Book Reviews

Aspects of Degradation and Stabilization of Polymers: A Review

Edited by H. H. G. Jellinek

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A comprehensive discussion of the entire field encompassed by the title of this book would require many large volumes. Professor Jellinek has assembled a group of authors, each with an international reputation in his speciality, who have written on 14 topics. Some of these, like Oxidative Degradation, Photodegradation and Degradation Kinetics, one would expect to form the backbone of a book of this kind while others like Ceiling Temperatures, Ignition and Flame Propagation, and Ablation which are perhaps, 'not normally treated in a work of this nature . . . . . illustrate the wide ramifications of polymer degradation'.

The opening chapter by Jellinek is a comprehensive mathematical treatment of, 'Degradation and Depolymerisation Kinetics'. Busfield's chapter on, 'Ceiling Temperatures', provides an up to date summary of our knowledge of this phenomenon with many references to real systems. It should greatly assist in dispelling some of the misapprehensions which exist about the role of ceiling temperatures in degradation processes. Kamiya and Niki give a useful summary of the very broad field of, 'Oxidative Degradation'. Schnabel's two chapters on 'Degradation by High Energy Radiation', and on 'Photodegradation', (with Kiwi) are excellent summaries of experimental data while Mita's contribution on, 'The Effect of Structure on Degradation and Stability of Polymers', is not just a catalogue of thermal analysis data of high temperature polymers as one might have anticipated but a penetrating analysis of a very large amount of information covering the whole range of polymer structures.

The account of 'Mechanical Degradation', (Murakami) is concerned principally with networks, crosslinked polymers and vulcanizates while, 'The Effect of Degradation on Mechanical Properties of Polymers' (Kambe) is confined to high temperature polymers and includes an account of the application of thermomechanical analysis and torsional braid analysis. Chapter 9 is largely devoted to Jellinek's own extensive work on 'Reactions of Polymers with Pollutant Gases'. He discusses in considerable detail the chemistry involved in the reaction of sulphur dioxide, nitrogen dioxide and ozone with a number of commercial polymers and some new techniques for measuring the effect of these reactions on mechanical properties.

The following chapter comprises a predominantly theoretical treatment of the 'Ignition of Polymers and Flame Propagation', (Akita) but with no mention of the extremely topical subject of fire retardance. 'Polymer Degradation Processes in Ablation', (Strauss) is an interesting and comprehensive description of the various factors involved in the ablation process with specific reference to the reentry problems of missiles, satellites and spacecraft. In his account of 'Thermogravimetric Analysis and Differential Thermal Analysis', Flynn describes typical commercially available instruments and gives a useful analysis of the use of these methods for quantitative kinetic investigations. This is followed by a brief account of the new technique of 'Thermal and Mass Chromatography', (Stivala and Gabbay) mainly devoted to instrumentation and method with a very short section on its application to polymers. The book closes with an excellent account by Potts of the work which has been done on 'Biodegradation', which concludes that polymers in general are not readily biodegradable unless they are of very low molecular weight, with the exception of aliphatic polyesters and polyurethanes derived from polyester diols.

In the preface, Professor Jellinek claims that this book differs considerably from previous books on the degradation of polymers. He has succeeded admirably in illustrating the wider ramifications of polymer degradation and the book, as well as being a useful source of specific data for graduate students and research workers in industry, will be a rich source of information about a wide variety of topics relevant to the degradation of polymers to all those concerned with their manufacture, processing and application.

N. Grassie

Advances in Polymer Science Vol. 25

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The 25th volume in the review series 'Advances in Polymer Science' has been dedicated to Maurice Huggins on the occasion of his 80th birthday. This is an action which the reviewer applauds, but readers hoping to find articles relating to the areas of research in which Huggins was, and still is most active will be disappointed. However, this deficiency is largely offset by the generally high standard of the four review articles contained in the volume.

The first of these by Davydov and Krentsel covers the chemistry of polyconjugated systems. This begins with methods of formation and goes on to highlight how the conformation of a polyene chain determines the conjugation efficiency of the system. An outline of the chemical properties, including thermal stability and the formation of charge transfer complexes follows and the section is concluded by a description of some catalytic properties. The authors have presented a somewhat unbalanced treatment by covering only their own work in detail, but the extensive list of references which they include, adequately compensates, as it will provide anyone with rapid access to much of the relevant (especially Russian) literature.

An excellent review of general interest by Gabrielyan and Rogovin deals with the chemical modification of fibres based on acrylonitrile. The widespread use of polyacrylonitrile (PAN) as a fibre has led to great interest in reactions leading to improvements in its properties. Some of this effort has been directed towards modification of PAN by random copolymerization. A wide variety of comonomers have been used and in some instances advantages accrue when the incorporated comonomer is itself modified. Of particular interest is the enhancement of nitrile group reactivity when acrylothioamide is the comonomer. Incorporation of this monomer in the chain also leads to a variety of further possibilities for chemical modification. A description of the more controlled block and graft copolymer structures which provide convenient ways of introducing desirable qualities in the resulting fibres completes the coverage.

One aspect of the fascinating field of synthetic enzymes has been selected by Okubo and Ise, who have reviewed the use of synthetic polyelectrolytes as models of nucleic acid and esterases. The importance of hydrophobic interactions is repeatedly stressed throughout, particularly in relation to template synthesis and base stacking. The study of synthetic polyelectrolytes as model esterases makes interesting reading and their use as catalysts in hydrolysis reactions reveals some encouraging results.

The behaviour of furan derivatives in polymerization reactions is the subject of the article by Gandini. It is a well presented review containing detailed discussion on a remarkably large number of controversial issues. The author does well to present the arguments and counter-arguments, but in doing so has ensured that while the specialist interested in this subject will derive benefit from the treatment, the casual reader will be tempted to skim through at a fairly superficial level.

On the whole, the general reader will find much to attract his attention in this volume, which can be recommended for inclusion in library collections. A personal copy is perhaps best restricted to those with committed interests in any one of the areas covered.

J. M. G. Cowie