) including postage and packing (surface mail overseas)—*payment with order please.*

BOOKS

THEORETICAL RHEOLOGY

Edited by J. F. HUTTON, Thornton Research Centre, Chester, England, J. R. A. PEARSON, Imperial College of Science and Technology, London, England, and K. WALTERS, University College of Wales, Aberystwyth, Wales.

6 × 9" (15.5 × 23 cm). xvi + 377 pages. 73 illus. 1975. Price: £12.00.

CONTENTS: *Section 1: Converging and Diverging Flow*—1. Creeping flow of a viscoelastic liquid through a contraction; a numerical perturbation solution. 2. Deceleration of viscoelastic liquids. 3. Plane entry flows of viscoelastic fluids. 4. Stability and over-stability of the plane flow of a simple viscoelastic fluid in a converging channel. 5. Hydrodynamic factors affecting the growth of fibrous crystals of extended-chain polymers. *Section 2: Thermomechanics*—6. The thermomechanics of materials with fading memory. 7. Rheological equations of state and thermodynamic principles. 8. A non-isothermal theory of viscoelastic materials. 9. Thermomechanics of compressible materials with entropic elasticity. *Section 3: Composites and Suspensions*—10. Finite deformations of strongly anisotropic materials. 11. Balance laws for mixtures of granular materials. 12. Mechanical properties of semi-crystalline polymers regarded as composite materials. 13. The mechanics of fluid suspensions. 14. The effect of the non-Newtonian properties of a suspension of rod-like particles on flow fields. *Section 4: Rheometry*—15. Progress in experimental rheology. 16. The start-up of steady elongational flow of viscoelastic materials. 17. Some new validity tests on the Bird-Carreau type constitutive equations. 18. The theory of a universal oscillatory rheometer for the study of linear viscoelastic materials using the principle of normalised resonance. 19. Correlations between linear and non-linear viscoelastic data for polymer solutions. 20. The effect of the non-Newtonian properties of polymer solutions on flow fields. 21. Report of the discussion. Index.

PROGRESS IN NUMERICAL FLUID DYNAMICS

Short Course Held at the von Karman Institute for Fluid Dynamics,
Rhode-St.Genèse, Belgium, February 11–15, 1974.

Editor: H. J. Wirz, Rhode-St.-Genèse, Belgium.

Soft cover DM 37,—; co. US \$15.20.

Berlin-Heidelberg-New York: Springer-Verlag.

ISBN 3-540-07408-2.

Contents: F. R. Bailey: On the computation of two- and three-dimensional steady transonic flows by relaxation methods.—S.-I. Cheng: A critical review of numerical solution of Navier-Stokes equations.—B. Fraeijs de Veubeke: Variational principles in fluid mechanics and finite element applications.—E. Krause: Recent developments of finite-difference approximations for boundary layer equations.—P. Kutler: Computation of three-dimensional, inviscid supersonic flows.—T. J. Mueller: Numerical and physical experiments in viscous separated flows.—J. Smolderen: Stability of explicit time dependent treatment of hyperbolic boundary problems.—G. C. Vansteenkiste: Improving of the numerical solutions by using analogue subroutines.—H. J. Wirz: Computation of unsteady boundary layers.

INEQUALITIES IN MECHANICS AND PHYSICS

G. DUVAUT, University of Paris VI, Paris, France;

J. L. LIONS, College of France, Paris, France

Translated from the French by C. John

28 figures. Approx. 400 pages. 1975.

Cloth DM 98,—; ca. US \$42.20

Berlin-Heidelberg-New York: Springer-Verlag

ISBN 3-540-07327-2

Contents: Problems of Semi-Permeable Media and of Temperature Control.—Problems of Heat Control.—Classical Problems and Problems with Friction in Elasticity and Visco-Elasticity.—Unilateral Phenomena in the Theory of Flat Plates.—Introduction to Plasticity.—Rigid Visco-Plastic Bingham Fluid.—Maxwell's Equations Antenna Problems.

NOTE

The Council have suggested that wandering rheologists who plan to visit foreign towns should notify the editor of their itinerary; if possible, well in advance of their engagements.

APPLICATIONS FOR MEMBERSHIP

Dr. V. V. Chauhan, B.Tech.(Hons.), M.Sc., Ph.D. f,et,sa,B,D,F,G,J,L,N.	Unilever Research, Olivier van Nodertlaan 120, Vlaardingen, Post BUS 114, The Netherlands.
Dr. M. Colpaert, Ph.D. f,e,sa,C,F,G.	Rue d'Anderlecht, 33, B-1620 Drogenbos. Gent.
Mr. W. C. Gorissen, Ingenieur T.H.Delft. f,et,sa,C,D,H.	University of Technology, Twente, Enschede, Holland.
Professor J. F. Ingenhouz, Mech. Engr. f,et,a,C,D,H.	Twente Univ. of Technology, P.O. Box 217, Enschede, The Netherlands.
Dr. R. Khanna, Ph.D., M.Tech. p,et,sa,C,D,F,G,H.	Berger Paint, Carpenters Road, Stratford, London E.15.
Dr. B. J. Launchbury, B.Sc. p,e,a,D.	Cyanamid BV, Box P.O. 7085, Rotterdam, Holland.
Mr. G. A. LeGrys, B.A.(Physics), M.Inst.P. f,et,a,F,G,H,L,M.	Lord Rank Research Centre, Lincoln Road, High Wycombe, Bucks.
Mr. J. W. Semple, B.Sc., Grad.P.I. p,et,sa,D,F,G,H.	Polytechnic of the South Bank, Borough Road, London, S.E.1.

RESIGNATIONS

Miss R. Samel, 31, Redington Road, London, N.W.3 7QY.	Mr. P. Lockyer, U.C.W., Aberystwyth.
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NEW MEMBER

Mr. D. R. Thompson, B.Tech. p,et,a,F,G.	Wallcoverings Research Labs, March House Lane, Darwen, Lancs.
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DIARY

- 29 March–1 April.** "Deformation, Yield and Fracture of Polymers", Cambridge.
- 5–6 April.** "Microscopy of Organic Sediments", Oxford University (RMS).
- 7–9 April.** "Pneumotransport 3", Bath.
- 8–9 April.** "Rheology of Colloids", Bristol University.
- 8–9 April.** "Hydraulic Cement Pastes", Tapton Hall, Sheffield University.
- 8–9 June.** "The Weathering of Plastics and Rubbers".
- 28 June–1 July.** "World Congress on Chemical Engineering", Amsterdam.
- 5–9 July.** "International Symposium on PVC", Lyon.
- 23–27 August.** VIIth International Congress on Rheology, Gothenburg, Sweden.
- 1 October.** "Future Developments in Rheology", B.S.R. Autumn Meeting, AGM & Dinner, London.
- 29 September–1 October.** "The Technology of Plastics and Rubber Interface", Brussels.