

BULLETIN



BRITISH SOCIETY OF RHEOLOGY

1977, Vol. 20, No. 3

CONTENTS

Foreword	i
Officers and Members of Council	ii
Award Proposal	25
Technical Enquiry—Coanda Effect	27
S.R.C. Panel Report—Rheology Instrument Project	30
J. S. Walker Memorial Fund—P.R.I. mould Design Award	33
Call for Papers	
Rheology & Rheometry of Multi Phase Systems—September 6th-8th, 1978, Plymouth	34
Screw Extrusion—April 1979, London	35
Future Meetings	
Rheology of Inorganic Materials and Cement and Concrete Admixtures and Improving Additives—Nov. 14th-18th, Mons, Belgium	36
Physical Chemistry and Rheology—Cranfield, 4th-5th January, 1978	41
Courses	
Fluid Rheology—November 21st-25th, 1977, Stevenage	43
Polymer Processing—May 1st-5th, 1977, London	45
Applications for Membership	46
Diary	46

Hon. Editor:

M. CAMINA,

Paint Research Association,

Waldegrave Road,

Teddington,

Middlesex.



FOREWORD

Every now and then the secretary of the B.S.R. is asked for rheological information covering diverse industries. Some of the questions received seem of sufficient interest to publish the replies.

So the new series of technical enquiries will start in this issue. The question received concerned the Coanda Effect and Mr. Desty of British Petroleum has kindly consented to write a short article on this effect. He gives a brief history of Coanda's life, a general description of the effect and its applications.

To try and keep the series going we need more enquiries of this type, so if any of our members have queries or problems rheological we would be pleased to publish the question and answer; if there is one.

OFFICERS AND MEMBERS OF COUNCIL 1976-77

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

DR. M. SHERRIFF, Department of Pharmaceutical Chemistry, School of Pharmacy, Brunswick Square, London.

British Society of Rheology
PROPOSAL FOR AN ANNUAL AWARD

Motion proposed by Council for consideration at the Annual General Meeting on September 8, 1977 in Edinburgh.

The Motion

That the Society should institute an Annual Award to be made to an individual or a group of individuals or an institution for significant or promising contribution(s) and/or services to the advancement of rheology in all its aspects,

And that Council be empowered to draw up the rules in accordance with the Explanatory Notes given below.

The first of the Annual Award will be made in 1978 and the monetary value is not to exceed £350.

Background

The British Society of Rheology has made a series of Gold Medal Awards. The first was presented in 1966 to Professor M. Reiner to honour his 80th year (Bulletin 1966 (3), 1; (4), 20).

The next award was to be made in 1967 for applied rheological research, for "the best contribution to the solution of an industrial or technological problem by the application of rheological science" (Bulletin 1966 (3), 2). But in the event none of the submissions to the open competition was successful (Bulletin 1968 (3), 13).

The rules of the competition were revised for the 1969 Competition (Bulletin 1968 (3), 13) and this time the Gold Medal was awarded to Professors D. M. Dowson and G. R. Higginson for their work on "The role of lubricant rheology in engineering applications of elastohydrodynamic lubrication" (Bulletin 1969, 12 (4), 14).

The next Gold Medal Award was made in 1970 to Drs. G. W. Scott Blair and V. G. W. Harrison, founders of the Society (Bulletin 1970, 13 (4), 108).

The original intention was to repeat the Gold Medal Competition every three years. However, the experience of the 1967 and 1969 ventures shows that the format did not appear to be very fruitful. Council therefore made proposals for changes (Bulletin 1971, 14 (4), 50), which were discussed at the 1971 A.G.M. in Exeter. It was resolved that a panel of three past Presidents should be empowered to make recommendations once a year to Council regarding possible recipients of the Gold Medal Award. Subsequently, a Gold Medal was awarded, in 1972, to Professor L. R. G. Treloar for "his significant contribution to the solution of major industrial problems (especially in the field of rubber elasticity) by the application of fundamental rheological knowledge" (Bulletin 1972, 15 (4), 69)

No award has been made since that date and this year, again, the panel of past Presidents did not feel able to make any specific recommendation as to possible recipients.

However, for the past few years, Council has continued to feel that there is a need to encourage workers, both in industry and in the academic institutions, to make greater practical use of fundamental rheological principles or otherwise contribute to the advancement of rheology. It is considered that, whilst achievements that warrant the distinction of a Gold Medal Award may be rare, there are nevertheless significant contributions and services made to rheology that deserve recognition and that the Society should institute an Annual Award to confer this recognition and to stimulate future endeavours. To this end, Council wishes to place the Motion above in front of the A.G.M.

The following Explanatory Notes give some details of how the Annual Award might be implemented.

Explanatory Notes

It is not intended to define closely what constitutes "significant or promising contributions and/or services to the advancement of rheology". But that once a year (say, in December) an open notice will be published in the *Bulletin* and as a press release to invite submissions. These may be personal applications or nominations by individuals, academic or industrial supervisors, or heads of institutions. The submission will have to state in what way the particular contribution or service is significant or promising.

No restriction will be put on the scope of the contribution or service. It might be, for example, (i) the best published paper, open report or thesis, or (ii) the most stimulating presentation to a Society conference, or (iii) services to the Society, such as long and distinguished service on Council or otherwise, or, of course, (iv) the best contribution to the solution of an industrial or technological problem by the application of rheological principles. Any others that can be shown to be significant or promising will be admitted for consideration.

