



Faculty of Engineering

**APPLICATION OF OIL PALM EMPTY FRUIT BUNCH
COMPOSITE AS AN ECO-EFFICIENT PRODUCT**

Mohd Faliq Bin Mohd Jalani

Bachelor of Engineering with Honours
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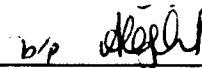
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(TANDATANGAN PENYELIA)

Alamat Tetap: C18 Riverdale Park,
Bukit Antarabangsa,
68000 Ampang,
Selangor Darul Ehsan.

Mdm. Ervina Junaidi

Nama Penyelia

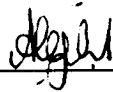
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b/p 

(Mdm. Ervina Junaidi)

Project Supervisor

Faculty of Engineering

University Malaysia Sarawak

Date: 06/5/2008

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MOHD FALIQ BIN MOHD JALANI

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Dedicated to my beloved family and friends

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ABSTRACT

In this project the main idea is to propose a different type of material in usage of producing a product. The different type that is mention in this project is natural composite. This innovation can be called an act on satisfying the changing needs of society, in means of efficient, economical and environmental. Eco-efficient can be suitable in describing those aspects. In this study the evaluation of relationship between natural composite and eco-design product towards environmental is conducted. The result of each of those entities can construct a new mean of environmental product. Natural composite is done by combining two elements which is natural waste and polyester for this particular research. Oil palm empty fruit bunch fiber is a common waste that is increasing in Malaysia agricultural region. From the analysis and the study of design for environment, it shown that the quality of oil palm empty fruit bunch fiber composite can be used for designing an eco-efficient product. In the design process, evaluation is conducted using axiomatic design application. The result for the second level of FR_1 is uncoupled design matrix, FR_2 decoupled design matrix and FR_3 uncouple design matrix. Results of the design satisfied both customer requirement and DFE (design for environmental). End product for this project is eco-cooler pad. The product is an efficient design with added environmental aspect, can be reuse, remanufactured and no waste is involved during the process and after life span.

ABSTRAK

Idea utama dalam projek ini adalah untuk menawarkan jenis bahan yang berlainan untuk kegunaan dalam menghasilkan produk. Jenis berlainan yang dimaksudkan bagi projek ini ialah komposit semulajadi. Perubahan ini boleh dipanggil sebagai satu tindakan bagi memuakan perubahan keperluan masyarakat iaitu kecekapan, ekonomik dan alam sekitar. *Eco-efficient* boleh dikatakan sesuai dalam menerangkan aspek tersebut. Dalam pembelajaran, penilaian terhadap hubungan antara komposit semulajadi and *Eco-efficient* produk terhadap alam sekitar dilaksanakan. Keputusan bagi setiap entiti boleh membina maksud baru dalam produk alam sekitar. Komposit semulajadi dihasilkan dengan menyatukan dua elemen iaitu buangan alam semulajadi dan *polyester* seperti dalam penyelidikan ini. Serat kelapa sawit ialah bahan buangan yang semakin meningkat dalam kawasan pertanian di Malaysia. Daripada analisis dan pembelajaran rekabentuk untuk alam sekitar, ia menunjukkan bahawa kualiti komposit serat kelapa sawit boleh digunakan untuk merekabentuk *Eco-efficient* produk. Dalam proses merekebentuk, penilaian dibuat dengan menggunakan aplikasi rekabentuk axiomatik. Keputusan untuk peringkat kedua bagi FR₁ adalah rekabentuk matrik *uncoupled*, FR₂ adalah rekabentuk matrik *decoupled* dan FR₃ juga rekabentuk matrik *uncoupled*. Keputusan daripada rekabentuk telah memenuhi kedua-dua keperluan pelanggan dan rekabentuk untuk alam sekitar. Produk untuk projek ini adalah *Eco-cooler pad*. Produk ini adalah rekabentuk kecekapan dengan penambahan aspek alam sekitar, yang boleh diguna semula, boleh dibuat semula dan tiada bahan buangan yang terlibat semasa pemprosesan dan selepas jangka hayat produk.

