



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS FOR DEVELOPMENT OF NATURAL BASED FOOD PACKAGING PROCESS

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (MAINTENANCE TECHNOLOGY) with Honours.

by

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ABSTRAK

Serat semula jadi merupakan sumber yang boleh diperbaharui. Hal ini kerana ia adalah alternative yang seseuai untuk menggantikan sintetik dan jenis tetulang. Selain itu serat kenaf merupakan serat yang mempunyai kos yang rendah, ringan, mesra alam dan penghasilan yang mudah. Malahan itu juga beras pulut dipilih untuk campuran semulajadi mempunyai sifat-sifat mekanikal yang baik. Oleh itu, tujuan kajian ini dibuat ialah untuk menghasilkan rekaan dan analisis berkaitan dengan pembungkusan makanan. Hal ini kerana sebelum ini pembungkusan makanan diperbuat daripada bahan yang boleh memudaratkan kesihatan seperti Polystrene. Selain itu, tujuan kajian ini adalah untuk membuat komposit baru diantara beras pulut dan serat kenaf. Gentian kenaf dan beras pulut digunakan dalam peratusan yang berbeza untuk mendapatkan komposit yang sesuai untuk membuat pembungkusan makanan. Untuk mendapatkan sampel, beras pulut dimasak kemudian dicampurkan dengan serat mengikut peratusan yang telah dibuat. Sampel diambil sebanyak 14 sample dimana ia merangkumi 0%, 30%, 35%, 40%, 45%, 50% dan 55%. Jarak diantara peratusan ini dibuat melalui kajian yang pernah dibuat sebelum ini. Sample ini dibahagikan 2 kategori iaitu 1 minggu dan 2/3 hari untuk pengerasan. Hal ini bertujuan untuk mendapatkan perbezaan pengerasan terhadap sampel. Selepas pengerasan, sampel ini diuji dengan ujian tegangan untuk menentukan modulus keanjalan bagi sampel itu. Sampel yang terbaik ialah 40% iaitu 2.945 GPA. Sampel yang terbaik diperlukan dalam pembuatan pembungkusan makanan.

ABSTRACT

Natural fibers are renewable sources. This is because it is the ideal alternative to replacing synthetic and reinforcing types. In addition, kenaf fiber is a fiber that has low cost, light weight, environmentally friendly and easy production. In fact, the glutinous rice is selected for the natural mixture to have good mechanical properties. Therefore, the purpose of this study is to produce design and analysis related to food packaging. This is because previously food packaging was made of substances that could be harmful to health such as Polystyrene. In addition, the purpose of this study was to create new composites between glutinous rice and kenaf fiber. The kenaf and glutinous rice are used in different percentages to obtain suitable composites for making food packaging. To get a sample, cooked glutinous rice is then mixed with fiber according to the percentage that has been made. Samples were taken as 14 samples which included 0%, 30%, 35%, 40%, 45%, 50% and 55%. The distance between these percentages is made through previous research. The sample is divided into two categories: 1 week and 2/3 days for hardening. This is to obtain a hardening of the sample. After hardening, this sample was tested with a tensile test to determine the modulus of elasticity of the sample. The best sample is 40% which is 2.945 GPA. The best samples are needed in the manufacture of food packaging.

DEDICATION

I dedicated this report to my beloved parents, supervisor and friends for their support, and great guidance to complete the bachelor degree project successfully

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CHAPTER 1

INTRODUCTION

1.1 Background

Current today, manufacturing in food packaging sector is widely used in the world. Additionally, food packaging is getting high demand as food packaging is a daily routine used for storing food. This is because packaging can store and protect food from physical slump, maintaining food quality and hygiene. However, some examples of chemicals that affect food such as gas exposure, humidity and light. Besides that, it can also prevent food from vibrating during transportation and distribution

Extending the shelf life of food products is the basis of the food supply chain and it is an important thing in the packaging basics. Reducing a lot of cost to a food product and facilitating production helps a lot for packaging use. Additionally, it can also provide a wide range of food products. Packing also reduces the risk of harassment and safety. This is because the product package is a face or it represents the identity of a product. In addition, it can also communicate important information about food. This is to enable customers to know or make wise choices for their will or desires.