The assessment of submissions will be carried out by a panel composed of the President, two past Presidents and a member of the Society who will be elected at the A.G.M. immediately preceding the December publication date or, failing that, coopted by Council. The panel will make its recommendation to Council who will make the Award on behalf of the Society. The result of the Award will be announced at the A.G.M. in September in the year following, and the presentation of the Award made at the corresponding Conference Dinner.

It is suggested that submissions should be encouraged mainly from members of the Society and concerning work carried out mainly in

an institution located in the United Kingdom. However, Council does not wish to recommend a definite prohibition on foreign members where a piece of work is of special merit.

The assessing panel will also be asked to make recommendations about the form of the Annual Award for the year in question. Again, there will be no specific restriction except that the monetary value will not exceed, say, £350 or such sum that the A.G.M. will decide. Otherwise, the form of the Award could be, for example, a book prize or a cash prize and/or a commemorative certificate or a medal of some material other than gold; or an honorary membership or life membership of the Society; or a Gold Medal if the submission is of special merit. The winner of the Annual Award will be invited to present a paper or give an address at the principal scientific meeting of the Society and his/her expenses for attendance will be paid by the Society.

THE COANDA EFFECT AND ITS APPLICATIONS

by D. H. Desty

Coanda was a very interesting character of Rumanian origin who had an extremely inventive intuitive approach to engineering problems. The effect which bears his name was discovered by him around 1910 when he tried to build the first aeroplane powered by primitive reaction jets. He was worried about the impact of the hot gas efflux on his wooden fuselage and thought he would protect it with curved sheets of thin steel attached to the sides of the back end of the aircraft. It was somewhat disconcerting for him when the wooden airframe took fire rather more quickly than he had expected in his worst predictions. In spite of this disaster however he recognised why it had happened. The hot gas jets had adhered to the curved steel sheets and remained attached to them over the entire length. This simple observation led to a personal preoccupation with the potentiality of the effect, which was to last the rest of his long life as he only died a few years ago at the age of 84.

Like so many significant original observations of this kind the concept of attached fluid jets lay fallow for almost 20 years until Coanda himself in the thirties took up the subject again and did sufficient ad hoc experimental work on possible practical applications in all sorts of fields, to take out several tens of patents. All these never quite defined his ideas well enough to represent an effective description of how to make a practically useful device and, as far as I have been able to discover, he never published any formal papers on the subject in the technical literature.

He formed his own small company in this period just before the Second World War to endeavour to achieve some financial profit

from his patents but the war overtook him. Perhaps in a characteristic way he made the mistake of working for the Germans in order to support his technical interest in practical Coanda devices. It seems rather strange now but they accepted his proposals to build a sledge for the Russian front propelled by a Coanda effect propulsion unit. This practical goal, although never achieved, led him to successfully apply his undoubted engineering artistry to maximising the augmentation of thrust, as compared with a simple reaction jet, which the use of Coanda propulsion devices allow. At the end of the war he was imprisoned by the French in Paris and was about to be shot when American and British Air Force Officers, appreciating the significance of his work, interviewed him several times in order to obtain as much information as possible from poor Coanda before his demise. His attempts, under such pressure, to justify his claim that he had reached thrust augmentation values of 2.7 present a rather pathetic story of this phase of his life. In the event, of course, he survived and continued actively with his work on Coanda propulsion for many years after the war, largely with such poorly directed American support that he never again demonstrated his original impressive work in the propulsion field. It is indeed unfortunate, looking back, that he was never able to bring his ideas to fruition in any well established application and his disciples in both industry and the academic area, were to achieve this only later when he had become old and discouraged. Still at the end of a long life the rewards of his life-long dedication to his original observation must have been apparent to him and he was finally recognised by his own countrymen in a special Symposium organised in his honour in Bucharest, a few years before he died.

To revert to the actual physical effect however, it is manifest in its simplest form in a poorly designed milk jug. The failure of the milk, when being poured out, to detach from the lip leads to the stream bending round against gravity and running down the side of the body.

A more general description is that when a fluid jet is ejected from an unsymmetrical orifice with an extended surface downstream of the latter, the jet will attach to this surface and be deflected. The amount of such deflection obtainable is surprising in that angular turns of 90° and beyond can be accomplished.

Although the basic fluid dynamics of the Coanda effect is still not understood in detail, in a very simple way, it is possible to balance the centrifugal force induced on the bending jet at right angles to the stream against the force produced by atmosphere pressure pushing it against the deflection surface. The latter arises since the streaming action prevents air getting behind the jet stream. When the centrifugal force produces a vacuum on the deflection surface of 1 atmosphere the film breaks away and the Coanda effect fails.

This general form of the Coanda effect leads to two characteristics which have been the basis of most of the practical applications. The more obvious is that the bending of the stream leads to its acceleration and the production of a moderate reduction in pressure in a zone on the open side of the orifice into which secondary air is entrained. Such entrainment flows can be very much larger than the pressure induced flow from the primary orifice and ratios as high as 27 have been measured for devices of suitable geometry. The other aspect of the effect concerns the much lower pressure skin which lies close to the deflection surface itself the origin of which has been described earlier in simple terms. This low pressure skin produces a substantial reduction in the boundary layer friction between the deflected jet and the closely adjacent surface.

