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Signature : .....  
Name of Supervisor : .....  
Date : .....

**THE STUDY OF PALM OIL FIBER FOR FILTRATION APPLICATION**

**YONG POH YEE**

**This report is submitted in partial  
fulfillment of the requirements for the award of  
the Degree of Bachelor of Mechanical Engineering (Structure and Material)**

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Universiti Teknikal Malaysia Melaka**

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## PENGAKUAN

“Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya telah jelaskan sumbernya”

Tandatangan : .....

Nama Penulis : YONG POH YEE

Tarikh : .....

## DECLARATION

“I hereby, declare this thesis is the result of my own research except as cited in the references”

Signature : .....

Author : YONG POH YEE

Date : .....

*Specially dedicated  
to my beloved family and friends*

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## ABSTRAK

Pokok minyak sawit adalah sejenis tumbuhan biasa di Malaysia tetapi ia adalah satu asset yang memainkan peranan penting dalam pembangunan ekonomi. Malaysia adalah pengeluar terbesar dan pengeksport produk minyak kelapa sawit dalam dunia ini dan sawit pembuatan sektor adalah satu industri utama dalam negara ini. Sementara itu, Tandan-tandan Buah Kosong (EFB) adakah produk sisa yang dapat diperolehi selepas tandan-tandan buah itu ditekan pada kilang minyak dan minyak itu mengambil. Serat kelapa sawit dikeluarkan daripada bungkusan vaskular kelapa sawit dalam tandan buah kosong (EFB). Oleh itu, serat sawit dengan banyaknya boleh didapati di Malaysia. Dalam turas pengeluaran industri, bahan yang paling biasa digunakan untuk pengeluaran penapis adalah gentian sintetik yang dilalui proses-proses kimia. Dalam tahun-tahun kebelakangan ini, banyak minat dan perhatian orang awam telah dicetuskan bagi membangunkan bahan-bahan komposit daripada serat semula jadi kerana masalah isu-isu pencemaran alam sekitar dan penyusutan dan ketidakpastian kira-kira sumber petroleum. Tesis ini bertujuan untuk mengkaji kelapa sawit serat dan ciri-ciri biasanya dalam penggunaan penurasan industri. Ia mendedikasikan memerhati serat struktur ukuran yang berbeza dan membuat perbandingan tentang perbezaan mereka dalam keadaan saiz pori melalui ujian porositas dan juga meletup ujian kekuatan yang digunakan untuk mengetahui kekuatan meletup yang serat kelapa mampu menahan. Penelitian ini mengungkapkan bahawa serat kertas berasaskan sawit memberikan kekuatan meletup lebih tinggi dan lebih besar dalam saiz pori berdasarkan penilaian ujian di mana ujian standard untuk menyiasat prestasi Filtrasi adalah merujuk pada Standard ASHRAE 52,1 dan 52,2. Kerja ini mengesahkan bahawa kertas serat kelapa akan awet dan tahan lama kerana kekuatan tinggi dari bahan kelapa serat berbanding dengan kertas penapis debu sekarang. Selain itu, beberapa perbaikan juga dianjurkan untuk membuat pendekatan lebih ke penapis hari ini.

## ABSTRACT

Palm oil tree is a common type of plant in Malaysia but it is an asset that plays important role in economy growth. Malaysia has been the largest producer and exporter of palm oil products in the world and thus making oil palm sector one of the major industries in this country. Meanwhile, Empty Fruit Bunches (EFB) is the natural waste products obtained after the fruit bunches are pressed at oil mills and the oil extracted. Oil Palm Fiber is extracted from palm oil vascular bundles in the empty fruit bunch (EFB). Hence, the oil palm fiber is abundantly available in Malaysia. In filter manufacture industry, the material that is most frequently used to manufacture a filter is synthetic fiber which is created by chemical processes. In recent years, much interest has been triggered to develop composite materials from natural fiber due to the intensified problem in environment pollution issues and the depletion of and uncertainty about petroleum resources. This thesis is purposed to study the palm oil fiber and its characteristic properties in filtration application industry. It is dedicated to observe the fiber structure of different size of and make comparison on their differences in pore size condition through porosity testing and also the burst strength testing which used to know for bursting force that palm fiber able to resist. This study revealed that the palm fiber based paper provides the higher burst strength and greater in pore size based on the evaluation of testing where the testing standard to investigate the filtration performance is refer to the ASHRAE Standard 52.1 and 52.2. This works verified that palm fiber made paper will be durable and long lasting to use due to the high strength of palm fiber material in comparison with current dust paper filter. Besides, some improvements are well recommended to make it more approach to the current pre-filter.



