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REVIEWS

Heat Transfer and Fluid Flow in Rotating Coolant Channels. By W. D. MORRIS. Research Studies Press/Wiley, 1981. 228 pp. £13.00.

Advances in Heat Transfer, Vol. 15. Edited by J. P. HARTNETT and T. F. IRVINE, Jr. Academic, 1982. 352 pp. $54.00.

Power Condenser Heat Transfer Technology. Edited by P. J. MARTO and R. H. NUNN. Hemisphere/McGraw-Hill, 1981. 490 pp. $47.50.

Fouling of Heat Transfer Equipment. Edited by E. F. C. SOMERSCALES and J. G. KNUDSEN. Hemisphere/McGraw-Hill, 1981. 743 pp. $75.00.

Heat and Mass Transfer in Metallurgical Systems. Edited by D. B. SPALDING and N. H. AFGAN. Hemisphere/McGraw-Hill, 1981. 758 pp. $85.50.

The monograph by Morris, which reviews current research into coolant flows in rotating channels, is the second in a series entitled 'Mechanical Engineering Research Studies'. The subject has applications in the cooling of electrical machines and turbine blades, and, although the material is rather specialized, the clear presentation will ensure easy assimilation by newcomers equipped with a basic knowledge of engineering fluid mechanics and heat transfer. The author has been active in the field for a number of years and his obvious expertise has prevented the book from deteriorating into an uncritical reference catalogue, a trap into which so many review articles fall.

After an introductory chapter on applications, the bare bones of the mathematics of rotating fluids are lucidly presented. The remainder of the book is then devoted to a study of the effects of rotation on the frictional losses and heat transfer in straight ducts rotating about axes either parallel to or normal to their length. Both laminar and turbulent flows are fully discussed. The monograph is characterized throughout by an engineering approach and it is particularly gratifying that the results have been correlated in order to present the information in a form suitable for industrial design.

To reduce cost the book has been printed from typed manuscript, but, notwithstanding, the presentation is good and the diagrams are well drawn. A very worthwhile addition to the literature of engineering fluid mechanics.

Advances in Heat Transfer, vol. 15, the latest in this established and successful series, contains five well-written reviews on some wide-ranging topics in heat transfer.

The opening article on 'Second Law Analysis in Heat Transfer and Design' by A. Bejan is an unusual approach in that it considers the design of heat transfer equipment from the point of view of minimizing thermodynamic irreversibility rather than maximizing performance. This is followed by two articles on non-Newtonian fluids, the first by Y. I. Cho and J. P. Hartnett entitled 'Non-Newtonian Fluids in Circular Pipe Flow' and the second by A. V. Shenoy and R. A. Mashelkar entitled 'Thermal Convection in Non-Newtonian Fluids'. The fourth chapter is on 'Direct Contact Condensation' by S. Sideman and D. Moalem-Maron and discusses condensation on free liquid interfaces and in bubble columns. The volume is completed by 'A Unified Theory of Linear Diffusion in Laminated Media' by P. E. Wirth and E. Y. Rodin, a highly mathematical approach to the problem including discussion on the existence and uniqueness of the solution.

Each article is accompanied by at least one hundred references and will be of value both to new researchers in the field and to 'old hands'. The presentation is excellent

and in all respects the volume maintains the high standards which have come to be expected from this series.

The title page and external appearance of *Power Condenser Heat Transfer Technology* lead the unsuspecting purchaser to expect a treatise on the design of power station condensers. It is revealed in the preface, however, that the collection of papers comprising the book are the proceedings of a Workshop entitled 'Modern Developments in Marine Condensers' which was held at the Naval Postgraduate Centre, Monterey, California, in March 1980. This type of disguise is being increasingly employed by publishers, presumably so that certain, often insubstantial, conference proceedings may be accepted as genuine, solicited review material.

Be that as it may, the set of papers presented at this particular conference were both substantial and informative. A number of important areas were discussed and each session was initiated by an invited 'overview' paper, which highlighted the progress achieved to date. The various sessions considered: computer modelling of condensers (4 papers), the effect of non-condensable gases on heat transfer performance (4 papers), vapour shear and condensate inundation (5 papers), heat transfer enhancement by surface irregularities (4 papers) and fouling of heat transfer surfaces (4 papers). Transcriptions of the discussions are also included, together with a final summary by each of the 'overview' authors.

Many of the papers are of high quality and, taken as a whole, the volume gives a good indication of the problems facing heat transfer engineers in the condenser industry.

