EFFECTS OF CRUDE PALM OIL ON THE PHYSICO-CHEMICAL PROPERTIES OF POLYETHYLENE BLOWN FILM

By

MIN MIN AUNG

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malayisa, in Fulfilment of the Requirement for the Degree of Master of Science

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Dedication

With gratitude for their love, support, and guidance,

I dedicate this thesis to my parents,

U Nay Myo Aung and Daw Ah Mar Sein

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Chairman : Chuah Teong Guan, PhD

Faculty : Engineering

The influence of small amounts of crude palm oil (CPO) content on the physical and chemical properties of high density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) have been investigated. HDPE and LLDPE containing, 2, 3 and 5% CPO were prepared in a twin-screw extruder. Then, films of 0.2mm thickness were produced by using blown film technique. The melting point of CPO is 35.65°C and melting point of PE is 130-140°C in HDPE and 85-125°C in LLDPE. Thermal observation by Differential Scanning Calorimetry (DSC) is not significant in melting and crystallisation. Similar observation was also presented in storage modulus, tan δ and loss modulus of Dynamic Mechanical Analysis (DMA) results.

The improvement of tensile strength and elongation at break showed that the enhancement in toughness of the polymers in the addition of CPO. A gradual increase in impact strength of HDPE with the CPO content further supported above

notation. The enhancement in the physical properties in the presence of CPO is believed to be attributed to the increased chain mobility of the polymer along with improved orientation strengthening in HDPE and LLDPE. Evidence from Scanning Electron Micrographs (SEM) were also used to support this contention. However, the decline in impact strength of LLDPE with the addition of CPO is associated with the formation of defects in amorphous phase of LLDPE.

With increasing of CPO addition, viscosity is increased at the low shear rate in rheological examination. Melt Flow Index (MFI) value is increased with the incremental of CPO addition. FT-IR analysis shows that almost same spectra of modified PE with control. The results indicate that no chemical reaction occurred between PE and CPO.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia sebagin memenuhi kerperluan untuk ijazah Master Sains

KAJIAN TERHADAP PENGUBAHSUAIAN POLITELINE MENGGUNAKAN MINYAK KELAPA SAWIT MENTAH

Oleh

MIN MIN AUNG

April 2006

Pengerusi : Chuah Teong Guan, PhD

Fakulti : Kejuruteraan

Kajian mengenai pengaruh kandungan minyak sawit mentah (CPO) dalam kuantiti yang kecil terhadap keadaan fizikal dan ciri-ciri kimia politeline ketumpatan tinggi (HDPE) dan politeline ketumpatan rendah (LLDPE) telah dijalankan. HDPE dan LLDPE yang mengandungi 2, 3 dan 5 % CPO disediakan di dalam 'twin-screw extruder'. Kemudian, filem-filem dengan ketebalan 0.2mm dihasilkan dengan melalui teknik pencairan filem. Takat lebur bagi CPO ialah 35.65°C manakala, bagi PE pula ialah 130-140°C di dalam HDPE dan 85-125°C di dalam LLDPE. Pemerhatian dari segi haba pula tidak signifikan untuk peleburan dan pengkristalan. Pemerhatian yang sama turut ditunjukkan dalam modulus simpanan, tan δ dan modulus pengurangan dalam keputusan analisis mekanikal dinamik (DMA). Peningkatan dalam kekuatan regangan dan pemanjangan pada titik penamat dengan penyelarasan penurunan telah meningkatkan tahap

kekerasan polimer melalui penambahan CPO. Manakala, penurunan secara berperingkat dalam kesan kekuatan HDPE yang mengandungi CPO telah menyokong 'above notation'. Peningkatan ciri-ciri fizikal dengan kehadiran CPO dipercayai menyumbang kepada peningkatan pergerakan rantaian polimer selaras dengan perkembangan orientasi kekuatan HDPE dan LLDPE. Bukti-bukti daripada pengimbas Mikrograf Elektron juga turut digunakan untuk menyokong pendapat ini. Walau bagaimanapun, penurunan dalam kesan kekuatan LLDPE yang mengandungi CPO adalah sama dengan pembentukan kerosakan dalam fasa amorphous LLDPE.

