



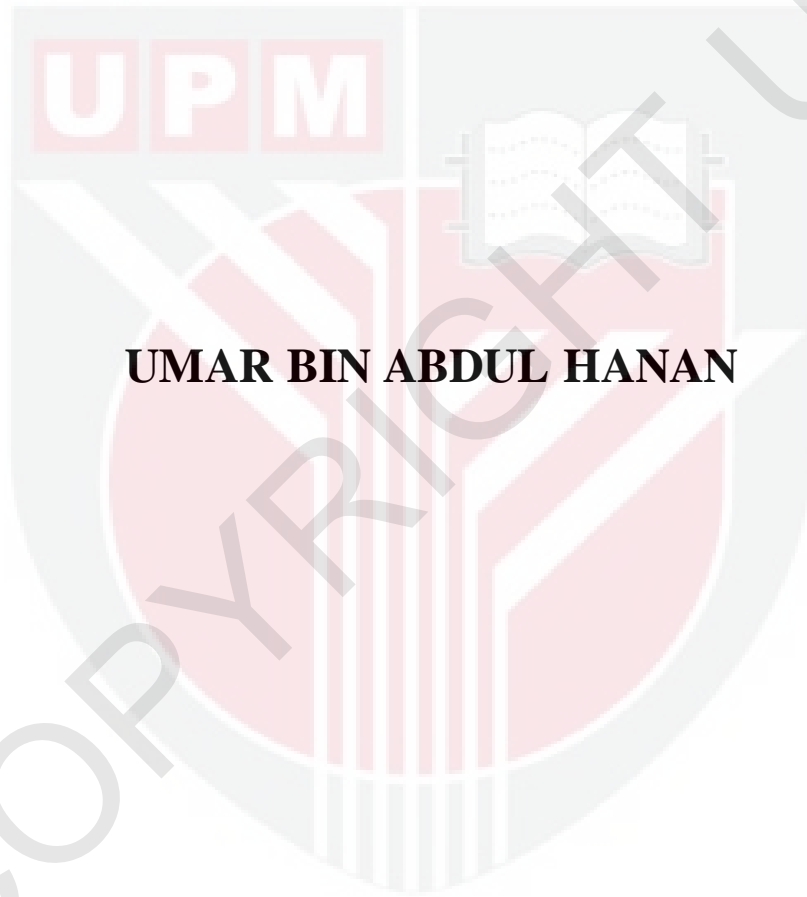
UNIVERSITI PUTRA MALAYSIA

**EFFECT OF ACCELERATED WEATHERING ON KENAF-REINFORCED
HIGH DENSITY POLYETHYLENE COMPOSITE**

UMAR BIN ABDUL HANAN

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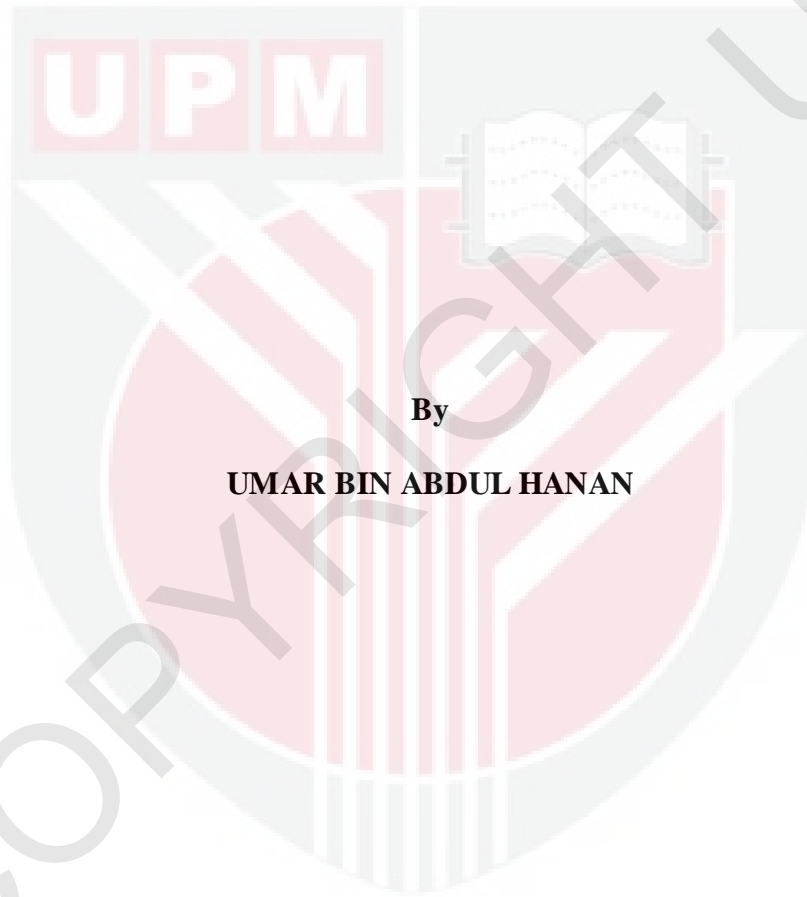


