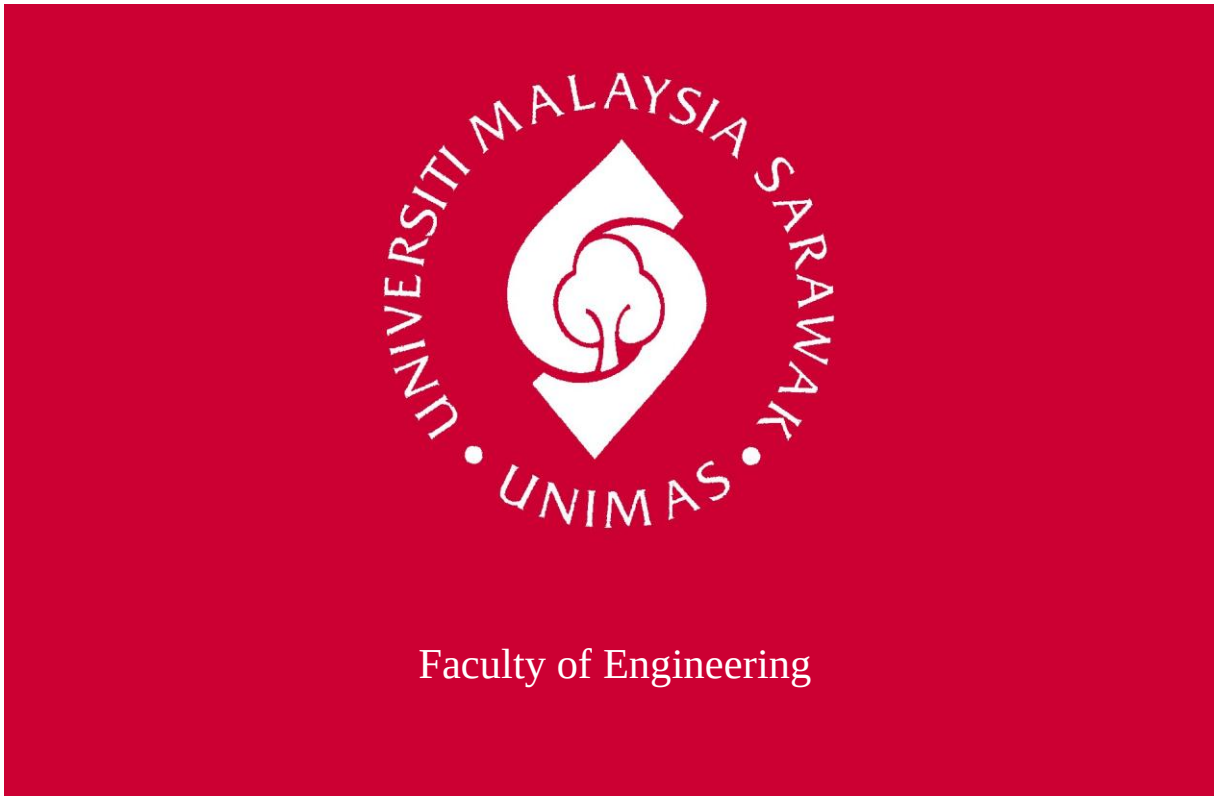

ANALYSIS OF WOOD WASTE COMPOSITE

Omar Qaiyum Bin Sulaiman

Bachelor of Engineering with Honours
(Mechanical and Manufacturing Engineering)
2008

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN STATUS TESIS

JUDUL: ANALYSIS OF WOOD WASTE COMPOSITE

SESI PENGAJIAN: 2007/2008

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APPROVAL SHEET

This project report attached here to, entitle **"ANALYSIS OF WOOD WASTE COMPOSITE"** prepared and presented by OMAR QAIYUM BIN SULAIMAN (12743) as a partial fulfillment of the requirement for degree of Bachelor of Engineering with Honours in Mechanical and Manufacturing Engineering is hereby read and approve by:

_____ Date: _____

(Mdm. Marini Bt Sawawi)

Project Supervisor

Faculty of Engineering

University Malaysia Sarawak

ANALYSIS OF WOOD WASTE COMPOSITE

OMAR QAIYUM BIN SULAIMAN

This report is submitted in partial fulfillment of the requirements for the degree of
Bachelor of Engineering with Honours
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Dedicated to my beloved family and friends

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ABSTRACT

Wood waste can be economically utilized to generate energy, produce new product or will be disposed. Another alternative is utilizing the wood waste as reinforcement materials to produce a wood waste composite with promising potential.

