



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**NEW PACKAGING MATERIAL BY USING MECHANICAL  
RETTING KENAF AS A NATURAL FILLER**

This report submitted in accordance with requirements of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Engineering Material) with Honours.

by

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FACULTY OF MANUFACTURING ENGINEERING

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## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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**TAJUK:** New Packaging Material By Using Mechanical Retting Kenaf As a Natural Filler

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I hereby, declared that this report entitled “New Packaging Material By Using Mechanical Retting Kenaf As a Natural Filler” is the result of my own research except as cited in the references.

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## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Material) with Honours. The member of the supervisory committee is as follow:

.....

(Principal Supervisor)

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## ABSTRACT

Egg packaging material mostly produced from non-biodegradable material such as PET and the material itself cannot protect the product properly such as recycle paper. The new natural composite which contain natural source and recycle material developed to design a new material packaging which are economically and environmental friendly. Different composition of starch, recycle newspaper, mechanical retting and water retting kenaf fiber contain in composition 2 until composition 6. This natural composite composition produce by using manual cold press technique and dried it under the sunlight. There are four mechanical tests and one physical test has done which are Tensile Test, Flexural Test, Impact Test, Water Absorption Test and Vibration Test. These entire tests will be following the ASTM D 638, ASTM D 790, ASTM D 256, ASTM D 570 and ASTM D 3580 standard respectively. Composition 9 and 10 as reference compositions contain 100 percent of PET and recycle paper which these materials exist in the market. Young's Modulus value for composition 9 or PET higher 99.31 % than composition 2 which is the third higher because PET is a polymer and the elasticity should be higher and the common failure mode is delamination and pull out condition. From impact test result, the impact energy of specimen composition 2 more higher 100 % impact energy absorb and impact strength compare to composition 9. This is because composition 9 has a very small value that cannot detect by the machine. Critical damping value composition 2 for vibration test has higher 97.05 % than composition 9. This value is the maximum damping that can reduce the amplitude of the vibration. This natural composite can replaced current material from observation and data analysis. The best composition is composition 2 which contains 70 percent of tapioca starch, 20 percent of recycle newspaper and 10 percent of mechanical retting kenaf fiber with thickness  $10.3 \pm 0.2$  mm has Young's modulus, impact strength and critical damping value are 11234.88 kPa,  $17 \text{ kJ/m}^2$ , 0.85. Some of the result has a small different and some has a large different value when compare to the available material where the reference specimen made from different process method that involve high technology such as injection molding.

## ABSTRAK

Penghasilan bahan pembungkusan bagi telur kebiasaanya diperbuat daripada bahan bukan organik seperti *PET* dan juga daripada bahan yang tidak mampu menampung beban yang berlebihan seperti kertas yang dikitar semula. Komposit semulajadi ini mengandungi sumber bahan semulajadi yang digabungkan dengan bahan kitar semula untuk dijadikan sebagai bahan pembungkusan yang baru dimana lebih ekonomi dan mesra alam. Perbezaan komposisi kanji, surat khabar yang dikitar semula, gentian kenaf dalam bentuk *mechanical retting* dan *water retting* adalah bahan yang terkandung di dalam komposisi 2 hingga komposisi 6. Semua komposit semulajadi ini dihasilkan menggunakan *cold press* secara manual dan dikeringkan di bawah cahaya matahari. Sebanyak empat jenis ujian mekanikal dan satu ujian fizikal telah dijalankan iaitu Ujian Tegangan, Ujian Lenturan, Ujian Hentaman, Ujian Resapan Air dan Ujian Getaran dan kesemua ujian ini adalah berdasarkan piawaian ASTM D 638, ASTM D 790, ASTM D 256, ASTM D 570 dan ASTM D 3580. Komposisi 9 dan 10 merupakan komposisi rujukan yang mengandungi seratus peratus *PET* dan kertas yang dikitar semula dimana ianya merupakan bahan pembungkusan yang terdapat di pasaran. Komposisi 9 mempunyai nilai modulus keanjalan sebanyak 99.31 % berbanding komposisi 2. Ini kerana *PET* merupakan sejenis polimer dimana mempunyai sifat elastik dan jenis kegagalan *delamination* dan juga *pull-out* terjadi kepada hampir kesemua spesimen yang telah diuji. Daripada ujian hentaman, didapati komposisi 2 mempunyai 100 % tenaga hentaman yang diserap dan tenaga hentaman lebih tinggi berbanding komposisi rujukan. Ini kerana nilai bagi komposisi 9 adalah terlalu kecil dan tidak dapat dikesan oleh mesin. Komposisi 2 mempunyai nilai *critical damping* sebanyak 97.05 % berbanding *PET*. Nilai ini merupakan nilai maksimum bagi komposisi ini untuk mengurangkan amplitud getaran tersebut. Komposit semulajadi ini mampu menggantikan penggunaan bahan pembungkusan yang sedia ada. Komposisi 2 merupakan komposisi yang terbaik dimana mengandungi 70 peratus kanji, 20 peratus surat khabar kitar semula dan 10 gentian kenaf *mechanical retting* yang mempunyai ketebalan  $10.3 \pm 0.2$  mm serta mempunyai nilai modulus keanjalan, tenaga hentaman

