UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BIOFUEL FIRE STARTER FROM EMPTY FRUIT BUNCHES OF OIL PALM FRUIT WASTE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Process and Technology) (Hons.)

by

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TAJUK: **Biofuel Fire Starter from Empty Fruit Bunches of Oil Palm Fruit Waste**

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I hereby, declared this report entitled "**Biofuel Fire Starter from Empty Fruit Bunches of Oil Palm Fruit Waste**" is the results of my own research except as cited in references.

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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 in Manufacturing Engineering Technology (Process and Technology) with Honors. The member of the supervisory is as follow:

………………………………

(Project Supervisor)

ABSTRAK

Penyala api adalah produk keluaran kilang dibina untuk dijadikan kayu api. Penyala api direka untuk menjadi murah, dan membantu untuk mewujudkan api dan lebih cekap daripada api kayu. Penyala api secara tradisinya dihasilkan menggunakan dua kaedah. Pertamanya, hanya menggunakan hampas kayu yang dimampatkan dan kedua adalah campuran hampas kayu dan paraffin yang dimampatkan sekali ke dalam bentuk tertentu. Penyala api baru yang bersih pencemaran kini telah dibangunkan dengan menggunakan sisa gentian daripada tandan kelapa sawit, EFB. Tidak seperti penyala api hampas kayu, penyala api ini dibakar tanpa perlu menebang pokok untuk penghasilannya. Penyala api ini telah dicipta menggunakan EFB dan minyak kelapa dara, VCO sebagai pengikat. Sebuah jig khas telah direka dan digunakan dalam membuat 20 sampel penyala api. Jig ini menggunakan daya mampatan dari berat yang berkuantit 6 kilogram. Daya dikenakan pada EFB melalui sebatang rod keluli berdiameter 15 milimeter, mm selama 10 saat dan daya (berat) dikenakan adalah lebih kurang sekitar 59 Newton. Diameter acuan yang digunakan ialah 15mm lebar X 20mm tinggi. Semua sampel perlu dikeringkan selama 24 jam. Hasil daripada pembakaran ujian menunjukkan bahawa masa pembakaran meningkat dengan jumlah pengikat kuantiti yang lebih tinggi. Keadaan ini mungkin disebabkan oleh VCO berlebihan dalam EFB. Daya dikenakan semasa proses fabrikasi memaksa VCO untuk meresap lebih ke dalam EFB. EFB mempunyai ciri higroskopi. Kesimpulannya, penyala api yang terbaik daripada EFB adalah dari sampel 3ml VCO kerana ia menunjukkan masa pembakaran yang paling lama di kalangan sampel lain.

ABSTRACT

A fire starter is a manufactured product constructed to be used as wood fuel. Fire starter are designed to be inexpensive, and helps to create fire and more efficiently than fire wood. Fire starter are traditionally made manufactured using two methods. The first used only compressed sawdust and second used sawdust and paraffin, which is mixed and extruded into a certain shape. A new cleaner fire starter has now been developed using waste fibre from oil palm fruit bunches, EFB. Unlike sawdust logs, it burns without having trees to be felled off due to producing fire starter. This firestarter were created using EFB and virgin coconut oil, VCO as binder. A special jig has been fabricated and used in making 20 samples of firestarter. This jig used compression force from 6kgs of weight. The force applied on the EFB through a steel rod in diameter of 15 milimeters,mm for 10 seconds and the force (weight) applied is approximately around 59 Newton. The diameter of the mold used is 15mm in diameter X 20mm height. All samples need to be dry for 24 hours. The result from burning test shows that the burning time increased with higher binder volume quantity. This situation may be due to excess VCO in the EFB. The force applied during fabrication process force VCO to diffuse more into EFB. EFB has hygroscopic properties. As the conclusion, the best fire starter from EFB is the 3ml of VCO because it shows the longest burning time among other samples.

DEDICATION

I dedicated this project to my loving family, my strong pillar. They have been so supportive throughout completing this project. This project is dedicated to my mother, Normala binti Abu Samah, my father, Ishak bin M Roni and not to forget my brother, Muhammad Asyraf bin Ishak who has encouraged me so much and whose encouragement has made sure that I give it all it takes to finish this project. Thank you.

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Above all, thank you to Allah S.W.T for giving me the strength, patience and courage that enables me to successfully completed this project. Peace and blessing be upon Muhammad S.A.W, the true messenger of Allah for his munificent bond of love to his community.