This project investigated the potential of wood waste to produce a composite material by determining the mechanical properties of the composite. Polyester resin and particle of wood waste were used to produce wood waste composite. The specimen preparation and tensile test have been carried out according to ASTM D 3039, the standard method for determination of tensile properties of polymer matrix composite.

The result from this project shows that, the wood waste has a potential to produce a composite materials with high tensile strength and high Young's modulus. The highest tensile strength is achieved with sample A with particle size of 0.0064 mm^2 or less at 30% particle volume fraction which is 22.013 MPa while the Young Modulus is 553.003 MPa. The strength of the wood waste composite is also influenced by the size of particle of wood waste. The smaller the size of particles, the inherent flaws will be reduces and tensile strength will increase. The tensile strength of sample A (smaller particle size) is proportional to the increase in volume fraction of particle. Whereby, for tensile strength of sample B is inversely proportional to the increase in volume fraction of particle.

ABSTRAK

Hampas kayu boleh digunakan secara ekonomis untuk menjana tenaga, menghasilkan produk baru atau dibuang. Alternatif lain adalah menggunakan hampas kayu sebagai bahan penguat untuk menghasilkan komposit hampas kayu yang berpotensi.

Projek ini menyelidik tentang potensi hampas kayu untuk menghasilkan bahan komposit dengan menentukan sifat-sifat mekanikal bagi komposit. Resin polyester dan partikel hampas kayu digunakan untuk menghasilkan komposit hampas kayu. Penyediaan spesimen dan ujian regangan dijalankan berpandukan ASTM D 3039. kaedah piawai bagi sifat regangan untuk matrik polimer komposit.

Keputusan daripada projek ini menunjukkan bahawa hampas kayu mempunyai potensi untuk menghasilkan bahan komposit yang mempunyai kekuatan regangan dan "Young's Modulus" yang tinggi. Kekuatan regangan yang paling tinggi dicapai dengan sampel A dengan saiz partikel 0.0064mm^2 atau kurang bagi 30% pecahan isipadu partikel iaitu 22.013 MPa manakala "Young's Modulus" ialah 553.003 MPa. Kekuatan komposit hampas kayu dipengaruhi oleh saiz hampas kayu. Semakin kecil saiz partikel hampas kayu, kewujudan kecacatan akan berkurang dan kekuatan regangan akan bertambah. Kekuatan regangan bagi sampel A (partikel yang bersaiz lebih kecil) adalah berkadar terus dengan penambahan pecahan isipadu partikel. Manakala, kekuatan regangan bagi sampel B adalah berkadar songsang dengan penambahan pecahan isipadu partikel.

NOMENCLATURE

w_p	Weight fraction
W_p	Weight of particles
W_m	Weight of matrix
W_c	Weight of composite
υ_p	Volume fraction
V_p	Volume of particles
V_m	Volume of matrix
V_c	Volume of composite
ρ_m	Density of matrix
ρ_p	Density of particles

CHAPTER 1

INTRODUCTION

1.1 Introduction

Production of wood waste from the logging activities and wood-based processing mill such as plywood mills is not only causing environmental problems but also can create wastetage if it not being utilized properly. One aspect that should be looking at is by utilizing the waste as a reinforcement materials to produce composite. The combination of wood waste and matrix will offer interesting mechanical properties that cannot be achieved by coventional materials. Apart from that, utilizing wood waste as reinforcement materials will not only impose great saving but also for producing a wood waste composite with promising potential.

1.2 Wood-Based Industry

The production and supply logs in Peninsular Malaysia are subjected to the National Forest Policy, which determines the annual allowable cut, in line with Malaysia's commitment towards sustainable forest management. The State Government of Sarawak has introduced Forest (Planted Forests) Rules 1997, which provide for the orderly development of forest plantations in the State. Main source of logs are from Sarawak, followed by Sabah, with supplies from natural forest, plantation forest and rubber plantation declined from 30.4 million cubic meters in 1996 to 26.9 million cubic meters in 2005 is shown in Table 1.1 (Wood-Based Industry).

