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Preface

Natural fiber composites

With the strong emphasis on environmental awareness, much attention has been brought in the development of recyclable and environmentally sustainable composite materials since the last decade. The world is currently facing a serious problem on developing proper methods of treating solid wastes, e.g. to decompose the wastes through different chemical processes with minimal energy, which are actually not cost-effective and may subsequently produce harmful gases during the processes. Environmental legislation as well as consumer demand in many countries is imposing higher pressure on manufacturers of materials and end-products. They have to consider the environmental impact of their products at all stages of their life cycle, including recycling and ultimate disposal. These environmental issues have recently generated considerable interest in the development of recyclable and biodegradable composite materials. Typically, some biodegradable composites can also be used in tissue engineering applications, in which the composites can be degraded or resorbed naturally inside the human body with time, while the neo-tissues will be grown to recover their function simultaneously. These materials must be capable of being used in or on the human body without eliciting an adverse response to surrounding tissues at the implantation site.

Therefore, research in the field of using natural fibers, such as animal silk, feather, hemp, sisal, pineapple leaf, wood and even bamboo, has attracted much attention in the material science and engineering discipline. Mixing these fibers with biodegradable and bioresorbable polymers can produce new classes of materials for fixators in bio-medical applications, and products in some well-developed countries where environmental awareness is of a great concern. However, before applying these fiber-reinforced composites into real-life applications, particularly for massive production, the characteristics of the materials have to be studied in-depth to ensure repeatable and reliable results can be obtained. These include the fiber/matrix interaction, mechanical performance, manufacturing process and dispersion properties of the resultant composites. Several issues such as the moisture absorbability and change in microstructure of these fibers subjected to loading may also substantially affect the final properties of the composites. On the other hand, their biodegradability with different fiber compositions may also play a key role to produce fully biodegradable composites. Natural fiber is indeed a renewable resource that can be grown and made within a short period of time, in which the supply can be unlimited as compared with traditional glass and carbon fibers for making advanced composites.

In this special issue, a total of 14 papers are sorted under 3 sections in the fields of plant-based, animal-based fiber-reinforced biodegradable composites, and modeling of biocomposites are included, they are:

Plant-based fiber-reinforced plastic composites

Paper 1

W. Yamsaengsung and N. Sombatsompop

Effect of Chemical Blowing Agent on Cell Structure and Mechanical Properties of EPDM Foam, and Peel Strength and Thermal Conductivity of Wood/NR Composite-EPDM Foam Laminates.

An improved interfacial strength with reduced thermal conductivity of rubber laminates between wood/NR composite and EPDM layers for roofing applications was achieved by foaming the EPDM layer with 3–5 phr of 4,4′-oxybis(benzenesulfonylhydrazide) (OBSH) blowing agent.

Paper 2

Ahmad Alawar, Ahmad M. Hamed and Khalifa Al-Kaabi

Characterization of Treated Date Palm Tree Fiber as Composite Reinforcement.

Chemical and mechanical characterization study on date palm tree fibers is essential to be able to evaluate the behavior of these fibers as mutual reinforcement for polymer based composites.

Paper 3

Hiroyuki Kinoshita, Koichi Kaizu, Miki Fukuda, Hitoo Tokunaga, Keisuke Koga and Kiyohiko Ikeda

Development of green composite consists of woodchips, bamboo fibers and biodegradable adhesive.

The woodchips matrix composite with a biodegradable resin and bamboo fibers was developed. The composite has the high bending strength, high impact strength and good water resistance.

Paper 4

Nitinat Suppakarn and Kasama Jarukumjorn

Mechanical Properties and Flammability of Sisal/PP Composites: Effect of Flame Retardant Types and Contents.

The flame retardancy of sisal/PP composites can be enhanced by the addition of $Mg(OH)_2$ *and zinc borate without sacrificing their mechanical properties.*

Paper 5

Yupaporn Ruksakulpiwat, Jatuporn Sridee, Nitinat Suppakarn and and Wimonlak Sutapun

Improvement of Impact Property of Natural Fiber–Polypropylene Composite by using Natural Rubber and EPDM Rubber.

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Natural rubber (NR) and Ethylene Propylene Diene Monomer (EPDM) rubber were used as an impact modifier for Vetiver grass–Polypropylene composites. Mechanical properties of the composites were elucidated.

Paper 6

Kasama Jarukumjorn and Nitinat Suppakarn

Effect of Glass Fiber Hybridization on Properties of Sisal Fiber–Polypropylene Composites.

Incorporating glass fiber into sisal-polypropylene composites enhanced tensile, flexural, and impact strength without having significant effect on tensile and flexural moduli. In addition, adding glass fiber improved thermal properties and water resistance of the composites.

