

REVIEWS

The Flow of Complex Mixtures in Pipes. By G. W. GOVIER and K. AZIZ.
Van Nostrand Reinhold 1972. 792 pp. £17.65.

In their preface the authors of this book state that its objective was “to meet the need for an integrated presentation of the extensive and widely scattered information relating to the flow in pipes of non-Newtonian fluids and other complex mixtures”. Certainly, the book represents a brave attempt to gather together a great deal of the available information and I personally felt it quite interesting to read about other fields in complex flows of which I did not have detailed experience. Naturally, when such a wide range of topics has been covered, one finds that the treatment of subjects with which one is familiar in detail appears to be superficial; a more worrying feature is that the treatment of these latter areas appeared occasionally to be misleading (I shall return to this below), though I must admit that the extrapolation of this observation to chapters with whose subjects I am less familiar would be statistically unreliable!

In my view there is indeed a need for an integrated presentation of complex-mixture flows. Ideally, such a presentation would give a unified theoretical approach, stressing the common features among such flows and the reasons for deviation from the common patterns. I am not sure whether such a general, integrated presentation is possible at the present state of knowledge. The subject of flow of complex fluids has an enormous industrial importance as well as being of intense scientific interest. This has generated, as the authors of this book point out, a vast amount of literature. Even when covering a fraction of the total field, it is difficult to bring together the information in a cohesive manner, particularly when presenting it in a way suitable for industrial application. The need has been generated, therefore, for books in specialized areas of complex-mixture flows and this need is being reflected in the publication of a number of books in various areas.

I believe that the authors have failed to meet either of the needs which I enumerated in the previous paragraph. The book falls between two stools in that it does not stress strongly enough the similarities between various fields and the descriptions of individual subjects in complex-mixture flows may be too superficial to be of lasting value.

The book starts with a chapter on the classification on characteristics of complex mixtures and I found this to be a useful brief description, though the classification charts presented to encompass all the many cases were, in my view, rather artificial and are not particularly helpful. Chapter 2 deals with the flow properties of fluids and I really wondered whether it was justified to include over 50 pages on this subject within this book. Though the chapter is well written, the user would normally wish to turn to specialist textbooks and handbooks in this area.

Chapter 3 gives a quick summary of the basic concepts of the flow of Newtonian fluids and provides a useful revision of the background. Chapter 4 deals

with the flow of Newtonian fluids in pipes and, though the chapter seems to be basically satisfactory, one wonders why it was necessary to include it in this particular book since the subject is covered very adequately elsewhere. This was the first chapter in which a section on "Recommended Design Methods" was included. This would have been very much more helpful with worked examples. One realizes the problems, of course, in a book produced from North America, but how much better it would have been had the units been consistent throughout. This is nowhere more important than in the design procedures.

Chapters 5 and 6 deal respectively with the time-independent and time-dependent flow of non-Newtonian fluids in pipes. A good feature of these chapters is their clear statement of recommended design methods in a field which tends to be highly dominated by theoretical treatments of limited applicability.

Chapter 7 deals with fundamental concepts of the flow of multi-phase mixtures and states the basic conservation equation. In the literature on two-phase, gas-liquid, pressure drop, some authors have calculated the frictional pressure-drop term from the wall shear stress via the momentum equation and others have attempted to define the frictional pressure drop in terms of the energy equation. Different answers are obtained and though the latter approach is to be preferred most correlations for frictional pressure drop are based on the first definition. The authors of this book appear not to have recognized the distinction too clearly and there is an inconsistency between their definition of the frictional (irreversibility) term and the terms used in the correlations which they recommend. In effect, the authors are recommending the use of a mixture of the momentum and energy equation approaches and this could give rise to considerable errors in some circumstances. Though the Bankoff treatment of void fraction should certainly have a place in a book of this kind, I feel that it would have been better to treat it as one extreme of the more general treatments which are now available (e.g. Zuber or Malnes).

In chapter 8 some 130 pages are devoted to the vertical flow of gas-liquid and liquid-liquid mixtures in pipes. The first section gives typical results for flow patterns, liquid hold-up and pressure gradient and includes some excellent diagrams illustrating various modes of flow. The authors then give empirical overall correlations for flow patterns, hold-up and pressure gradient but in this section and in the preceding one I was surprised by the lack of reference to the many recent articles in this area. It seems possible that much better calculations can now be made than are indicated in the book.

Chapter 8 goes on to discuss the individual flow patterns, discussing bubble, slug and annular-mist flows respectively. The treatments are somewhat superficial and, again, much recent work is omitted. For instance, Levy's analysis is stated in detail though this is now recognized to be of the same form as that of Wallis, which in turn is in the same form as many other analyses. It is a pity that the generic nature of two-phase flow analyses has not been stressed adequately. This prevents the reader from getting to the heart of the problem.