I want to express my sincerest gratitude and thankfulness to my supervisor, Madam Nooririnah binti Omar, for her endless guidance, helpful assistance and support as well as her big patience in helping me to complete this work successfully. It was tough for me but she was never not to assist me.

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Finally, my special words of appreciations go to my beloved family, for their never ending love and support through this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

TGA	-	Thermal Gravimetric Analysis
DSC	-	Differential Scanning Calorimetry
FTK	-	Faculty of Engineering Technology
OPT	-	Oil palm trunk
OPF	-	Oil palm frond
EFB	-	Empty fruit bunches
MF	-	Mesocarp fruit fibre
PKS	-	Palm kernel shell
POME	-	Palm oil mill effluent
MPOB	-	Malaysian palm oil board
UTEM	-	University technical of Malaysia Malacca
FEFB	-	fire starter from empty fruit bunches of oil palm waste
VCO	-	Virgin coconut oil

CHAPTER 1

INTRODUCTION

1.0 Background of Research

Fire creation, fire igniting or fire skill is the method of starting a fire artificially. Fire is a crucial tool in primary human cultural progress. It needs completing the fire trio, usually by starting the burning of a suitably combustible material. That is the traditional way of creating fire. Nowadays, there are much easier way in creating fire. There are few fire ignite tools in this modern day. One of it is matches which is a bunch of small made of wood sticks or firm paper with a coating that can be easily catch fire by friction. Another common fire ignition tool is lighters. It used ferrocerium "flint" for the spark, and gas fuels such as butane or liquid naphtha/gasoline-impregnated wick as the tinder and fuel. It is so simple to ignites, often using a wheel mechanism that when turned with the thumbs creates friction on the internal rod of ferrocerium "flint" and flings a shower of white -hot sparks into the tinder.

A fire starter is a man-made item developed to be utilized as wood fuel. Fire starter are designed to be low-cost, while being easy to ignite, burn longer, and more efficiently than fire wood. Fire starter are conventionally manufactured using two methods. The first use only compressed sawdust and the second uses compressed sawdust and paraffin, which is mixed and extruded into a certain form.

A new cleaner fire starter has now been developed using oil palm fruit bunches waste. Unlike sawdust logs, these burns without having no trees need to be chopped off to produce it. By using oil palm fruit waste, the wastes can be used to good by producing useful product. This will help the oil palm industry save their financial on handling the waste

There are some improvements that can be made is to enhance the properties of fire starter. One of it is by using organic binder like virgin coconut oil that will improve it burning period. Therefore, analysis technique that can be done is burning test. On this burning test, all the firing time of samples that will be fabricated will be recorded to makes comparison. Furthermore, this project will be held only in Faculty Engineering Technology (FTK).

1.1 Problem Statement

According to statistic year 2009, Malaysia has 3.75 million hectare of oil palm estate. Malaysia is the second largest maker and exporter of oil palm in the world, through crude production of 13.35 million tonnes per year. Production of bio-waste included kernel, shell, empty fruit bunch and fibre as below:

i. Kernel shell = 4.6 million tonnes per year
ii. Empty fruit bunches = 15.3 million tonnes per year
iii. Fibre = 8.6 million tonnes per year

Since Malaysia is the second highest producer in this industry, it has high potential to commercialize the biomass waste to produce a useful product. On top of that, using bio-waste to fabricate biofuel fire starter using organic binder to support national agenda which is green technology.

1.2 Objectives

The objectives of this study:

i. To fabricate biofuel fire starter from oil palm fruit waste using virgin coconut oil as the binder.
ii. To fabricate biofuel fire starter samples using a special jig.

1.3 Scope of study

Scopes for this project that will be carry out:

i. To fabricate biofuel starter from oil palm fruit waste using virgin coconut oil as organic binder.

ii. To fabricate biofuel fire starter samples using a special jig.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

In this chapter, a review of biofuel fire starter from biomass waste of oil palm fruit is provides. References and understanding were taken from various sources which are from SMK Lenga student's, journals, books and internet. Each source was selected based on similarity with the scope of study. The focus in this literature is about the properties of oil palm and fire starter.

2.1 Oil palm industry

Oil palm tree has been cultivated and grown immensely in Malaysia. This tree produce palm oil which is been use for food and other goods. In this chapter, the critical information on the oil palm, and the administration and usage of waste produced by palm oil industry are displayed.

