Preface

Present is an era of advance materials including polymer composites, nanocomposites, and biocompatible materials. With advancements in science and technology and increase in Industrial growth, there is a continuous deterioration in our environmental conditions. Emission of toxic gases such as dioxin on open burning of plastics in the air and the poisoning of soil-fertility due to nonbiodegradability of plastics disposed in the soil are continuously adding pollution load to our surrounding environment. Therefore, keeping in view the deteriorating conditions of the living planet earth, researchers all over the world have focused their research on eco-friendly materials, and the steps taken in this direction will lead toward Green-Science and Green-Technology.

Cellulosics account for about half of the dry weight of plant biomass and approximately half of the dry weight of secondary sources of waste biomass. At this crucial moment, cellulose fibers are pushed due to their "green" image, mainly because they are renewable and can be incinerated at the end of the material's lifetime without adding any pollution load in the atmosphere. Moreover, the amount of CO_2 released during incineration process is negligible as compared to the amount of CO_2 taken up by the plant throughout its lifetime. Polysaccharides can be utilized in many applications such as biomedical, textiles, automobiles, etc. One of the promising applications is using them as a reinforcing material for the preparation of biocomposites. The most important factor in obtaining mechanically viable composite material is the reinforcement–matrix interfacial interaction. The extent of adhesion depends upon the chemical structure and polarity of these materials. Owing to the presence of hydroxyl groups in cellulose fibers, the moisture regain is high, leading to poor organic wettability with the matrix material and hence a weak interfacial bonding between the reinforcing agent and hydrophobic matrices. In order to develop composites with better mechanical properties and environmental performance, it becomes necessary to increase the hydrophobicity of the reinforcing agent and to improve the compatibility between the matrix and cellulose fibers. There exist several pretreatments that are conducted on cellulose fibers for modifying not only the interphase but also the morphological changes in fibers. Nowadays, to improve the compatibility between natural fibers and hydrophobic polymer matrices, various greener methods such as plasma treatment and treatments using fungi, enzymes, and bacteria have been explored.

Reinforcement of thermoplastic and thermosetting composites with cellulose fibers is increasingly regarded as an alternative to glass fiber reinforcement. The environmental issues in combination with their low cost have recently generated considerable interest in cellulose fibers such as isora, jute, flax, hemp, kenaf, pineapple leaf, and man-made cellulose fibers as fillers for polymer matrices-based composites.

Criteria for cleaner and safer environment have directed enormous parts of the scientific research toward bioplastic materials that can easily be degraded or bio-assimilated toward the end of their life cycle. Degradation of the biocomposites could be either a photodegradation or microbial degradation. Photodegradation of biofilms plays an important role as mulching sheets for plants in agricultural practices that ultimately gets degraded in the soil as an organic fertilizer. Microbial degradation plays a significant role in the depolymerization of the biopolymers, and final degradation products are carbon dioxide and water, thereby adding no pollution load to the environment.

Development of polymer nanocomposite is a fast-growing area of research. Significant efforts are focused on the ability to obtain control of the nanoscale structures via innovative synthetic approaches. The properties of nanocomposite materials depend not only on the properties of their individual constituents but also on their morphology and interfacial characteristics. This rapidly expanding field is generating many exciting new materials with novel properties. All types and classes of nanocomposite materials lead to new and improved properties when compared to their macrocomposite counterparts. Therefore, nanocomposites promise new applications in diversified fields such as high-strength and light-weight components for aerospace industry, corrosion-resistant materials for naval purpose, etc.

Researchers all over the world are working in this field, and only a few books are available on cellulose fiber polymer composites and nanocomposites. Therefore, this book is in the benefit of society, covering all the essential components of green chemistry. The book is divided into four parts. It starts off with Part-I: structure and properties of cellulose fibers and nanofibers and their importance in composites, medical applications, and paper making. Part-II of the book covers the polymer composites and nanocomposites reinforced with cellulose fibers, nanofibers, cellulose whiskers, rice husk, etc. Greener surface modifications of cellulose fibers, morphology, and mechanical properties of composites are also covered in this part. Part-III of the book covers the biodegradable plastics and their importance in composite manufacturing, reinforced with natural and man-made cellulose fibers. Present section also discusses the biodegradation of polymer composites. Part-IV of the book includes the use of cellulose fiber-reinforced polymer composites in automotives, building materials, and medical applications.

Book covering such vital issues and topics definitely should be attractive to the scientific community. This book is a very useful tool for scientists, academicians, research scholars, polymer engineers, and industries. This book is also supportive for undergraduate and postgraduate students in Institutes of Plastic Engineering and Technology and other Technical Institutes. The book is unique with valuable contributions from renowned experts from all over the world.

The Editors would like to express their gratitude to all contributors of this book, who made excellent contributions. We would also like to thank our students, who helped us in the editorial work.

Solan (Shimla Hills), India — Susheel Kalia
Jalandhar, India — Balbir Singh Kaith
Shimla, India — Inderjeet Kaur
February 2011

http://www.springer.com/978-3-642-17369-1

Cellulose Fibers: Bio- and Nano-Polymer Composites
Green Chemistry and Technology
Kalia, S.; Kaith, B.S.; Kaur, I. (Eds.)
2011, XX, 738 p. 195 illus., 118 illus. in color.,
Hardcover
ISBN: 978-3-642-17369-1