UNIVERSITI PUTRA MALAYSIA

PREPARATION AND CHARACTERISATION OF LAMINATED KENAF FIBRE – REINFORCED POLYPOPYLENE/ETHYLENE VINYL ACETATE/ORGANOCLAY COMPOSITES

SITI HASNAH BINTI KAMARUDIN

IPTPH 2011 3

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By

SITI HASNAH BINTI KAMARUDIN

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

April 2011

DEDICATED TO

MY BELOVED FAMILY

Hubby: ***Fadlullah Jili Fursani Kemrry***
Daughter: ***Imaan Irdina***
Father: ***Kamarudin Esa***
Mother: ***Maziah Mohd***
Sister: ***Siti Asiah***
Family in law

For their prayers and moral support

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

PREPARATION AND CHARACTERISATION OF LAMINATED KENAF FIBRE-REINFORCED POLYPOPYLENE/ETHYLENE VINYL ACETATE/ORGANOCLAY COMPOSITES

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SITI HASNAH BINTI KAMARUDIN

April 2011

Chairman : Khalina Abdan, PhD

Institute : Institute of Tropical Forestry and Forest Products

There is an increasing need to investigate more environmental friendly, sustainable materials to replace existing materials as industry attempts to lessen the dependence on petroleum based fuels and products. The natural fibre composites offer specific properties comparable to those of conventional fibre composites**.** This research focused on preparation and characterisation of laminated kenaf fibre reinforced polypropylene (PP)/ethylene vinyl acetate (EVA)/organoclay composites. Effect of organoclay and EVA loading on the properties of PP/EVA/clay composites were characterized. Furthermore, effect of kenaf fibre on properties of laminated kenaf fibre reinforced polypropylene (PP)/ethylene vinyl acetate (EVA)/organoclay composites was also studied. In this study**,** polymer/clay composites from polypropylene (PP), organoclay and ethylene vinyl acetate (EVA) were prepared using a Brabender twin screw extruder and pelletized. The composites pellets were then laminated with kenaf fibres before

being put into hot and cold press. The composites were characterized using Thermogravimetric analysis (TGA), Dynamic mechanical analysis (DMA), Instron machine and Transmission Electron Microscopy (TEM). The presence of clay and EVA in PP/clay composite improved the thermal stability as shown by thermogravimetric analysis (TGA). DMA studies established that EVA led to decrease of stiffness of the composite. The properties of composite with organoclay showed an improvement in tensile strength, tensile modulus, flexural strength and flexural modulus. However, the reduction in impact strength for the PP/clay composite was observed. The tensile and flexural strength of PP/clay composite decreased while impact strength increased with the addition of EVA. TEM micrographs show that the composite types were intercalated. PP/clay composite with 5 phr EVA loading showed the optimum mechanical and physical properties. Laminated kenaf reinforced composites were examined by Instron machine, Shinho Thermal Conductivity machine, and Scanning Electron Microscopy (SEM). The amount of water absorption rate decreased with the addition of organoclay and EVA to kenaf fibre reinforced PP composites. The mechanical properties such as tensile, flexural and impact strength are compared between PP/EVA/clay composite reinforced kenaf fibre and PP/EVA/clay composite without kenaf fibre. All the composites reinforced kenaf fibre showed higher mechanical properties compared to the composites without kenaf fibre. Incorporation of kenaf fibre to the composites increased heat insulator behaviour by reducing the value of thermal conductivity. SEM micrographs gave clear indication of the effect of EVA in reduction of void sizes and numbers, and close interaction of PP/clay and fibre was clearly demonstrated for composite with elastomer.