dan *critical damping* adalah 11234.88 kPa, 17 kJ/m<sup>2</sup> dan 0.85. Sesetengah keputusan yang didapati mempunyai perbezaan peratusan yang kecil dan besar berbanding dengan bahan yang sedia ada dimana PET dihasilkan daripada proses yang berbeza serta melibatkan teknik berteknologi tinggi seperti *Injection molding*.

## DEDICATION

*Dedicated to my beloved Allahyarham Cikgu Hj. Mustafa Bin Hussein, thank you for being such a great teacher and grandfather to your grand daughter. Also to my beloved abah, ummi, ammar and Noor Afendi.*



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## LIST OF ABBREVIATIONS

ASTM	–	American Society for Testing & Materials
C	–	Complete break
DUT	–	Device Under Test
EPS	–	Expandable Polystyrene
H	–	Hinge Break
HDPE	–	High Density Polyethylene
KWh	–	KiloWatt per Hour
NB	–	Non Break
P	–	Partial Break
TMP	–	Thermo Mechanical Pulp
UTM	–	Universal Tensile Machine
PET	–	Polyethylene terephthalate

## LIST OF SYMBOLS

$\epsilon_f$	–	Flexural Strain
$\sigma_f$	–	Flexural Stress
mm	–	Milimeter
$C_c$	–	Critical damping
$\zeta$	–	Damping ratio
%	–	Percent
$\omega_n$	–	Omega N
h	–	Thickness
b	–	Wide
L	–	Length
E	–	Young's Modulus
KPa	–	KiloPascal
$N/mm^2$	–	Newton per mililimeter squared
kN	–	kilonewton
Hz	–	Hertz
C	-	Damping Coefficient
MPa	–	Mega Pascal
KPa	–	Kilo Pascal
J	–	Joule
KJ	–	KiloJoule
$J/mm^2$	–	Joule per millimeter squared
g	–	Gram

# **CHAPTER 1**

## **INTRODUCTION**

Kenaf or known as Hibiscus Cannabinus L is a wild plantation from Africa. In China and America, this plant has been planted commercially to get the fiber and supply it to produced paper (Kenaf Conference Proceedings 1994). In Malaysia, this plant is still under progress to replaced tobacco plant and government still doing research on the function of kenaf fiber to produce and invent a new product. This research will use kenaf fiber as a natural filler to produce one new packaging material. The main function of packaging is to protect the product from manufacturing process, loading and unloading till the product goes to the consumer. So that, the product will be in good condition and avoiding from any disadvantages of the packaging. Egg pallet packaging is a one type of cushion in packaging that used to protect, relaxing, holder, and absorb the external vibration of the product. Majority the pallet is made from PET (polyethylene terephthalate) and recycles paper. In this research, the material of this egg pallet will be replaced with an organic material (matrix material, filler and hardener). Composite is a combination of two materials that have different types of mechanical properties. In this project, the researcher used natural composite to produce a new material packaging. Natural composite means the materials are from natural source. Then the researcher do comparison by using between water retting kenaf and mechanical retting kenaf. Figure 1.1 shows the mechanical retting kenaf fiber as filler and Figure 1.2 shows the recycled newspaper fiber as a matrix material. Starch will be as hardener. All these materials are environmental friendly, biodegradable and at the same time, cost can be reduced.