TABLE OF CONTENTS

CONTENT	PAGES
ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
ABSTRAK	iv
LIST OF FIGURES	ix
LIST OF TABLES	xii
LIST OF EQUATIONS	xiii
CHAPTER 1: INTRODUCTION	1 ~ 5
1.1 Project Background	1
1.2 Project Objectives	5
CHAPTER 2: LITERATURE REVIEW	6 ~ 32
2.1 Introduction	6
2.2 Eco-efficiency	7
2.2.1. Eco-design concept	9
2.2.2. Material choice for eco-design	10
2.3 Composite material	11
2.3.1. Eco-composite	11
2.3.2. Categories and combination of composite materials	12

2.3.3. Matrix	13
2.3.3.1. Types of matrix materials	14
2.3.4. Reinforcement	15
2.4 The evaluation of natural composite	18
2.5 Background of natural composite materials	18
2.6 Advantages of natural fibers	19
2.6.1. Advantages and disadvantages of natural fibers and glass fibers materials	21
2.6.2 Example of natural fiber application in industry	21
2.7 Environmental aspect	23
2.8 Application of axiomatic design	24
2.8.1. Elements of axiomatic design	24
2.8.2. The concepts of domains	25
2.8.3. Axioms	26
2.8.3.1. The first axiom: The independence axiom	27
2.8.3.2. The second axiom: The information axiom	28
2.8.4 Axiomatic design framework	28
2.8.5 The examples of eco-design application in Vacuum cleaner design	29
 CHAPTER 3: METHODOLOGY	 33 ~ 43
3.1 Introduction	34
3.2 The design process	34
3.2.1. Fabrication of natural composite	35

3.2.1.1 Natural resource finding	35
3.2.1.2 Natural fiber selection	35
3.2.1.3 Fiber volume fraction	37
3.2.1.4 Fabrication of Natural composite	38
3.2.1.5 Fabrication of part	40
3.2.2. Fabrication of design	40
3.2.2.1 Design phase	40
3.2.2.2 Type of design product	40
3.2.2.3 Design for environment (DFE)	41
3.2.2.4 Concept development	42
3.2.2.5 Concept evaluation	42
3.3 Process of development	43
3.3.1 Product development	43
3.3.2 Process of fabrication	43
3.3.3 End review product	43
CHAPTER 4: RESULTS AND DISCUSSIONS	44~68
4.1 Introduction	44
4.2 Identify the needs	44
4.3 Types of the design projects	46
4.4 Develop engineering specification	46
4.5 Conceptual design	48
4.5.1 Drawing of cooler pad product	48
4.5.2 Concept generation	52

4.5.3 Axiomatic evaluation	53
4.6 Natural composite fabrication	57
4.6.1 Fiber selection	57
4.6.2 Fiber preparation and composite specification	57
4.6.3 Natural composite analysis	60
4.6.4 Process selection	62
4.7 Product specification and function	63
4.8 Discussion	66
4.8.1 Material Fabrication	66
4.8.2 Design matrix	67
4.8.3 Design fabrication	67
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS	69~70
5.1 Conclusions and recommendations	69
REFERENCES	71 ~ 72
APPENDIX A	73
APPENDIX B	74
APPENDIX C	79

LIST OF FIGURES

Figures		Pages
Figure 1.1	Ecological footprint by region in 1996	2
Figure 1.2	Global consumption rate of natural resources	3
Figure 2.1	Sustainable development chart	9
Figure 2.2	Broad classification of Natural/Bio-fibers: Strong potential reinforcing fibers in designing bio-composites for Building Products Industry	15
Figure 2.3	Photos of the existing natural fiber	16
Figure 2.4	Influence of fibre content on storage modulus E' and loss factor $\tan \delta$ (PPN, FLa15HC, FLa28HC)	20
Figure 2.5	Four domains of the design world	25
Figure 2.6	Environmental impacts of a vacuum cleaner with filter bag	30
Figure 2.7	Prototype of vacuum cleaner	30