Fibers that can act as reinforcement in classification in 2 categories such as natural or synthetic. In addition, these fibers are often used in industries such as cars, medical, aircraft and electronics. In fact, fibers show the improvement of eco-friendly and biodegradable composite materials. Biodegradability, availability, low density is the potential advantage of natural fibers compared to synthetic fibers.

Natural fibers have its deficiencies from the industrial sector. This is because for the past few years the natural fibers reinforced composites have received too high demand in advertising applications. In this high-tech era, the use of synthetic materials in engineering showed a reduction as green product in the composite field showed increasing demand. The most popular natural fibers are cellulose or lignocellulose. This is because the reinforcement in fiber-reinforced composites uses cellulose or lignocellulose in enhancing the mechanical properties of the material.

In this world, there is a kind of source for natural resources one of them is kenaf. Economic and ecological advantages are the sources of cellulose for kenaf plants. In Malaysia, kenaf fibers become very popular. This is because it is one of the natural ingredients that can contribute to the development of eco-friendly resources. Examples of industries that use this natural material are the furniture industry, sports and food packaging. The high demand of plastic industry to produce petroleum-based materials led to the rapidly expanding research of kenaf composites.

Various applications that use long fibers plastic kenaf can be used if these properties are not comparable to existing synthetic composites. This is because, kenaf can be in the form of long fibers, mechanical properties that can be determined in the use of industrial applications such as insulation seals. In this study, analyzing the behavior of natural fibers or polymer composites is very important in comparison with its synthetics to conclude whether the natural fibers are technically capable of replacing synthetic fibers

1.2 Objectives

1. To design and analyse a food packaging
2. To develop food packaging based on new composition of with Natural Fiber/Natural Binder

1.3 Work Scope

The scope of project is very important in order to support in the build and development process of this project. Listed below are the descriptions of scope for this project

- I. Design and analyse a food packaging using Solid Work Software
- II. Developing of food packaging with a new composite by combination Natural Fiber and Natural Binder using hand lay-up molding technique

1.4 Problem Statement.

Over the last few decades, households have become increasingly busy with their daily routine and has made it an important factor in purchasing such as packing something, whether food, clothing or daily necessities. While packaging can prevent damage or safety, it also has a weakness in the material, cost and environmental aspects. As an example, it can also affect the environment.

Based on Henriette et al., 2009 has explained nowadays, most materials used for food packaging are practically undegradable, representing a serious global environmental problem. New bio-based materials have been exploited to develop edible and biodegradable films as a big effort to extend shelf life and improve quality of food while reducing packaging waste. However, the use of edible and biodegradable polymers has

been limited because of problems related to performance (such as brittleness, poor gas and moisture barrier), processing such as low heat distortion temperature and cost.

Polystyrene is one of the polymers. Polystyrene is a petroleum-based plastic made from the styrene monomer. Beside that most people know the name is Styrofoam. The biggest environmental health concern associated with polystyrene is the danger associated with Styrene, the basic building block of polystyrene. Styrene is classified as a possible human carcinogen by the EPA and by the International Agency for Research on Cancer (IARC). Meanwhile toxic chemicals leach out of these products into the food that they contain (especially when heated in a microwave). These chemicals threaten human health and reproductive systems.

Based on (Chandra et al., 2016) has explains that this Styrofoam is very harmful to humans. This is because it increases from cancer like leukemia, depression, headache, fatigue, weakness and minor effects on kidney function. Additionally, the properties of Styrofoam make it very difficult to recycle. In fact, it also contributes to the accumulation of many solid waste disposal areas. In addition, the customer likes Styrofoam and low cost making the most widely used demand for food packaging. However, by making it very light, the cost of Styrofoam transportation to the recycling plant is not interested in recycling.

