UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF PINEAPPLE LEAF CUTTER (PLC) DEVICE IN PINEAPPLE INDUSTRY

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

by:

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DECLARATION

I hereby, declared this report entitled “Design and development of portable leaf cutter device in pineapple industry” is result of my own research except as cited in references

Signature :

Author’s Name : MARWAN SHAFIQ BIN MOHD LATFI

Date : 16/12/2017

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Maintenance Technology) with Honour. The member of the supervisory is as follow:

……..

(Project Supervisor)

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ABSTRAK

Kebiasaannya, pekerja atau penduduk kampung akan menghadapi masalah ketika memotong daun nanas. Ciri-ciri daun nanas yang mempunyai daun yang tajam dan berduri membuatkan ia sukar untuk dipotong. Oleh sebab itu, kemungkinanan untuk tercedera ketika memotong daun nanas ini akan lebih tinggi. Menurut kenyataan ini, tujuan projek ini diadakan adalah untuk membuat satu inovasi dengan merekebentuk satu produk baru yang dinamakan "Pineapple Leaf Cutter" (PLC) bagi menyelesaikan masalah yang dihadapi oleh pengguna yang ingin memotong daun nanas. Oleh dengan itu, produk ini adalah hasil inovasi dari beberapa kajian yang sebelum ini menggunakan pisau atau parang untuk memotong daun nanas dan dari kajian ini mendapati mereka memerlukan banyak tenaga untuk memotong daun nanas. Kaedah "3D solid modelling" yang digunakan untuk merekabentuk "pineapple leaf cutter" (PLC) ini. Projek ini dihasilkan adalah untuk menjimatkan masa dan tenaga bagi pengguna. Selain itu, produk ini direka sebagai pemotong daun nanas mudah alih kerana ciri-cirinya yang kecil berbanding mesin, supaya ia mudah disimpan dan digunakan.Untuk mendapatkan dan menghasilkan struktur produk PLC yang baik, beberapa bahan logam digunakan seperti keluli lembut dan keluli tahan karat. Semasa menghasilkan produk ini, ia melibatkan beberapa proses pemasangan seperti rolling, drilling, grinding dan kimpalan. Kesimpulannya, hasil dari projek ini berjaya untuk membantu pengguna bagi memudahkan kerja mereka untuk memotong daun nanas dengan amaun yang banyak dalam satu masa dan juga produk ini sangat sesuai digunakan dalam industri nanas.

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ABSTRACT

Normally, workers or villagers will face a problem when they want to cut the pineapple leaves. The characteristics of pineapple leaves that have sharp and thorny leaves make it difficult to cut. Therefore, the possibility of being injured when cutting this pineapple leaf will be higher. According to this statement, the purpose of this project is to create an innovation by designing a new product is call "Pineapple Leaf Cutter" (PLC) to solve the problems that faced by consumers who want to cut the pineapple leaves. Therefore, this product is the result of innovation from several studies that previously used a knife or machete to cut the pineapple leaves and from this study found that they needed a lot of energy to cut the pineapple leaves. The "3D solid modeling" method used to design this "pineapple leaf cutter" (PLC). This project is designed to save consumer time and energy. Additionally, this product is designed to be a portable pineapple leaf cutter because of its small features compared to the machine, so that it can be easily stored and to be used. In order to obtain and produce a good PLC product structure, some metal materials are used such as soft steel and stainless steel. When producing this product, it involves several installation processes such as rolling, drilling, grinding and welding. In a conclusion, the results of this project have been successful in helping consumers to facilitate their work to cut more pineapple leaves in one time and this product is particularly suitable in pineapple industry.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Pineapple leaf is a plant that has 50-150cm height, elongated leaf like the sword with spiked or not spiked edge, the length of 80-150 cm. Pineapple is a Xerophyte plant and includes plants that are very resistant to drought conditions because they are classified as critically Crassulacean Acid Metabolism. Depending on the species or type of plant, pineapple leaf length is between 55cm to 75cm by 3.1cm to 5.3 cm wide and 0.18cm thick leaves of up to 0.27cm (Hidayat, 2008). Research shows that the leaves of the pineapple plant contain approximately 3% of strong white silky fibres. These valuable long fibres can be used in industrial applications in place of jute and other bast fibers. They also can be used to make heavy fabrics such as upholstery material or curtains, and in industrial applications such as tyres and conveyor belts. The aim of this project is to design and develop a machine that can facilitate the work to cut the leaves from the pineapple tree, hence the leaves can be extract as fiber which can be a new source of raw material to the industries and can be potential replacement of the expensive and nonrenewable synthetic fiber.

