

Book Reviews

Formation of Synthetic Fibers
Zbigniew Walczak
Gordon and Breach Science
Publishers (New York—London
—Paris), June 1977, £19.70

In the above book Dr Walczak in his preface defines what he considers the scope of his work. This appears to be to curtail the extent of his studies to a minimum; i.e. to cover in the main the theoretical aspects of melt spinning, and to refer to the wet and dry (evaporative) methods of extrusion in as far as that field of work is relevant to the development of his studies. Even with these limitations the work covers 320 pages. His definition of this programme is given in the following sentence in his preface, 'As a main subject this book covers melt spinning, since this method appears to be the simplest and technologically the most *elegant*.' The contents are divided into ten chapters in a sound logical sequence. The first four are such as would be expected in any standard work on the subject, basically the raw materials, the polymer in melt spinning, and fibre structure. He then deviates in an interesting way to engineering problems, mainly from a theoretical and mathematical point of view. In this chapter the theoretical conditions of heat exchange on drawing and quenching of melt spun polymers is treated in considerable mathematical detail. There follows an original presentation of the analysis of process variables in Chapter 6. This deals mainly with the influence of the structure and size of the polymer molecule, on its flow properties during passage through the capillaries of the spinning jet and its flow in its molten and subsequent plastic condition after leaving the extrusion orifice, and during coagulation. Chapter 7 changes the field of study to a very short survey of spinning from solution by wet and dry (evaporative) methods. The author here has little published material to work from as both wet and dry spinning were for many years a subject restricted to the major companies involved in their development and little work was done in the academic field. Any information available was mainly confined to patent literature. This is changing now, and microextrusion techniques are being developed which should give the necessary practical results of use in developing a theoretical analysis of the extrusion processes involved.

Chapter 8 summarizes the properties of the resultant fibres, and the main value of this is probably to draw the attention of the reader to the wide field of techniques, mathematical and physicochemical, which have been used to obtain such information. This includes mechanical properties, swelling, absorption of liquids and dyestuffs, thermal properties, and the influence of crystalline/amorphous ratios etc. The information given is essentially a minimum but references are available for the reader to consult. The last

Conference Announcement

Plastics in Medicine and Surgery III

Twente University of Technology, Enschede, The Netherlands,
21 and 22 June 1979

The third international conference on Plastics in Medicine and Surgery will be held at Twente University of Technology, Enschede, The Netherlands, 21 and 22 June 1979. The aim of the conference will be to review recent progress, and to highlight advances made in the application of polymeric materials and to discuss problems arising from the interface and interaction between materials, with the emphasis on the chemical/physical properties, and handling of those materials. Topics to be discussed will include: blood compatibility of materials and devices; toxicity of plastics and rubber; sterilization of materials and devices; tissue compatibility of materials and devices; aspects of materials applications in orthopaedics. Offers of papers under any of the above headings which are examples only and not exclusive of other relevant topics, are now invited. Further details may be obtained from the Secretary, The Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL.

two chapters are very short, one on the scaling up of processes, which is a matter of great importance from a practical industrial angle. The final chapter on practical applications ends the work but, of necessity, is far too short to do other than pose a series of questions and suggest ways in which the mathematics of earlier chapters might be developed.

The book should recommend itself to all serious students of polymer science. Dr Walczak is to be congratulated on a most meticulous presentation of his book.

F. Happey

Twin Screw Extrusion
L. P. B. M. Janssen
Elsevier, Amsterdam, 1978,
pp 172, \$34.75

While there is a considerable body of published work on the single screw extrusion process for polymeric materials, this is not so for twin screw extrusion. One of the reasons is that the geometry of twin screw machines is much more complex and the flow mechanisms consequently more difficult to understand, let alone analyse. Also, although multiscrew extruders have been in use for almost as long as single screw machines, it is only relatively recently that they have been applied successfully to polymeric materials.

This is an interesting monograph based on the author's personal research work. It rep-

resents an important attempt to describe, both qualitatively and quantitatively, the performance of twin screw extruders. Although non-intermeshing and corotating machines are discussed, most of the work is concerned with intermeshing counterrotating screw arrangements. The main emphasis is on understanding how such machines work rather than how they should be designed for different materials.

The text is divided into ten chapters. The first two serve to introduce the subject and provide a review of the more significant technical literature. Chapter 3 is concerned with the mechanism of fluid flow created by closely intermeshing screws. The basic flow unit is shown to be a C-shaped chamber formed by a screw channel and the barrel surface, with its ends closed by the flight of the other screw. Material is not completely isolated in this chamber as leakage can occur both through the clearances between screw flights and barrel, and through the gaps between screw channel and the intermeshing flight. Flow analyses are presented for estimating volumetric pumping efficiency and pressure generation in the extruder. Overall machine performance is discussed in Chapter 4 in terms of throughput—pressure relationships resulting from the series of interacting flow chambers formed by typical pairs of screws. The lack of sensitivity of throughput to die resistance is explained in terms of limited leakage between chambers leading to positive displacement of the contents along the extruder. Experimental results are reported for both a model using silicone polymers and a laboratory machine processing a poly-

propylene supplied in granular form.