Table 1.1: Production of Logs From Natural Forests, Plantation Forests, and Rubber Plantation (Wood-Based Industry)

Year	Peninsular Malaysia	Sarawak	Sabah	Total
	('000 cubic meters)			
1996	8,419	16,080	5,931	30,430
2000	5,074	14,270	4,151	23,495
2005	8,585	12,040	6,280	26,905

Sources: Forestry Department, Peninsular Malaysia, Forestry Department, Sarawak and Forestry Department, Sabah

1.3 Wood Waste

Wood waste can be obtained from wood-based processing mill such as plywood mills, sawmills, and integrated pulp and paper mills. In 2005, the production of selected intermediate wood-based product amounted to 11.3 million cubic meters is shown in Table 1.2. Major products were plywood, at 5.1 million cubic meters or 45.4 percent of total production and sawn timber product, at 5.1 million cubic meters or 45.1 percent of total production (Wood-Based Industry)**.**

Table 1.2: Production of Selected Wood-Based Product (Wood-Based Industry)

	1997	2000	2005
	('000 cubic metres)		
Total	13,532	11,857	11,284
Plywood	4,448	4,435	5,126
Sawn timber	7,176	5,590	5,087
Mouldings	743	716	375
Veneer	1,165	1,116	696
Pulp and Paper	681	1,078	1,372

Source: Ministry of Plantation Industries and Commodities

Plywood and sawn timber has recorded the highest production of selected wood-based product. That means the large quantity of wood waste has been produced by plywood mills and sawmills. Sawdust is the best example of wood waste which can be used to produce wood waste composites. Usually, the wood waste will be disposed or can be economically utilized for co-production of energy. The productions of wood waste composites provide an additional market for wood waste, thereby helping to reduce waste disposal burdens. The flow of wood as it is converted to new products is shows in Figure 1.1