1.1 Problem Statement

As known, pineapple is among one of the Malaysia local fruit. Other than savoury fruit, pineapple leaf also has many uses. Among the usability pineapple leaf fiber is now popular in commercial textile industry. There are already many

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mechanical machine to obtain fiber from pineapple leaf, but until now, a mechanism to cut the pineapple leaf easily to get the fiber is still unavailable. People nowadays cut the pineapple by using knife or machete and exposed to danger because they easily injured when cuts through the thorns from pineapple leaves.

1.2 Objective

The objectives of this study are:

i. To generate a concept design of pineapple leaf cutter machine
ii. To develop a prototype of pineapple leaf cutter machine

1.3 Work Scope

In order to achieve the objective of this study, the scopes of this study are prepared as shown below:

i. This machine is limited to cut pineapple leaf only.
ii. The machine can cut more than a piece of leaves but not more than a bunch of pineapple tree at one time.
iii. The machine is portable and easy to use.

1.4 Result Expectation

i. The design of pineapple leaf cutter device is easy to use and portable.
ii. The development of this pineapple leaf cutter can cut more than a piece of leaves but not more than a bunch of pineapple tree at one time.

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter covered the study about a pineapple leaf fiber and how the extraction of pineapple fibers for making commercial product. This chapter also reviewed previous study from research or paper and article that related with fiber

2.1 Natural Fiber

It is believed that source of petroleum based products are limited and uncertainty. So an alternative with cheap sustainable and easily available raw material is required. The countries growing plant and fruit are not for only agriculture purpose but also to generate raw materials for industries. Most of the developing countries trade lignocellulosic fibers for improving economic condition of poor farmers as much as country support. Near about 30 million tonnes of natural fibers are produced every year and used as component of many manufacturing processes like clothing, packaging, paper making, automobile, building materials, and sport equipment. Natural fibers composites are eye-catching to industry because of its density and ecofriendly nature over traditional composites. Other than plant fibres, various animal fibres also have different types such as products from the wool, silk, feathers, avian fibre, and animal hairs which are prime resource. Fruit fibres are taken from fruits like coconut (coir) fibre. Stalk fibres are collected from husk and straw of crops like wheat, rice, barley, and so forth. Tree wood can also be used as fibre. Natural fibers have been used for a long time in many developing countries as cement materials. It can be

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extracted from the bast stem, leaf, and seeds from the plants in a bundle form. Therefore it is also called fibre bundles.

Natural plant fibres are cell walls that occur in stem and leaf parts and are comprised of cellulose, hemicelluloses, lignin and aromatics, waxes and other lipids, ash and water-soluble compounds. The chemistry and structure of fibres determine their characteristics, functionalities and processing efficiencies. Extraction method of fibres is similar in both bast stem and leaf, while seed fibres have many methods like cotton lint extracted from ginning process (Asim et al., 2015). The variety of fibres in nature is enormous. Depending on their function within the plant, fibres may be located in different regions of the plant. The location of fibres in the stem depends on the species. Plant fibres can be found, for example, within stems of monocotyledonous and dicotyledonous plants and dicotyledonous and gymnosperm trees at different positions. Natural fibres used for technical applications range from secondary xylem fibres such as wood fibres for paper production, phloem fibres such as hemp bast fibres, extra-xylary fibres such as sisal and seed hairs such as cotton. Figure 2.0 gives an overview of the broad range of organic and inorganic natural fibres. Natural fiber also will take a major role in the emerging "green" economy based on energy efficiency, the use of renewable materials in polymer products, industrial processes that reduce carbon emission and recyclable materials that minimize waste. Natural fibers are kind of renewable resources, which have been renewed by nature and human ingenuity for thousand years.

This paper focus on different properties of natural fibers (such as hemp, jute, bamboo and sisal) and its application which were used to substitute glass fiber (Ashik et al., 2015). Other than that, natural fibers and its composites utilized as a part of different commercial and engineering applications. Based on this article (Sanjay et al., 2016) it helps to provide details about the potential use of natural fiber and its composite materials, mechanical and physical properties and some of their application in engineering sectors. Besides that, natural fibers are getting attention from researchers and academician to utilize in polymer composites due to their eco-friendly nature and sustainability. According to this review article, the aim is to provide a comprehensive review of the foremost appropriate as wll as widely used natural fiber reinforced polymer composites (NFPCs) and their application. In addition, it presents

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summary of various surface treatments applied to natural fibers and their effect on NFPCs properties. The properties of NFPCs vary with fiber type and fibers reinforcements thermoplastics composites were studied (Mohammed et al., 2015). The scheme subdivides the organic fibres into plant and animal fibres. Refer Figure 2.1 and Figure 2.2 below.

