PROPERTIES OF LOW DENSITY POLYETHYLEN/NATURAL RUBBER/CHEMICAL MODIFIED WATER HYACINTH FIBERS (*Eichhornia crassipes*) COMPOSITES

by

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A thesis submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy

School of Materials Engineering
UNIVERSITI MALAYSIA PERLIS

2013

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Academic Session	:	2012/2013

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ACKNOWLEDGEMENT

First of all, thank God for giving me utmost strength, patience and ability to complete this thesis successfully.

I would like to express my greatest appreciation and sincere gratitute to my supervisor, Associate Professor Dr. Supri A. Ghani for the continuous support in my PhD study and research. He helped me with his enthusiasm, inspiration, and great effort in explaination clearly and simply. Throughout my thesis-writing period, he provided encouragement, guidance, useful advices and motivations. I would like to extend my gratitude to my co-supervisor, Dr Teh Pei Leng for her cared and guidance on my study.

Special thank to Dr. Khairel Rafezi Ahmad, Dean of School of Materials Engineering for his support in completion my research and thesis. My sincere thanks also go to all the technicians and PLV of School of Materials Engineering for their generous effort and assistance in the laboratory's work; and not to forget to all the staffs in this school those help me directly and indirectly.

I dedicated special thanks to my friends and my postgraduate colleagues for helping me to get through the difficult times, and for all the emotional support they provided. My days of completion my PhD study would be extremely difficult without their help.

Last but not least, I record my gratitude to my lovely family especially my parents for their supports, understanding, loveliness and providing the financial support. I am also grateful to the Universiti Malaysia Perlis for giving me a space to learn and opportunity to complete my PhD study and thesis. Thank you very much.

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LIST OF ABBREVIATIONS, SYMBOLS

ASTM	American Society for Testing and Materials
BF	Banana fiber
CF	Curaua fibers
CMC	Ceramic matrix composites
CNFs	Cellulose nanofibers
DGEBA	Diglycidyl ether of bisphenl A
DSC	Differential scanning calorimetry
EA + MMA	Ethyl acrylate with methyl methacrylate
EED	Epoxy-ethylene diamine
EPDM	Ethylene propylene diene monomer
ER	Epoxy resin
ESD	Electrostatic dispersive
FTIR	Fourier transform infrared
HDPE	High density polyethylene
HVA-2	N, N-m-phenylenebismaleimide
IC	Integrated circuit
ICI	Imperial Chemical Industries
IM	Injection molding
KF	Kenaf fiber
KP	Kenaf powder

L/D	Length-to-diameter ratio
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
LNR	Liquid natural rubber
MAH	Maleic anhydride
MAPE	Maleic anhydride polyethylene
MAPP	Maleic anhydride polypropylene
MLDPE	Maleated low density polyethylene
MMC	Metal matrix composites
MPR	Melt-processible rubber
NaOH	Sodium hydroxide
NBR	Acrylonitrile butadiene rubber
NBRr	Recycled acrylonitrile butadiene rubber
NBR-g-MMA	Acrylonitrile butadiene rubber grafted methyl methacrylate
NR	Natural rubber
NRL	Natural rubber latex
NRP	Natural rubber powder
OH	Hydroxyl groups
PA	Phthalic anhydride
PA-6	Polyamide-6
PANI	Polyaniline
PANI-DBSA	Polyaniline doped with dodecylbenzene sulfonic acid
PE	Polyethylene
PEG	Polyethylene glycol

PE-g-MAH	Polyethylene-grafted-maleic anhydride
PP-g-MAH	Maleic anhydride grafted polypropylene
PF	Phenol-Formaldehyde
PLA	Poly (lactic acid)
PMC	Polymer matrix composites
PMMA	Poly (methyl methacrylate)
PP	Polypropylene
PPEAA	Poly (propylene-ethylene-acrylic acid)
PRIM	Rubber Research Institute Malaysia
PS	Polystyrene
PVA	Poly (vinyl alcohol)
rHDPE	Recycled high density polyethylene
RTR	Reclaimed tire rubber
RWF	Rubber wood finer
SBR	Styrene butadiene rubber
SEM	Scanning Electron Microscopy
SHF	Sunn hemp fibers
$T_{-50\%wt}$	Temperature at 50 % weight loss
T_D	Maximum decomposition temperature
T_g	Glass transition temperature
T_m	Melting temperature
T_o	Onset degradation temperature
TEM	Transmission electron microscopy
TGA	Thermogravimetric analysis
TPEs	Thermoplastic elastomers