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

PENYEDIAAN DAN PENGANALISAAN GENTIAN KENAF BERLAMINA DIPERKUKUH POLIPROPELINA/POLI (ETILENA-KO-VINIL ASETAT)/TANAH LIAT KOMPOSIT

Oleh

SITI HASNAH BINTI KAMARUDIN

April 2011

Pengerusi : Khalina Abdan, PhD

Institut : Institut Perhutanan Tropika dan Produk Hutan

Terdapat permintaan yang semakin meningkat untuk mengkaji bahan yang mesra alam untuk menggantikan bahan yang sedia ada memandangkan industri berusaha untuk mengurangkan sikap kebergantungan terhadap produk dan bahan api berasaskan petroleum. Komposit gentian semulajadi menawarkan ciri-ciri khusus setanding dengan komposit gentian yang lazim. Penyelidikan ini menjurus kepada penyediaan dan penganalisaan gentian kenaf berlamina diperkukuh polipropelina/poli (etilena-ko-vinil astetat)/tanah liat komposit. Kesan penambahan organo-tanah liat ke atas sifat nanokomposit PP/EVA/tanah liat diperiksa. Sebagai tambahan, kesan gentian kenaf terhadap sifat gentian kenaf berlamina diperkukuh polipropelina/ poli (etilena-ko-vinil asetat)/ tanah liat komposit turut dikaji. Dalam kajian ini, komposit polimer/organo-tanah liat daripada polipropilena, organo-tanah liat dan poli (etilena-ko-vinil asetat) (EVA) dihasilkan dengan menggunakan mesin ekstruder skru berkembar Brabender dan dipeletkan. Pelet komposit yang terhasil kemudian dilapiskan dengan gentian kenaf

sebelum dimasukkan ke dalam pemampat panas dan sejuk. Nanokomposit dikaji menggunakan analisis termogravimetri (TGA), analisis dinamik mekanik (DMA), mesin Instron dan mikroskop transmisi elektron (TEM). Kehadiran organo-tanah liat dan EVA dalam komposit PP/ organo-tanah liat telah memperbaiki kestabilan terma seperti yang ditunjukkan dalam analisis termogravimetri (TGA). Kajian DMA menunjukkan EVA menjurus kepada penurunan ketegangan komposit. Sifat komposit dengan organo-tanah liat menunjukkan ciri peningkatan terhadap kekuatan tegangan, modulus tegangan, kekuatan lenturan dan modulus lenturan. Walau bagaimana pun, penurunan dari segi kekuatan impak dapat dilihat pada komposit PP/ organo-tanah liat. Kekuatan tegangan dan lenturan komposit PP/tanah liat menurun manakala kekuatan impak meningkat dengan penambahan EVA. Imej TEM menunjukkan jenis nanokomposit adalah interkalasi. Komposit PP/ organo-tanah liat dengan 5 phr kandungan EVA menunjukkan sifat mekanik dan fizikal yang optimum. Gentian kenaf berlamina diperkukuh nanokomposit dikaji menggunakan mesin Instron, mesin kekonduksian terma Shinho dan kajian mikroskop imbasan elektron (SEM). Didapati kadar serapan air menurun dengan penambahan organo-tanah liat dan EVA terhadap PP yang berlamina dengan gentian kenaf. Sifat mekanik seperti tegangan, kelenturan dan kekuatan impak dibandingkan di antara PP/EVA)/organo-tanah liat yang dilamina dengan gentian kenaf dan komposit PP/EVA/ organo-tanah liat tanpa gentian kenaf. Semua komposit yang diperkuatkan dengan gentian kenaf menunjukkan sifat mekanikal yang lebih tinggi berbanding komposit tanpa gentian kenaf. Penggabungan gentian kenaf bersama komposit menaikkan sifat penebat haba dengan mengurangkan nilai kekonduksian terma. Mikrograf SEM jelas menunjukkan kesan penambahan EVA dapat

mengurangkan saiz dan bilangan rongga dan interaksi antara PP/tanah liat dan gentian dapat ditunjukkan dengan jelas dalam komposit dengan elastomer.

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I certify that a Thesis Examination Committee has met on 6 April 2011 to conduct the final examination of Siti Hasnah Binti Kamarudin on her thesis entitled "**Preparation and Characterisation of Laminated Kenaf Fibre-Reinforced Polypropylene/Ethylene Vinyl Acetate/Organoclay Composites**" in accordance with the Universities and University College Act 1971 and the Constitution of the University 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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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of Supervisory Committee were as follows:

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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 any other institutions.

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SITI HASNAH KAMARUDIN

Date: 6 April 2011

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