Encyclopedia of Polymer Science and Engineering

Vols. 1–10: A–Pentadiene Polymers

By H. F. Mark, N. M. Bikales, C. G. Overberger, and G. Menges, Eds., J. I. Kroschwitz, Editor-in-Chief, Wiley-Interscience, New York, 2nd Ed., 1985-1987, approx. 820 pp./vol. $200.00/vol.

In an era when it appears that any multiauthored book of marginal quality can be called an "encyclopedia" (c.f., this Journal, **33**(8), p. 1405, Aug., 1987), it is a pleasure to be able to report on a real scientific encyclopedia. Publication of the second edition of the *Encyclopedia of Polymer Science and Engineering* began in January, 1985, and the first ten volumes of a projected 19 have now appeared. The Encyclopedia contains many articles by chemical engineer authors (including Journal Consulting Editor John Riggs), and a considerable number of articles will be of interest to chemical engineers outside the "polymers community."

I have been reading articles at random since the volumes started to arrive. I have also been preparing a short article for a forthcoming volume; it is partly because of the latter experience, which does give me a minor personal interest but provides insight into the production process, that I have taken the liberty of reviewing this publication. The editors have defined the content of the entire Encyclopedia (though occasional references to articles in the Supplement suggest some initial omissions). The invitation to write an article specifies length, indicating editorial judgment regarding the weighting of various topics: published articles range from a few pages to more than 60. My article received two anonymous reviews; the reviewers were knowledgeable and perceptive, and the reviews were helpful in preparing a revision. Clearly an informed editorial hand (or hands) is guiding the production of this publication, as evidenced by the quality of most of the articles and the completeness of topical coverage and cross-referencing.

Five broad topics are covered: synthesis and properties of classes of polymers, polymer physics, methods of characterization, applications, and processing technology. In most cases, the Encyclopedia article is an excellent forum for someone new to the area to get a good overview and a good set of references. The level of articles is typically appropriate for a scientifically-literate nonexpert, but insufficiently quantitative to serve as the final word. The balance in references between patents and journal articles and books is variable, and generally seems to reflect the industrial or academic background of the authors more than the subject. I checked references carefully in articles where I felt that I knew the literature well, and I found few omissions of what I considered to be important papers or books. The processing technology articles rarely contained references to quantitative treatments of the process, however, and most of these lists need to be supplemented by reference to the books on Processing [especially those by Pearson and Richardson (1983) and Pearson (1985)] in a 20-page compilation of polymer books in an article on Literature of Polymers (Lee). No chemical engineering publication is listed as a source of polymer-related papers in the latter chapter (nor is *J. Non-Newtonian Fluid Mechanics* or *Rheologica Acta,* although *J. Rheology* is listed). As just one example of the growing importance of the chemical engineering literature on polymers, the article on Devolatilization (Biesenberger) can be usefully supplemented by two recent papers in this Journal (Collins et al., 1985; Albalek et al., 1987) and by Denson's (1985) chapter in *Advances in Chemical Engineering.*

I was particularly impressed with the quality of the articles on various characterization methods, including Electron Microscopy (Thomas), Infrared-Absorption Spectroscopy (Coleman and Painter), Light Scattering (Berry), Neutron Scattering (Wignall), and Nuclear Magnetic Resonance (Bovey and Jelinski). Many chemical engineers are now using these techniques in research, yet neither we nor our students have typically studied them in our formal education. These Encyclopedia articles are excellent places to start.

There is considerable interest at present in polymer interfaces, and there is good coverage in the articles on Adhesion and Bonding (Gent and Hamed), Adsorption (Silberberg), and Interfacial Properties (Koberstein). The last of these does not deal with "active" interaction between melts and metal surfaces (Ramamurthy, 1986), where processing behavior is influenced by the selection of materials of construction of the die. The discussion on "direct force measurements" in the chapter on Adsorption can be updated by reference to the book by Israelachvili (1985).

As expected, the encyclopedia is currently a good place to be introduced to new areas of application, although this advantage will pass with time as the information becomes dated. There are good, readable chapters on High Modulus Polymers (Jaffe) and Liquid Crystalline Polymers (Kwolek, Morgan, and Schaefgen); curiously, the latter chapter contains no cross-reference to the former. Chapters on Lithographic Resists (Blevins, Daly, and Turner) and Electrically Conductive Polymers (Frommer and Chance) are good introductions. Electrooptical Applications (Thakur and Tripathy) is very brief regarding applications of liquid crystalline polymers in nonlinear optics, and contains no cross-referencing to the article on Liquid Crystalline Polymers; a review paper by Williams (1984) is a useful supplement. The chapter on Optical Fibers (Levy and Taylor) discusses only glass fibers, which is surprising in a polymer encyclopedia.

Indexing is currently a problem for users. Separate indices have been published for Volumes 1–4 and 5–8, but they do not overlap. To look up "fracture," for example, one needs to use both, because there are distinct entries in each. I was surprised to find that there was no separate entry in the text for Free Volume; "free volume" was entered twice in the Index to Volumes 5–8, with reference to "in the glassy state" and "theory of transport," but there is no way at present to tell if there is relevant coverage in Volumes 9 or 10. I presume that there will be a comprehensive index available when the series is complete. Though cross-referencing is quite good, there are obvious slips, as noted above. Others include duplication of material on chain statistics without cross-referencing in articles on Conformation and Configuration (Tonelli) and Elasticity (Queslel and Mark), and concepts of reptation in the chapter on Me-

chanical Properties (Ward) without reference to the more complete discussion in Macromolecular Dynamics (Klein). [The latter is missing a reference to either edition of Bird et al. (1976, 1987).]

