

Degradation and Stabilization of Polymer Materials

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1. Introduction

The growing awareness of the consequences of climate change has prompted the formulation of policies and regulations to foster sustainability. This global concern has had a far-reaching impact, influencing change and innovation in various sectors, including the plastics industry [1]. Researchers in this field face a myriad of challenges. They are engaged in several efforts, including (i) a substantial research and development endeavor that is directed towards the creation of sustainable and environmentally friendly materials, including recycled materials and biodegradable/bio-based plastics delivered from renewable resources. These materials are favored due to their reduced carbon footprint and lower environmental impact [2]. (ii) Research into the stabilization and degradation of plastic materials, where understanding the environmental implications of plastics is vital, as plastics affect the environment at all stages of their life cycle, from production to disposal. Researchers focus on assessing the environmental impact of plastics on terrestrial and aquatic ecosystems and studying the processes of plastic stabilization and degradation [3]. (iii) The development and use of novel technologies and analytical methods to determine the stability and degradation of polymeric materials [4–6].

In the field of plastics, the development of new polymer materials and methods that address environmental and sustainability concerns is being promoted. Novel materials are engineered to be more environmentally friendly, but their stabilization and tendency to degrade require careful assessment of their performance in various environmental conditions, including exposure to factors such as UV radiation, microorganisms, increased humidity, and temperature stress [7]. Plastics that enter natural environments during or after their lifetime decompose into microplastics and even nanoplastics, with diverse consequences for ecosystems and living organisms [8–10]. It is thus imperative to thoroughly investigate the full range of impacts of microplastics and nanoplastics on the environment. Scientists are encouraged to conduct extensive research in all relevant fields, and the general public should be informed about the potential negative consequences of the accumulation of plastics in the environment [11,12].

Given these challenges and ongoing research, the Special Issue “Degradation and Stabilization of Polymer Materials” presents ten articles by experts addressing various aspects and challenges related to (bio)plastic materials and their interaction with the environment. The articles explore research and development progress in the realm of (bio)polymers, encompassing their stabilization and degradation, as well as the formation and decomposition of microplastics and their environmental impact. The contributions are underpinned by significant innovations in characterization methods and techniques, offering a comprehensive perspective on this important field. A summary of the articles is provided below.

2. An Overview of Published Articles

Some polymers are susceptible to biodegradation in the natural environment by microorganisms such as bacteria and fungi or small organisms [13] such as earthworms. The



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Polymer Stabilization And Degradation

W L Hawkins, H J Harwood



Polymer Stabilization And Degradation:

Polymer Degradation and Stabilisation Norman Grassie, Gerald Scott, 1988-04-14 The study of polymer degradation and stabilisation is of considerable practical importance as the industrial uses of polymeric materials continue to expand In this book the authors lucidly relate technological phenomena to the chemistry and physics of degradation and stabilisation processes Degradation embraces a variety of technologically important phenomena ranging from relatively low temperature processes such as weathering of plastics fatigue of rubbers through the processing of polymers in shearing mixers to very high temperature processes such as flammability and ablation All these technological phenomena have in common certain basic chemical reactions Thus weathering has its roots in photo oxidation fatigue and melt degradation in mechano oxidation and flammability and ablation in ablation in pyrolysis and vapour phase oxidation Fundamentals of Polymer Degradation and Stabilization N.S. Allen, M. Edge, 1992-10-31 During the past decade the field of polymer degradation and stabilization has become a subject of central importance in polymer science and technology This book provides a fundamental source of information designed for those with only a basic understanding of the background of the field **Polymer Degradation and Stabilization** W. L. Hawkins, 2012-12-06 The development of polymers as an important class of material was inhibited at the first by the premature failure of these versatile compounds in many applications The deterioration of important properties of both natural and synthetic polymers is the result of irreversible changes in composition and structure of polymers molecules As a result of these reactions mechanical electrical and or aesthetic properties are degraded beyond acceptable limits It is now generally recognized that stabilization against degradation is necessary if the useful life of polymers is to be extended sufficiently to meet design requirements for long term applications Polymers degrade by a wide variety of mechanisms several of which affect all polymers through to varying degree This monograph will concentrate on those degradation mechanisms which result from reactions of polymers with oxygen in its various forms and which are accelerated by heat and or radiation Those stabilization mechanisms are discussed which are based on an understanding of degradation reaction mechanisms that are reasonably well established The stabilization of polymers is still undergoing a transition from an art to a science as mechanisms of degradation become more fully developed A scientific approach to stabilization can only be approached when there is an understanding of the reactions that lead to degradation Stabilization against biodegradation and burning will not be discussed since there is not a clear understanding of how polymers degrade under these conditions **Polymer Stabilization and Degradation** Peter P. Klemchuk, 1985 Polymer Degradation and Stabilization W. Lincoln Hawkins, 1984 Polymer Stabilization and Degradation Peter P. Klemchuk, 1985 Handbook of Polymer Degradation S. Halim Hamid, Mohamed B. Amin, Ali G. Maadhah, 1992 This useful reference provides up to date coverage from both the engineering and scientific viewpoints of the most recent findings in the expanding field of polymer degradation and stabilization including areas in which polymers have only recently been used and detailed information has