Although it is possible to construct two dimensional models of the configuration for demonstration purposes practical devices, of necessity, have to employ linear slot jets in either a straight or circular form in order to produce an effect of any useful size. Perhaps the most obvious application is to fluid pump with no moving parts and, using air, such pumps have achieved widespread use in environments involving explosion hazards such as coal mines. The venturi shape form with a radial ingoing slot at the bottom has been most widely employed for this type of application since it is reasonably easy to construct and visualised as a substitute for the moral electrically driven axial flow fan. It is surprising however that the straight slot configuration has not been more applied as the geometry seems ideally suited to tunnels and other ducts. It has been claimed that, by good practice, the energy efficiency of such air pump can be as high as 80 per cent of the corresponding axial fans.

The extension of gaseous pumps of this type to simple premixed combustion burners is a step with which I myself have been much associated in the last decade. By substituting high pressure fuel gas for the compressed air of an air pump, the former may be burned in a stable fashion in the entrained stream of atmospheric air, which in general is a sufficient volume to achieve stoichiometric combustion. We have used successfully both the venturi geometry and its topological inversion in the tulip, which has a circumferential slot at its base with a radial outgoing flow of the primary flow. Very large burners of the latter form have been developed with tulips as large as 9 feet in diameter, which burn hundreds of tons of gas per hour smokelessly at petroleum crude oil production centres.

At the other end of the spectrum of size ingenious development of the Coanda Effect formed the basis of modern fluidic computers. If a single jet is ejected from a small orifice much less than a millimetre in diameter and two curved surfaces arranged close to the axis of the jet then the fluid flow is stable only when attached to one surface or another. It can however be made to jump from one side

to the other by applying a very small pressure pulse to one of a pair of small side entries in the curved deflectors. The device which in practice has the form of a flat plate a centimetre or so in dimension will act as a bistable flopping switch which has become the basic digital counter of fluidic computers.

Coanda himself was mainly preoccupied with the application of his effort for propulsion purposes. It is perhaps surprising that, after his effort in this direction, so little practical use has emerged of the thrust augmentation achievable by entrainment devices of the Coanda type. In principle, realistic alternatives without moving parts are possible to the propellor in water and air for moderate speed vehicles. The difficulty, which has been solved only in part, is that the most simple entrainment devices achieve only momentum transfer between the primary and secondary flow with a consequent maximum energy efficiency limitation of about 30%. Subtle methods of increasing this level of energy transfer recognised intuitively by Coanda 40 years ago, are now being actively explored both in terms of basis fluid dynamics and practical design compressible and non-compressible fluids. The additional practical difficulty in real propulsion systems is that the use of entrainment devices often leads to substantial increases in appendage drag. Such aircraft as the Boeing S.T.O.L. machine has begun to point the way to techniques by which the Coanda effect can be used, not only to propel the vehicle, but achieve positive drag reduction at the same time. The concept of a submarine driven by ejecting water at the bow which produces induced flow at the boundary layer over the whole hull is perhaps an easily appreciated approach to this end.

S.R.C. NON-NEWTONIAN FLOW PANEL—RHEOLOGY INSTRUMENT PROJECT

Viscometer for very low shear rates

In a previous article, published in the *B.S.R. Bulletin* vol. 20, No. 2, the aims and objectives of the S.R.C. Non-Newtonian Flow Panel are described. It was stated that the Panel has initiated the Rheology Instrument Project to consider the development of novel rheological instruments to cover the areas not adequately served by existing equipment. One of the areas concerns the measurement of the limiting viscosity of low-viscosity fluid at zero shear and of low-yield stress properties. Information on industrial needs as far as it is known has been reviewed by the Project and tentative specifications for an ultra-lower shear viscometer have been drawn up. How the specifications might be achieved in practice was then considered. It was readily shown that to meet the tentative specification, very low forces and slow movements would have to be involved and they pose

severe problems of implementation and measurement. It was therefore decided that before proceeding further with the design of the ultra-low shear viscometer, a definitive survey should be made of the exact industrial requirement for such an instrument.

This article will describe what the Project saw as constituting industrial needs, the tentative specification for the ultra-low shear viscometer and the preliminary findings on considering its design. The purpose is to obtain the views of the rheology community, as a whole, academic as well as industrial, to confirm the industrial needs as stated or otherwise and so to revise the specification as appropriate and complete the design of a new viscometer.

The needs

There appears to be three areas in which needs exist for a low shear viscometer. The first is the measurement of the limiting viscosity at zero shear rate for fluids of low viscosity. The determination of the limiting viscosity for high viscosity materials, such as polymer melts, does not present difficulties. But with low viscosity fluids, the low shear stresses involved require special attention. The limiting viscosity is a measure of the molecular weight and configuration of the solute in a solution. The knowledge is required for fundamental scientific investigation and for industrial quality control. Examples of materials involved include polymers, thickeners, surfactants and other additives, as well as proteins and other biological systems.

The second area concerns the stability of products that are dispersed systems. Such as paints, inks and pigment preparations, pharmaceutical products, agricultural chemicals (weed killers and pesticides), certain foodstuffs and beverage like fruit squashes. Among other desirable properties, these systems should be capable of keeping the solid phases in suspension over periods of weeks, months and even a few years, as this determines the shelf-life and customer acceptability of the products. It is widely thought that such materials should possess a high limiting viscosity to reduce the sedimentation rate or even a reasonable yield stress, so that settling of the solids can be prevented altogether. Therefore, the call for a viscometer to measure the fluid properties at the low shear rates encountered in the settling process is often heard.