**Figure 1.1:** Kenaf Fiber



**Figure 1.2:** Newspaper Fiber

## 1.1 Objectives of the Research

- i. To obtain and analyze mechanical properties from purpose composite.
- ii. Design a new packaging material for egg pallet by using an organic fiber as a filler
- iii. To compare between mechanical retting kenaf fiber and water retting kenaf fiber.

## 1.2 Scope of the Research

- i. Literature survey on types of common natural filler that been used in packaging industry.
- ii. A replacement of the common filler with organic filler which is kenaf fiber as an alternative.
- iii. To combine two or more materials in such a way that a synergism between the components result in a new material that is better than individual components.
- iv. Mechanical retting kenaf and Water retting kenaf technique process.
- v. Recycled newspaper process.
- vi. Kenaf fiber as filler, starch as a hardener and recycle newspaper as a matrix material.
- vii. To learn the properties of kenaf fiber and recycled newspaper fiber.

- viii. Mechanical Testing based on ASTM Standard
- ix. To produce a product that environmental friendly packaging material from kenaf fiber, recycled newspaper fiber and glue.

### **1.3 Rational of Research**

The main purpose of this research is to analyze and investigate the exertion of kenaf fiber as an alternative organic fiber. Nowadays, there a lot of organic fiber can be used as natural filler such as wood flour and banana fiber. This research is to reduce out using all of the chemical filler that is expensive and can avoid any chemical reaction between the packaging and the product. It also can reduce of utilize in inorganic matrix such as PET (Polyethylene terephthalate). Furthermore, it can be easily to recycle and environmental friendly.

### **1.4 Problem Statement of Research**

Currently, packaging material are made of polymer. The usage of the natural fiber in the natural composite as the replacement of conventional fiber can reduce the production cost of the composite product. Global environment issues have led to a renewed interest in bio-based materials with the focus on renewable raw materials can be biodegradable or recyclable at reasonable cost (A.R Sanadi et al. 1994).

Based on the process of the kenaf fiber, there are two ways for a production of kenaf fiber which are mechanical retting process and water retting process Mechanical retting is an easy process compared to water retting because this process is easy and just need a short time compare to water retting process that really need a properly process in a long term. Even though water retting processes produce a nice and smooth fiber, the cost is really high rather than mechanical retting that has a rough surface fiber but in a low cost produce.

Inorganic filler are commonly used in industry to make the materials of product stronger and long lasting. However filler have a bad side effects to the environment

sometimes can produce chemical reaction. This wouldn't be environmental friendly user. Mica is a one of inorganic filler that commonly used now day's industry. In a good ways, mica has an outstanding mechanical, thermal, electrical and chemical properties rarely found in any other products. In a bad ways, mica is chemically inert and can easily resist actions of heat, light, water, oil, solvents, alkali and various chemicals. Plus, inorganic matrix like PET have a high cost in recycling it and it cant be vanish easily as refer to Malaysian, they will throw the inorganic egg packaging after they used the egg. Organic filler is natural filler by using hemp fiber or wood flour. The fiber is one of the most valuable parts of the hemp plant. It is commonly called bast, which refers to the fibers that grow on the outside of the woody interior of the plant's stalk, and under the most outer part (the bark). Bast fibers give the plants strength, which is especially true with the hemp plant

Petroleum chemical based materials are expensive and not biodegradable. Kenaf fiber plant will be used as filler, recycled newspaper as matrix material and starch will be as a hardener. In this case, all the materials are come from natural source. Mostly, materials for cushioning or foam packaging are made from polymer. Polymer or plastic mostly are not biodegradable. So, by using these entire natural sources at the same time this research can support the Malaysian Campaign which is 3R (reused, recycled and reduced) that been launched by Malaysia Plastic Forum at One Utama Shoopng Centre (Tan Karr Wei et, al 2007). This campaign is about to educate the public to less used plastic bags and reused it. So, Malaysia can save landfills rather than open the new one. Figure 1.3 below shows the benefit of using kenaf fiber as filler in products based on this research.