Chapter 9 deals with vertical flow of gas-solid and liquid-solid mixtures in pipes; these chapters are difficult for me to judge objectively owing to lack of direct personal experience in the area. Chapter 10 deals with horizontal flow of

gas-liquid and liquid-liquid mixtures and, again, the illustrations of the various flow patterns are excellently produced. Again, I found the review of correlations on two-phase pressure drop, etc., in horizontal pipes to be somewhat superficial and some of the more recent evidence has been omitted.

The final chapter of the book, chapter 12, deals with the flow of capsules in pipes and, though interesting, I cannot quite see the justification for including this chapter in this present book.

To summarize, therefore, I consider that the authors have made a brave attempt at what is virtually an impossible task. The book is unlikely to appeal to the specialist in any one of the fields covered but it should prove interesting for general reference, though its conclusions may not always be those which would have been arrived at in the totality of detailed knowledge in any given area.

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SHORTER NOTICES

Proceedings of the 13th International Congress of Theoretical and Applied Mechanics. Edited by E. BECKER and G. K. MIKHAILOV. Springer, 1973. 366 pp. DM 120 or \$46.20.

The last of these congresses, which are held every four years, was at Moscow in August 1972 and was attended by about 2500 participants. Five general lectures and 20 sectional lectures were given at the Congress, all by invitation, and this volume contains the texts of nearly all these lectures. The general and sectional lecturers form a distinguished set of authors, albeit of more than average age, and the volume provides much interesting and valuable reading. The range of topics is very wide – and weighted towards the theoretical side – so that the interest of any one reader will be concentrated on a small number of articles. At the end of the volume there is a list of titles and authors of the 225 contributed papers presented in six parallel sessions at the congress.

Proceedings of the International Symposium on Two-phase Systems. Edited by G. HETSRONI, S. SIDEMAN and J. P. HARTNETT. Pergamon Press, 1972. 766 pp. £20.00 or \$60.00.

This symposium at the Israel Institute of Technology, at Haifa, in August 1971 attracted a large gathering of mechanical and chemical engineers and applied mathematicians. There were sessions on boiling and condensation, moving gas-liquid interfaces, measurement techniques, turbulent fluid-particle interaction, flow around neutrally buoyant particles, and the mechanics of two-phase systems. The volume of proceedings contains the texts of the 'key-note lectures' given at the beginning of each session and of 33 contributed papers. Some of the keynote lectures are extensive and useful reviews of the state of a part of the subject.

Water Soluble Polymers. Edited by N. M. BIKALES. Plenum Press, 1973. 424 pp. \$20.00.

This volume of proceedings of an American Chemical Society Symposium held in New York in August 1972 contains 25 of the contributed papers. Some are concerned with the detailed chemistry of the production and quantification of polyelectrolytes, and will probably be of limited value to readers of this *Journal*. The papers in the first half of the book, however, are devoted to fluid applications of both practical and theoretical interest. Polyelectrolytes can flocculate suspended matter through molecular bridging (rather than by the screening of coulombic repulsion that occurs with an inorganic electrolyte), giving rise to applications in the separation of rinse waste in electroplating, in sewage treatment, and in the improved retention of expensive pigments by paper in its manufacture. Two dramatic modifications of flow systems by very small additions of polymers are the reduction of water mobility in porous media (which can help secondary oil recovery) and the reduction of turbulent drag (which potentially has a multitude of engineering applications). Polyelectrolytes are used also in the electrodeposition of water-based coatings, and in medicine.

Thermodynamik. Third edition. By H. D. BAEHR. Springer, 1973. 440 pp. DM 48.

In this revised and enlarged edition of this excellent textbook on classical thermodynamics for students and practising engineers, the emphasis throughout is on non-cyclic processes, with only a relatively brief treatment of cyclic plant. The book is particularly valuable for its careful and detailed study of the different forms of work in both no-flow and steady-flow processes, and for its extensive treatment of the concepts of entropy production, energy dissipation, exergy and anergy which have come to the fore in recent years, particularly in Germany.

Fans. By B. ECK. First English edition, translated and edited by R. S. Azad and D. R. Scott. Pergamon Press, 1973. 592 pp. £15.00.

This book is the first English translation of Eck's classical work on fans. Unfortunately, it is the translation of the fourth German edition published in 1962 rather than the more recent and better fifth German edition of 1972 reviewed in this *Journal* (vol. 60, 1973, p. 410). Nevertheless it will no doubt be welcomed by the many engineers who have had good use from the previous German versions.