Figure 2.8	Thin filters of the vacuum cleaner	31
Figure 3.1	The design process of eco-efficient product	34
Figure 3.2	Cool press molding set	38
Figure 3.3	Female mold with dimension of 28cm X 28 cm	39
Figure 3.4	The life cycle of Design for environment (DFE) product	42
Figure 4	The percentage of answering yes, no and not sure for each question in the questionnaire	45
Figure 4.1	Body part of cooler pad	
Figure 4.1.1	Side part of cooler pad	49
Figure 4.1.2	Overall view of cooler pad	49
Figure 4.1.3	Top view of cooler pad	50
Figure 4.1.4	Overall top view of cooler pad	50
Figure 4.1.5	Bottom view of cooler pad	51
Figure 4.2	Hierarchy of functional requirement for cooler pad	52
Figure 4.3	Hierarchy design parameter for cooler pad	53
Figure 4.4	Cool press method	58

Figure 4.5	The graph of comparison stress over strain for 10%, 15% and 20% FVF	61
Figure 4.6	The graph of comparison 3 point bending test for 10%, 15% and 20% FVF	62
Figure 4.7	Eco-cooler pad function of cooling and air flow system	64
Figure 4.8	Ergonomic features in Eco-cooler pad	65
Figure 4.9	The specification of Eco-cooler pad	65
Figure 4.10	Eco-cooler pad for laptop	65

LIST OF TABLES

Tables	Pages
Table 2.1	8
Enviromental performance indicators recomended by WBCSD	
Table 2.2	21
Advantages and disadvantages between natural and glass fiber	
Table 2.3	22
Natural fiber used in automotive industry Worldwide	
Table 3	36
Modulus comparison of E-glass and some important Natural fibers	
Table 4	47
Modulus comparison of E-glass and some important Natural fibers	
Table 4.1	59
Composite material specification in project	
Table 4.2	60
Some properties of important commercial thermosets- polymer matrix	

LIST OF EQUATIONS

Equations	Pages
(2.1) Eco-efficient ratio	7
(2.2) Relationship between FR and DP	27
(3.1) Weight fraction	37
(3.2) Volume fraction	37
(3.3) Fiber volume fraction	37

CHAPTER 1

INTRODUCTION

1.1 Project Background

In the present, people are concerning more in globalization, but before society can think about globalization, people must consider sustainability. Sustainability development involves 3 dimensions which is people, profit and planet. Eco-design plays an important role in sustainability development. It covers the ecology dimension where it plays an important task in respecting the carrying capacity of nature. It is important to implement sustainable use of renewable and minimal use of nonrenewable material in designing a product.

The concept of sustainable development contains sustainable design which included eco-design product. Eco-design product is a design where it is strongly represent economic, functional safety and environmental friendly.

