

Preface

Rapid progress in the development and utilization of polymeric materials and functionalized polymers in agriculture and the food industry has occurred in recent years. The growing demand for food and food safety are the main impetus behind the need for more efficient operations in growing, producing, and processing foodstuffs for higher yields and better quality, and to rid foods from possible adverse health issues. The remarkably useful combination of properties possessed by polymers make their use in this field a rapidly expanding area with respect to requirements for health, nutrition, environmental pollution control, and economic developments.

This book provides a valuable literature source on polymers that have been used in this respect. It will help to close the gap between the two fields of polymeric materials and the areas of agriculture and food development both in quality and quantity. In addition, it will be useful as a guide for systems development and solving the problems of designing polymers that may lead to new frontiers for more efficient operations in both agricultural and industrial production of foodstuffs. It aims to provide a comprehensive review of the broad spectrum of research activities currently being undertaken in the field of functionalized polymeric materials and their significant uses to improve the production quality and processing quantity of food products.

The book is composed of six chapters: the first chapter is divided into two sections that give the background knowledge of the synthesis of reactive polymeric and composite materials and their physical and mechanical properties. In an attempt to examine the utility of polymeric materials in the field of agriculture and the food industry, the first section of this chapter is concerned with fundamental and background knowledge of the types necessary for their design. A brief description is given of the conditions employed in the preparation of reactive polymers either by polymerization or by chemical modification techniques as well as an explanation of potential advantages and disadvantages of each technique. The second section is devoted to the characterization of the polymer properties. Effective utilization of a polymeric material in agriculture and the food industry depends on their properties which include their physical form, porosity, solvation behavior, diffusion, permeability, and surface properties, chemical reactivity and stability, deterioration and stability, and mechanical properties. Such properties are crucial

and depend on the conditions employed during preparation and must be considered during the design of a new reactive functionalized polymer.

Part I of the book, which includes Chaps. 2 and 3, provides a general overview of the utilization of polymeric materials in a variety of agricultural fields not only as replacement for traditional materials but also as a significant improvement in technological processes in the growing of agricultural crops, in storage construction for crops and animals, and in agricultural equipment and drainage technology. These materials are used in the most diverse forms in agriculture, especially in the controlled release of agrochemicals and as useful media for plantations, as structural materials for plant protection, and in water conservation. The central aim of using polymers in agriculture is in increasing and improving crop yield in shorter time, in less space, and at lower costs. Chapter 2 covers a number of areas where polymers have been employed in growing crops and enhancing plant protection; it is divided into four areas: polymers in plantations, plant protection, farm construction materials, farm water handling and management. Chapter 3 describes the use of polymeric materials in agriculture for controlled-release formulations of agrochemicals, which are released into the environment of interest at relatively constant rates over prolonged periods of time to avoid the risk of the active agents being washed away by rain or irrigation. There are a number of agrochemical areas where polymers have been employed either as encapsulation membranes or as convenient supports to chemically attach the active agrochemical groups. In general, all principal classes of polymers have been utilized in agricultural applications of controlled-release formulations of agrochemicals.

Part II of the book, which consists of Chaps. 4, 5 and 6, provides a general overview of the utilization of polymeric materials in a variety of food processing fields. In general, polymers are not absorbed by the human body due to the size of macromolecules that prevents their diffusion across the membranes of the gastrointestinal tract. Thus, they are not of major toxicological concern with respect to low-molecular-weight food additives. The utilization of functionalized polymers in the food processing industry has a great potential for continuous industrial processes in large-scale applications. Polymeric ingredients allowed for use in the food industry are employed in three general areas: food processing and fabrication, food additives, and food protection and packaging.

Chapter 4 elaborates the basic principles of how reactive polymers can contribute to solving problems associated with conventional procedures in some areas of food processing. A broad range of polymeric applications to the food industry is covered, including various types of polymers that have a promising potential in respect to continuous processes, in particular those used in the dairy and sugar industries, the fruit juice and beverage industry, and in beer and wine production. It also covers the potential uses of polymers in tomato sauce production, and in potable water. Polymeric materials used to affect food processing and do not substantially become components of food, especially for the purification, recovery, and utilization of by-products, are not considered as food additives. In general, they are used in food processing to improve food characteristics, to aid in food processing, to make foods more attractive, or to keep food unspoiled for long periods of time under the conditions of storage. The most prominent driving factor behind the increasing need for using polymers in food products is population growth around

the world. The food industry requires suitable polymers to meet the specific requirements of the food industry to simplify food production processes and to reduce food production costs, while neither deteriorating nor altering food characteristics. Protecting health and preserving food quality are paramount. Reactive functional polymers in the form of ion-exchange resins, immobilized enzymes, membranes, and polymeric smart and nanomaterials have been utilized in various areas of the food processing and fabrication industries.

Chapter 5 describes the use of polymeric food additives such as colorants, antioxidants, nonnutritive sweeteners, nonnutritive hydrocolloids, animal feed additives, as well as indicators and biosensors in foods. Polymeric food additives are to enhance food quality, to preserve and enhance food flavor, taste, and appearance without affecting food nutritional value. They are substances other than basic food-stuffs, which exhibit their functions prior to consumption of the food products, either acting as aids in the manufacture, preservation, coloration, and stabilization of food products, or serving to improve the biological value of certain foods.

Chapter 6 focuses on the applications of polymers in food packaging and protection that include polymers in traditional food packaging, in coatings of metal cans, biodegradable and preservative food packagings, and polymeric active, modified atmospheric, and smart food packagings. Traditionally, food packages have been used to provide protection for food products and are designed to retard or delay the undesirable effects of physical, chemical, biological, and environmental factors. They are intended to extend shelf life and retain food quality by keeping the food contents clean, fresh, and safe for consumption. Their primary role in food safety is preserving and protecting the food from external contamination, maintaining food quality, and increasing shelf life. They protect foods from environmental factors, such as light, heat, oxygen, moisture, enzymes, microorganisms, insects, dust, gaseous emission and pressure, which all may lead to the deterioration of food products. Food packages are labeled to show required information regarding the nutritive value of the food and to communicate to the consumer how to use, transport, recycle, or dispose of the packages, as well as the nature of the deterioration of the product and any potential health issues that may result if the food is consumed beyond its expiry date.

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