Finally, I want to reiterate that this is a production of high quality, which will be of considerable use to the technical community. It is also a source of fun for the browser, as any encyclopedia should be. I recommend articles on Fine Arts (De Witte) and History of Polymer Science (Morawitz) as places to start.

Literature cited

Albalak, R. J., Z. Tadmor, and Y. Talmon, "Scanning Electron Microscopy Studies of Polymer Melt Devolatilization," *AIChE J.*, **33**, 808 (1987).

Bird, R. B., O. Hassager, R. C. Armstrong, and C. F. Curtiss, *Dynamics of Polymeric Liquids: II, Kinetic Theory*, Wiley, New York (1976); 2nd Ed. (1987).

Collins, G. P., C. D. Denson, and G. Astarita, "Determination of Mass Transfer Coefficients for Bubble-Free Devolatilization of Polymeric Solutions in Twin-Screw Extruders," *AIChE J.*, **31**, 1288 (1985).

Denson, C. D., "Stripping Operations in Polymer Processing," *Advances in Chemical Engineering*, Vol. 12, J. Wei, Ed., Academic Press, New York (1985).

Israelachvili, J. N., *Intermolecular and Surface Forces*, Academic Press, New York (1985).

Pearson, J. R. A., *Mechanics of Polymer Processing*, Elsevier Applied Science, London (1985).

Pearson, J. R. A., and S. M. Richardson, eds., *Computational Analysis of Polymer Processing*, Elsevier Applied Science, London (1983).

Ramamurthy, A. V., "Wall Slip in Viscous Fluids and Influence of Materials of Construction," *J. Rheol.*, **30**, 337 (1986).

Williams, D. J., "Organic Polymeric and Non-Polymeric Materials With Large Optical Nonlinearities," *Angew. Chem. Int. Ed. Engl.*, **23**, 690 (1984).

Morton M. Denn
Department of Chemical Engineering
University of California at Berkeley
Berkeley, CA 94720

Dynamics of Polymeric Liquids

Volume 1: Fluid Mechanics

By R. Byron Bird, Robert C. Armstrong, and Ole Hassager, Eds. John Wiley & Sons, Inc., New York, 2nd Ed., 1987.

Much has been said and written about the lack of incentives for scholars to devote time to the writing of books. Book writing is tedious business. If, upon completion of a major manuscript, the author does not feel drained, either he or she has not alloted sufficient energy to the task to do it well, or the author belongs to a cadre of persons with a gift seldom bestowed to mortals. What can happen when an author, or in this case three authors, perceive a need to write a book, know much about the subject, are patient, and expend themselves on the project, is shown here. The book is a superb contribution with value well worth the authors' efforts.

Such an introduction may seem out of place for a book that is a second edition. The first edition of Volume 1 of *Dynamics of Polymeric Liquids* was published in 1977, but the second edition is far from a cut-and-paste (a mode of editing soon to become obsolete) revision with a brief additional preface containing words such as, "... in order to include results of recent research appearing in the years since the initial publication of...." On the contrary, it is clear that every page of the first edition has come under careful scrutiny, and the book has been essentially rewritten. Much of the first edition has been retained, but only if, in the eyes of the authors, it served their purposes better than another alternative. An example of the level of inspection lavished on their earlier writing is found as early as the second sentence of the Preface. The words of the first edition, which read, "Although untold man-years of research have been devoted to the study of fluids..." have been converted to "Although many years of research have been devoted...." Similar attention to detail occurs, sentence-by-sentence, throughout the book.

The above is an example of change at the microscopic level. There are also important changes at the macroscopic level. Changes in the number of pages (approximate) devoted to various topics reflect some of these changes:

Thus, both the structure and the content have been significantly altered. Probably the largest change in content was the nearly total exclusion of corotational derivatives in constitutive equations. This change is described in the prefatory material as a "major change in viewpoint" by the authors.

Those familiar with publications by these authors will find the familiar hallmarks: meticulous annotation of sources, copious tables and flow charts in which codification of a bewildering jargon of time derivatives, constitutive models, and other paraphernalia of rheology is attempted. The attempts are often successful.

Part I is a presentation of principles of fluid (and some continuum) mechanics considered to be the irreducible minimum requisite for subsequent material of Volumes 1 and 2. Readers will not be surprised to find that the sign convention for stress continues to be the opposite of that generally used by authors of works on fluid, solid, and continuum mechanics. The stream function is introduced in a manner which suppresses its physical content; when low Reynolds number hydrodynamics is discussed, one finds no emphasis on the use of singular solutions to obtain, very efficiently, forces and torques on bodies. Good examples and problems appear regularly. Part I continues, and expands, an excellent motivational chapter of the first edition by adding to the examples and confirming the authors' claim that, "a fluid that's macromolecular is really quite weird..."

In Chapter 3 a division is introduced which, although mentioned in the first edition, has been elevated in the second

First Edition	Second Edition
500 pages	650 pages
9 chapters, 2 appendices	4 parts with a total of 10 chapters, 3 appendices
General subject of material functions	
70 pages	70 pages
Generalized Newtonian fluid	
70 pages	80 pages
Linear viscoelasticity	
30 pages	40 pages
110 pages on *corotational models*	170 pages on *nonlinear models*
50 pages on *codeformational models*	30 pages on *continuum mechanics*
	40 pages on *rheometry*