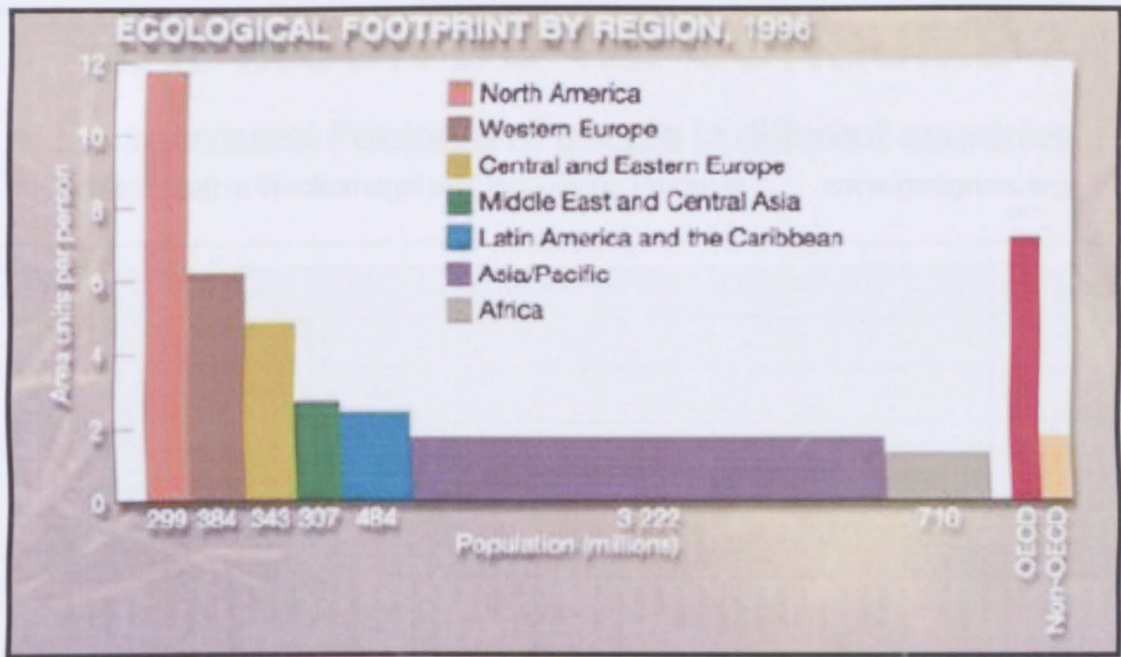


Figure 1.1 Ecological footprint by region in 1996

Figure 1.1 shows the graph of ecological footprint by region in 1996. It shows that 20 % of the world population only uses 80 % of natural resources where the remaining world population only uses 20 % of natural resources. The situation proved that 80 % of the world population is not using the natural resources and prefer more in conventional material. Based on the graph itself only 20 percent of the world population acknowledge the importance of the natural resources.