Chapters 5 and 6 examine mixing and residence time distributions, which are particularly important if twin screw extruders are to be used as polymerization reactors. Mixing occurs both in the flow chambers and in the intensely sheared leakage flows. Although twin screw extruders are often considered to offer much better mixing performance than single screw machines, the author points out that this is not always true and depends on the geometry of the particular machine. An analysis of residence time distributions is presented, as are experimental results from both the model apparatus and laboratory extruder, using coloured fluid and radioactive tracer techniques, respectively. Although there is only moderately good agreement between theory and experiment, counterrotating closely intermeshing twin screw extruders are shown to have remarkably stable residence time characteristics, largely independent of operating conditions.

In Chapter 7, some experiments on melting suggest that it takes place over a short axial length of the extruder, and the complete melting sequence can be observed in each flow chamber. The mechanism of melting is quite different from that found in single screw machines. Overall machine operating conditions and performance are discussed in Chapter 8 and relatively simple control system models are developed to represent the observed behaviour. Finally, Chapter 9 compares and contrasts single and twin screw extruders on a largely qualitative basis, and the last chapter summarizes the main conclusions of the work.

The monograph does not offer a complete description and accurate analysis of twin screw extrusion. It does, however, provide qualitative descriptions of a number of previously poorly understood aspects of the process. Although the essentially isothermal Newtonian flow analyses presented are of only limited usefulness in predicting extruder performance, they provide starting points for more realistic treatments. Also, the investigation of melting is relatively superficial. In view of the limited amount of previous work on twin screw extrusion, however, the author is to be congratulated on the extent of his contributions to the subject. The book will be of interest to engineers and technologists concerned with the design and operation of twin screw extruders, and indispensable for those involved with extrusion research. As pointed out in the Preface, a knowledge of the physical phenomena that underly the process is necessary for attempts to improve it.

R. T. Fenner

ESR Spectroscopy in Polymer Research (Polymers: Properties and Applications, Volume 1)

B. Rånby and J. F. Rabek

Springer-Verlag, Heidelberg—Berlin, 1977, pp 410, \$49.30

The volume under review is one in the series *Chemie, Physik und Technologie der Kunststoffe in Einzeldarstellungen* which is now entitled *Polymers: Properties and Applica-*

tions. It is written by two authors who work in the Technical University of Stockholm and is written for polymer physicists, chemists, biochemists and material scientists who may wish to apply e.s.r. methods to their research problems. The emphasis throughout is on research but there is a chapter on the fundamental principles of e.s.r. spectroscopy for those who want an introduction to the field. In this the background, nomenclature and theory is given and since the basic interpretation of e.s.r. spectra requires understanding of quantum mechanics and the use of matrix, vector and tensor calculations these are included where appropriate but with a minimum of mathematical treatment. There is an up to date chapter on experimental instrumentation and then there follow chapters on

e.s.r. studies of polymerization and degradation processes of polymers in reactive gases, oxidation, molecular fracture, graft copolymerization and crosslinking. In their preface the authors say they hope the book will provide a useful source of information by giving a coherent treatment and extensive references to original papers, reviews and discussions in monographs and books. This it does. There is an abundance of information, 2519 references obtained from an exhaustive survey of the literature and of *Chemical Abstracts* in the period 1960 to 1975 and the book is profusely illustrated with e.s.r. spectra. It should be available to any research scientist working in this field.

H. G. Jerrard

Conference Announcement

Chromatography of Polymers and Polymers in Chromatography

Institute of Macromolecular Chemistry, Heyrovský Square 2,
Prague 6-Petřiny, Czechoslovakia, 17–21 July 1978

The 6th Discussion Conference on Chromatography of Polymers and Polymers in Chromatography is being organized by the Czechoslovak Academy of Sciences, Institute of Macromolecular Chemistry in cooperation with the Institute of Chemical Technology, Prague, the Laboratorní Pístroje, Prague and the International Union of Pure and Applied Chemistry, Macromolecular Division. The conference will be held in Prague from 17–21 July 1978. The meeting will cover fundamental (theoretical and experimental) aspects of separation of synthetic and natural macromolecules by various chromatographic techniques. Topics to be discussed will include: chromatography of polymers; polymers in chromatography; theory of chromatography. The programme will consist of invited lectures, panel discussions and poster sessions. All correspondence should be addressed to the P. M. M. Secretariat, c/o 162 06 Prague 616, Czechoslovakia.

Conference Announcement

Synthetic and Semisynthetic Polymer Catalysts and Affinants: 18th Microsymposium on Macromolecules

Institute of Macromolecular Chemistry, Heyrovský Square 2,
Prague 6-Petřiny, Czechoslovakia, 10–13 July 1978

The Czechoslovak Academy of Sciences, Institute of Macromolecular Chemistry in cooperation with the Institute of Organic Chemistry and Biochemistry, Prague and the International Union of Pure and Applied Chemistry, Macromolecular Division are organizing a conference on Synthetic and Semisynthetic Polymer Catalysts and Affinants to take place in Prague in July 1978. The Microsymposium will review the most promising ways of synthesizing polymers with intended catalytic and affinity functions and should help to elucidate the role of the polymeric carrier in binding active groups and in the functional mechanism of final products. The programme will consist of invited lectures and contributed papers, and topics covered will be: carriers of catalytic functions; carriers of enzymatic functions; carriers of affinity functions. All correspondence should be addressed to the P. M. M. Secretariat, c/o Institute of Macromolecular Chemistry, Czechoslovak Academy of Sciences, 162 06 Prague 616, Czechoslovakia.