PREPARATION, CHARACTERIZATION AND BIODEGRADABILITY PERFORMANCE OF POLY(3-HYDROXYBUTYRIC ACID)/POLYVINYL ACETATE FILMS

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ABSTRACT

In this work, microbial polyester, poly(3-hydroxybutyric acid) (PHB) was blended with polyvinyl acetate (PVAc) in various composition %(100/0, 95/5, 90/10, 85/15, 80/20, 75/25, 70/30, 65/35 and 0/100) and the film for each ratio was prepared by the solution casting method. The prepared films were then characterized by Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) for information regarding chemical structure and surface morphology of the films. Thermal stability of the blends was investigated by thermogravimetric analysis (TGA) while the melting point and glass transition temperatures (T_g) were investigated by Differential Scanning Calorimetry (DSC) at a heating rate of 10 $^oC\ min^{-1}$. Results showed that the thermal stability increased with increasing PVAc ratio. In addition the blends were also characterized by X-Ray Diffraction (XRD). For the biodegradability studies the films were buried in the soil for various specified days followed by chemical analysis.

Intermolecular hydrogen bonding was observed from FTIR spectra and the best improvement in thermal stability and mechanical properties was shown by the blend ratio of PHB/PVAc (65/35). Biodegradability of the blends was studied by volume change measurement at room temperature and it was found to improve with increasing PVAc content. Blends of poly(hydroxyalkanoate) (PHA) with other biodegradable polymers also usually show similar improved biodegradability when compared with pure poly (hydroxyalkanoates) (PHAs).

ABSTRAK

Dalam penyelidikan ini, mikrobial poliester poli(3-hidroksibutarik asid) (PHB) telah diadun dengan polivinal asetat (PVAc) pada pelbagai komposisi% (100/0, 95/5, 90/10, 85/15, 80/20, 75/25, 70/30, 65/35 and 0/100) dan filem bagi setiap nisbah disediakan dengan kaedah tuangan larutan. Tipisan yang telah disediakan kemudiannya dicirikan oleh Spektroskopi Fourier Transform Inframerah(FTIR) dan Mikroskopi Imbasan Elektron (SEM) bagi maklumat berhubung struktur kimia dan morpologi permukaan tipisan. Kestabilan terma adunan dikaji dengan analisis termogravimetri (TGA) manakala takat cair dan suhu peralihan kaca (T_g) dikaji dengan Kalometri Imbasan Kerbedaan (DSC) pada kadar pemanasan 10 $^oC\ min^{-1}$. Keputusan menunjukkan bahawa kestbilan terma bertambah dengan pertambahan nisbah PVAc. Sebagai tambahan adunan juga dicirikan dengan Pembelauan Sinar-X (XRD). Untuk kajian berhubung kebio filem ditanam dalam tanah untuk beberapa hari yang ditetapkan diikuti oleh analisis kimia.

Ikatan hydrogen antaramolekul diperhatikan berlaku melalui spektra FTIR dan kemajuan terbaik dalam kestabilan terma dan sifat sifat mekanikal diperlihatkan peda nisbah adunan PHB/PVAc (65/35). Bio adunan dikaji melalui pengukuran perubahan isipadu pada suhu bilik dan didapati biobertambah baik dengan bertambahnya kandongan PVAc. Adunan poli(hidroksialkanoat) (PHA) dengan polimer bio yang lain juga biasanya menunjukkan bio yang bertambah baik berbanding dengan poli(hidroksialkanoats)(PHAs) yang tulen.

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T_g	Glass transition temperature (°C)
T_m	Melting temperature (°C)
T_c	Crystalline temperature (°C)
W	Weight (g)
V	Volume (mL)
M.W	Molecular weight (g mol^{-1})

LIST OF ABBREVIATIONS

CAB	Cellulose Acetate Butyrate
CAP	Cellulose Acetate Propionate
DP	Degree of Polymerization
DSC	Differential Scanning Calorimetry
FTIR	Fourier Transform Infrared Spectroscopy
GPC	Gel Permeation Chromatography
HECA	Hydroxyl cellulose acetate
MW	Molecular Weight
PBA	Poly(1,4-butylene adipate)
PHBV	Poly(3-hydroxybutyrate-co-3-hydroxyvalerate)
PHB	Poly(3-hydroxybutyric acid)
PECH	Polyepichlorohydrin
PEG	Poly(ethylene glycol)
PET	Poly(ethylene terephthalate)
PHA	Poly(hydroxyalkanoate)
PLA	Poly(lactic acid)
PVA	Poly(vinyl alcohol)
PLLA	Poly- L-lactic acid
PVAc	Poly(vinyl acetate)
PBS	Polybuthylene succinate
PCLO	Polycaprolactones

PE	Polyethylene
PGA	Polyglycolic acid
PP	Polypropylene
PVLO	Polyvalerolactones
SEM	Scanning Electron Microscopy
SA	Starch acetate
TGA	Thermogravimetric Analysis
XRD	X-Ray Diffraction

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