2.1.1 Oil palm

Oil palm is the most ingenious oilseed yield on the planet because of its high profitability per hectare. It has oil production effectiveness (oil produced/land area) of 4000 kg/ha which is higher than the main oil seeds and oil plant. Moreover, long life expectancy of oil palm with fairly long economic life span of 25-30 years, giving a solid supply to oil generation. Alongside the high creation proficiency, this has driven the quick development of oil palm ranch far and wide. (Kurnia et al., 2016)

2.1.2 Environmental problems in the palm oil industry

Since oil palm products global demand has stood increasing, it has driven the rapid growth of oil palm plantation around the world. (Kurnia et al., 2016).

In Thailand, oil palm has been used for biofuel production. This caused increase demands and leads to growing oil palm growth. This growing growth donates to environmental problem like biodiversity loss and pollution caused by emissions of nutrients, air contaminants and greenhouse gases from estates and palm oil mills. (Saswattecha et al., 2016)

Although, the crude palm oil mill effluent discharge standards by stages but still the present air pollution control measures in CPO mill are still inadequate for full compliance of regulatory requirements. Further studies should be conduct in areas like boiler design technology, solid fuel treatment and combustion, fly ash control system, and energy conservation concept in relation to complete combustion. The preparation of the crude palm oil must meet with the environmental friendly standard. The self-regulation approach by the industry will certainly complement the present environmental management system and the national environment as a whole. (Yusoff, 2006)

The ebb and flow transfer for POME is to store it in anaerobic and high-impact processing lakes before being discharged into conduits. This method needs a large area of land and always creates a problem of discharging POME into water and also can gives to the greenhouse gas emissions. Biomass watse as well as makes a considerable measure of waste as utilized cooking oil. The used cooking oil dumping is straight release into the water drainage system that pose severe environmental dangers. (Kurnia et al., 2016)

2.1.3 Oil palm wastes: current utilization and disposal scenario

Huge quantity of wastes or residues that has been created by palm oil industry. This wastes or residues can be process to produce biofuel. In the oil extracted from the oil palm establishes just 10% of the aggregate biomass created while other 90% is waste. The outgrowth delivered from palm oil creation incorporates oil palm trunk, OPT, oil palm frond, OPF, discharge organic product bundle, EFB, mesocarp natural product fiber, MF, palm piece shells, PKR and palm oil process emanating, POME. Except for POME, these wastes have high fibre content. (Kurnia et al., 2016)

OPF is accessible in the estate consistently. OPT is accessible just amid the replanting season. Oil palm trees have a long future and when they accomplished the end of their business future they should be supplanted by new plants. The current practice that is leave the dead trees between the lines of palm trees creates a risk. It will attract harmful insects to reproduce. Furthermore, leaving the trunk in the plantation will block re-plantation activity. The ash produced in boilers is transported back to plantations and burning the dead trees to utilize them as soil fertilizer. It will decrease risk of insects but it will result in pollution that should be avoided which is air pollution. Other than use OPF as fertilizer, it also can be cut into small pieces to be use as livestock feed. Fuel in mill boilers are normally EFB, MF and PKS. Mentioned here that the contains of EFB which is high moisture content, low heating value leads to air pollutions shows that it cannot be burned directly and hence, it should be dry to decrease the moisture content. That makes MF and PKS are more indispensable as evaporator fuel while EFB is ordinarily disposed of in homes. MF additionally been use as fillers really taking shape of canteen plastics and thermoset composites. While EFB can be utilized to create bioplastics. The biomass from oil palm likewise been use to create sponges for harmful gas and overwhelming metal. The main fluid waste created from the palm factory is POME. It contains high groupings of natural mixes makes it reasonable as plant manure on the off chance that it is effectively treated. (Kurnia et al., 2016)