TPNR	Thermoplastic natural rubber
TPOs	Thermoplastic polyolefin blends
TPVS	Thermoplastic vulcanizates
UFNBRP	Ultra-fine-vulcanized acrylonitrile butadiene rubber powder
WHF	Water hyacinth fibers
WRHA	White rice husk ash
XRD	X-ray diffraction

Sifat-sifat Komposit Polietilena Ketumpatan Rendah/Getah Asli/Serat Keladi Bunting (*Eichhornia crassipes*) Yang Diubahsuai Secara Kimia

ABSTRAK

Komposit serat semula jadi daripada polietilena ketumpatan rendah (LDPE)/getah asli (NR)/serat keladi bunting (WHF) telah dikaji. Komposit disediakan dengan menggunakan Brabender Plasticorder pada suhu 160 ^{o}C dengan kelajuan motor pada 50 rpm. Kesan pembebanan WHF, pengserasi dan pelbagai jenis modifikasi kimia ke atas sifat mekanikal, sifat pembengkakan, sifat morfologi, sifat terma, pencirian spektroskopi infra merah dan pencirian XRD terhadap komposit LDPE/NR/WHF telah dikaji. Pengserasi yang digunakan dalam kajian ini ialah polietilena-dicantumkan-maleik anhidrida (PE-g-MAH). Pelbagai jenis modifikasi kimia yang digunakan ke atas komposit LDPE/NR/WHF adalah poli (metil metakrilat) (PMMA), poli (vinil alkohol) (PVA), polianilin (PANI), rawatan alkali (NaOH), dan epoksi-etilena diamina (EED). Komposit dengan pengserasi meningkat 15.38 % pada kekuatan tegangan dan 17.63 % pada modulus Young tetapi menurun 35.79 % pada pemanjangan pada takat putus, 26.21 % pada molar penyerapan, dan 4.22 % pada purata jarak antara zarah. Komposit LDPE/NR/WHF dimodifikasi dengan MMA menunjukkan penambahan 29.18 % pada kekuatan tegangan, 31.86 % pada modulus Young, 35.66 % pada pemanjangan pada takat putus manakala penurunan sebanyak 5.36 % pada molar penyerapan dan 5.84 % pada purata jarak antara zarah. Komposit LDPE/NR/WHF dimodifikasi dengan PVA menunjukkan satu peningkatan dalam kekuatan tegangan, modulus Young , dan pemanjangan pada takat putus di mana penambahan masing-masing sebanyak 23.96 %, 16.34 % , dan 24.69 %, manakala molar penyerapan dan purata jarak antara zarah masing-masing berkurang sebanyak 3.22 % dan 2.35 %. Komposit LDPE/NR/WHF dimodifikasi dengan PANI menunjukkan penambahan sebanyak 4.71 % pada kekuatan tegangan, 24.46 % pada modulus Young, 85.5 % pada pemanjangan pada takat putus tetapi berkurang sebanyak 3.60 % pada molar penyerapan dan 11.29 % pada purata jarak antara zarah. Serat keladi bunting dimodifikasi dengan NaOH dalam komposit LDPE/NR/WHF menunjukkan satu penambahan sebanyak 2.46 %, 202.33 % dan 68.77 %, masing-masing dalam kekuatan tegangan, modulus Young dan pemanjangan pada takat putus manakala penurunan sebanyak 25.30 % dan 19.39 %, masing-masing dalam molar penyerapan dan purata jarak antara zarah. Komposit LDPE/NR/WHF dimodifikasi dengan EED bertambah sebanyak 16.30 % pada kekuatan tegangan, 17.13 % modulus Young , dan 507.05 % pemanjangan pada takat putus tetapi berkurang sebanyak 8.6 % pada molar penyerapan dan 11.52 % purata jarak antara zarah. Komposit LDPE/NR/WHF dimodifikasi dengan PE-g-MAH, PMMA, PVA, PANI, NaOH and EED menunjukkan kestabilan terma yang baik tetapi pengurangan pada % penghabluran kecuali untuk komposit LDPE/NR/WHF dimodifikasi dengan PMMA. Mikrograf SEM permukaan patahan tegangan untuk komposit yang dimodifikasi dengan kimia menunjukkan interaksi antara muka dan lekatan antara WHF dengan adunan LDPE/NR telah meningkat. SEM micrograf untuk WHF yang dimodifikasi dengan NaOH and EED menunjukkan permukaan yang kasar untuk lekatan yang lebih baik. Komposit LDPE/NR/WHF dimodifikasi dengan PANI