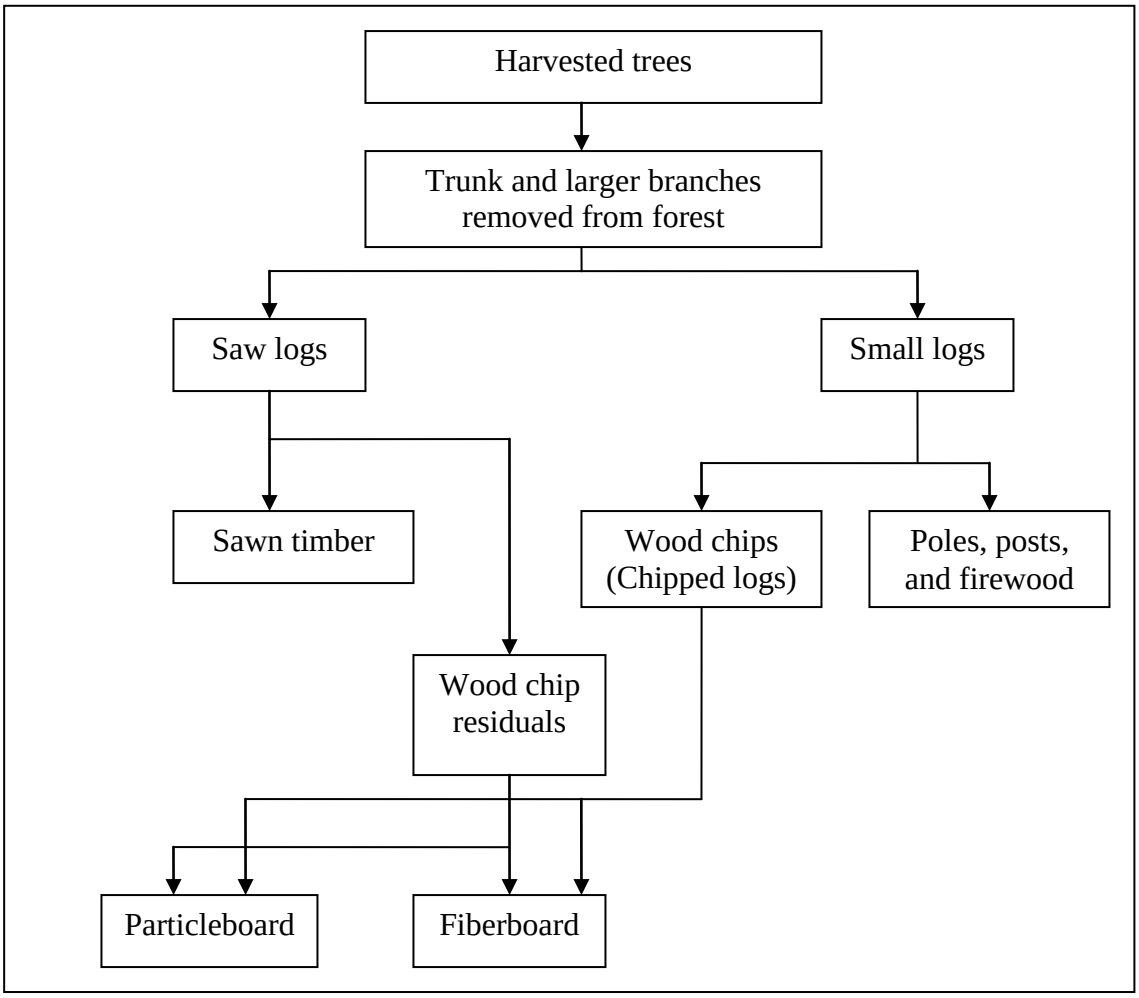

Figure 1.1: Flow of wood as it is converted to new products

(Environmental Statistics team. 2006)

Harvested tree from logging activity is converted into trunk and larger branches. The trunk and branches will pass through the saw logs which produce sawn timber. The trunk and branches also pass through the small logs which produce wood chips, poles, post and, firewood. The wood chips or wood waste from saw logs and small logs can be use to produce a new product (Environmental Statistics Team. 2006).

Wood chips can be produced by grinding small logs and pulp logs into small pieces. Chipping process is important to make pulp, paper and a final export product. However, there is an increasing use of wood chips as an energy source, for example burning them for space and water heating.

The particular wood chips are useful to produce new products. The forestry industry has become very adept at making use of residual products or wood waste from the manufacture of other products. For example, the residual chips and sawdust from saw mills can be use to produce composite and panels such as fiberboard, chipboards, particleboard and wood cement boards.

Fiberboard is a wood product reconstituted from wood fibers and regularly made from lower quality logs and some wood waste. The most common use for fiberboard is on joinery and furniture manufacturing due to its even density and smooth surface. Particleboard is a composite product made from wood particles. The development of particleboard manufacturing arose from the desire to utilize waste (Environmental Statistics Team. 2006).

1.4 Composite

The development and usage of natural composites is starting with composite wall made of straw and mud in a long time ago. Then, the utilization of natural composites has been extended into modern applications such as automotive industries. The usage of natural fibers is domestically grown and available in a large quantity which can reduce cost. The production of natural composites is concentrate to increase the usage of waste materials from wood, coconut, sago palm and many more (Peter, C.F.K. 2006). The development of natural composites is one of the factors that leading to this project, "Analysis of Wood Waste Composite".

The combinations of wood fibers and thermoplastic polymers will produce composite materials that are lightweight, and offer high strength to weight ratios. The combination of wood fibers and thermoplastic polymers also presents a number of problems. The problems are incompatibility and inferior interface between the fiber and matrix that does not adequately transfer stress to the load bearing fiber. Therefore the mechanical properties of wood waste composite are dependent on the characteristics of the wood fiber and thermoplastic polymers interface (McHenry, E. and Stachurski, Z.H. 2002).

Composites are becoming an essential part of materials in modern technologies. Composites have unique and unusual properties that cannot be met by conventional materials such as metal alloys, ceramics, and polymers. Composite materials offer advantages such as less weight, lower cost and more strength (Matthews F.L. and Rawlings R.D. 1994).

1.5 Scope And Objective

The objective of studying and implementing this project are listed below;

1. To investigate the potential of wood waste to form a composite material.

2. To analyze and evaluate the mechanical properties of wood waste composite.