COMPATIBILITY AND DEGRADABILITY OF KENAF-FILLED LINEAR LOW DENSITY POLYETHYLENE/POLYVINYL ALCOHOL COMPOSITES

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by

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LIST OF ABBREVIATIONS

AFTA	ASEAN Free Trade Area
APTES	3-aminopropyltriethoxysilane
ASTM	American Society for Testing and Materials
COCA	Coconut oil coupling agent
DSC	Differential Scanning Calorimetry
DTG	Derivative thermogravimetric
EFCA	Eco-friendly coupling agent
EVA	Ethylene vinyl acetate
FESEM	field emission scanning electron microscope
FTIR	Fourier transform infrared
HDPE	High density polyethylene
KCF	Kenaf core fiber
KNF	Kenaf bast fiber
KF	Kenaf fiber
KP	Kenaf powder
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
MAPE	Maleated polyethylene
$NaHCO_3$	Sodium hydrogen carbonate
NaOH	Sodium hydroxide
NKTB	National Kenaf and Tobacco Board
NR	Natural rubber
PA	Phthalic anhydride
PALF	Pineapple leaf fiber
PE	Polyethylene

PE-g-MA	Polyethylene-grafted maleic anhydride
PLA	Poly (lactic acid)
pMDI	Polymeric methylene diphenyl diisocyanate
PP	Polypropylene
PSP	Peanut shell powder
PU	Polyurethane
PVC	Poly (vinyl chloride)
PVOH	Poly (vinyl alcohol)
rHDPE	Recycled high-density polyethylene
rPP	Recycled polypropylene
SEM	Scanning Electron Microscopy
SS	Sago starch
TGA	Thermogravimetric analysis
TMS	3-3-(trimethoxysilyl)propyl methacrylate
TPSS	Thermoplastic sago starch
UV	Ultra-violet
WMCF	Waste maize cob flour
WTD	Waste tire dust

LIST OF SYMBOLS

E_b	Elongation at break
Kg	Kilogram
cm^3	Centimetre cube
rpm	Revolutions per minute
phr	Parts per hundred resin
wt.%	weight percent
MPa	MegaPascal
℃	Degree celcius
mm	Millimetre
μm	Micrometer
N/m	Newton per metre
mW	Miliwatt
ΔH_f	Heat of fusion
T_m	Melting temperature
T_c	Crystallization temperature
%	Percentage
X_c	Degree of crystallinity
J/g	Joule per gram
$T_{5\%}$	Temperature at 5% weight loss
$T_{50\%}$	Temperature at 50% weight loss
W_t	Total water absorption (in weight)
W_1	Weight of specimen before immersion
W_2	Weight of specimen after immersion
W_b	Weight of sample before degradation test
W_a	Weight of sample after degradation test

KESERASIAN DAN KEBOLEHDEGRADASI KOMPOSIT POLIETILENA BERKETUMPATAN RENDAH LINEAR/POLIVINIL ALKOHOL TERISI KENAF

ABSTRAK

Penyelidikan berkaitan komposit polimer gentian semula jadi sedang meningkat dengan cepat disebabkan permintaan tinggi pada produk polimer yang mesra alam dengan harga yang berpatutan. Usaha-usaha yang berterusan adalah tertumpu untuk meningkatkan sifat-sifat komposit ini. Di dalam kajian ini, adunan polietilena berketumpatan rendah linear (LLDPE)/polivinil alkohol (PVOH) telah digunakan sebagai matrik polimer dengan komposisi yang telah ditetapkan pada 60/40 (wt. %), manakala gentian kenaf bast (KNF) digunakan sebagai pengisi. Kesan pembebanan pengisi dan pelbagai rawatan kimia terhadap pengisi semula jadi tersebut ke atas ciri-ciri pemprosesan, sifat-sifat tensil, struktur, morfologi, termal dan biodegradasi komposit LLDPE/PVOH/KNF telah dikaji. Komposit LLDPE/PVOH/KNF mengandungi pembebanan KNF yang berbeza (0, 10, 20, 30 and 40 phr) telah disediakan menggunakan pencampuran leburan dan pengacuanan mampatan. Didapati bahawa peningkatan pembebanan KNF, tork pemprosesan, modulus tensil, kestabilan termal dan penyerapan air komposit telah meningkat. Walau bagaimanapun, kekuatan tensil dan pemanjangan pada takat putus komposit telah didapati menurun. Ini menunjukkan lekatan antara muka yang lemah di antara matrik LLDPE/PVOH dan KNF sebagaimana dibuktikan dalam kajian SEM. Pencuacaan semula jadi dan penanaman di dalam tanah telah memberikan kesan negatif kepada sifat-sifat komposit LLDPE/PVOH/KNF, sebagaimana ditunjukkan oleh kemerosotan di dalam sifat-sifat tensil, kerosakan permukaan yang terdedah, dan peratusan kehilangan berat yang lebih tinggi. Seterusnya, keputusan daripada spektra FTIR mengesahkan kehadiran degradasi dengan kemunculan puncak karbonil yang jelas. Kehadiran perawatan kimia ke atas KNF telah meningkatkan sifat-sifat tensil, morfologi, sifat terma dan juga mengurangkan penyerapan air komposit LLDPE/PVOH/KNF. Perawatan kimia KNF telah disahkan melalui spektroskopi FTIR. Berdasarkan keputusan yang diperolehi, didapati penambahan KNF terawat 3-(trimetosisilil)propil metakrilat (TMS) ke dalam matrik LLDPE/PVOH telah meningkatkan tork pemprosesan, kekuatan tensil, modulus tensil, kestabilan terma dan mengurangkan penyerapan air komposit. Ini dibuktikan dengan peningkatan lekatan antara muka di antara KNF terawat TMS dan matrik LLDPE/PVOH melalui analisis SEM. Penambahan KNF terawat dengan agen pengkupel mesra alam (EFCA), kromium (III) sulfat dan lisin ke dalam matrik LLDPE/PVOH juga didapati meningkatkan tork pemprosesan, sifat-sifat tensil, kestabilan terma dan mengurangkan penyerapan air komposit. Keputusan daripada analisis SEM menunjukkan peningkatan di dalam lekatan antara muka di antara KNF terawat dan matrik LLDPE/PVOH. Keputusan FTIR juga mengesahkan pembentukan ikatan kimia di antara agen-agen pengkupel dan KNF, seterusnya menghasilkan pautan di antara KNF and matrik LLDPE/PVOH.