Good insulation properties and low cost make Styrofoam often used in food industry services. However, this Styrofoam will often be contaminated with food residues and it requires cleaning before being processed for recycling. This will lead to rising costs and making it less economically viable for recycling. Styrofoam will become fragile if it is exposed to UV sunlight. Photodegrading will be small pieces and will turn into powder. In facts, when animals like birds eat Styrofoam that has become dusts, it will cause the animal digestive system to become stingy and cause death and starvation.(Chandra et al., 2016)

CHAPTER 2

LITERATURE REVIEW

2.1 Food Packaging

Based (Marsh et al., 2007) has explained that food packaging used to protecting the food from damage which does not allow the food to be suitable for consumption. This is because it can lead to food poisoning if the food is not covered. The goal of food packaging is to satisfy the needs of the industry and consumer's desires. Additionally, minimizing the environmental impact is also one of the goals of food packaging. Packaging is the mixture of preservation, food science and food science. (Trinetta, 2016)

2.1.1 Material of packaging

In food industrial, to get the right selection of the packaging material, there are many materials can be used in producing which is metal (aluminum), glass and plastic. Most popular forms of packaging come from metal. This is because of its good sifits such as physical protection, recycling and subsequently receiving acceptance to consumers. Aluminum and steel are the 2 metals predominantly. For example, aluminum has a corrosion resistance. However, glass is one of the ingredients used to make food packaging. This is because, the glass has a very long history in food packaging. Materials such as silica, sodium carbonate (molten agent) and limestone / calcium carbonate and alumina (stabilizers) will be heated in 1 mixture so that these substances are diluted into thick liquid mass and poured into mold

Glass packaging has advantages and disadvantages where the advantages of the environment are renewable and recyclable, for lack of it, it can increase the cost of the carrier. This is because the packaging of this glass is heavy and easy to break. (Marsh., et al 2007). In addition, plastic is also one of the sources or materials used in the manufacture of food packaging. In fact, plastic is made of condensation polymerization (polycondensation) or polymerization of the monomer unit (polyaddition). Thermoset and thermoplastic are the two main categories of plastic. Cannot be formed and irreversibly when heated is a polymeric feature available on the thermoset. In addition, thermosets have long and strong durability. For thermoplastic, it is easy to mold into various products such as bottles, jugs, plastic plates. In fact, it is also best suited for food packaging. The advantages of thermoplastics are that it can be recycled.(Bugusu et al., 2007)

2.2 Introduction Of Composite

From (Elanchezhian et al., 2017) the composite is mixture of two resources in which one of the materials called the reinforcing phase such as fibers and particles. Addition, other the material called matrix phase which is inserted in alternate materials. Composites are usually not only for their structural properties, but also for electrical, thermal, tribological, and environmental applications form. Beside that's the composites typically have a fiber that is harder and stronger than the matrix phase. However, the matrix phase is more ductile than the fiber and thus performances as a source of composite toughness. According to (Vijaya et al., 2018) the composites are multifunctional material system that provide characteristic not obtainable from any discrete material.

2.2.1 Classification of Fiber

Fiber is an important source of material. Despite the fact that they have diverse properties but they additionally have similarities to each other. Some fiber, commonly natural fiber, just exist in fiber frame and their extraordinary properties whether mechanical or of surface have been utilized for times, but today numerous are finding increasing applications in mechanical applications and reclaim markets for materials, which had been lost to synthetic fibers. In option, these fibers likewise have their own group which is natural fiber and synthetic fiber. Process fiber are exceedingly present in our daily life and can be either natural fiber (recovered cellulose) and synthetic (made with petrochemicals). (Alkbir et al., 2016)

