PROJECT SOLID FUEL FROM A BINARY MIXTURE OF WASTE MATERIALS OF PALM OIL INDUSTRY

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SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in term of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Thermal-Fluids)"

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Date : 1 JULY 2015

DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged".

Signature: ……

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Date : 1 JULY 2015

Special for

My Beloved Parent

My supervisor

My panels

My Friends

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ABSTRACT

The waste products from the palm oil processing industry are used to make production of solid fuel. The types waste material of the palm oil industry are empty fruit brunches, palm fiber, palm shell and decanter cake. So, this study focus on three types of waste material which is palm fiber, palm shell and decanter cake. The objective of this study is to study the binary mixture of waste palm oil industry waste as a potential solid fuel in physical and mechanical. The sample will be created based on decanter cake: fiber ratio, decanter cake: shell ratio, weight of loading (50 N) and type of fiber and shell. The hexagon shape are chosen as a mold for the sample (radius = 1 inch, length = 8 inch and thickness = 0.003 inch). Before undergo the several test, the sample was grind and sieve to have a finer structure. The sample will undergo two types of test which is moisture test and compression test. This project found out that the best mixture ratio among all the sample ratio were 60% decanter cake and 40% shell. The mixture that has highest compression force, 2215.7 N is 60% decanter cake and 40% shell compared to other sample ratio. The value of compression force was nearest to the commercial solid fuel, 2480 N.

ABSTRAK

Bahan-bahan buangan dari industri pemprosesan minyak sawit telah digunakan untuk membuat pengeluaran bahan api pepejal. Jenis bahan buangan industri minyak sawit adalah tandan buah kosong serat kelapa sawit , tempurung kelapa dan decanter cake . Oleh itu , kajian ini memberi tumpuan tiga jenis bahan buangan yang merupakan serat kelapa , tempurung kelapa dan decanter cake . Objektif kajian ini adalah untuk mengkaji campuran binari sisa industri minyak sawit sebagai bahan api sisa pepejal yang berpotensi dalam fizikal dan mekanikal. Sampel akan dihasilkn berdasarkan campuran nisbah decanter cake dengan serat kelapa sawit, nisbah decanter cake dengan tempurung kelapa, berat muatan dan jenis serat dan tempurung. Bentuk heksagon dipilih sebagai acuan untuk sampel (jejari = 1 inci, panjang = 8 inci dan ketebalan = 0.003 inci). Sampel akan menjalani dua jenis ujian iaitu ujian kelembapan dan ujian mampatan. Projek ini mendapati bahawa nisbah campuran yang terbaik di antara semua nisbah adalah sampel 60 % decanter cake dan 40 % tempurung kelapa. Campuran yang mempunyai kekuatan mampatan yang paling tinggi sebanyak 2215.7 N ialah 60 % decanter cake dan 40 % tempurung kelapa berbanding nisbah sampel yang lain. Nilai daya mampatan 60% decanter cake dan 40 % tempurung kelapa adalah sampel campuran terbaik yang terdekat dengan bahan api pepejal komersial, 2480 N.

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K_a	=	Percentage of moisture, %
W_f	=	Weight final, gram
W_i	=	Weight initial, gram

LIST OF ABBREVIATION

CPO	=	Crude palm oil
CPKO	=	Crude palm kernel oil
DC	=	Decanter cake
F	=	Fiber
PKS	=	Palm kernel shells
S	=	Shell
UTM	=	Ultimate Tensile Machine

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Living sustainably means conserving nonrenewable resources by intelligent use of renewable resources. Renewable resources may take a long time to replenish forests can take 100 years to mature or a short time, such as sunlight that returns each morning. Even renewable resources must be managed carefully or else they too can disappear faster than they are replaced. The new biomass energy industry will optimize this process by taking the best of conventional power methods and the best of alternative methods. Biomass energy production serves as a simple technology for energy production when compared with advances in solar satellites, large tidal energy collectors, and other plans for the future of renewable energy. Biomass energy at its most basic is the collection and burning of organic wastes not much different from what society has done for centuries (Morisson and Heijndermans, 2013).

Malaysia government has taken the proactive measure to counter back the problem of the rising by introducing the National Energy Policy, Five- Fuel Policy was in 2001 under the 8th Malaysia Plan 2001-2005. Nowadays, Malaysia palm oil industry has grown tremendously over the last 4 decades and it has maintained its position as the leading world's country in the production of oil palm (Nasrin et al, 2008).

Oil palm is a perennial crop. It has an economic life span of about 25 years. Besides palm oil and palm kernel, oil palm industry generates large quantity of biomass residue which is side products as stated before like fronds, trunks, palm fiber and shell that have not been fully commercially exploited (Yuhazri et. al, 2012). Generally, most of this biomass can be used as combustion fuels. Currently, the shell and fiber are the main sources of energy in palm oil mills. Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. The biomass sources contribute 14% of global energy and 38% of energy in developing countries (Beena & Bharat, 2012). These fuels are burn in boiler to produce steam for electricity generation to be used in the milling process. Densification or briquette is the process of compacting the biomass residue into a uniform solid fuel called briquettes. It has higher density and energy content and less moist compared to its raw materials (Nasrin et al, 2008). Based Nasrin, (2008) research, in Malaysia the briquette industry was started with wood waste, mainly in the form of sawdust. Most of the local sawdust briquettes or charcoal briquettes are exported for oversea markets.