Indeks Aliran Lebur (MFI) berkurangan dengan peningkatan kandungan CPO. Kelikatan yang berkurangan dengan kadar sekata pula menunjukkan tahap kelinciran CPO. Ini membuktikan bahawa kemampuan pemprosesan PE adalah meningkat dengan penambahan CPO. Sifat-sifat rheologikal juga sepadan dengan perubahan morfologi terhadap politeline yang telah dimodifikasi. Aliran ciri-ciri CPO/ PE pula tidak menunjukkan perubahan sebagaimana yang dijangka dengan mengambil kira CPO sebagai agen penyesuaian. Begitu juga keputusan analisis daripada Fourier Transform Infrared (FTIR) yang menunjukkan secara relatifnya interaksi intermolekular yang kuat antara CPO dan PE adalah wujud dalam filem PE termodifikasi.

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Finally, I dedicate this thesis to my beloved family, in particular, my parents, without their love, support and encouragement, it would not be possible for me.

I certify that an Examination Committee has met on 13 April 2006to conduct the final examination of Min Min Aung on her Master of Science entitled "Effect of Crude Palm Oil on the physio-chemical properties of polyethylene blown film" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Russly Abdul Rahman, PhD
Professor
Faculty of Food and Science
University Putra Malaysia
(Chairman)

Robiah Yunus, PhD
Associate Professor
Faculty of Engineering
University Putra Malaysia
(Internal Examiner)

Siti Asslina Hassan, PhD
Lecturer
Faculty of Engineering
University Putra Malaysia
(Internal Examiner)

Che Husna Azhari, PhD
Professor
Faculty of Engineering
University Kebangsaan Malaysia
(External Examiner)

HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 11 JUL 2006

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Chuah Teong Guan, PhD
Associate Professor
Faculty of Engineering
University Putra Malaysia
(Chairman)

Suraya Abdul Rashid, PhD
Lecturer
Faculty of Engineering
University Putra Malaysia
(Member)

Chantara Thervy Ratnam, PhD
Radiation Processing Technology Division
Malaysia Institute for Nuclear Technology
(Member)

Wan Hasamudin Wan Hassan, MS
Biomass Technology Centre
Engineering & Processing Division
Malaysian Palm Oil Board
(Member)

____

AINI IDERIS, PhD
Professor/ Dean
School of Graduate Studies
University Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

MIN MIN AUNG

Date:

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LIST OF ABBREVIATIONS/ NOTATIONS

CPO	**Crude palm oil**
PE	**Polyethylene**
LDPE	**Low density polyethylene**
LLDPE	**Linear low density polyethylene**
HDPE	**High density polyethylene**
DMA	**Dynamic mechanical analysis**
DSC	**Differential scanning caloimetry**
MD	**Machine direction**
TD	**Transverse direction**
SEM	**Scanning electron microscopy**
Ts	**Tensile strength**
Eb	**Elongation at break**
MFI	**Melt Flow Index**
SCB	**Short chain branching**
UTM	**Instron Universal Testing Machine**
ECSR	**Environmental Stress-Crack Resistance**
MWD	**Molecular weight distribution**
HMW	**High molecular weight**
LCB	**Long chain branch**
EPOP	**Epoxidized palm oil and palm oil products**
ESBO	**Epoxidized soyabean oil**

PVC	**Polyvinyl chloride**
PP	**Polypropylene**
OTR	**Oxygen transmission rate**
WVTR	**Water vapour transmission rate**
PS	**Polystyrene**
MPE	**Maleated polyethylene**
ASTM	**American society of testing and materials**
DOBI	**Deterioration of bleachability index**
VLDPE	**Very low density polyethylene**
EVA	**Ethylene vinyl acetate**
FFB	**Fresh fruit bunches**
DOBI	**Deterioration of bleach ability index**
LVDT	**High sensitivity displacement detector**
DBS	**Distance between the supports**
FTIR	**Fourier transform infrared spectra**
WS	**Water sorption**

T_c	**Crystallisation temperature**	**°C**
T_m	**Melting point**	**°C**
w_c	**Thermal conductivity**	**W/m °C**
ρ_a	**Denstiy of amorphorous phase**	**kg/m^3**
ρ_c	**Density of crystalline phase**	**kg/m^3**
ρ	**Density of polymer**	**kg/m^3**
E'	**Storage modulus**	**Pa**
E"	**Loss modulus**	**Pa**
T_g	**Glass transition temperature**	**°C**
M50	**The dart drop impact weight**	**g**
Mo	**The lowest missile weight**	**g**
Dw	**Uniform weight decrement/ increment**	**g**
A/N	**Sum of number of failure occurred at a specified mass multiply by the number of mass increment and sum of failed specimen respectively**	