The third area of need is found with flow phenomena such as levelling of paints (flow-out of brush marks) and various coating fluids, and sagging of paints, jointing and other building mastics. Here either the motive force for flow, derived from gravity, is low or the velocities involved are small. Thus a knowledge of the low shear properties of the materials is thought to be useful.

Tentative specifications

Many commercial viscometers already exist that are capable of 10^{-3} s^{-1} in shear rate, one would be looking for shear rates that are one or two decades lower, down to 10^{-4} or 10^{-5} ss^{-1} , in an ultra-low shear viscometer.

A simple calculation will demonstrate that these figures are realistic. Consider the sedimentation of a $1 \mu\text{m}$ diameter particle in a container of 100 mm height. If one imagines that this represents the situation in a product that has to be stable over six months, the sedimentation rate would be of the order of $100 \text{ mm}/6 \text{ months} = 6.5 \times 10^{-6} \text{ mm/s}$. Using the equation derived by Sato et al. (1966), the shear rate involved is $0.6 \times 6.5 \times 10^{-6} (\text{mm/s})/1 (\mu\text{m}) = 4 \times 10^{-9} \text{ s}^{-1}$. Thus even 10^{-5} s^{-1} is much larger than would be required.

The specification for shear stress depends on whether the test material is a low viscosity fluid or whether it possesses a yield stress. For a low viscosity fluid, one can assume the viscosity to be 1 mPa s , corresponding to aqueous systems that are commonly encountered. Taken together with the above shear rates, the shear stress would be 10^{-7} or 10^{-8} Pa .

Rheologists in industry have been known to be measuring stresses at 10^{-6} Pa level at 10^{-3} s^{-1} using an existing commercial instrument. But they ran into problems of meter fluctuations. Thus even some means of accurate measurement at 10^{-6} Pa level would be welcome.

For materials with yield stress, a different order of shear stress seems to be required. The lowest yield stress recorded in the literature appears to be about 0.1 Pa and several commercial instruments give this order of sensitivity. Thus one would be looking for stresses of about 10^{-2} or 10^{-3} Pa in yield stress measurement.

Summarising, a tentative specification for an ultra-low shear viscometer would be 10^{-4} or 10^{-5} s^{-1} in shear rate and perhaps 10^{-6} or 10^{-7} Pa in shear stress. Other important features of the new viscometer would be provision for prevention of evaporation from the sample, good temperature control and that it should be simple to set up and operate, preferably by semi-skilled personnel.

Conclusions

The R.I.P. with the assistance of S.R.C. Rutherford Laboratory carried out a preliminary study of how the above low shear rates and stresses might be achieved in practice. Conventional geometrics for viscometers were considered: falling sphere or rod, tube flow, Couette cylinders, cone-and-plate and parallel plates. It was readily shown that very low forces and very small velocities are involved.

For example, if a 10 mm diameter sphere is used, the velocity to achieve 10^{-5} s^{-1} is $1.7 \times 10^{-7} \text{ m/s}$ (1.5 mm/day). If the viscosity is 1 mPa s , the force involved is $16 \times 10^{-12} \text{ N}$ ($1.6 \times 10^{-6} \text{ mgf}$).

Alternatively, if tube flow is used, the volume flow rate to achieve 10^{-5} s^{-1} in a 10 mm diameter tube is about $10^{-2} \text{ m}^3/\text{s}$ ($8.5 \times 10^{-2} \text{ ml/day}$). With a 1 mPa s fluid at 10^{-5} s^{-1} , the shear stress is 10^{-8} Pa . If it is assumed that one can measure a pressure drop of 10 Pa (1 mm water), the length of the 10 mm tube has to be $2.5 \times 10^6 \text{ m}$ (a distance from London to Istanbul).

Now, although it is not impossible with present day technology to achieve and measure these very small forces and velocities, it is obvious that conventional viscometric techniques are inapplicable. New concepts have to be used to develop the ultra-low shear viscometer and no small effort will be involved. Before the R.I.P. proceed with further consideration of the design of this viscometer, it would like to have confirmation that the industrial needs and academic interest has been accurately identified and that the tentative specifications of shear rate and shear stress accord with what is desired by the rheology community.

This summary of the findings of the Project has therefore been prepared for comment. The Project would be pleased to learn about other areas of industrial problems where it is thought that a need for low shear property exists. Does one really want a viscometer to reach the very low shear rates and shear stresses indicated above? If confirmed, an instrument could well be designed to cope. But there is no need to go to unnecessary lengths if less severe shear rates and shear stresses are acceptable. The Rheological Instrument Project invites everyone who has an interest or a contribution to make on this problem to communicate with it through the S.R.C. Non-Newtonian Flow Panel.

J. S. WALKER MEMORIAL FUND CONTRIBUTES TO THE P.R.I. MOULD DESIGN AWARD

The J. S. Walker Memorial Fund was set up by a Mr. Blitz, who as a G.I. (Sergeant Saul Blitz) attended a plastics course at the Borough Polytechnic, and was so impressed by the work of Mr. Walker, who was director of the old-established firm of injection moulders, Fraser & Glass Ltd., and co-author with E. R. Martin of the P.I. monograph "Injection moulding of plastics", that following the latter's death, he set up a trust fund to provide a prize for students working with plastics.