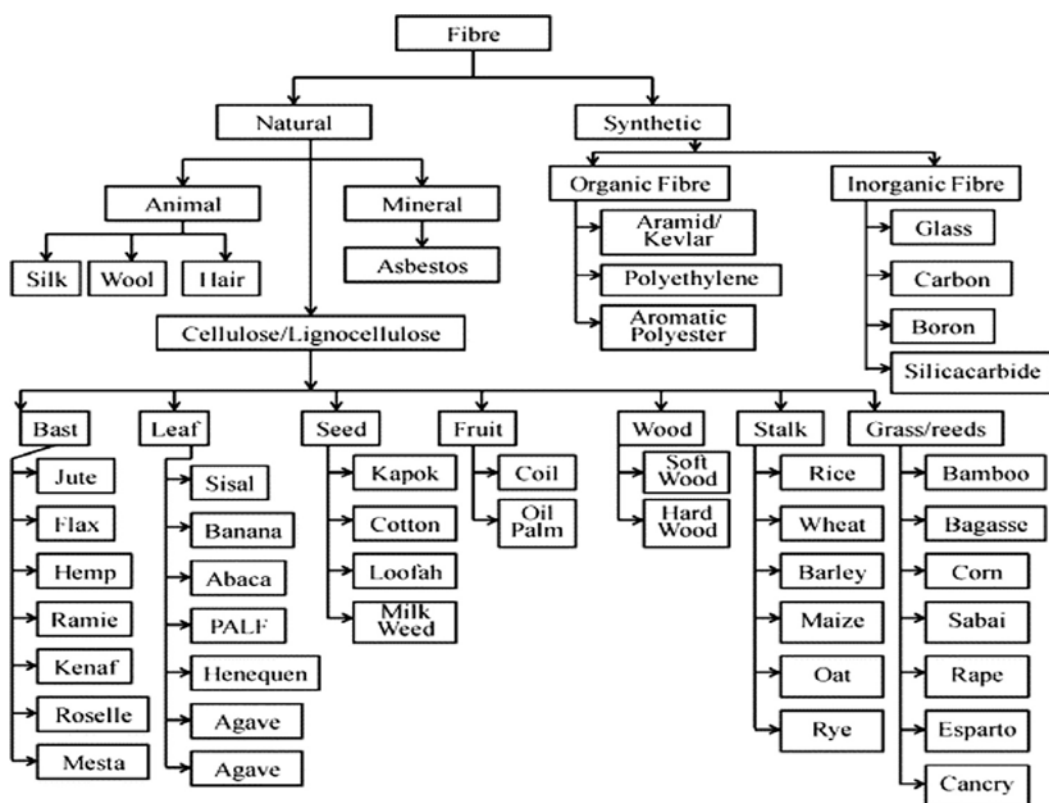


Figure 2. 1: Classification of Fiber (M.F.M Alkbir et al.,2016)

2.2.2 Type Of Fiber

In categories of fiber, there have 2 categories of the fiber which is natural and synthetic fiber. Based on (Codispoti et al., 2015) has state the natural fiber are divided into 3 categories which is vegetable, mineral and animal. Each of these classes is divided into some sub-categories. Beside that's for the synthetic fiber, there have 2 categories which is organic fiber and inorganic fiber. In these categories, there have a sub- category in synthetic fiber. Based on (M. Sivapragash et al., 2013) explained that natural fiber are cheap and have a great of stiffness. Figure 2.2 shows that the example of natural fiber which is silk, cotton, coir and wool. Beside that`s the ecological effect is littler since the natural fiber can be thermally recycled and fibers comes from a renewable resource



Figure 2. 2: The Example of Natural Fiber, Silk, Cotton, Coir, Wool

2.3 Synthetic Fiber

Synthetic fiber used in polymer composites is ageing because they are expensive and non-biodegradable. They are polluting the environment and limited in advanced of applications. Lately, the industry which is composite component in sports, automotive, construction and other heavy industries has focused about the unending and renewable reinforced composites. This interest involves a variety of substances that vary from synthetic fibers to natural fibers. This is due to meet the composite