

Degradation of Filled Polymers

M. T. Bryk

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This volume, subtitled *High Temperature and Thermal-oxidative Processes*, is one of an expanding series on *Polymer Science and Technology* edited by T. J. Kemp and J. F. Kennedy. Professor Mikhail Bryk is the Head of the Department of Physical Chemistry of Membranes at the Institute of Colloid Chemistry, Ukrainian Academy of Sciences, Kiev, and is known for his work in the field of polymer composites and filled polymers. The book was originally published in Russian (*Destrucktsiia napolnenykh polimerov*) in 1989 by Khimiya, Moscow, and has been translated by K. A. Babutkina, with translation editing by T. J. Kemp.

In relation to this background, two important comments can be made at the outset. First, the quality of the translation is as near perfect as could ever be expected. There are none of those angularities in the English which are so often present in translated scientific works, and no ambiguities in the science arising from the conversion of the Russian style. Indeed, the book is clear and readable from start to finish. Secondly, the book is a veritable mine of information and references about the compendious work on this subject in the (former) Soviet Union. There are 344 references in total, and it is extremely useful to have a conducted tour through these as one reads the text.

The book is structured quite logically in four sections. The first section considers the thermal and thermal-oxidative stability of a range of polymers of the type which are often used in composites. A wide variety of carbochain, heterochain, and corresponding cyclochain polymers are considered and their breakdown behaviour is discussed in terms of their structure. However, for those not so familiar with the problems of studying thermal and oxidative degradation, a cautionary note may be desirable. Many specific statements are made in the book about the values for rates, activation energies and other degradation parameters (e.g. 'the polymer begins to degrade at 423 K'). These statements do not have the absolute significance that the reader may be tempted to assume, because the values depend very much on how the experiment was performed, on

sample size, and on the criteria used to make the judgement. The general significance of this comment is that comparative measurements of the types used may yield useful information about relative stabilities, but calculations based on (for example) the quoted activation energies could result in misleading conclusions about other degradation conditions.

The second section of the book considers the types of inorganic polymer fillers generally used, and examines their thermal properties in isolation. The materials include metals and their oxides and salts; silicas, silicates and glass; and carbon and graphite. The surface chemistry, and physical and chemical properties of these fillers are discussed in relation to their usefulness in providing thermal or thermal-oxidative stability of polymers. In most cases the introduction of a filler increases the stability of the host polymer, and this is generally attributed either to their effect in decreasing the kinetic mobility of the macromolecules, or the contributions of their surfaces to chain termination processes. However, some fillers, especially metals or metal oxides, can promote oxidative degradation of the host polymer.

The third section is concerned with methods of studying the thermal and oxidative degradation of the filled polymers. The methods themselves are not different from those used to study the degradation of conventional polymers (e.g. thermal analysis, spectroscopic, mass spectroscopic and chromatographic methods) but the special problems of studying filled polymers (not least of which are the methods of production and introduction of the filler into the polymer, and the form of the sample to be used for analysis) are given appropriate consideration. The use and limitations of dynamic t.g.a. (i.e. temperature-ramped t.g.a.) are discussed as a method for obtaining the total kinetic parameters for the degradation process. The usual mathematical treatment of this is given, involving the attribution of an 'effective reaction order'. The reviewer has little confidence in kinetic parameters obtained in this way, and would be rather more cautious than the author in recommending it.

The final section reviews a host of published work on the thermal and oxidative degradation of filled polymers, and a lot of ground is covered in the 44 pages devoted to this. Many contradictory results have been published in the

literature, and the author sets out in a systematic way to assess the extent to which the structure and properties of the polymer and those of the filler (especially its surface chemistry) contribute to the thermal and oxidative degradation. It is, of course, inevitable that the selection of systems and examples will be coloured by the author's interests and experience, but the reviewer found it a little surprising that there appears to be no mention whatever of the effects of carbon on the thermal and oxidative degradation of rubber, whereas the effects of many metals and metal oxides are included.

This book is a valuable source book, not only for those who have to deal with and utilize commercial filled polymers, but also for those who are faced with the problem of selecting an appropriate filler for a host polymer. If, as a result of this book, an enlightened selection is made on the basis of the overall thermal stability, then the author and the translators should receive the credit they deserve.

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Frontiers of Organosilicon Chemistry

Edited by A. R. Bassindale and P. P. Gaspar

Royal Society of Chemistry,
Cambridge, 1991, £52.50
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This book reports the proceedings of the IXth International Symposium on Organosilicon Chemistry held in Edinburgh in July 1990, a very successful conference attended by over 500 participants who presented and discussed their work in a hundred or so papers and twice as many posters. Invited contributions from a mixture of established experts and younger scientists are reproduced here as short surveys (10-12 pp.) of their respective areas.

Inevitably, the treatment they give is varied. The use of camera-ready copy makes the occasional diagram difficult to decipher, and the subject matter is necessarily selective; styles range from highly personal to objective, and the coverage of relevant literature from full