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Book Review

Aspects of Degradation and Stabilization of Polymers, edited by H.H.G. Jellinek, Elsevier, Amsterdam, 1978, 2nd impression, 1979, 690 pp., Dfl. 305.00.

This successful book now in its 2nd impression contains a wealth of material submitted by a galaxy of internationally famous authors. The editor points out that it aims to present quantitative aspects whenever possible. The editor further points out that it would be helpful to graduate students and research workers in industry. It would seem that this aim is justified.

The method of reviewing an edited book of this nature is difficult to decide but it would seem best to deal with it by considering each contribution in turn.

The introductory chapter by H.H.G. Jellinek deals with degradation and depolymerization kinetics. This type of topic is divided as usual into a section dealing first with random chain scission followed by a second section dealing with depolymerization. The treatment is entirely mathematical and very rigorous. However, it deals with only the initial degradation reaction — i.e. the actual chain scission step or the breaking of the chain. In practice, subsequent degradation can involve reaction with an atmosphere, usually oxygen, or can be quite different in an inert atmosphere, e.g. nitrogen. The final products in chain scission can be tars and carbons but polymer chemists often ignore these subsequent processes. However, we must admire the logical manner in which Prof. Jellinek presents this material.

The second chapter by W.K. Busfield deals with ceiling temperatures. In thermodynamic terms the ceiling temperature T_c associated with a certain polymerization system is the temperature at which the partial molar free energy of a monomer molecule in that system, $\bar{G}_m$, is equal to the partial molar free energy of a monomer unit in the polymer molecule in that system, $\bar{G}_p$. This implies that below the ceiling temperature, T_c, depolymerization is impossible. Again the treatment is rigorous and the explanation adequate.

The oxidative degradation of polymers by molecular oxidation is described by Yoshio Kamiya and Etsuo Niki who include important sections dealing with inhibition and catalysis. Degradation by high energy radiation is set out by W. Schnabel and is followed logically by a chapter on photodegradation by Schnabel and J. Kiwi. The chapter by I. Mita on the effect of structure on degradation and stability of polymers needs some explanation. It deals in fact with the effect of bond strength in chain scission, reactions of radicals, termination, cage effects in initiation, etc. An important aspect dealt with here is the effect of irregular structures on degradation and stability, although the importance of this in dealing with natural products is not stressed. In both this chapter and in the very first chapter it is stressed that the main process of degradation considered is thermal. This makes thermogravimetric procedures directly applicable and mention is made of TG data on polystyrene cross-linked by trivinyl benzene. Other TG data are extensively quoted in this chapter.

Mechanical degradation is reviewed by K. Murakami. He deals with structural changes of polymers which occur due to various kinds of mechanical conditions, while the second part deals with changes in polymers due to conditions such as oxidation, irradiation, etc. In a scholarly composition Hirotaro Kambe deals with the effect of degradation on mechanical properties of polymers. This is material with which thermal analysts will be aware, and includes a short section on nomenclature under the heading "Thermomechanometry", which deserves careful consideration by those framing the recommended nomenclature conventions. There are further chapters, one by H.H.G. Jellinek dealing with the reaction of polymers with pollutant gases, another by K. Akita dealing with ignition and flame propagation, while a third chapter by E.L. Strauss concerns polymer degradation processes in ablation.

The chapter of most direct interest to those working in thermal analysis is that by J.H. Flynn on thermogravimetric analysis (TG) and differential thermal analysis (DTA and DSC). This chapter sets out details of equipment and the manner in which the techniques may be applied to polymer systems. There is an extended section dealing with kinetic problems and a careful and gently critical appreciation of non-isothermal kinetic analysis.

Thermal and mass chromatography techniques and their application are set out by S.S. Stivala and S.M. Gabbay. A final chapter on biodegradation is by J.E. Potts.

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