BOOKS

Rheology in Polymer Processing, by Chang Dae Han, Academic Press, 366 pp., 1976, $29.50.

Rheology is the science of deformation, strain, and flow. The rheology of polymer melts has been intensively studied for the past several decades, and more recently there has been a focus on the use of melt rheology for understanding practical problems of polymer processing. A book elucidating the present state of application of rheology in polymer processing would be a welcome addition to the literature, but Professor Han's book is far too personal an account to meet this goal.

Han has based the entire book on his own research results. Experienced rheologists may find it useful to have this collection of previously published experimental data gathered together in one place, but the dependence on studies from a single laboratory results in a highly distorted, sometimes inaccurate picture of the present state of the art. For example, conventional methods of rheological measurement are barely mentioned or are completely ignored, while considerable space is devoted to the use of slit and capillary rheometry for normal stress measurement. This technique, used only by Han, contains errors of unknown magnitude resulting from unverified approximations which are known to be incorrect in the limit of Newtonian Fluid behavior. Readers without previous exposure to rheometry should acquire some background before examining this book; Walters' recent text ("Rheometry," Applied Science Publishers, 1975), which was recently reviewed in this journal, would be a good place to start.

There is a fundamental error in mechanics in the treatment of pressure throughout the book; Han has incorrectly identified the *estra* stress with the *deviatoric* stress and has thus been led to a traceless extra stress tensor. For a Maxwellian material, which is often used as an example, the extra stress *cannot* be traceless because the trace is identifiable with the entropic free energy of deformation. Rheologists spent many years sorting out the significance of the pressure, and this type of error is common in the older literature; the sorting has been done, and it is a shame that a book published in 1976 perpetuates old misunderstandings instead of contributing clarification.

In a book of this title one expects to find a careful and complete discussion of extensional flows, since the connection between rheology and processing is clearest here. Yet, the well-defined steady extensional experiments of Meissner and others are not discussed at all. Transient elongational analyses are dismissed without discussion with the remarkable statement that "they seem to have little relevance to the deformation processes actually occurring in fiber spinning," despite a subsequent observation that "melt spinning can give rise to unsteady elongational flow." Melt spinning is the *prototype* unsteady elongational flow! Apparent extensional viscosities measured in unsteady flows are discussed at length, without the recognition that the measurement is an artifact of the particular experiment. The student who reads that the uni-axial extensional viscosity of high density polyethylene is a sharply decreasing function of extension rate (Figure 8.A) and a constant or increasing function of extension rate (Figure 9.A) may wonder at the absence of explanation (or even mention).

In short, those seeking access to Han's data will find this book a useful reference; those seeking an introduction to the use of rheology in polymer processing would do well to look elsewhere.

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Thermodynamics of Polymerization, H. Sawada, Marcel Dekker, Inc., New York, 403 pages, $39.50.

The kinetics of polymerization reactions are covered in a large number of standard textbooks in the Polymer Science field. The emphasis of these treatments is generally on the areas of predicting rates, molecular size characteristics, and, in the case of copolymerization, molecular composition. The thermodynamics of the polymerization reactions are usually not treated in detail. The thermodynamics of polymerization reactions are quite important from a fundamental point of view, and they are becoming more important for those who produce polymers on a commercial scale. The traces of monomer, left in a polymer, at the end of the polymerization reactions might be due to insufficient reaction time or to thermodynamic equilibrium considerations. This problem, in light of the recent concern for health problems, is but one of a number of problems in which thermodynamics may be an important determining factor.

This book by Dr. Sawada is organized in a clear and concise manner, and should be a useful text for those interested in the fundamentals of polymerization reactions and a useful reference source for those who work in the area. The first two chapters of the book present an introductory survey and a general discussion of polymerization thermodynamics. These two chapters on general concepts are followed by six chapters which treat the thermodynamics of specific types of polymerization reactions. Those included are: anionic, cationic, radical, polycondensation, ring opening, and equilibrium polymerization. There are two chapters on the thermodynamics of copolymerization, a chapter on polymer degradation, and a final chapter on special topics including stereospecific polymerization, polymerization under high pressure, and polymerization in a solid state. The chapters on the specific types of polymerization reactions can be read independently after the reader has progressed through the first two introductory chapters.

