CHARACTERISTIC OF RENEWABLE POLYMER INCORPORATED WITH STABILIZER TO CHARACTERIZE THE ENDURANCE TO ULTRA VOILET IRRADIATION EXPOSURE

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In the name of ALLAH, Most Gracious, Most Merciful.

This thesis especially dedicated to;

My beloved husband

~Ahmad Azirun Bin Ab. Rahman~

My beloved father

~Mat Hassan Bin Bakar~

My beloved late mother

~Raja Nab Binti Raja Kechek~

My supportive supervisor

~Assoc. Prof. Dr. Anika Zafiah Binti Mohd Rus~

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ABSTRACT

Waste vegetable from palm oils are most abundant biological sources and important raw materials for production of renewable polymer because of their versatility with high possibility to modify the chemical structure of triglycerides and it derivatives. In this study, waste vegetable oil was synthesized and crosslink with polymethane polyphenyl isocyanate, distilled water and titanium dioxide (TiO_2) as filler to form renewable polymer. Two fabrication method was used; (i) manual casting which produced renewable polymer foam (RF) and (ii) compression moulding at 90 ^{o}C based on the evaporation of volatile matter and the product is known as compressed renewable polymer (CR). Composites of RF and CR is known as RFC and CRC respectively. The physical, vibration and damping properties are measured to determine the endurance of renewable polymer to UV irradiation exposure. The morphological structure and porosity of renewable polymer shows no significant changes after UV irradiation exposure. As the loading of TiO_2 increased (up to 10 % of monomer weight), the thermal degradation temperature were increased at three different decomposition stages. The vibration transmissibility of renewable polymer based on resonance peak, resonance frequency and attenuation frequency at different thickness were shifted to lower frequency range from 23 Hz to 21 Hz with increasing of UV irradiation exposure time. Meanwhile, the damping property of 10 % and 5 % TiO_2 filler loading (RFC_{10} and CRC_5) gives maximum values of 0.5 and 0.6 respectively with increasing of UV irradiation exposure time. This is due to the potential of RFC_{10} and CRC_5 to dissipate more energy in foam block system. Hence, TiO_2 act as UV stabilizer enhance the photostability of renewable polymer which exhibit endurance to prolonged UV irradiation exposure.

ABSTRAK

Sisa minyak sayuran berasaskan kelapa sawit adalah kaya dengan sumber biologi dan merupakan bahan mentah untuk menghasilkan produk polimer yang diperbaharui kerana sifat kepelbagainya yang mempunyai potensi yang tinggi untuk mengubah struktur kimia pada trigiserida dan terbitannya. Dalam kajian ini, polimer yang boleh diperbaharui berasaskan sisa minyak sayuran telah disintesis dan bersambung silang dengan *polymethane polyphenyl isocyanate*, air suling and titanium dioksida (TiO_2) sebagai bahan penambah untuk membentuk polimer yang diperbaharui. Dua kaedah pembuatan telah digunakan iaitu (i) penuangan manual yang menghasilkan buih polimer yang diperbaharui (RF) dan (ii) mampatan panas pada suhu 90 ^{o}C berdasarkan penyejatan bahan yang tidak menentu dan menghasilkan polimer mampat yang diperbaharui (CR). Komposit bagi RF dan CR masing-masing dinamakan sebagai RFC and CRC. Sifat fizikal, getaran dan redaman diukur untuk menentukan ketahanan polimer yang diperbaharui terhadap pendedahan sinaran UV. Struktur morpologi dan keliangan pada polimer yang diperbaharui menunjukkan tiada perubahan yang ketara selepas pendedahan kepada sinaran UV. Merujuk kepada peningkatan TiO_2 sebagai bahan penambah (sehingga 10 % daripada berat monomer), suhu penguraian haba meningkat pada tiga peringkat penguraian suhu. Sifat pengalihan getaran oleh polimer yang diperbaharui berdasarkan kepada puncak resonans, frekuensi resonans dan pengecilan frekuensi diuji pada ketebalan yang berbeza dan memberikan anjakkan ke frekuensi yang lebih rendah dari 23 Hz kepada 21 Hz dengan peningkatan masa pendedahan sinaran UV. Walaubagaimanapun, sifat redaman pada 10 % dan 5 % bahan penambah TiO_2 (RFC_{10} dan CRC_5) masing-masing memberikan nilai maksimum iaitu 0.5 dan 0.6 dengan peningkatan masa pendedahan sinaran UV. Ini disebabkan keupayaan RFC_{10} dan CRC_5 untuk melepaskan banyak tenaga semasa dalam sistem blok busa. Oleh itu, TiO_2 bertindak sebagai penstabil UV yang mana meningkatkan kestabilan foto bagi polimer yang diperbaharui dengan ketahanan terhadap pendedahan sinaran UV yang berpanjangan.

CONTENTS

LIST OF FIGURES

LIST OF TABLE

LIST OF SYMBOL AND ABBREVIATIONS

A/Abs	-	Absorbance
ASTM	-	American Society for Testing Materials
ATR	-	Attenuated total reflection
CO_2	-	Carbon dioxide
CR	-	Compressed renewable polymer
CRC	-	Compressed renewable polymer composite
FTIR	-	Fourier Transform Infrared
H	-	Hours
KOH	-	Pottasium hydoxide
MDI	-	Methylene diisocyanate
N	-	Normality
NaOH	-	Natrium hydroxide
TiO_2	-	Titanium dioxide
%	-	Percent
λ	-	Wavelength
nm	-	Nanometer
μm	-	Micrometer
$°C$	-	Degree Celsius
α	-	Conversion
ζ	-	Damping
ρ	-	Density
TGA	-	Thermal gravimetric analysis
Ea	-	Activation energy

R	-	Gas constant
T	-	Absolute temperature (K)
RM	-	Renewable monomer
RF	-	Renewable polymer foam
RFC	-	Renewable polymer foam composite
UV	-	Ultraviolet
UV-Vis	-	Ultraviolet visible
WO	-	Waste vegetable oil

LIST OF APPENDICES

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