

Book Reviews

Fundamentals of Fibre Formation — the Science of Fibre Drawing and Spinning *Andrzej Ziabicki* Wiley New York, 1976, £19.50

The Foreword to this book by Professor H. Mark places a stamp of excellence on the work, but it is not for the mathematically faint-hearted. In fact it changes man-made filament production from the empirical study which it was forty years ago to a science which is rapidly becoming mathematically based. The work is well set out, consisting of seven chapters each one specific to the processes which are being analysed, and under each chapter heading details of the points to be considered are given. For example in Chapter 2 'General Theoretical Fundamentals' there are five main headings into which the work is divided. These include spinnability of fluids, some rheological properties of fibre forming materials, hydrodynamics of fibre formation etc. Each one of these sections is then subdivided into several subject headings.

In the sections devoted to mathematical analysis many aspects of spinning and drawing are studied. Melt spinning is dealt with in great detail as this appears more readily amenable to mathematical treatment. There are also chapters on wet and dry spinning from solution, a chapter on other spinning techniques, on drawing and finally on conditioning and heat treatment of filaments. In such a work it might be expected that the mathematical symbols used might cause the reader some difficulty, but on pages IX to XIV the main signs and symbols are printed in detail and their units tabulated and defined. e.g. E^* has units dyne/cm^2 and is the sonic modulus.

It would be impossible to make a detailed critical survey of the work presented in this book. The reference list of over 1200 gives some idea of the effort which the author has put into the compilation of the volume. I found it almost exhausting to read, but as a work of reference it is easy to follow. Not only is this an excellent book for advanced students and research workers, but it reflects great credit on the author and his polymer school in Warsaw. It is no book for the dilettante or the faint-hearted, but should form a standard work for many years to come. It has been a stimulating pleasure for me to review this book.

F. Happey

Encyclopedia of PVC Volume 1 *Edited by Leonard I. Nass* Marcel Dekker, New York, 1976, 600 pp. 240 SFr.

In the preface to this book the editor refers to the shortage of 'hard-bound' technical reference literature on PVC and indicates that

this 3-volume encyclopedia is intended to rectify the deficiency by providing a single source reference work on both the scientific and technical aspects of the polymer. The extent to which the first volume of the encyclopedia fulfills this requirement is measured by the wide coverage of the eleven chapters that it contains.

The first four chapters (~170 pp.) are concerned with the manufacture of the monomer and its polymerization to the homopolymer and the copolymers. This is followed by chapters on testing and characterization of the polymers, on chemical modifications and on the elucidation of the polymer structures (~100 pp.). Two chapters are included (~115 pp.) on degradation and stabilization and the volume is completed by two chapters (~115 pp.) on plasticizers and plasticization.

The information gathered together here from the wide technical and scientific literature on PVC amply justifies the publication of this first volume of the encyclopedia and it will be of considerable use to all those concerned in any way with PVC.

There are of course deficiencies and perhaps its greatest limitation arises from the fact that the twelve contributing Authors are all located in the USA. This has led in places to an essentially American slant on PVC technology which is perhaps most noticeable in the chapter dealing with testing and characterization where no tests except ASTM ones are mentioned.

The gap between writing and publication always leads to some loss of up to date information. In general this does not detract from the present work but it is unfortunate that the chapter on 'Structure elucidation' has no references subsequent to 1967. The presently accepted view that the branches in PVC are predominantly $-\text{CH}_2\text{Cl}$ groups is thus left out and no mention is made of ^{13}C nmr investigations of tacticity.

This first volume will be of considerable use to those specializing in one aspect of PVC science or technology who require a summary of the position in other aspects of the subject. Although at current exchange rates the 600 pp. book costs over £60 it will be an essential purchase for many organizations working on PVC science and technology who will also look forward to the publications of the next two volumes.

G.S. Park

Polymeric Carbons — Carbon Fibre, Glass and Char *G.M. Jenkins and K. Kawamura* Cambridge University Press, Cambridge, 1976, £8.50

Polymer chemists have done a great deal of work on the degradation of polymers by thermal and radiant energy leading to the elucidation of mechanisms of decomposition in air and *in vacuo*. No attention however

seems to have been paid to the structures and properties of any carbonaceous residue or how they can be altered. It has been left to the carbon experts to show that these residues are of considerable scientific and technological importance.

This is an interesting book by two workers in the carbon field who have made significant contributions in characterizing the structure of glassy carbon formed by the pyrolysis of thermosetting resins and showing how it relates to that of carbon fibres derived from a thermoplastic rig, polyacrylonitrile in fibre form. In both cases the structure consists of long narrow fibrils built up from the parallel stacking of ribbon like graphite basal planes, but in glassy carbons these fibrils are in a tangled array with no orientation whereas in carbon fibres they have a pronounced orientation parallel to the fibre axis. This accounts for the great difference in properties, e.g. Young's modulus parallel to the carbon fibre axis of upto 700 GN/m^2 but an isotropic modulus of only about 40 GN/m^2 for glassy carbons.

The authors have subdivided the book logically into an introduction with definitions, pyrolysis of polymers and the fabrication, structure, properties, chemical reactivity and some applications of polymeric carbons.

The polymer chemist will be disappointed in the description of polymer structures done in one and a half pages. Chapter 4 on structure is good — Figures 17 to 20 (c) high resolution electron micrographs showing fibrils tell the structural story very well. Chapter 5 on physical properties gives a ratio of only 3.5 for the values of the parallel and perpendicular thermal conductivities of the graphite crystal whereas it should be at least 210. The thermal expansion coefficient parallel to the layer planes is quoted as zero at 4000°C instead of 400°C .

The treatment of mechanical behaviour is reasonable, if somewhat brief, (Chapter 6). A fuller treatment on strength reducing flaws in carbon fibres with scanning electron microscope pictures of fractured ends would have been worthwhile. In Table 9 the properties of carbon fibres Types I and II are reversed but given correctly in Table 12.

There is a tendency for too much generalization in the text as in the section on carbonization where it is stated that chlorine and nitrogen are removed in the temperature regime $300^\circ - 500^\circ\text{C}$. This is certainly not true of polyacrylonitrile fibres which retain substantial amounts of nitrogen at 500°C , even 5% at 1000°C .

There are some misprints as in Figure 3 where an H atom is missing from the cellulose structure and furfuryl alcohol is given as a polymeric system.

Despite a tendency for overgeneralization and at times somewhat muddled writing this book is a brave initial attempt to bring together the facts and theories of carbonization of polymers and how the different polymeric carbon structures arise. It should be of considerable interest to polymer chemists and perhaps stimulate them into work in the new and exciting field.

William Watt