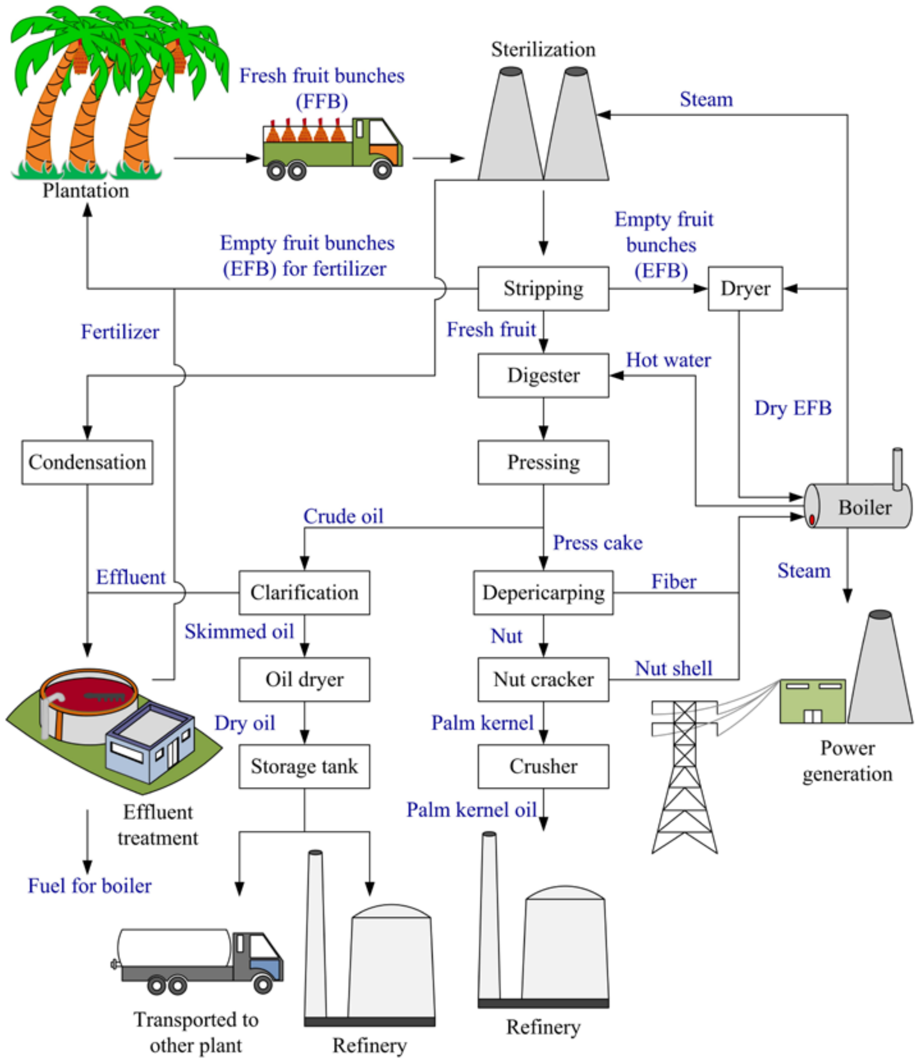

Figure 2.0: Palm oil production process (Kurnia et al., 2016)

Some scientists and companies are trying to use oil empty fruit bunches and palm kernel shells harvested into renewable electricity, cellulosic ethanol, biogas, bio hydrogen and bio plastic. Thus, helps reducing greenhouse gas emissions. Some oil palm manors use biomass by burn it to create power. Scientists treat palm oil mill effluent to extract biogas in efforts to reduce greenhouse gas emissions. Biogas can substitute for natural gas for use at factories after purification. (Wikipedia 2016)

Aziz et. Al proposed an integrated small-scale in-situ energy generating process utilizing EFB and POME. This project said it can lower environmental impact.(Aziz et al., 2016)

2.2 Oil palm fibre

2.2.1 Extraction of fibre

In retting process, oil palm fibre, OPF is extracted from empty fruit bunches, EFB. List of the available retting processes are mechanical retting (hammering), chemical retting (boiling with chemicals), steam/vapor/dew retting and water/microbial retting. According to Raju et al., the most popular retting process is water retting. The only environmentally friendly extraction is mechanical extraction while other methods pollute water bodies. (Shinoj et al., 2011)

There are enormous requests of lightweight materials for use in transportation and development areas. Characteristic fibres (NFs) in fortified polymer composites are generally lightweight. Be that as it may, NFs have a few confinements because of their dampness affinity, poor wettability furthermore, low warm solidness amid preparing with engineered polymers. These disadvantages have been overcome by viable physical and substance medications of NFs. Among different NFs, oil palm biomasses (OPBs) are promptly accessible in some tropical nations and have gotten extraordinary consideration in the composite enterprises. In this part, the execution of untreated and distinctively treated OPB fibres, strengthened thermoplastic and thermoset composites arranged through expulsion, pressure and infusion moldings have been talked about in detail. (M. D. H. BEG et al, 2015)