Fouling of Heat Transfer Equipment is another volume from 'Hemisphere' of disguised conference proceedings, in this case dealing with the 'International Conference on the Fouling of Heat Transfer Equipment', which was held at Rensselaer Polytechnic Institute in August 1979.

The subject is of comparatively recent origin and, as noted by a number of papers, is still in a state of transition. Much of the basic groundwork has still to be laid and many of the articles deal with the formulation of the problems rather than the methods of solution. In a field of such obvious technical difficulty it is not surprising that empiricism abounds and considerable emphasis is laid on the necessity of establishing foundations with greater scientific reliability. Economically the importance of the subject appears to be without question, for it is claimed that the cost of fouling of equipment in Britain alone is in the region of £300M to £500M per annum, about 0·5 % of the gross national product.

A number of different types of fouling can be identified and there were sessions dealing with Corrosion Fouling (3 papers), Microbial Fouling (6 papers), Particulate Fouling (3 papers), Chemical Reaction Fouling (6 papers) and Precipitation Fouling (2 papers). Other sessions considered Experimental Methods (4 papers) and Economic Aspects (3 papers). The conclusions from various workshop discussions have also been included.

Although the volume contains much that is ephemeral, anyone wishing to acquaint himself with current thoughts on the subject will not find the information so well collated elsewhere.

Finally, *Heat and Mass Transfer in Metallurgical Systems* is a very expensive book which contains the papers presented at the 1979 Seminar of the International Centre for Heat and Mass Transfer, held in Dubrovnik, Yugoslavia. According to the preface, the purpose of the seminar was 'to draw together, from all parts of the world and from all relevant disciplines, scientists who were interested in and knowledgeable about heat and mass transfer in metallurgical systems'. Because of these aims, papers

on a wide variety of topics were presented and individual researchers may well find the subject matter rather too broad and diffuse.

The conference was divided into the following sessions: Blast Furnaces (7 papers), Other Iron and Steel Processes (6 papers), Heat and Mass Transfer during Crystallization (9 papers), Heat and Diffusion Treatment (7 papers), Nuclear Reactors (4 papers), Turbines and Combustors (4 papers) and Corrosion (4 papers). Overview papers were not invited and workship discussions (if there were any) are not included. The volume simply contains the basic set of conference papers with little or no editing. It is doubtful, therefore, whether the book will appeal to any except the specialist seeking out a particular paper. If conference proceedings are to appear in published hardback form, retailing at such high prices, then rather more editorial effort is required.

J. B. YOUNG

Rheometry: Industrial Applications. Edited by K. WALTERS. Wiley, 1980. 418 pp. £25.

Mechanics of Viscoelastic Fluids. By S. ZAHORSKI. Martinus Nijhoff, 1982. 321 pp. Dfl 160.00.

The contents of these two books represents extremes in approach to the study of non-Newtonian fluids. *Rheometry: Industrial Applications* is a collaborative venture consisting of an introduction and six chapters on different areas of application by six experts (four from industry and two from universities; three from the UK and three from abroad). The introductory chapter on fundamental concepts is written by Professor Walters, who has attempted to weld the contributions into a unified whole, and his success in this is greater than is the case in many multi-author monographs. The overall result is a unique book whose aim is to complement Walters' earlier book (*Rheometry*, Chapman & Hall, 1975) which describes both experimental techniques for measuring rheological properties and mathematical analysis for interpretation of measurements in terms of material properties (such as viscosity and normal stress functions). As is explained in the preface, this second book addressed itself to questions such as 'How much rheometry is carried out in the various industries? What use is made of the data when these become available? What level of sophistication does industry require?' The hope is expressed that elucidating the problem of the gulf between research laboratory and the shop-floor will generate genuine efforts to bridge the gap. It certainly must be hoped that it is unduly pessimistic to apply here the final reference cited in the book, verse 26 of chapter 16 of the Gospel according to Luke.

After the introductory chapter, which does all that it should to set the scene and mention recent (1979) work, there are chapters on detergents by H. A. Barnes of Unilever (88 pages, 144 references), lubricants by J. F. Hutton of Shell (59 pages, 42 references), foods by M. Van den Tempel of Unilever (29 pages, 57 references), molten polymers by J. L. White of the University of Tennessee (72 pages, 198 references), paints and printing inks by J. Mewis of the Catholic University of Leuven (58 pages, 123 references) and industrial aqueous suspensions by K. M. Beazley of English China Clays (75 pages, 129 references). The chapters are written with differing levels of mathematical sophistication and the mechanics contained is limited. It is impossible to judge how the differences reflect differences in the states of the art in the six subject areas and how much they reflect differences in experience and approach among the authors.