UMAR BIN ABDUL HANAN

**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

2012

**EFFECT OF ACCELERATED WEATHERING ON KENAF-REINFORCED
HIGH DENSITY POLYETHYLENE COMPOSITE**



By

UMAR BIN ABDUL HANAN

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

June 2012

DEDICATION

For all your encouragement and advice, this thesis is gratefully dedicated to:

My Beloved Father and Mother

Family and Friends

Thank you very much for your continuous support and effort towards the completion of this thesis.

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

EFFECT OF ACCELERATED WEATHERING ON KENAF-REINFORCED HIGH DENSITY POLYETHYLENE COMPOSITE

By

UMAR BIN ABDUL HANAN

June 2012

Chairman : Edi Syams bin Zainudin, PhD

Faculty : Engineering

Kenaf bast fibre reinforced high-density polyethylene (HDPE) composites were produced by compression moulding method. The composite material consists of 40% (by weight) fibres and 60% matrix. Two types of composites were fabricated from two different types of kenaf fibres; bleached and unbleached fibres were compared to investigate the effect of delignification of fibre on composites strength. Other additives such as ultraviolet (UV) stabilizer and maleic anhydride grafted polyethylene (MA-PE) as coupling agent were added into the composite material. Then, accelerated weathering test of 1000 hours (h) was conducted on the composite. The test simulates the outdoor environment which consists of heat, moisture and UV light. Mechanical properties of the composites were recorded after it was fabricated and after 200h, 400h, 600h, 800h and 1000h exposure of accelerated weathering. The mechanical performance and the weather durability of kenaf-HDPE composites were compared to neat HDPE and HDPE with UV stabilizer (HDPE+UV). The composites that used bleached fibres (K-b-HDPE) shows no significant difference with composites that used raw fibres (K-HDPE) in term of tensile strength, Young's modulus and impact strength. However, K-HDPE composite has better flexural strength compared to K-b-HDPE. The advantage of kenaf-HDPE

composites is it has better stiffness compared to HDPE or HDPE+UV. Unfortunately, the appearance of kenaf-HDPE composites becomes discoloured after weathering. Material shows the least deterioration under weathering is HDPE+UV, while neat HDPE experiences the severest damage such as rapid mechanical properties loss, chalking and micro-cracking due to weather-induced degradation. Therefore, UV stabilizers used in the composites was proven to counter UV-induced degradation. On the whole, weathering exposure on kenaf-HDPE composites enhanced with UV stabilizer and MAPE experience deterioration in term of fading and loss of mechanical properties due to weather elements such as UV light, heat and mostly because of moisture as the major contributor of degradation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**KESAN LULUHAWA TERPECUT TERHADAP KOMPOSIT KENAF
DIPERKUAT POLIETILENA BERKETUMPATAN-TINGGI**

Oleh

UMAR BIN ABDUL HANAN

Jun 2012

Pengerusi : Edi Syams bin Zainudin, PhD

Fakulti : Kejuruteraan

Komposit gentian basta kenaf diperkuat polietilena berketumpatan-tinggi (HDPE) telah dihasilkan dengan kaedah pengacuan tekanan. Bahan komposit tersebut mengandungi 40% gentian dan 60% adalah matrik (peratusan merujuk kepada nisbah berat dalam komposit). Dua jenis bahan komposit telah dihasilkan dari dua jenis gentian kenaf; gentian yang diluntur dan tak diluntur telah dibandingkan untuk mengkaji kesan pendeligninan gentian terhadap kekuatan komposit. Bahan-bahan penambah seperti pengimbang ultraungu (UV) dan maleik anhidrida dicantum polietilena (MA-PE) sebagai agen pengganding telah ditambah ke dalam bahan komposit. Kemudian, ujian luluhawa terpecut selama 1000 jam (j) telah dilakukan terhadap bahan komposit. Ujian ini mensimulasi pencuacaan luar rumah yang terdiri daripada unsur haba, kelembapan dan cahaya UV. Sifat-sifat mekanik komposit telah direkod sebelum ujian luluhawa dan setelah 200j, 400j, 600j, 800j and 1000j pendedahan kepada luluhawa terpecut. Sifat-sifat mekanik komposit dan ketahanannya terhadap luluhawa telah dibandingkan dengan HDPE dan HDPE yang mempunyai pengimbang UV (HDPE+UV). Komposit yang menggunakan gentian terluntur (K-b-HDPE) menunjukkan tiada perbezaan signifikan