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**LIST OF SYMBOLS**

$\Delta P$	=	Differential Pressure, $\text{kgf/cm}^2$
P	=	Differential Pressure Across the Medium, Pa
L	=	Depth or Thickness of the Bed or Medium, m
Q	=	Volumetric Flow Rate of Fluid, $\text{m}^3/\text{s}$
$\mu$	=	Kinematic Viscosity of the Fluid, $\text{Ns/m}^2$
A	=	Area Occupied by Flow, $\text{m}^2$

**LIST OF ABBREVIATIONS**

AHU	=	Air Handling Unit
ASHRAE	=	American Society of Heating, Refrigeration, and Air Conditioning Engineer
CPO	=	Crude Palm Oil
EFB	=	Empty Fruit Bunches
ELV	=	End of Life Vehicle
EU	=	European Union
FFB	=	Fresh Fruit Bunch
HVAC	=	Heating Ventilating and Air Conditioning
MERV	=	Minimum Efficiency Reporting Value
OD	=	Outer Diameter
OPEFB	=	Oil Palm Empty Fruit Bunch
PSE	=	Particle Size Efficiency
SEM	=	Scanning Electron Microscope
USDA	=	U. S. Department of Agriculture

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background Study

The oil palm sector is one of the major industries in Malaysia. Since the 1970s, Malaysia has been the largest producer and exporter of palm oil products in the world. Palm oil industry in Malaysia is currently the number 2 export commodity in the country. According to the Figure 1.1 USDA report, the palm oil production in Malaysia is increasingly year by year start from 1979.

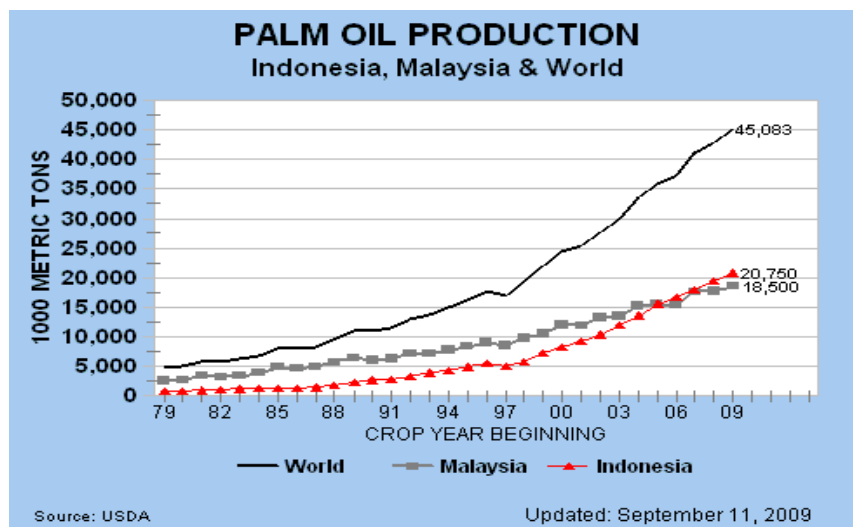


Figure 1.1: The palm oil production in Malaysia, Indonesia and World  
(Source: www.cmegroup.com (2009))

Based on the intertek report, the export of oil palm was 1.12 million tons till the July 2009 in Malaysia. Oil palm industry provides job opportunity directly to 500 thousand people and indirectly to 2 million people. Oil palm plays an important role in Malaysia economy.

The Empty Fruit Bunches (EFB) is one of the waste products produced from palm oil. In total of renewable biomass (trunks, fronds, shells, palm press fiber and the empty fruit bunches) are produced each year, the empty fruit bunches (EFB) represent about 23% of this total. The Empty Fruit Bunches (EFB) is the residue left after the fruit bunches are pressed at oil mills and the oil extracted. In more detail, an average oil palm mill can handle about 100 metric ton of fresh fruit bunches daily. At the mills where oil extraction takes place, solid residues and liquid wastes are generated. The solid residues, mainly EFB are more than 20% of the fresh fruit weight.

EFB is a suitable raw material for recycling because it is produced in large quantities in localized areas. Normally in the past, it was often used as fuel to generate steam at the mills. The EFB is now used mainly as mulch. Placed around young palms, EFB helps to control weeds, prevent erosion and maintain soil moisture. The EFB is composed of 45% to 50% cellulose and about equal amounts (25% to 35%) of hemicellulose and lignin. Hence, EFB is fibrous kind of material and the palm oil fibers stick together to form vascular bundles. The EFB was very fibrous. Even when it was piled up to more than 1.5 m in height, the bottom mass was still loose and porous. Therefore, air can pass through freely with this type of characteristics. Due to the advantages, we must fully use the waste product to convert it into useful final quality products or to diversify some product.

## 1.2 Problem Statement

Basically, the pre-filter in current market are divided to four main types; there are washable filter, disposable filter, HEPA filter and carbon filter. Most of the current pre-filter for Air Handling Unit (AHU) is made by synthetic fibers such as polycarbonate fibers, pleated media or polyurethane foam. Malaysia is the largest producer and exporter of palm oil products in the world. Moreover, the palm oil will come out some waste product after the fruit bunches are pressed at oil mills and the oil extracted. One of the waste products is the Empty Fruit Bunches (EFB).

As the information in market listed, it is still have no a pre-filter made by palm oil fiber which used for HVAC system. Hence, we should probably make use on this source. Natural fibers are the nature fiber materials which is environment friendly. Due to the cost profit, natural fibers is a good choice where total cost of natural fibers made product will be less than any other type of fiber utilized in the industry. Therefore, the natural fiber made product is much favorable due to the phase of profit. Furthermore, the process from uninstal a filter for cleaning purpose until install back in air handling unit (AHU) is very take time. Principally, it is not fulfill the concept of business due to the waste of human time and cost. But for the palm oil fiber filter, we can just replace a palm oil fiber made new filter which is low cost. For example, the AHU room and the cleaning room is large distance apart, we are directly replace a low cost new filter is much better rather than clean or wash a filter and setup back the filter again. Based on this, the delivery product time, cleaning time and setup/assembly time can be reduce or save.