One general (and perhaps inevitable) criticism of a book covering as wide a range as this one is that in places it reads more like a catalogue than a text – perhaps only a reviewer should attempt to read the whole book in a short space of time. There are misprints, though not many that this reviewer noted are likely to mislead. More serious, because it places an obstacle in the way of the newcomer's comprehension, is the habit of at least two of the authors of using quotation marks to warn the reader that a word is being used in an technical sense which is never explained, or perhaps in a sense loosely connected to a technical sense. There are also inconsistencies in technical usage – one term notable for the confusion it appears to cause is yield. Barnes refers to yield stress measurement 'at very low shear rates', van den Tempel introduces a 'Bingham yield value' and a strength 'often called yield value' which is completely different and (reassuringly) Mewis points out that 'terms like yield value are used with different meanings'. This, when Walters has apparently defined yield stress unambiguously, does seem to point to a need for more careful discussion of the topic since a glance at the subject index will show how important it is (nearly fifty references, more than to any other topic).

There is not space here to discuss all the chapters individually. It seems to the reviewer that the inclusion of the chapter on molten polymers was a mistake. White has made a heroic effort to compress at least three books into one chapter. The result is deceptive in the sense that there are some major references missing from the enormous list he has given, and some judgements he makes are not justified in the text and could be argued (for example on the rheometers he prefers). The reviewer may be over-critical here since the chapter is the one closest to his own interests; he found the section on flow birefringence (about which he is more ignorant) interesting and helpful.

One topic which occurs in several chapters is that of flow in the nip between counter-rotating rollers. This is well described by Mewis, both in connection with the dispersion of solids in a suspension, in the application of coatings such as printing ink, and in discussion of the rotary tackmeter. This chapter, and one on lubricants will probably be those where readers of the *Journal of Fluid Mechanics* will feel most at home, but other chapters should not be neglected.

Readers will find in this book a wealth of information on the materials used in many different industries and on some of the questions and problems which arise, connected with the mechanics of complex fluids. It is not merely a book about measuring viscosity and other rheological properties, and an evangelical rheologist might well feel that here is a book to inspire (or tempt) mathematicians to stray from classical paths.

Mechanics of Viscoelastic Fluids is a 1981 translation of the 1978 Polish text, and contains a few footnotes and references dating from 1979 to 1981. The preface is dated November 1978; it cites 27 books on rheology and continuum mechanics dating from 1958 to 1978 and attempts to place the book in the context of the existing literature. Dr Zahorski sets out his chief aim as being to give a concise but general 'exposition of the fundamentals of the mechanics of viscoelastic fluids and its relation to modern continuum mechanics'. He identifies five recent (1974–78) books which resemble his monograph in scope. For a specialized topic this is heavy competition, and the reviewer is not convinced that there was a need for this book since he judges that three of the five competitors are excellent.

The question of what particular niche is filled by *Mechanics of Viscoelastic Fluids* is partly answered by a quick look at the contents – there are six chapters entitled Basic concepts, Constitutive equations of viscoelastic fluids, Viscometric flows,

Motions with constant or proportional stretch history, Nearly viscometric flows and complex flows, and Secondary flows and stability problems. There are ample references (between 60 and 100 per chapter) although in some areas these are rather out of date (perhaps more so than the 1978 date leads one to expect).

The style is that of continuum mechanics rather than non-Newtonian fluid mechanics, but is more approachable than the classical formality of Truesdell and Noll. The coverage is most detailed in areas where Zahorski has been actively involved, and so there is a useful account of several of his contributions, for example on 'motions with proportional stretch histories'. The rapid account of the fundamentals of continuum mechanics is, no doubt, necessary but would hardly help a newcomer to the field.

There are a number of points with which this reviewer would take issue, in particular in the discussions of convected (co-deformational) and co-rotational derivatives, and the claim that the rheological equation of LeRoy and Pierrard is not that of a simple fluid. These are areas where there is some room for controversy, but generally Zahorski has produced a balanced account of his chosen topics. 'Inner energy' for internal energy and 'the cause of such errors is lightened' are the only lapses noticed in a generally good translation. There is enough discussion of physical phenomena and experimental results to make the book interesting to readers of this journal.

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