For some years this prize was awarded to students at the Borough Polytechnic (now the Polytechnic of the South Bank) but the trustees consider that the fund should now support the P.R.I.'s annual Mould Design Award. The organisers of the Award are most grateful to the trustees of the J. S. Walker Memorial Fund for their generous offer.

The Mould Design Award was instituted by the Mould Design and Manufacturing Subcommittee of the Institute's Processing and Engineering Group in an attempt to encourage young designers in the plastics and rubber industries to become aware of "good" design, and its importance to the future of the industries.

Further details and entry forms for the Mould Design Award are available on request from Trish Durston at the Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL (telephone: 01-245 9555).

CALL FOR PAPERS

"THE RHEOLOGY AND RHEOMETRY OF MULTIPHASE SYSTEMS"

This Conference will be held at the College of St. Mark and St. John, Plymouth, Devon from September 6-8, 1978.

The theme of the conference will be the deformation and flow of suspensions, dispersions and other multiphase systems. Within this general framework it is hoped to include special sections on:

Biological systems

Food

Materials of interest to the oil industry
and

Filled and blended polymers

Papers on both theoretical and experimental rheology will be welcome. Contributions discussing the observation of rheological phenomena in practical situations will be especially appreciated.

Early notification of the intention to submit a paper would be appreciated by:

Dr. T. E. R. Jones

Department of Mathematical & Physical Sciences

Plymouth Polytechnic

Drake Circus

Plymouth

Devon PL4 8AA

Dr. K. M. Beazley

44 Brockstone Road

Boscoppa

St. Austell

Cornwall PL25 3DP

and

The Secretary

to either of whom a title and abstract (200 words) should be sent before January 1, 1978.

SCREW EXTRUSION

(an up-to-date review of the *process* and its *products*)

The Plastics and Rubber Institute will hold an international conference designed to interest all those working in the general field of screw extrusion of thermoplastics and rubbers.

The expected date is April 1979 and the venue will be London.

Papers are called from machinery manufacturers, processors, raw materials suppliers and researchers to cover the following general subject areas—any other related topics are welcomed, and illustration by case history is appropriate:

Films—plastics papers; co-extrusions; stretched films; melt-coating

Compounding—thermoplastics and rubbers; thermosets

Sheet—wide and thick sheets

Pipe—large diameter; high speed production

Profiles—rigid expanded; solid

It is intended to develop the theme of product need leading to process improvement and machinery development. Papers therefore should include all necessary theory but with emphasis on the successful end-product. This does not preclude specific specialised contributions on any aspect of extrusion technology.

Offers of papers, together with a synopsis of approximately 250 words, should be sent to Trish Durston, The Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL (telephone: 01-245 9555).

FUTURE MEETINGS

INTERNATIONAL CONFERENCES

RHEOLOGY OF INORGANIC MATERIALS

Mons, November 14-15, 1977

organised by

Association belge pour favoriser l'étude des verres et des
matériaux céramiques

a.s.b.l.

and

The Belgian group of Rheology
(A.F.N.R.S. contact group)

CEMENT AND CONCRETE ADMIXTURES AND IMPROVING ADDITIVES

Mons, November 16, 17, 18, 1977

organized by

Association belge pour favoriser l'étude des verres et des
matériaux céramiques

a.s.b.l.

Rheology of Inorganic Materials

PROGRAMME

November 14, 1977

- 9 h. 45 Dr. C. Marco, President B.G.R. (Université de Mons,
Belgium)
Opening of the meeting
- 10 h. 00 J. Mewis (University Leuven, Belgium)
Invited Lecture:
*General Rheological Behaviour of Concentrated Inorganic
Dispersions*
- 11 h. 30 T. E. R. Jones and S. Taylor (Plymouth Polytechnic,
United Kingdom)
*Rheological Properties of Cement Pastes—effect of Addi-
tives*
- 12 h.00 Tadahiko Okumura (Shimizu Construction Co. Ltd., Japan)
*A Study on the Application of Rheological Properties of
Intrusion grout to estimate the lateral Pressure of preplaced
Aggregate Concrete*

- 14 h. 30 Y. Ivanov and E. Stanoeva (Bulgarian Academy of Sciences, Bulgaria)
On the Influence of Cement Composition and other Factors on the rheological Behaviour of Cement Pastes
- 15 h. 00 C. Coulon (Lafarge, Lab. Centr. Le Teil, France)
Anomalies rhéologiques apportées par des plastifiants à base de lignosulfonates
- 15 h. 30 A. M. Paillere, Ph. Briquet (Laboratoire Central des Ponts et Chaussées, Paris, France)
Etude comparative du comportement rhéologique et mécanique des bétons avec plastifiants, réducteurs d'eau et fluidifiants. Essais spécifiques aux fluidifiants
- 16 h. 30 *General Assembly of the Belgian Group of Rheology*

November 15, 1977

- 9 h. 30 M. Van Wallendael (C.R.I.C., Bruxelles, Belgium)
 Invited Lecture:
Les méthodes rhéologiques dans l'industrie cimentière
- 10 h.30 J. Lukas and F. H. Wittmann (Delft University of Technology, The Netherlands)
Methods of predict Creep and Shrinkage of Hardened Cement Paste and Concrete
- 11 h. 30 L. M. Blondiau, Ch. Descamps, W. Steyaert (S.A. Ciments d'Obourg, Belgium)
Corrélations entre différentes méthodes de mesures rhéologiques sur bétons frais
- 12 h. 00 M. Van Wallendael (C.R.I.C., Bruxelles, Belgium)
L'utilisation des ultra-sons pour les mesures rhéologiques dans les matériaux à base de ciment
- 14 h. 30 C. Legrand et M. Barrioulet (Inst. Nat. Sc. Appliquées de Toulouse, France)
L'hétérogénéité, caractère essentiel de l'écoulement du béton frais vibré
- 15 h.00 J. Horovitz, Z. Kalmar, F. D. Tamas (Institute of Building Science, Budapest, Hungary; Veszprem University of Chemical Engineering, Veszprem, Hungary)
Effect of plasticizing admixtures upon the rheological properties and the hardening of Concrete
- 15 h.45 *General Discussion and Short Communications*

