UNIVERSITI PUTRA MALAYSIA

EFFECTS OF GRAFTING ON KENAF FIBER REINFORCED POLY VINYL CHLORIDE/ETHYLENE VINYL ACETATE BLEND COMPOSITES

NURFATIMAH BINTI ABU BAKAR

IPTPH 2011 2

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By

NURFATIMAH BINTI ABU BAKAR

Thesis submitted to the school of Graduate Studies, Universiti Putra Malaysia, in Fullfilment of the Requirements for the Degree of Master of Science

June 2011

This work is dedicated to:

My husband: Mohd Adzhar bin Ismail,

My son: Muhammad Anas Haqimi,

ibu, abah,

and

my big family

Thank you for provided constructive advice for the completion of this thesis. I also appreciate for their love, support, understanding and patience.

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 : **Associate Professor Luqman Chuah Abdullah, PhD**

Institute : **Institute of Tropical Forestry and Forests Product**

Kenaf fiber is an environmentally friendly alternative which can be used as important reinforcing filler for thermoplastic composites. Kenaf also can be a good potential to make significant contribution. The main objective of this works is to investigate the possibility of producing new composites with methyl methacrylate (MMA) grafted kenaf as filler by using poly (vinyl chloride)/ethylene vinyl acetate as a polymer matrix. Graft copolymerization of methyl methacrylate (MMA) onto kenaf fiber has been carried out. Response surface methodology (RSM) based on centre composite design (CCD) was used to evaluate the effects of process variables (temperature, reaction time and amount of hydrogen peroxide) and their interaction towards the attainment of their optimum condition (grafting percentage). According to statistical analysis, the grafting reaction model proved to be highly significant with a very low probability value (<0.0001). The optimum condition (P_g = 51.85%) obtained at the temperature of 60^{o}C,

reaction time, 112 min and the amount of hydrogen peroxide is 7 mL. The presence of the functional group in the grafted polymers was characterized by fourier transform infrared (FTIR) spectroscopy. Scanning electron microscopy (SEM) also confirmed the presence of poly methyl methacrylate (PMMA) on the surface of kenaf fiber. Effect of kenaf fiber and kenaf-g-PMMA on mechanical properties of poly (vinyl chloride) (PVC)/ethylene vinyl acetate (EVA) blend were studied. The composites were prepared by blending using HAAKE Rheomixer Polydrive R600/610 at temperature and rotor speed of 150^{o}C and 50 rpm. Effect of different fiber loading (0%, 10%, 15%, 20% and 30%) on their tensile strength, tensile modulus, flexural modulus, impact strength and hardness were determined. An increasing trend was observed in the tensile modulus, flexural modulus and hardness while a slight decrease was observed in tensile strength and impact strength was decreased. This observation indicates that grafting PMMA on the surface of kenaf fiber was improved the interfacial adhesion between the matrix and fiber. Differential Scanning Calorimetric (DSC) results show that the EVA crystallization behaviour is significantly influenced by the presence of kenaf fiber. The incorporation of grafted and ungrafted kenaf did not affect the thermal stability of the composites. Dynamic mechanical analysis (DMA) showed an increase in the storage modulus of the grafted composites.

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

KESAN CANGKUKAN KE ATAS GENTIAN KENAF DALAM KOMPOSIT ADUNAN POLI VINIL KLORIDA/ETILINA VINIL ASETAT

Oleh

NURFATIMAH ABU BAKAR

June 2011

Pengerusi : **Profesor Madya Luqman Chuah Abdullah, PhD**

Institut : **Institut Perhutanan Tropika dan Produk Hutan**

Gentian kenaf adalah salah satu alternatif mesra alam di mana ia boleh digunakan sebagai pengisi dalam komposit termoplastik. Kenaf juga berpotensi untuk memberi sumbangan yang signifikan. Tujuan utama kajian ini adalah untuk mengkaji kemungkinan menghasilkan komposit baru dengan metil metakrilat (MMA) dicangkokkan ke atas gentian kenaf dengan menggunakan adunan poli vinil klorida (PVC) / etilina vinil asetat (EVA) sebagai matrik polimer. Pengkopolimeran cangkuk metil metakrilat (MMA) kepada gentian kenaf telah dilakukan. RSM jenis rekabentuk komposit pusat (CCD) digunakan untuk menilai kesan pembolehubah proses (suhu, masa tindakbalas dan jumlah hidrogen peroksida) dan hubungan mereka pada keadaan optima (peratusan cangkukan). Berpandukan analisis statistik, model reaksi cangkukan terbukti sangat signifikan dengan nilai kebarangkalian sangat rendah (<0,0001). Keadaan optima (P_g = 51.85%) diperolehi pada suhu 60^{o}C, masa tindakbalas berlaku,

112 minit dan jumlah hidrogen peroksida adalah 7 mL. Kehadiran kumpulan berfungsi dalam cangkokan polimer dapat dikesan oleh FTIR. SEM juga menjelaskan adanya poli (metil metakrilat) (PMMA) pada permukaan gentian kenaf. Kesan gentian kenaf dan gentian kenaf yang telah dicangkukkan dengan PMMA terhadap sifat mekanikal adunan PVC/EVA telah dikaji. Komposit adunan telah disediakan dengan menggunakan pencampur dalaman HAAKE Polydrive R600/610 pada suhu 150^{o}C dan kelajuan rotor 50 rpm. Kesan campuran gentian yang berbeza (0%, 10%, 15%, 20% dan 30%) pada kekuatan tegangan, modulus tegangan, modulus keterlenturan, kekuatan hentaman dan kekerasan telah dikaji. Keputusan menunjukkan peningkatan di modulus tegangan, modulus keterlenturan dan kekerasan manakala sedikit penurunan pada kekuatan tegangan dan kekuatan hentaman. Ini menunjukkan bahawa cangkukan PMMA pada permukaan gentian kenaf dapat meningkatkan lekatan permukaan antara matrik dan gentian. Keputusan DSC menunjukkan penghabluran EVA adalah dipengaruhi oleh isian gentian kenaf. Campuran gentian kenaf dan gentian kenaf yang telah dicangkukkan dengan PMMA tidak memberi kesan kepada kestabilan terma komposit. DMA menunjukkan peningkatan modulus penyimpanan pada gentian kenaf yang telah dicangkukkan dengan PMMA.

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Last but not least, I would like thanks those who had helped me directly and indirectly in order to improve and complete this thesis.

I certify that a Thesis Examination Committee has met on 27 June 2011 to conduct the final examination of Nurfatimah binti Abu Bakar on her thesis entitled " Effects of Grafting on Kenaf Fiber Reinforced Poly Vinyl Chloride/Ethylene Vinyl Acetate Blend Composites " 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 degree of Master of Science.

Members of the Thesis Examination Committee were as follows:

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

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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.

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NURFATIMAH BINTI ABU BAKAR

Date:

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