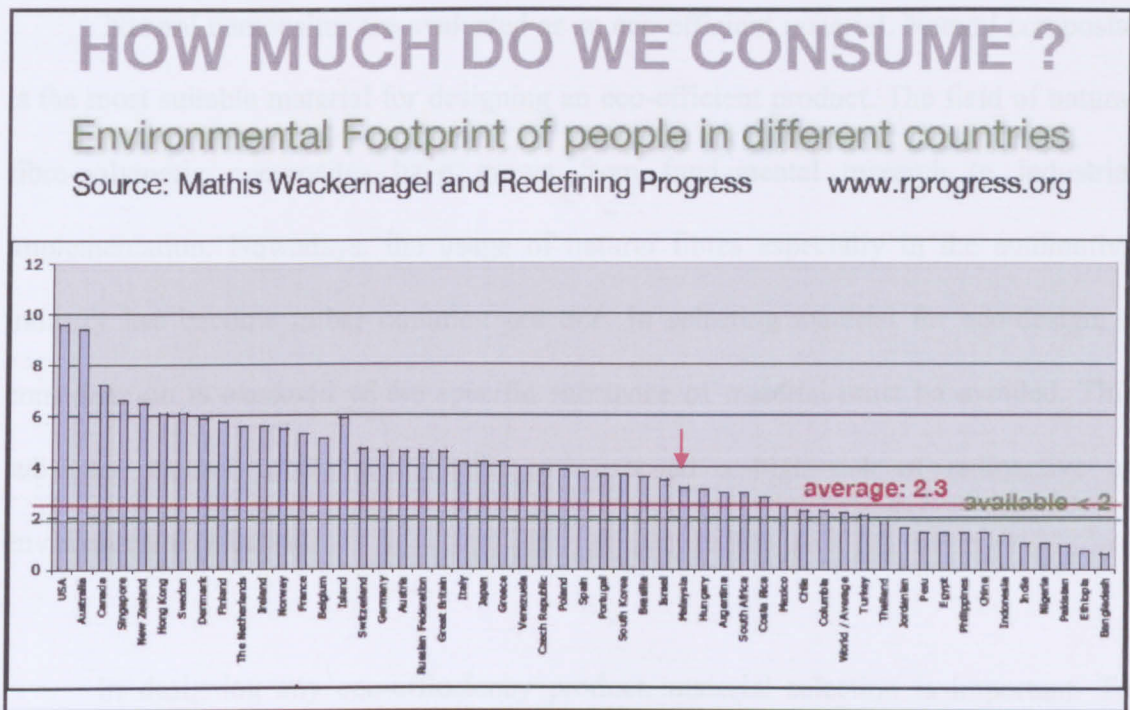


Figure 1.2 Global consumption rate of natural resources

The sense of importance in sustainability is due to the consumption rate of people nowadays. According to figure 1.2, the graph of global consumption rate of natural resources, it shows that Malaysia only consumes an above average rate, hence showing that Malaysia lacks in supporting the sustainability development.

Eco-Efficiency comes into view after combination issues of economic efficiency which has positive environmental benefits and cleaner production starts from issues of environmental efficiency which have positive economic benefits. Innovation and efficiency thinking must be implemented in every consumer and developer.

Natural composites are evaluated as an eco-efficient material. Natural composite is the most suitable material for designing an eco-efficient product. The field of natural fibre-polymeric composites have grown from fundamental research to industrial implementation. Nowadays, the usage of natural fibres especially in the automotive industry has become rather common practice. In selecting material for eco-design, a consideration is executed where specific substance of material must be avoided. This substance caused problematic health and exposed a high risk of radioactive or environmental pollution.

In designing any eco-efficiency product, material selection is important. To produce an eco-design product natural resources is the suitable material. Natural composite strength is based on the selection of its fibres. Sustainable fibres or natural fibres are used in making natural composites. The product can invoke people in using natural composite material rather than the conventional material source such as wood, metal and etc.

1.2 Project Objectives

The main objective of this project is to apply oil palm empty fruit bunch composite as eco-efficient product. The other objectives are:

- a) To investigate the properties of the oil palm empty fruit bunch fiber.
- b) To study and evaluate oil palm empty fruit bunch fiber as a composite.
- c) To evaluate oil palm empty fruit bunch composite as ecological-efficient products.
- d) To fabricate an eco-efficient product using the oil palm empty fruit bunch fiber.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In designing an eco-efficiency product, there are a lot of areas that are needed to be covered. Eco-efficiency product is design based on an eco-design concept. This design is under the application of sustainable development where it is strongly represent environmental, functional and economical efficiency. To fabricate a product based on eco-design concept, the material must be toxic proof or environmental friendly.

Throughout the research of eco-design product it is most likely that the design method is seldom approach. This is due to the fact that the design itself is under research and slowly develops to society interest. In industrial company a lot of people are still using the conventional material. Natural resources is slightly neglected due to lack of knowledge on the benefits of using the resources. This chapter will evaluate the potential of natural resources and the outcome of the development that other idealist society had created.

Furthermore it is also important to know the function of eco-design and eco-efficiency concept. The concept explained the criteria of eco-design that is required in producing an environmental friendly product. This section included the material selection which is suitable for designing eco-design product.

This chapter included some of the example of methodology that is being used in designing eco-design product. The last section will discuss the advantages and disadvantages between conventional material and natural resources.

2.2 Eco-efficiency

Eco-efficiency has been defined as “the efficiency with which ecological resources are used to meet human needs” [12]. The purpose of eco-efficiency is to maximise value creation while having minimised the use of resources and emissions of pollutants. Measuring ecoefficiency is important in order to measure the decoupling of economic growth and environmental pressure. Eco-efficiency is in most cases expressed by the ratio [15].

$$\text{Eco - efficiency} = \frac{\text{Product or service value}}{\text{Environmental influence}} \quad (2.1)$$