



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF CRUDE PALM OIL AS PLASTICIZER
IN POLYOLEFIN BLOWN FILM***

EMILIANA ROSE BINTI JUSOH @ TAIB

FK 2011 135

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MASTER OF SCIENCE

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BLOWN FILM**

By

EMILIANA ROSE BINTI JUSOH @ TAIB

**This Thesis Submitted to the School Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

August 2011



**DEDICATED TO
ISLAM
AND
MY FAMILY**

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

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Chairman: Mohd Halim Shah bin Ismail, PhD

Faculty: Engineering

The growing of public concern about environmental and health potential risks of polymer and plasticizer industry promises to increase the market for an alternative of safer plasticizer such as a vegetable oil based plasticizer. The purpose of this study was to investigate the effect of crude palm oil (CPO) as plasticizer in polyolefins blown film. The two types of polyolefins ; low density polyethylene (LDPE) and polypropylene (PP) were blended with 1%, 3%, 5% of CPO using a twin screw extruder. The extruded samples were blown using the blown thin film technique. Mechanical, thermal, physical and morphological properties were characterized. The addition of CPO into low density polyethylene (LDPE) enhanced the elongation at break about 79 to 90% in machine direction (MD) and transverse direction (TD) and gradually decreased the tensile strength about 9%. The rupture properties (impact and tear strength) of LDPE modified with CPO showed the decrement pattern due to the plasticization effect. The polypropylene (PP) modified with CPO results

presented a good mechanical properties results on tensile strength (increased about 17% in TD and decreased about 17% in MD), elongation at break (enhanced about 30-90% in MD and decreased about 40-50% in TD), increased the impact strength and tear strength. The scanning electron microscopy photographs of LDPE and PP modified CPO did not modify the basic fracture mechanism of LDPE and PP matrix. The presence of CPO in LDPE and PP matrices were decreased the density and increased the melt flow rate. From Fourier Transmission Infra-Red (FTIR) spectras, the presence of CPO showed the addition peak in 1745 to 1747 cm^{-1} region indicated the physical molecular interaction between polyolefins and CPO. The thermogravimetric analysis (TGA) results showed that incorporation of CPO as plasticizer showed small increased effect in the thermal stability for both polyolefins. From the dynamic mechanical analysis, the storage modulus and loss modulus for both polyolefins presented decreasing pattern due to the action of CPO as plasticizer which introduced free volume and enabled the polyolefins chains to deform more easily. The glass transition temperatures (T_g) of both polyolefins determined from the peak of $\tan \delta$ and were shifted to lower temperature with the increasing CPO content. This observation showed that the CPO reacted as plasticizer in polyolefins system. The plasticising effect of CPO in polyolefins was investigated and proved that the plasticization mechanism occurred in the polyolefins systems. These findings have contributed new knowledge to the additives area and give important implications for designing and manufacturing polymer packaging materials.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

**KESAN MINYAK SAWIT MENTAH SEBAGAI AGEN PEMPLASTIK
DALAM FILEM TIUPAN POLI OLEFIN**

Oleh

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Peningkatan kesedaran orang ramai terhadap potensi risiko alam sekitar dan kesihatan dalam industri polimer dan agen pemplastik menyebabkan peningkatan kepada pasaran agen pemplastik yang lebih selamat seperti agen pemplastik berasaskan minyak tumbuhan. Tujuan kajian ini adalah untuk menyiasat kesan minyak sawit mentah sebagai agen pemplastik dalam filem tiupan poli-olefin. Dua jenis poli-olefin ; poli-etilina berketumpatan rendah (LDPE) dan poli-propilina (PP) dicampurkan dengan 1%, 3%, 5% minyak sawit mentah dengan menggunakan penyemperitan jenis skru berkembar. Sampel yang telah disemperitkan telah ditiup menggunakan teknik peniupan filem nipis. Sifat-sifat mekanikal, termal, fizikal dan morfologi telah diuji. Penambahan minyak sawit mentah kedalam poli-etilina ketumpatan rendah (LDPE) telah meningkatkan pemanjangan untuk putus sebanyak 79 hingga 90% dalam arah mesin (MD) dan arah bertentangan (TD) dan kekuatan regangan sedikit menurun sebanyak 9%. Sifat pecah (kekuatan impak dan koyakan)

