MECHANICAL PROPERTIES OF PINEAPPLE LEAF FIBRE REINFORCED POLYPROPYLENE LAMINATED COMPOSITES

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MASTER OF SCIENCE UNIVERSITI PUTRA MALAYSIA

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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

iii

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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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 %.

V

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.

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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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TABLE OF CONTENTS

			Page
DEI	DICATIO	N	ii
ABS	STRACT		iii
ABS	STRAK		\mathbf{v}
ACI	KNOWLE	DGEMENTS	vii
API	PROVAL		ix
DEC	CLARATI	ON	xi
LIS	T OF TAE	BLES	xiii
	T OF FIG		xiv
LIS	T OF ABE	BREVIATIONS	xvii
CH	APTER		
1	INTR	ODUCTION	1
	1.1	Background of The Study	1
	1.2	Scope of Study	2
	1.3	Objective of The Study	3
	1.4	Structure of The Thesis	3
2	LITEI	RATURE REVIEW	5
	2.1	Introduction	5
	2.2	Fibre	8
	2.3	Nature Fibre	9
		2.3.1 Kenaf Fibre	9
		2.3.2 Oil Palm Fibre	10
		2.3.3 Vegetable Fibre	11
		2.3.4 Bamboo Fibre	12
		2.3.5 Jute Fibre	13
		2.3.6 Sisal Fibre	14
	2.4	Pineapple Leaf Fibre (PALF)	15
	2.5	Manufacturing Methods of PALF Composites	19
	2.6	Tensile Properties of PALF Composites	22
	2.7	Flexural Properties of PALF Composites	25
	2.8	Impact Properties of PALF Composites	27
	2.9	Other Properties of PALF Composites	28
	2.10	Products of PALF Composites	29
	2.11	Closure	30
3		HODOLOGY	31
	3.1	Introduction	31
	3.2	Materials	31
	3.3	Methods	32
		3.3.1 Preparation of Pineapple Fibre From Pineapple	

3.3.2 Determination of Physical Properties of Fibre Diameter Determination Diameter Determination Moisture Content Determination Density Determination Determination of Tensile Strength, Young's Modulus and Elongation at Break Modulus and Elongation at Break 3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) Jizod Impact Test (ASTM D256) ASEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION AND DISCUSSION AND Mechanical and Physical Properties of PALF and Polypropylene AND Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Moisture Content Determination 35 Density Determination 36 Determination of Tensile Strength, Young's Modulus and Elongation at Break 36 3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation 36 Tensile Test (ASTM D638) 42 Flexural Test (ASTM 790) 43 Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 45 4 RESULT AND DISCUSSION 46 4.1 Mechanical and Physical Properties of PALF and Polypropylene 46 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Density Determination Determination of Tensile Strength, Young's Modulus and Elongation at Break 3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Determination of Tensile Strength, Young's Modulus and Elongation at Break 3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Modulus and Elongation at Break 3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
3.3.3 Mechanical Properties of PELF-PP Composites Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Composites Preparation Tensile Test (ASTM D638) Flexural Test (ASTM 790) Izod Impact Test (ASTM D256) 3.3.4 SEM Fracture Surface Morphological Study 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Flexural Test (ASTM 790) 43 Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 45 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Flexural Test (ASTM 790) 43 Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 45 4 RESULT AND DISCUSSION 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
Izod Impact Test (ASTM D256) 44 3.3.4 SEM Fracture Surface Morphological Study 45 4 RESULT AND DISCUSSION 46 4.1 Mechanical and Physical Properties of PALF and Polypropylene 46 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
3.3.4 SEM Fracture Surface Morphological Study 45 4 RESULT AND DISCUSSION 46 4.1 Mechanical and Physical Properties of PALF and Polypropylene 46 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites
 4.1 Mechanical and Physical Properties of PALF and Polypropylene 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites
Polypropylene 46 4.2 Mechanical Properties and SEM Morphological Study of PALF-PP Composites 48
4.2 Mechanical Properties and SEM MorphologicalStudy of PALF-PP Composites48
Study of PALF-PP Composites 48
•
4.2.1 Tensile Properties 48
4.2.2 Effect of Fibre Loading in Tensile Tests 58
4.2.3 Flexural Properties 59
4.2.4 Effect of Fibre Loading in Flexural Tests 73
4.2.5 Impact Properties 74
5 CONCLUSIONS AND RECOMMENDATIONS 72
5.1 Conclusions 72
5.2 Recommendations 73
REFERENCES 75
APPENDICES 79
BIODATA OF THE AUTHOR 80