MECHANICAL PROPERTIES OF PINEAPPLE LEAF FIBRE REINFORCED POLYPROPYLENE LAMINATED COMPOSITES

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MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

2004

DEDICATION

Thanks to my beloved wife, Fadilah and my loving daughter, Noor Aishah
for their patience and support during the long preparation
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

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By

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June 2004

Chairman: **Associate Professor Mohd Sapuan Salit, PEng., Ph.D**

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Pineapple leaf fibre which is rich in cellulose, relatively inexpensive and abundantly available has the potential to be used as reinforcement in polymer composite. The present research investigates the tensile, flexural and impact behaviours of pineapple leaf fibre-polypropylene (PALF-PP) composites as a function of volume fraction. Composites specimens with the dimensions of 115 mm x 19 mm and 127 mm x 12.7 mm were cut from the 3 mm thickness laminates to determine tensile and flexural properties using an Universal Testing machine. Specimen with dimensions 63.5 x 12.7 x 3.0 mm were used for Izod impact test was using a TMI pendulum tester.

The tensile modulus and tensile strength of the composites were found to be increased with fibre content in accordance with the rule of mixtures. The tensile modulus and tensile strength with a volume fraction 10.8 % are 687.02 MPa and 37.28 MPa respectively. The flexural modulus gives higher value at 2.7 % volume fraction. The flexural strength of the composites containing 5.4 % volume fraction was found to be

higher than that of pure polypropylene resin by 5.1 %. At 2.7 % volume fraction, the work of fracture is about 6.1 % higher than that of virgin polypropylene. However, at higher percentage volume fraction (5.4 %, 10.8 % and 16.2 %) the work of fracture decrease by about 19.2 % and then 2.7 % of volume fraction. The reasons why flexural and impact properties gave lower values for volume fraction above 5.4 % are possibly due to the fibre-to-fibre interaction, void and dispersion problems. This was confirmed by the micrographs of scanning electron microscopic (SEM). Studies on SEM micrographs were carried out to understand the fibre –matrix adhesion and fibre breakage.

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

SIFIT-SIFAT MEKANIKAL KOMPOSIT BERLAPIS POLIPROPILENA BERTETULANG GENTIAN DAUN NANAS

Oleh

MOHD NOOR ARIB MD REJAB

Jun 2004

Pengerusi: Profesor Madya Mohd Sapuan Salit, PEng., Ph.D

Fakulti; Kejuruteraan

Gentian daun nanas yang mempunyai banyak selulosa, agak murah dan mudah diperolehi dalam kuantiti yang besar berupaya dijadikan sebagai tetulang bagi komposit polimer. Penyelidikan ini telah mengkaji tabiat tegangan, lenturan dan hentaman komposit polipropilena-gentian daun nanas dalam fungsi pecahan isipadu. Sampel-sampel komposit dengan dimensi 115 mm x 19 mm dan 127 mm x 12.7 mm yang berketebalan 3 mm telah dipotong untuk menentukan sifat-sifat tegangan dan lenturan dengan menggunakan Mesin Pengujian Universal. Sampel berdimensi 63.5 mm x 12.7 mm x 3.0 mm telah digunakan untuk ujian hentaman Izod dengan menggunakan TMI bandul penguji.

Modulus tegangan dan kekuatan tegangan komposit, didapati meningkat dengan penambahan kandungan gentian mengikut peraturan campuran. Modulus tegangan dan kekuatan tegangan pada pecahan isipadu 10.8 % masing-masing adalah 687.02 MPa dan 37.28 MPa. Nilai paling tinggi bagi modulus lenturan adalah pada pecahan isipadu 2.7 %.

Kekuatan lenturan komposit yang mengandungi pecahan isipadu 5.4 % ialah 5.1 % lebih tinggi daripada polipropilena tulen. Kerja patah pada pecahan isipadu 2.7 % ialah 6.1 % lebih tinggi daripada polipropilena tulen. Walau bagaimanapun, pada peratusan pecahan-pecahan isipadu tertinggi (5.4 %, 10.8 % dan 16.2 %) kerja patah didapati menurun sebanyak 19.2 % berbanding dengan pecahan isipadu 2.7 %. Penyebab sifat-sifat lenturan dan hentaman menunjukkan nilai yang rendah pada pecahan isipadu di atas 5.4 % adalah mungkin interaksi gentian-gentian, lompang dan masalah serakkan. Ia telah dipastikan daripada gambar mikroskop elektron imbasan. Kajian dengan menggunakan gambar mikroskop elektron imbasan telah dilakukan untuk memahami rekatan gentian-matriks dan pepecahan gentian.

ACKNOWLEDGEMENTS

First and foremost, I would like to extend my deepest praise to Allah S.W.T who has given me the patience, strength, determination and courage to complete this thesis.

This work could have not been completed without the aid of several individuals. Firstly I would like to acknowledge the chairman of supervisory committee, Associate Professor Ir. Dr. Mohd Sapuan Salit and the members of the supervisory committee, Associate Professor Dr. Megat Mohamad Hamdan Megat Ahmad, Associate Professor Dr. Paridah Md Tahir and Dr. Khairul Zaman Mohd Dahlan, for guidance and advice throughout the duration of this study.

Thanks are also extended to Associate Professor Dr. Md. Jelas Haron, Head of Department of Chemistry, Faculty of Science and Environmental Studies, and Associate Professor Dr. Hj. Mohd Zaki Abd Rahman, a lecturer from the same department, for their permission to use their laboratory facilities to conduct this study.

I also thankful to Mr. Mohd Zahir, and Mr. Aminullah Ashari for their assistance and patience during the mechanical testing of samples. Thanks are also extended to Dr. Fauziah, Director, Putra Infoport, University Research Part and Mrs. Nooraini Mohd Ain for permission and help in scanning electron microscopic (SEM) work.

Finally, I would like to express sincere appreciation my loving wife, Fadilah, my daughter, Noor Aishah and family for their support sacrifice and patience from the

beginning of this thesis project and for throughout the long hours it has taken to complete it.

I certify that an Examination Committee met on 19 Mac 2004 to conduct the final examination of Mohd Noor Arib Md Rejab on his Master of Science thesis entitled " Mechanical Properties of Pineapple Leaf Fibre Reinforced Polypropylene Laminated Composites" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science.
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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.

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MOHD NOOR ARIB MD REJAB

Date :

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