The text material is well-documented with important references in the field and, in fact, an extensive addendum which contains references published after the text was written is also included.

Experimental techniques for measuring thermodynamic properties and constants are not discussed in detail. Numerous references are given for those readers who are interested in the experimental problems of measuring polymerization thermodynamics. The text does include a great deal of thermodynamic data for a large number of polymer systems. I believe that this book will be a valuable asset to those wishing to learn more about polymerization reactions, and to those who need a ready resource in terms of theory and data for thermodynamic problems associated with polymerization reactions.

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Unit Operations of Chemical Engineering, 3rd Edition, W. L. McCabe and J. C. Smith, McGraw-Hill, New York (1976). 1028 pages. $22.50.

This third edition of a rather standard chemical engineering text continues in the fine tradition of its two earlier editions. It serves well its declared purpose as a beginning text on the unit operations for undergraduate students. This reviewer has also found it useful as an understandable yet thorough introduction to chemical engineering for technical persons not trained therein, e.g., chemists, mechanical engineers.

There are a number of significant additions of new subject matter in this new edition. In the area of mass transfer, I particularly welcome the inclusion of such new topics as liquid-phase activity coefficients, multicomponent-stage operations, batch distillation and steam distillation. I had always deplored the omission of these topics in the earlier edition. The authors do not present many applications of this new material, however. Also, some readers may object to the removal of the K-value charts in this new edition.

Unfortunately, this text suffers the same deficiency that so many others in this area do; namely, such important unit operations as adsorption, dialysis and ion exchange are not treated. The authors' reason for this omission is lack of space. In view of the present size of the text, this is certainly a valid point. It has often occurred to me, however, that the first 16 chapters of the text, which deal with fluid mechanics and heat transfer, could be separated out as a stand-alone text. Indeed, there exist many such adequate texts. Alternately, it seems to this reviewer that much of this material could be condensed significantly. With the addition of the above-mentioned omitted unit operations to the remaining 14 chapters of the text, one would then truly have a comprehensive textbook on the unit operations of chemical engineering.

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Heat Transfer, ,4th Ed., J. P. Holman, McGraw Hill Book Company, 530 pages, price: $17.00.

This is a fine elementary treatment, excellent for a strong first course in heat transfer. Analytical, numerical, and empirical techniques are used to good advantage for a very understandable treatment. The number of problems presented is generous.

In addition to analytical treatment of steady and transient conduction, numerical techniques are also presented. For both forced and natural convection, an integral analysis is given, followed by presentations of empirical results. The nature of thermal radiation is discussed and exchange analysis is by the network method. An introduction to two phase heat transfer systems is given in Chapter 9 on condensation and boiling. The treatment is more abbreviated than one would perhaps wish, but serves as a good starting point. Heat exchanger design presents both the log mean temperature difference and the NTU effectiveness methods. The mass transfer chapter (Ch. 11) is far too brief to be effective. Special topics in Chapter 12 give a helpful introduction to several topics and the final chapter on Heat Transfer in the Environment is timely and undoubtedly will provoke student interest.

The primary set of units used is the SI, with conversion tables given to the English units for those of us who still "think" in the old system.

To restate my initial appraisal: this is an excellent, well put together introductory text on heat transfer. I recommend it.

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CALL FOR PAPERS

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ERRATA

In the note "An Empirical Method for Evaluating Critical Molar Volumes" by Alessandro Vetere [*AIChE J.*, **22**, 950-52 (1976)],

1. Equation (6) should read

$$V_c = 33 + \left(\sum_i \Delta v_i M_i \right)^{1.028} \tag{6}$$

2. In Table 1 the Δv_i value for the functional group —O— (epoxid) should be 0.710 instead of −0.252; $\Delta \nu_i$ should be Δv_i.

3. On page 952 the sentence "Regarding the various classes of compounds . . ." should end as follows: "while Fedors' method furnishes less satisfactory results for hydrocarbons."

In the table of contents [*AIChE J.*, 23, No. 1 (1977)] the author for "Kinetic Behavior of Mixtures with Many First-Order Reactions" should read Hong H. Lee and not J. Hong H. Lee.