Cement and Concrete Admixtures and Improving Additives

PROGRAMME

November 16, 1977

- 9 h. 20 P. Fierens (Université de Mons, Belgium)
Introduction to the Meeting
- 9 h. 30 F. Massazza (Polytechnic de Milan, Italcementi, Italy)
Invited Lecture:
Développements récents dans le domaine des adjuvants des ciments et des bétons
- 11 h. 00 G. Lahajnar, R. Blinc, M. Rozmarin (University of Ljubljana, Yougoslavia); I. Kocuvan, J. Ursic (Salonit Anhovo, Yougoslavia)
Evaluation of various Cement Additives by pulsed N.M.R.
- 11 h. 30 P. L. Owens (Pozzolanit Ltd., United Kingdom)
Assessment of the Effect of Fineness of fly Ash when used as a partial Portland Cement replacement Material
- 12 h. 00 S. Chatterji, H. Gudmundson, A. D. Jensen (Tecknologisk Institut Tastrup, Denmark)
The Characteristics of Air-Bubble Systems in hardened Concrete produced by three Types of Air-entraining Agents-Plasticizer Combination
- 14 h. 30 A. M. Paillere (Laboratoire Central des Ponts et Chaussées, Paris, France)
Relation entre le comportement des bétons et mortiers hydrauliques avec entraîneurs d'air et l'aspect, dimension et répartition des bulles d'air occlu dans la masse
- 15 h. 00 J. Bensted (The Associated Portland Cement Manufacturers Limited, United Kingdom)
Early Hydration Behaviour of Portland Cement in Water, Calcium Chloride and Calcium Formate Solutions
- 15 h. 30 M. Collepardi (University of Ancona, Italy); M. Corradi (Research and Development Laboratories, Mac Master Builders, Treviso, Italy)
High Strength and reliable Concretes
- 16 h. 30 *General Discussion and Short Communications*

Le soir à 20 h. 00: BANQUET

November 17, 1977

- 9 h. 00 A. Rimmer (Pilkington, United Kingdom)
Invited Lecture:
Glass for Glass-Cement composite Materials

- 10 h.00 I. Odler and O. Schmidt (Technical University, Clausthal, Germany)
Effect of Zinc Salts upon Hydration of Portland Cement
- 11 h. 00 K. L. Watson, N. B. Eden, J. R. Farrant (Portsmouth Polytechnic, United Kingdom)
The Effect of Admixtures on the Relationship between compressive Strength and Density of autoclaved aerated Concrete made from Slate Powder and Portland Cement
- 11 h. 30 F. H. Wittmann (Delft University of Technology, The Netherlands)
Influence of Water reducing Admixtures on the rheological behaviour, capillary Shrinkage and Structure of Cement Paste
- 12 h. 00 R. Sierra, M. H. Tinturier (Laboratoire Central des Ponts et Chaussées, Paris, France)
Action des fluidifiants sur les processus d'hydratation des ciments et de leurs constituants
- 14 h. 30 D. D. Double (University of Oxford, United Kingdom)
An Examination of the Hydration of Portland Cement by Transmission Electron Microscopy
- 15 h.00 P. Fierens, Y. Kabuema, J. Tirlocq (Université de Mons, Belgium)
Etude cinétique de l'hydratation du silicate tricalcique en présence d'adjuvants
- 15 h. 30 V. S. Ramachandran, R. F. Feldman (National Research Council of Canada, Ottawa, Canada)
The Influence of Calcium Chloride on the Hydration of Cement
- 16 h.30 *General Discussion and Short Communications*

November 18, 1977

- 9 h. 00 J. P. De Berraly, N. Tenoutasse (Université de Bruxelles, Belgium)
Mécanisme d'action des adjuvants sur les ciments Portland et leurs composants
- 9 h. 30 R. K. Dhir, E. S. Darfour, J. G. L. Munday (The University, Dundee, United Kingdom)
Strength and Durability of Concrete containing P.F.A. Additive
- 10 h. 00 Y. Dechamps, P. Dutron, M. Van Wallendael (C.R.I.C., Bruxelles, Belgium)
Etude des Hydrofuges

- 11 h. 00 J. F. Young (University of Illinois, Urbana, U.S.A.)
A Discussion of the Interactions between hydrating Calcium Silicates and Set-modifying Admixtures
- 11 h. 30 F. D. Tamas (Veszprem University of Chemical Engineering, Veszprem, Hungary)
Effect of Calcium Chloride upon the oligomerisation of Calcium Silicates and Cement
- 14 h. 30 V. Zak, S. Slanicka (Research Institute of Civil Engineering, Bratislava, Czechoslovakia)
Influence of Plasticizers and Air entraining Agents on the Properties of white exposed Concrete with Special Regard to the Use of suitable Aggregate
- 15 h. 00 *General Discussion and Short Communications*