2.2.2 Morphology and properties

Figure 2.1 shows sketch of OPF and fibre arrangement of EFB cross section. Tables 2.0 and 2.1 indicates synthetic arrangement and physical-mechanical properties of OPF as testified by different specialists. OPF suitable for composite applications due to high cellulose content and high toughness. There is 4.5% residual oil contains in OPF which unfavourably affects fibre-matrix compatibility. Surface modifications can improve fibre properties substantially. (Shinoj et al., 2011)

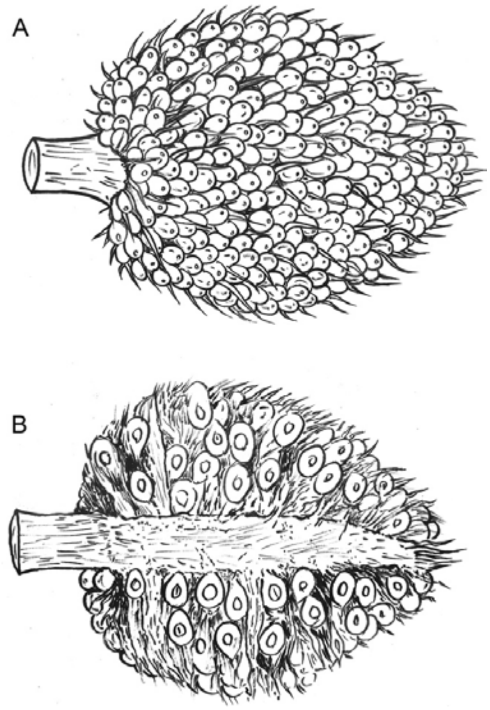

Figure 2.1: Sketch of (A) OPF (B) fibre arrangement of EFB cross section

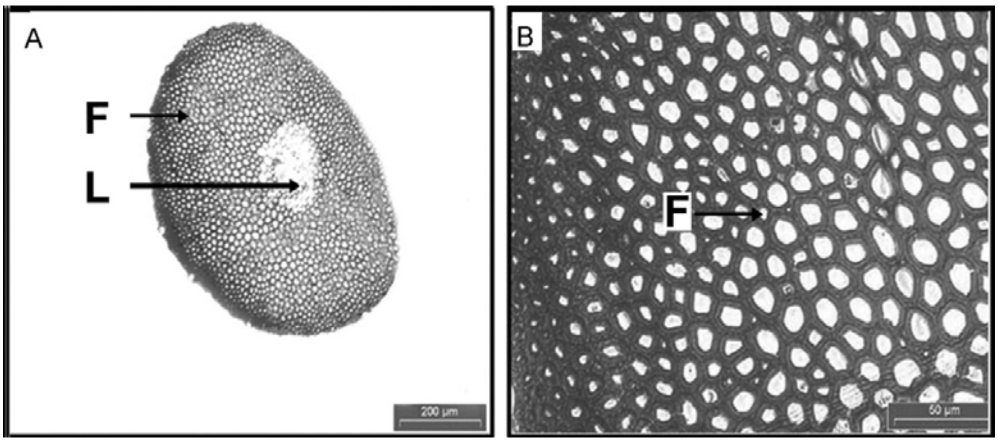

Figure 2.2: images of transverse sections of OPF (4×).

Table 2.0: Chemical Composition of OPF (Shinoj et al., 2011)

Property	Range
Cellulose (%)	42.7–65
Lignin (%)	13.2–25.31
Hemicellulose (%)	17.1–33.5
Holocellulose (%)	68.3–86.3
Ash content (%)	1.3–6.04
Extractives in hot water (100 °C) (%)	2.8–14.79
Solubles in cold water (30 °C) (%)	8–11.46
Alkali soluble (%)	14.5–31.17
Alfa-cellulose (%)	41.9–60.6
Alcohol–benzene solubility (%)	2.7–12
Arabinose (%)	2.5
Xylose (%)	33.1
Mannose (%)	1.3
Galactose (%)	1.0
Glucose (%)	66.4
Silica (EDAX) (%)	1.8
Copper (g/g)	0.8
Calcium (g/g)	2.8
Manganese (g/g)	7.4
Iron (g/g)	10.0
Sodium (g/g)	11.0

Table 2.1: Physical-mechanical properties of OPF (Shinoj et al., 2011)

Property	Range