FABRICATION AND CHARACTERIZATION OF SURFACE MODIFIED NANOFIBRILLATED CELLULOSE INCORPORATED POLYPROPYLENE COMPOSITES

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Degree of Master of Science

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Sri Lanka

June 2018

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Declaration

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Abstract

Increasing demand for materials with improved properties leads to acquiring advancement of nanomaterial. Therefore, Interest in nanocellulose has been increasing exponentially in recent years. Nanocellulose extracted from plant materials are divided into two main two categories as nanofibrillated cellulose (NFC) and nanocrystalline cellulose (NCC). Compared to NCC, NFC has gained more attention due to attractive properties such as high mechanical properties, reinforcing ability and aspect ratio. Reinforcement of NFC with synthetic polymer materials is an interesting area in the polymer-based researches over the past decades to enhance mechanical and thermal properties as well as to deplete the environmental pollution. Polypropylene is one of the widely used thermoplastic materials as matrix material in engineering composite applications. In nature, NFC is hydrophilic and polypropylene is hydrophobic. Therefore, surface modification of NFC reinforcement is necessary to prepare a nanocomposite with good performance. The prepared nanocomposite material can be used for many engineering applications. In the present research discuss mechanical, thermal and water absorption properties of polypropylene with up to 5 wt. % loading of unmodified and silane surface modified NFC reinforced composites. Scanning electron microscopic images, Fourier-transform infrared spectra, X-ray diffractograms and thermal gravimetric analysis were used to characterize the raw materials and surface modified NFC samples. The best thermal resistance and mechanical properties were given by the 3.5% silane surface modified NFC loaded polypropylene composite such as the hardness, tensile strength, and impact strength values are respectively 7.4%, 12.6%, and 86.1% higher than that of untreated NFC reinforced composite materials and neat polypropylene. In addition, the composite sample has the intermediate level of water absorption (0.1 wt. %) and processability (21.1 g/10 min) with respect to all the other samples including pure polypropylene.

Keywords: nanofibrillated cellulose; polypropylene; surface modification; silylation; nanocomposite

Acknowledgement

Research is a creative work which discovers the world in a new way. Therefore, I want to express my gratitude through simple words to the people who did a great job to their nation.

In the first instance, I wish to acknowledge to Mr. V. S. C. Weragoda, the head of the Department of Materials Science & Engineering, University of Moratuwa to grant me a valuable opportunity to follow a Master of Science at the University of Moratuwa. Then I am grateful to Mr. A. M. P. B. Samarasekara the research supervisor and Dr. D. A. S. Amarasinghe, for the enthusiasm, guidance, assistance, and encouragement in the research studies and in the preparation of the dissertation. I am especially indebted to Mr. V. Sivahar, the coordinator of MSc/PGDip in Materials Science and the other academic staff members for monitoring and providing specific advice.

Sincere gratitude is extended to Mr. Pubudu, Mr. Premalal and Mr. Mihiranga in the same department at Moratuwa University, to expertly provide me the knowledge about different kinds of testing methods. In addition, I wish to thank all the other non-academic staff members of the Materials Science and Engineering, Moratuwa University for the assistance. Then I wish to express my special thanks to Dr. Dilhara Edirisinghe, the head of rubber technology and development department of Rubber Research Institute, Ratmalana (RRISL), to grant permission for further studies of the research. The research would not become success unless the support I gain from them.

Penultimately, I want to express profound gratefulness to my family for the love, care, support, and scarifications, to my colleagues and to all the other people who helped me even in a single word. Finally, I would like to thanks all the people who help me however, I fail to mention in this Acknowledgement.

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List of Abbreviations

PP	Polypropylene
iPP	isotactic Polypropylene
sPP	syndiotactic Polypropylene
aPP	atactic Polypropylene
NFC	Nanofibrillated Cellulose
NCC	Nanocrystalline Cellulose
PE	Polyethylene
PS	Polystyrene
PVC	Polyvinylchloride
PC	Polycarbonate
PET	Polyethylene Terephthalate
NC	Nanocellulose
ILs	Ionic Liquids
TEMPO	2,2,6,6-tetramethylpiperidinyl-1-oxyl
CDMIPS	chlorodimethyl isopropylsilane
SEM	Scanning electron microscope
TEM	Transmission electron microscope
FTIR	Fourier Transform Infrared Spectroscopy
TGA	Thermal gravimetric analyzer
DSC	Differential scanning calorimetry
DTA	Differential thermal analysis
XRD	X-ray diffraction
PLA	Polylactic acid
PHAs	polyhydroxyalkaonates
PHB	polyhydroxybutyrate
PHBV	poly(3-hydroxybutyrate-co-3-hydroxyvalerate)
MFC	Microfibrillated cellulose

MAPP/ MAHgPP	Maleic anhydride grafted polypropylene
MALDPE	Maleic anhydride low-density polyethylene
MFI	Melt flow index
PVA	Polyvinyl alcohol
Si-69	(Bis [3-(triethoxysilyl)propyl] tetrasulfide)

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