poli-etilina ketumpatan rendah diubah dengan minyak sawit mentah menunjukkan pola menurun kerana kesan pemplastikan. Poli-propilina (PP) yang diubahsuai dengan minyak sawit mentah menunjukkan keputusan sifat mekanikal yang baik keatas kekuatan regangan (meningkat sebanyak 17% untuk TD dan menurun sebanyak 17% untuk MD), pemanjangan ketika putus (meningkat sebanyak 30 - 90% untuk MD and menurun sebanyak 40 - 50% untuk TD), dan peningkatan kekuatan impak dan kekuatan koyakan. Pemerhatian ini dalam PP diubahsuai dengan minyak sawit mentah adalah dipercayai kerana kesan anti pemplastikan yang berlaku. Fotograf mikroskop imbasan elektron LDPE dan PP yang diubahsuai dengan minyak sawit mentah menunjukkan tiada sebarang perubahan terhadap struktur molekul LDPE and PP. Kehadiran minyak sawit mentah dalam matrik LDPE dan PP telah menurunkan ketumpatan dan meningkatkan kadar pengaliran leburan yang menunjukkan kelikatan berkurang dan memudahkan pemprosesan. Daripada spektra jalur Infra merah transmisi Fourier, kehadiran minyak sawit mentah menunjukkan pertambahan puncak dalam kawasan 1745 hingga 1747 cm^{-1} di mana menunjukkan wujud interaksi secara fizikal antara molekul poli-olefin dan minyak sawit mentah. Keputusan analisis termogravimetrik menunjukkan penggabungan minyak sawit mentah sebagai agen pemplastik memberikan sedikit kesan peningkatan dalam kestabilan terma untuk kedua-dua poli-olefin. Daripada analisis mekanikal dinamik, modulus simpanan dan modulus kehilangan untuk kedua-dua poli-olefin memberikan corak menurun kerana tindakan minyak sawit mentah sebagai agen pemplastik telah memperkenalkan ruang kosong dan membolehkan rantaian poli-olefin membentuk dengan mudah. Suhu peralihan kaca (T_g) untuk kedua-dua poli-olefin ditentukan daripada puncak $\tan \delta$ dan beralih ke suhu yang lebih rendah dengan penambahan

kandungan minyak sawit mentah. Pemerhatian ini menunjukkan minyak sawit mentah telah bertindak sebagai agen pemplastik dalam sistem poli-olefin. Kesan pemplastikan oleh minyak sawit mentah dalam poli-olefin telah dikaji dan dibuktikan bahawa mekanisma pemplastikan telah berlaku dalam sistem poli-olefin. Penemuan ini telah memberikan pengetahuan baru kepada bidang aditif dan memberikan implikasi penting dalam perancangan dan pembuatan bahan pembungkusan plastik.



ACKNOWLEDGEMENT

First of all, I would like to say Alhamdulillah and thank Allah, for giving me the strength and health to do this research. To my dear husband, Ashabulyamin bin Ayoub and my family supported me and encouraged me to complete this research so that I will not procrastinate in doing it.

Then I would like to thank my supervisor, Dr. Mohd Halim Shah bin Ismail for guiding me throughout this research. Also, high appreciation to three of my co-supervisors, Professor Dr Luqman Chuah bin Abdullah, Professor Dr. Robiah binti Yunus and Associate Prof. Dr. Wan Aizan bin Wan Abdul Rahman. I had some difficulties in doing this task, but they taught me patiently until I knew what to do. They tried to guide me until I understand what I supposed to do with the research.

I also wish to express my gratitude to Mr. Adli, Mrs. Hasni, Mr. Ismail, Mrs. Maslinda and other staffs of the chemical and environmental engineering department, Engineering Faculty, Universiti Putra Malaysia for their selfless help and the pains they have taken beyond the call of their duty in shaping this research. Also, my deepest gratitude are also for Mr. Suhee Tan, Miss Zainab, Mr. Azri and Mr. Shukor from Polymer Engineering Department of Chemical and Natural Resources Engineering, Universiti Teknologi Malaysia whom always helped me in doing the research. I would also like to convey thanks to the Ministry of Higher Education,

Universiti Putra Malaysia and MOSTI for providing the financial scholarship and grants for this research.

Last but not least, my friends who were doing this research with me and sharing our ideas. They were helpful that when we combined and discussed together, we had this research done.

Thank you all.



I certify that an Examination Committee has met on 11st August 2011 to conduct the final examination of Emiliana Rose Binti Jusoh @ Taib on her degree thesis entitled “Effect of Crude Palm Oil as Plasticizer in Polyolefin 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 student be awarded the Master of Science. Members of the Examination Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citation which have been duly acknowledge. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

EMILIANA ROSE BINTI JUSOH @ TAIB

Date : 11ST AUGUST 2011

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