not previously been available as advanced material for more in depth study Handbook of Polymer Degradation introduces new data on the effects of increased UV radiation on polymers and discusses how to decrease those effects considers artificially accelerated weathering and its relationship with natural weather examines weathering degradation of polyethylene with the relevant experimental results emphasizes the environmental aspects and waste management of polymers and combines insights on the environmental toxicology of plastics with a survey of current legislative issues different parts of the world Handbook of Polymer Degradation is an essential reference for chemical polymer environmental pollution control mechanical and materials scientists and engineers chemists environmental regulators and policy makers and upper level undergraduate and graduate students in these disciplines

Mechanisms of Polymer Degradation and Stabilisation G. Scott, 2012-12-06 The purpose of this publication is two fold In the first place it is intended to review progress in the development of practical stabilising systems for a wide range of polymers and applications A complementary and ultimately more important objective is to accommodate these practical developments within the framework of antioxidant theory since there can be little question that further major advances in the practice of stabilisation technology will only be possible on a firm mechanistic foundation With the continual increase in the number of commercial antioxidants and stabilisers often functioning by mechanisms not even considered ten years ago there is a need for a general theory which will allow the potential user to predict the performance of a particular antioxidant structure under specific practical conditions Any such predictive tool must involve a simplified kinetic approach to inhibited oxidation and in Chapter 1 Denisov outlines a possible mechanistic approach with the potential to predict the most useful antioxidant to use and the limits of its usefulness In Chapter 2 Schwetlick reviews the current state of knowledge on the antioxidant mechanisms of the phosphite esters with particular emphasis on their catalytic peroxidolytic activity Dithiophosphate derivatives show a similar behaviour but for quite different reasons and in Chapter 3 Al Malaika reviews information available from analytical studies particularly using ^{31}P -NMR spectroscopy to elucidate the complex chemistry that leads to the formation of the antioxidant active agents

Chemical Physics of Polymer Degradation And Stabilization N. Nikolai Markovich Emanuel', Anatoli Leonidovich Buchachenko, 1987-06

Stabilization and Degradation of Polymers David L. Allara, 1978

Stabilization of Polymeric Materials Hans Zweifel, 2012-12-06 Plastics are used worldwide in everyday life e g as food packaging electronics construction automotive parts and household appliances To produce these products with the desired service lifetimes the use of suitable stabilizers is necessary This book provides a concise and comprehensive overview of the basic mechanisms of plastic degradation processes caused by heat and light At its core is a detailed description of the stabilization of different polymers including an explanation of stabilization mechanisms and the influence of commonly used additives such as fillers flame retardants and pigments on the stability of plastic Every polymer scientist material technologist or application engineer dealing with the design of the properties of plastics will benefit from this new overview

Stabilization and Degradation of Polymers David L. Allara, Walter Lincoln Hawkins, 1978 Polymer Degradation and Stabilization W L Hawkins, H J Harwood, 1983-12-01 **Degradation and Stabilization of Polymers** Hans Helmut Gunter Jellinek, 1983 Stabilization and Degradation of Polymers David L. Allara, W. Lincoln Hawkins, 1978 *Polymer Degradation and Stabilization* W. Lincoln Hawkins, 1984 **Degradation and Stabilisation of Polymers** G. Geuskens, 1975 **Handbook of Polymer Degradation** S. Halim Hamid, 2000-06-30 Covers recent advances in polymer degradation and stabilization Focuses on the basics of photo and bio degradability Delineates special and general environmental parameters such as solar irradiation temperature and agrochemical exposure Surveys plastic waste disposal strategies such as recycling incineration chemical recovery by pyrolysis and source reduction *Kinetic and Thermodynamic Aspects of Polymer Stability* Gennadiĭ Efremovich Zaikov, 1996 Kinetic Thermodynamic Aspects of Polymer Stability **Photodegradation and Light Stabilization of Heterochain Polymers** Niyazi, Savenkova, 2006-11-14 Photodegradation and light stabilization are very important aspects of polymer aging Polymer degradation includes different types of processes thermodegradation oxidation acting of ozone photodegradation radiation hydrolysis mechanical degradation and biodegradation It is very important to know the mechanism of polymer degradation in order to select stabilizers against the degradation This volume presents the analysis of achievements in the field of photodegradation of polymers It includes first of all data of Russian investigators who have decisively contributed in the development of this field of knowledge the schools headed by academicians V V Korshak N M Emanuel N S Enikolopov A A Berlin and many others

Polymer Stabilization And Degradation Book Review: Unveiling the Power of Words

In a global driven by information and connectivity, the energy of words has be more evident than ever. They have the capacity to inspire, provoke, and ignite change. Such may be the essence of the book **Polymer Stabilization And Degradation**, a literary masterpiece that delves deep into the significance of words and their affect our lives. Published by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall affect readers.

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