GENERAL INFORMATION

Place of Conference

Mons (Belgium). Faculté Polytechnique, Salle Académique, Boulevard Dolez, 31

Official languages

French, English, German

Welcome office

November 13: from 15.00 to 18 h. 00

November 14, 15, 16, 17, 18: from 8.00 to 18 h. 00

Mailing address

Silicates Industriels

32, rue de Malplaquet, B 7000 MONS, Belgium

Participation fees

	B. frs.
1. Rheology of inorganic materials (2 days)	2000
Reduced price for members of organizing societies	1500
2. Cement and Concrete Admixtures (3 days)	3000
Reduced price for members of the organizing society	2250
3. Reduced price for participants to both meetings (5 days)	4000
Reduced price for members of organizing societies	3000
4. Participation to banquet	850

These fees are to be paid to the Crédit Communal de Belgique, compte 068-0528690-67 of Silicates Industriels, Mons, Belgium

Deadline for inscriptions

November 1, 1977

PHYSICAL CHEMISTRY AND RHEOLOGY

The Industrial Sub-Committee of the Faraday Division is organising a one and a half day Informal Discussion on:-

“MOLECULAR INTERACTIONS, MICROSTRUCTURE AND RHEOLOGY”

to be held at the Cranfield Institute of Technology, Cranfield, Nr. Bedford, on JANUARY 4th/5th 1978, where accommodation has been reserved provisionally for sixty participants.

The meeting will follow the established Faraday discussion format of pre-circulated original papers (in typescript), and short presentations by the authors, with most of the time being devoted to discussion.

Topics covered will be introduced by a review lecture, and will include the use of rheological responses to low deformations and low deformation rates to characterize structural changes due to:-

Interactions between polymers and low molecular weight species, such as drugs, ions or surfactants—Dr. B. Warburton, London School of Pharmacy.

Interactions in ordered systems of long chain alkyl derivatives, such as alcohols, glycerides, phospholipids, surfactants, etc.—Prof. B. Barry, University of Bradford.

Interactions between macromolecules such as natural and synthetic polymers—Prof. R. Koningsveld, D.S.M., Geelen, Holland.

The physical aspects covered will include, therefore, conformational effects arising from binding, multiphase behaviour, gelling, liquid crystal formation, excluded volume effects, coacervation and synergistic effects.

Since residential facilities at Cranfield may have to be limited, reservations must be treated on a ‘first come, first served’ basis.

Fees:-

British Society of Rheology Member	£3.25
Accommodation and Meals—Cranfield	£16.15

Information and Registration:-

B. Roberts, Pafra Ltd., Bentalls, Basildon, Essex, SS14 3BU

Molecular Interactions, Microstructure and Rheological Behaviour
Cranfield—4th/5th January 1978

Provisional List of Contributed Papers

Conformational transitions of Poly Acrylic Acid in mixtures of water, monohydric alcohol and HCl

Z. Priel and A. Silberberg.

Weitzmann Institute of Science, Rehovot, Israel.

Absorption of a homologous series of alkyl sulphate surfactants on a clean polystyrene latex

D. England.

Dept. of Pharmaceutical Chemistry, University of Bradford, BD7 1DP.

Alginate-gelatin interactions

E. L. Wilson and G. Stainsby.

Procter Dept. of Food Science, The University of Leeds, LS2 9JT.

Studies on the gelling process in polyvinylalcohol/congo red systems using rheological and inelastic light scattering techniques

G. C. Maitland and S. Sayegh.

Dept. of Chem. Eng. and Technology, Imperial College, London, SW7 2A.

Binding and viscosity studies on the precipitation of polyvinylpyrrolidone from aqueous solution by phenolic cosolutes

P. Molyneux.

Dept. of Pharmacy, Chelsea College, Manresa Road, London, SW3 6LX.

The phase separation of binary copolymers of styrene and methylmethacrylate from solvent/non-solvent mixtures in relation to copolymer structure and polymer solvent interactions

T. A. Strivens.

I.C.I. (Paints Division) Ltd., Wexham Road, Slough, Berks.

Observations on the defect structure and rheology of Lamellar liquid crystals

R. C. Horn and M. Kleman.

Laboratoire de Physique des Solides, Univ. de Paris-Sud, 91405, Orsay, France.

Rheological equations of state consistent with thermodynamics

A. J. B. Spaul.

School of Chemistry, Brunel University, Uxbridge, Middlesex.

Viscoelastic properties of natural rubber/Beta Pinene resin blends and their relation to pressure sensitive adhesion

M. M. Sherriff.

School of Pharmacy, University of London, Brunswick Square, London.

Rheology and Microstructure of the continuous phase of semi-solid emulsions.

G. M. Eccleston.

School of Pharmacy, Portsmouth Polytechnic, Portsmouth.

Rheological assessment of interactions between steroids and mucons
C. Marriott and I. Kelloway.

Dept. of Pharmacy, University of Nottingham, Nottingham.

Effect of cations on the Rheology of Mucociliary transport properties of Tracheal Mucous

M. Litt, C. Marriott and C. K. Shih.

Dept. of Bio Engineering, Univ. of Pennsylvania, Philadelphia, U.S.A.

The shearing destructibility of Cobalt surfaces coated with Monolayers of Stearic acid.

J. M. Georges and T. Mathia.

Laboratoire de Technologie des Surfaces, Ecole Centrale de Lyon, 36 route de Dardilly, 69130 Ecully, France.