Paper 7

P. Threepopnatkul, N. Kaerkitcha and N. Athipongarporn

Effect of Surface Treatment on Performance of Pineapple Leaf Fiber– Polycarbonate Composites.

The modified pineapple leaf fibers composite was used to enhance mechanical properties of the composite. The Young's modulus is the highest in the case of the pineapple leaf fibers treated with sodium hydroxide whereas the pineapple leaf fibers treated with aminopropyl trimethoxy silane showed the highest tensile strength and impact strength.

Paper 8

Chanakan Asasutjarit, Sarocha Charoenvai, Jongjit Hirunlabh and Joseph Khedari

Materials and mechanical properties of pretreated coir-based green composites.

The pretreatment of the coconut coir plays an important role in the physical, mechanical and thermal properties of the coconut coir green composite. The chemical composition analysis and scanning electron microscopy (SEM) investigation of the pretreated coir showed the chief cause of the improvement in the fiber/matrix adhesion.

Paper 9

L Yin and X. Z. Peng

Natural additives in protein coagulation casting process for improved microstructural controllability of cellular ceramics.

Through optimising the procedure of introducing a natural additive—starch in the environmentally friendly protein coagulation casting (PCC) technology, the microstructural controllability of the resulting cellular ceramics has been much improved. The underlying mechanisms leading to the uniform microstructures were elucidated.

Paper 10

Krishnan Jayaraman and Rex Halliwell

Harakeke (Phormium Tenax) Fibre-Waste Plastics Blend Composites Processed by Screwless Extrusion.

Phormium Tenax or Harakeke fibres and plastics from the post-consumer waste stream can be compounded into composite materials through screwless extrusion and converted to products through injection moulding and thermoforming. The tensile and impact properties of the Harakeke fibre-waste plastics blend composite material show reasonable improvements over those of the waste plastics blend. The Harakeke fibre-waste plastics blend composite material can be thermoformed into complex shapes. Formability of the composite sheets was assessed through shape conformance, thinning and wrinkling of the product; the presence of fibre reinforcement reduces the tendency of the waste plastics blend to exhibit localised thinning.

Animal-based fiber-reinforced plastic materials

Paper 11

Sha Cheng, Kin-tak Lau, Tao Liu, Yongqing Zhao, Pou-Man Lam and Yansheng Yin

Mechanical and Thermal Properties of Chicken Feather Fiber/PLA Green Composites.

This paper explores the possibility of making environmentally friendly composites from biodegradable polymers and chicken feather which is generally considered to be a waste product. The mechanical properties of poly(lactic acid) (PLA) are improved by the reinforcement of chicken feather fiber.

Paper 12

Hoi-yan Cheung, Mei-po Ho, Kin-tak Lau, Francisco Cardona and David Hui

Natural Fibre-reinforced Composites for Bioengineering and Environmental Engineering Applications.

The concerns of using conventional materials on environmental and bio-engineering fields were listed, and the reinforcing potential of different types of natural fibers (plant- and animal-based) for bio-composites in bioengineering and environmental engineering applications was introduced.

Paper 13

Jiashen Li, Yi Li, Lin Li, Arthur F.T. Mak, Frank Ko, Ling Qin

Fabrication of poly(L-latic acid) scaffolds with wool keratin for osteoblast cultivation.

Using paraffin sphere as porogen, PLLA/wool keratin scaffolds with controlled pore size and good inter-connectivity were fabricated. The keratin was added into the scaffolds to improve the cell affinity.

Modeling

Paper 14

Daniel Lin, Qing Li, Wei Li and Michael V. Swain

Design Optimization of Functionally Graded Dental Implant for Bone Remodeling.

In this paper, the main aim is to determine the optimal material setup for FGM dental implant, based on the bone remodeling performance of the dental bones, predicted by the computational bone remodeling technique.

Paper 15

J.K. Pandey, W.S. Chu, C.S. Kim, C.S. Lee and S.H. Ahn

Bio-nano reinforcement of environmentally degradable polymer matrix by cellulose whiskers from grass.

This paper explains the preparation of composites of cellulose whiskers, extracted from Grass, with PLA as biodegradable polymer matrix. The grass, one of cheapest cellulose source, was used to obtain cellulose whiskers of nano-dimension as the novel source. The effect of hydroxyl group modification of cellulose whiskers on the mechanical properties were also studied after filling at different concentration. The results exhibited that hydroxyl group modification may be of certain use for comparatively better dispersion inside matrix.

The editors express their sincere appreciation and thanks to all the authors and co-authors for their scientific contribution to this special issue "Natural Fiber Composites" of Composites Part B: Engineering. We convey our gratitude to all the reviewers for their time and dedication. We applaud Elsevier Science for their support and encouragement of this special issue and their staff for their special attention and timely response.

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