1.2 PROBLEM STATEMENT

In Malaysia, the palm oil industry has contributed the biggest income to the country for many years. About 90% of palm oil is used as food related products worldwide, and the other 10% is used for basic raw material. Crude oil palm which are the palm oil and palm kernel that produce during the process of extracting the oil palm. The fresh bunch produces only 20% of the oil.

During process extracting the crude oil palm many waste product wastes produce such as decanter cake, fiber, shell and etc. The waste material will become rotten and produce an uneasy smell toward the surrounding. In addition, the problems of the waste material become worse when in the raining condition (Mahlia et. al., 2000). It will cause pollution of water at the river if do not recycle back the waste product from oil palm. Some companies take an action to recycle back the waste product from oil palm become fertilizer to the oil palm plantation and source of fuel to run the boiler.

Research by Islam et. al., (2009) explain that there seems to be renewed impetus in promoting the growth of an indigenous “green economy” in Malaysia. Not only does the country face the threat of pollution and climate change but the Government also has to find new sources of growth and move up the value chain. However, the presence of these oil palm wastes has created a major disposal problem. Based on research of Abdullah and Sulaiman, (2013) state that the fundamental principles of waste management are to minimize and recycle the waste, recover the energy and finally dispose the waste. These principals apply to agro industrial wastes such as palm oil residues as they do to municipal waste. Simplifying that no longer afford to dispose the residues when there is an economically useful alternative.

1.3 OBJECTIVE

The objective for this project is to study the binary mixture of waste palm oil industry waste as a potential solid fuel in physical and mechanical properties.

1.4 SCOPE

The scope that was used is:

a) Identify the binary mixture of potential waste as a solid fuel in physical and mechanical properties.
b) Comparison between the solid fuel waste potential with commercial solid fuel: Physical and mechanical properties.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the literature review contains the renewable energy, biomass natural waste, palm oil process, decanter cake, fiber, shell and solid fuel.

2.2 RENEWABLE ENERGY

In the same way, the Earth contains renewable resources that replenish over time: forests, plants, wildlife, water, clean air, fresh soil, and sunlight. Renewable resources may take a long time to replenish forests can take 100 years to mature or a short time, such as sunlight that returns each morning.. Even renewable resources must be managed carefully or else they too can disappear faster than they are replaced. The world is now experiencing this very problem because in many places forests, plants, wild animals, clean water, clean air, and rich soil have become depleted before nature can replace them .Living sustainably means conserving nonrenewable resources by intelligent use of renewable resources (Maczulak, 2010).

Renewable energy sources are energy resources that are inexhaustible within the time horizon of humanity. Renewable types of energy can be subdivided into three

areas which are solar energy, planetary energy and geothermal energy. Energy stored in wind or rain, which also can be technically exploited, originate from natural energy conversions. A fully renewable energy supply must not only convert renewable energy sources into useful energy types, such as electricity or heat, but must also guarantee their availability. The annual renewable energy supply exceeds the global energy demand shown in the previous section on evolution of world energy demand by several orders of magnitude. Renewable energies can, theoretically, cover the global energy demand without any problem. (Islam et. al., 2009).

2.3 BIOMASS NATURAL WASTE

Natural waste or biomass waste is produced from the wastes that come from the nature resources. These natural wastes still can be reinvented and regenerate back into the form of the energy. This type of the waste can be found on death living thing, plantation crop and the processing of the crop. The energy from the natural waste can be converted into some sort of fuel that can be used to generate electricity. For example, mostly all the palm oil mill industries will reuse the fiber as a fuel to heat up the boiler to produce steam to generate electricity.

Waste or unwanted material is the thing that most people will not use in their life. This waste material was considered as the last life cycle of the thing. Mostly these waste materials come from the manufacture process and the household activity. The waste come from the manufacture can be useless or can be renewable as a product (Ting, 2014).

2.3.1 Potential of Biomass Waste

Biomass is the primary source of energy for nearly 50% of the world's population and wood biomass is a major renewable energy source in the developing world, representing a significant proportion of the rural energy supply. Since, the beginning of civilization, biomass has been a major source of energy throughout the world. In the past decade, the number of countries exploiting biomass opportunities for the provision of energy has increased rapidly, and has helped make biomass an

attractive and promising option in comparison to other renewable energy sources. The global use of biomass for energy increases continuously and has doubled in the last 40 years **(**Ladanai and Vinterback, 2009).

Due to the large amount of biomass generated yearly, Malaysia has the potential to utilize the biomass efficiently and effectively to other value added products. In addition, oil palm biomass also has a very good potential to be converted into renewable energy sources considering the calorific value of each component waste shown in table 2.1 (Siew et. al, 2008).

Table 2.1: Energy Potential of Oil Palm Biomass

Biomass Component	Quantity Available (million tonnes)	Calorific Value (kJ/kg) [20]	Potential Energy Generated (Mtoe)
Empty fruit brunches	17.00 [18]	18838	7.65
Fiber	9.60	19068	4.37
Shell	5.92	20108	2.84
Fronds & Trunks	21.10 [19]	-	-
Palm kernel	2.11 [20]	18900	0.95
Total	55.73	-	15.81

2.3.2 Palm Oil Mill Residue

Oil palm mills generate a numbers of oil palm wastes. The oil palm wastes contribute about RM6379 millions of energy annually. However, there is much to be done to optimize the utilization of oil palm wastes for cogeneration in Malaysia. Various studies conducted in Malaysia have indicated that the used of biomass as a source of energy is one of the most promising ways of effectively using the residues (Abdullah & Sulaiman, 2013). The type of palm oil mill residue is shown in table 2.2.