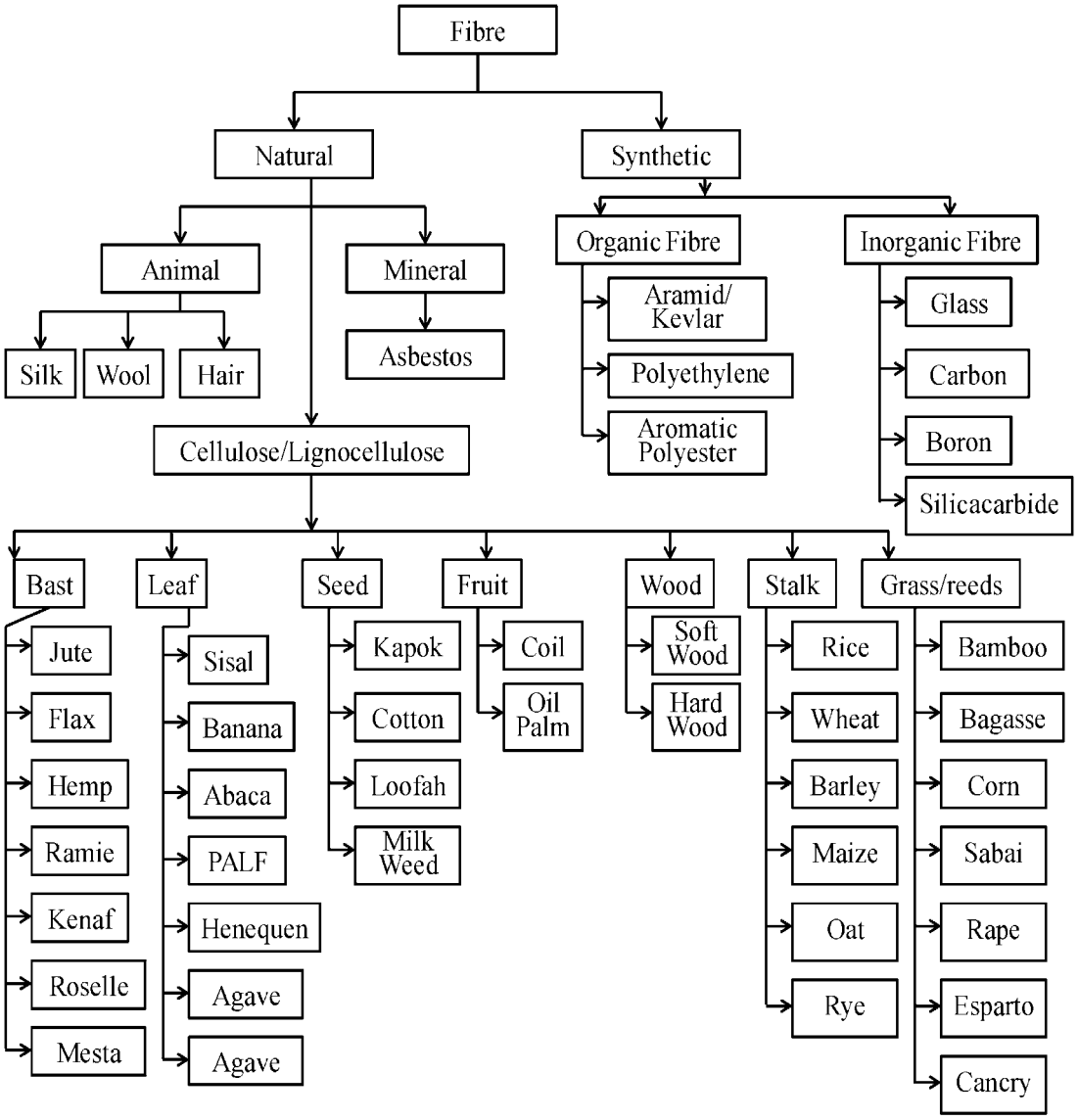

Figure 2.0: Overview of Natural Fibres

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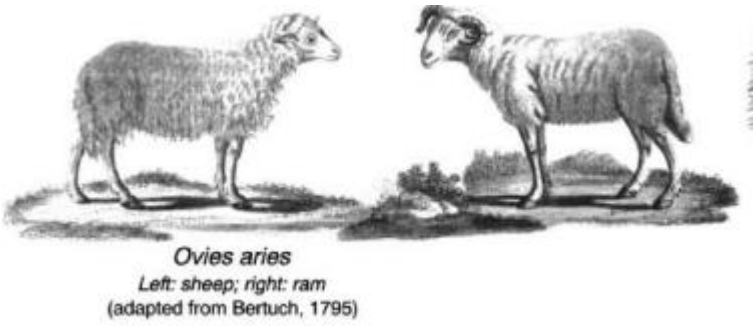

Figure 2.1: Example of Animal Fibre Sources

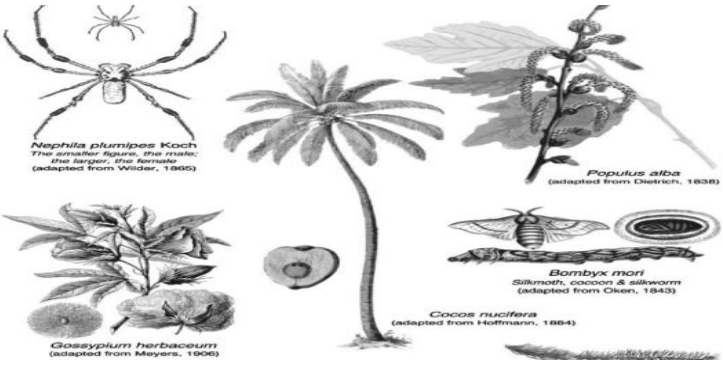

Figure 2.2: Example of Plant Fibre Sources.

2.1.1 Fiber Types

There are multitude of plant fibres that are used for technical applications or have the potential to be utilised. In the plant body they can appear as the dominating tissue type, in a ring-like fashion, or as separate clusters, organised in a characteristic pattern or just randomly distributed. Below is the comprehensive picture of where fibres can be located in various plant bodies. The schematic drawing is provided in the Figure 2.3. This is intended to provide a rough scheme of where technically utilised fibres can be found in plant stems, refered to Esau's Plant Anatomy (Evert, 2006).

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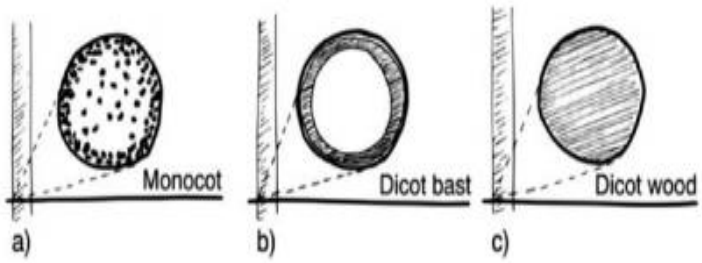

Figure 2.3: Schematic Drawing Showing Possible Locations of Fibres Within Stems of Monocotyledonous And Dicotyledonous Plants And Trees.

2.1.1.1 Fibres from Monocotyledonous Plants (leaves and stems)

In the production of natural fibres, sisal plays a dominant role in the field of leaf fibres. A total of 0.33 million of sisal is produced worldwide (0.01% of the production of all natural fibres). Sisal is well suited for technical applications because of the interesting properties of the fibres. The lifespan of a typical sisal plant varies from 7 to 15 years, depending upon cultivars, genetic species, climate, growing conditions and soil quality. It is classified within the family Agavaceae under genus *Agave*, and further subdivided into two subgenera, namely *Agave* and *Littaea* (Berger, 1915). There are several botanical species identified. However, some commonly found species include *Agave sisalana* and *Agave americana* (the century plant) are shown in Figures 2.4. It is also sometimes referred to as the century plant, and is now widely cultivated for its handsome appearance. The leaf in its variegated form has a white or yellow marginal or central stripe from base to apex, thus offering an ornamental appearance. As the leaves open up from the centre of the rosette, the impression of the spines on the edge is clearly visible on the still erect younger leaves. The leaves mature very slowly and die after flowering, but they are easily propagated by the offshoots from the base of the stem.

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