COURSES

FOURTH TRAINING COURSE IN FLUID RHEOLOGY*

at Warren Spring Laboratory, Stevenage

November 21-25, 1977

*Approved by: The British Society of Rheology,
The Institution of Chemical Engineers

Objectives

The course is primarily aimed at the practising rheologist, physicist, chemist and engineer who has responsibility for product formulation, quality and process control, process plant design selection and operation. But it should also be useful for the newly-appointed rheologist who wishes to be brought quickly up-to-date on information and know-how relevant to his/her job. The course will cover three main topics:

A Wider Introduction and Background Knowledge to Fluid Rheology

The physical and chemical basis of rheological properties will be discussed for different classes of materials, including suspensions of non-interacting particles in liquid, slurries of interacting particles, emulsions, very high solid-content materials, pastes, gels, polymer solutions and melts. Different types of rheological behaviour will be covered, such as non-Newtonian viscosity, yield stress, viscoplasticity, thixotropy, visco-elasticity, normal stress, creep and relaxation, elongational viscosity and granular characteristics. Measurement techniques in general will also be discussed.

Detailed Instructions on Viscometric Techniques

It is no longer necessary, as a general rule, to build one's own viscometer nowadays. Many commercial viscometers are commonly used to provide basic viscometric data in support of their projects. However, special attention to experimental techniques and data treatment is required if accurate results are to be obtained. These points are either not adequately emphasised in the manufacturers' instruction handbooks or their importance is not properly appreciated by the user. Drawing on some 15 years' experience at W.S.L., the course will give specialist instruction both in theory and in practice on how to get the best out of these instruments.

Industrial Applications of Rheology

The course will consider how rheological understanding and measurements can be applied to rheological knowledge and techniques find industrial applications, product formulation, quality control, process control, and process equipment design, optimisation and operation, such as pipeline transportation and mixing.

The participations will have ample opportunity to discuss individual problems, in confidence, with W.S.L. staff.

COURSE CONTENTS

Lectures

There will be five lectures on the rheological properties of:

1. suspensions of non-interacting particles;
2. slurries of interacting particles (non-Newtonian fluids);
3. thixotropic fluids;
4. pastes and high-solids materials, and
5. polymer solutions and melts.

Five lectures on measurement techniques:

6. non-Newtonian flow curve measurement using coaxial cylinder viscometers;
7. as above, with cone-and-plate viscometers and parallel plate viscometers;
8. as above, with tube viscometers;
9. measurement of thixotropic property, and
10. dynamic measurement of viscoelastic properties and normal stress measurement.

Five lectures on applications:

11. quality and process control;
12. pipeline design;
13. stirrer agitation and mixer design;

14. effect of processing on rheological property, and
15. use of viscoelastic data in industrial flow situations.

Practical Periods

A wide range of instruments (15 different types and models) available at W.S.L. will be used to demonstrate the practical importance of data treatment discussed in the lectures: calibrations and setting-up calculation of shear stress and shear rate, correction for instrumental and other errors.

Example Classes

Problems and exercises related to details of the lectures will be set.

Seminars and Surgeries on Industrial Problems

Ample opportunity will be available in open seminars to discuss industrial problems with W.S.L. staff and with other course participants, and in surgeries when each participant can discuss individual problems with W.S.L. staff in confidence.

Course Manual

Each participant will be supplied with a Manual which will contain a book list, lecture notes, instructions for the practical periods, and problems and exercises with hints for solution.

Course Organised: Dr. David C-H. Cheng.

For further details contact: Mr. Bob Richmond.

Course Fee

The fee for the course is £195 plus V.A.T., which includes accommodation for five nights—bed and breakfast—at a local hotel from Sunday night (November 20) to Friday morning (November 25), lunches and refreshments at W.S.L. and a Course Dinner during the evening of the Wednesday or Thursday.

POLYMER PROCESSING MATHEMATICAL MODELLING AND MECHANICAL ANALYSIS OF PROCESSES

Course

A series of 14 60-minute lectures on May 1-5, 1978 given by Professor J. R. A. Pearson.

Suitable for graduate physical scientists and engineers having some familiarity with polymer processing operations. The aim will be to present mathematical models based on continuum mechanics leading to quantitative methods of engineering analysis of the major problems.

Cost

£35 costs to include printed notes and refreshments.

Details

Further details are available from: Ms. Susan Hartman, Dept. of Chemical Engineering & Chemical Technology, Imperial College, London SW7 2AZ; phone: 01-589 5111, ext. 1998.

APPLICATIONS FOR MEMBERSHIP—JUNE 1977

J. E. Rudland, H.N.C.
f,et,sa,D,O.

Dr. I. H. Smith, B.Sc., Ph.D.
p,et,sa,D,L,O.

Tate & Lyle R.&D.,
Research Laboratory,
P.O. Box 68,
Reading, Berks.

Tate & Lyle Group Research &
Development,
P.O. Box 68,
Reading, Berks.

RESIGNATIONS

F. Hoyle,
Rowntree Mackintosh,
Castleford.

DIARY

1977

14-15 November. "Rheology of Inorganic Materials", Mons, Belgium.

21-25 November. "Training Course in Fluids Rheology", Stevenage.

19-22 December. "Food Texture and Rheology", London.

1978

4-5 January. "Molecular Interactions, Microstructure and Rheology", Cranfield.