

**MECHANICAL PROPERTIES OF PINEAPPLE LEAF FIBRE REINFORCED
POLYPROPYLENE LAMINATED COMPOSITES**

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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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June 2004

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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

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

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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 mengandung 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, lompong 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.

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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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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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