dengan komposit yang menggunakan gentian tak terluntur (K-HDPE) dari segi kekuatan tegangan, modulus Young and kekuatan hentaman. Walau bagaimanapun, komposit K-HDPE mempunyai kekuatan lenturan yang lebih baik berbanding komposit K-b-HDPE. Salah satu kelebihan komposit kenaf-HDPE berbanding HDPE dan HDPE+UV ialah ketegaran yang lebih tinggi. Malangnya, penampilan warna komposit kenaf-HDPE menjadi pudar selepas kesan luhawa. Bahan yang mengalami kemerosotan paling minimum selepas luhawa ialah HDPE+UV. Sementara HDPE mengalami kerosakan paling ketara seperti penurunan pesat kekuatan mekanik, pengapuran and keretakan mikro kesan daripada pengaruh luhawa. Oleh itu, penggunaan pengimbang UV dalam komposit telah terbukti menghindarkan degradasi yang berpunca dari UV. Secara keseluruhannya, pendedahan luhawa terhadap komposit kenaf-HDPE yang ditambah dengan pengimbang UV dan MAPE mengalami kemerosotan dari segi pertambahan pudar dan penurunan sifat-sifat mekanikal akibat daripada unsur-unsur pencuciaan seperti cahaya UV, haba dan disebabkan oleh kelembapan sebagai penyumbang utama degradasi.

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I certify that a Thesis Examination Committee has met on 11th June 2012 to conduct the final examination of Umar bin Abdul Hanan on his (or her) thesis entitled "Effects of Accelerated Weathering on Kenaf-Reinforced High Density Polyethylene Composite" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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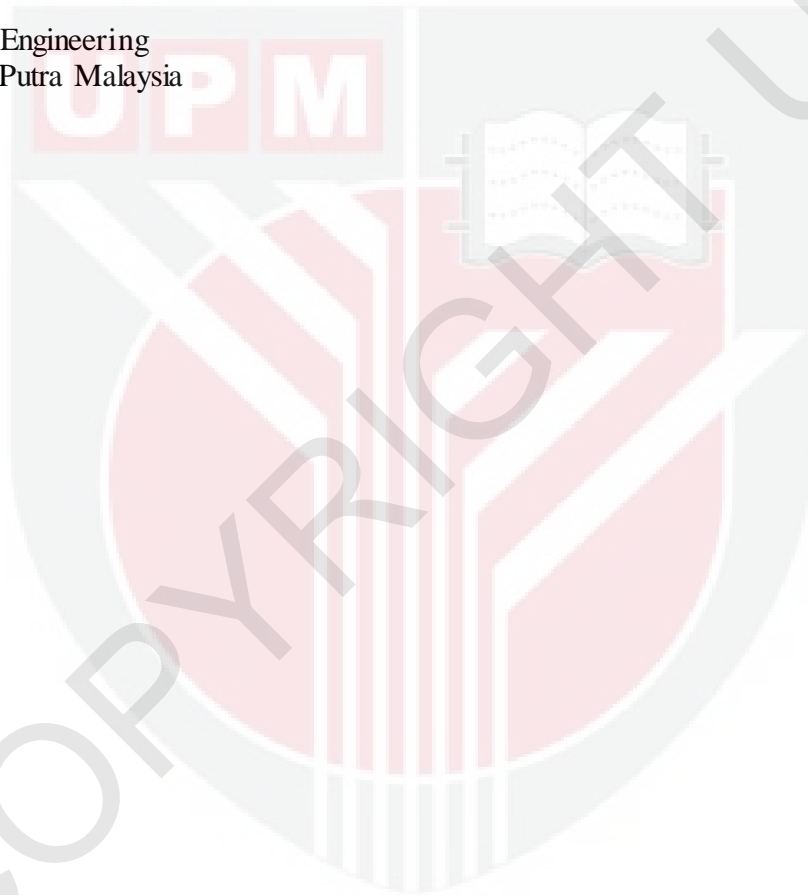
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Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. 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 institutions.

UMAR BIN ABDUL HANAN

Date: 11th June 2012

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