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.

MORTON M. DENN
Department of Chemical Engineering
University of Delaware
Newark, Delaware 19711

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 polymer-