CARBONISATION TEMPERATURE EFFECT ON PREPARATION OF BIOCHAR FROM TANDUK BANANA PEEL RESIDUE (*Musa paradisiaca fa. corniculata*) AS A SOLID BIOFUEL

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SUPERVISOR DECLARATION

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

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DECLARATION

"I hereby declare that the work in this report is my own expect for summaries and quotations which have been duly acknowledge."

Signature	:	……
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Dedicated to my beloved family.

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ABSTRACT

Malaysia has been blessed with so many natural resources such as forestry and agriculture. Hence, with all the option of feedstock, biomass energy is practical being performed. The main objective of this project are to utilize biomass (banana peel residue) waste as a solid biofuel in a briquette form, identify the effect on carbonization temperature to calorific value of briquette and characterize the briquette in term of fixed carbon, moisture content, ash content and volatile matter. Tanduk banana peel residue (*Musa paradisiaca fa. corniculata*) is chosen as a subject due to its availability, carbon neutrality and vitamins. To perform Tanduk banana peel residue into briquette needs to done carbonization process in three differences temperature affect there are 270, 370 and 470°C before go to compaction process. C470 briquette performs a good quality in term of calorific value compare to others.

ABSTRAK

Malaysia telah diberkati dengan begitu banyak sumber semulajadi seperti perhutanan dan pertanian. Oleh itu, dengan semua pilihan bahan mentah, tenaga biomass praktikal di lakukan. Objektif utama projek ini adalah untuk menggunakan biomass dari sisa buangan kulit pisang sebagai bahan api pepejal dalam bentuk briket, mengenal pasti kesan suhu karbonisasi kepada nilai kalori briket dan ciri-ciri briket dari segi karbon tetap, kandungan kelembapan, kandungan abu dan perkara yang tidak menentu. Kulit sisa Pisang Taduk *(Musa paradisiacal fa. Corniculata)* di pilih sebagai subjek kerana bahan yang mudah didapati, neutral karbon dan vitamin. Untuk melaksanakan sisa buangan kulit Pisang Tanduk ke dalam bentuk briket memerlukannya menjalani proses karbonisasi dalam tiga jenis suhu yang berbeza iaitu 270, 370 dan 470°C sebelum pergi ke proses pemampatan. Briket C470 mempunyai kualiti yang baik dari segi nilai kalori yang tinggi berbanding dengan briket yang lain.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The entire world continues to be depending on fossil fuels since the major way to obtain energy. These kinds of unsustainable energy sources will not previous extended and so, progressive move toward green renewable energy needs to be employed. Inside Malaysia, although fossil fuel dominates the energy production, alternative efforts for instance hydropower and also biomass are usually gathering popularity as a result of setup of energy procedures and also better comprehending around the significance about environmentally friendly energy. Malaysia has been blessed with so many natural resources such as forestry and agriculture. Hence, with all the option of feedstock, biomass energy is practical being performed and also oil palm lead the particular rating since biomass resource the following due to its large production. Nonetheless, fresh options needs to be popular concerning prevent the above reliance about the same resource [1]. Briquettes are created by utilizing farming waste materials that will normally not necessarily provide proficiently in any way. Biomass briquettes replace fossil fuels or wood for cooking and industrial processes. They may be clean and also better to deal with, and also minimize greenhouse gas emissions [2]. Biomass briquettes may be the energy source for the future for a lot of nations. It can decrease air pollution, enhance wellness and provide a comfortable method to obtain fuel. They are able to protect the actual jungles associated with nations around the world. Utilizing biomass briquettes with regard to renewable energy is a great option for a lot of benefit.

1.2 BACKGROUND

Bananas are usually expanded in every tropical region and also enjoy an integral function inside the economic climates of several developing nations around the world. Regarding of gross value of production, bananas are generally the world's fourth most important food crop right after rice, wheat and also maize. Bananas are the staple food as well as a good foreign trade item and the world's majority of exported fresh fruit with regards in terms to quantity as well as worth [3]. Sapuan, et. al. states in Malaysia, banana is the second most widely cultivated fruit with total production of 530,000 metric tons. About 50 percent of the banana growing land is cultivated with *Pisang Berangan* and the Cavendish type, and the remaining popular cultivars are *Pisang Mas, Pisang Rastali, Pisang Raja, Pisang Awak, Pisang Abu, Pisang Nangka* and *Pisang Tanduk* [4].

1.3 PROBLEM STATEMENT

Almost daily, the global dependence on fossil fuels as a primary energy source has increased. This nonrenewable energy source is now no longer able to bear the higher amount of demand. The burning of fossil fuels would release carbon dioxide into the atmosphere, thus the occurrence of global warming. In addition, the dumping of waste that many now poses a threat to the ecosystem of the environment. About 18-33% peels from the whole banana fruit are waste products which have valuable chemical contents [5]. Banana peel has potential to be modified has renewable energy in order to avoid the over dependence on a single source of fossil fuel. Biomass briquettes are mostly made of green waste and other organic materials [6]. The briquettes produce low greenhouse gas emissions compared to fossil fuels because the material used is already a part of the carbon cycle.

1.4 OBJECTIVES OF THE PROJECT

The objectives of the project are as follows:

i. To utilize biomass (banana peel residue) waste as a solid biofuel in a briquette form.
ii. To identify the effect on carbonization temperature to calorific value of briquette.
iii. To characterize the briquette in term of fixed carbon, moisture content, ash content and volatile matter.

1.5 SCOPES OF THE PROJECT

This project will focuses on the proximate analysis such as moisture, volatile matter, ash content and fixed carbon on a briquette. The purposes of this project also analyze the calorific value of the briquette and observation of temperature effect on preparation of briquette from tanduk banana peel (*Musa paradisiaca fa. corniculata*) will be performed. Besides, the compressive test will also be conducted on briquettes to determine the resilience of the briquette.

CHAPTER 2

LITERATURE REVIEW

2.1 ENEGY RESOURCE

The actual word energy hails from the actual Greek word which means "*energos*" meaning activity. Energy is usually a quality on the process which often talks about the flexibility on the process to accomplish many do the job. In the 19th century, this energy feature is called the energy preservation law. Almost all identified natural processes and phenomena may be discussed together with many kinds of energy in line with the pursuing explanations: kinetic energy, potential energy, thermal energy, gravity, elasticity, electromagnetic energy, chemical energy, nuclear energy and mass [7]. There are ten major energy sources that can be classified into two broad groups: nonrenewable and renewable.

2.1.1 Renewable Energy

Renewable energy is actually organic power that doesn't have a restricted provide. Some other explanations regarding renewable energy are “energy from the actual constant or even repeated currents associated with energy repeating within the organic environment" and "energy streams which might be replenished for the similar pace since they usually are "used"" [8]. Below is a list of renewable energy sources:

i. Biomass
ii. Hydro
iii. Geothermal
iv. Solar
v. Tidal
vi. Wave
vii. Wind
viii. Wood

From the Figure 2.1 below show that the cumulative global renewable electricity installed capacity has grown by 72% from 2000-2011 (from 748 GW to 1,285 GW) [9].

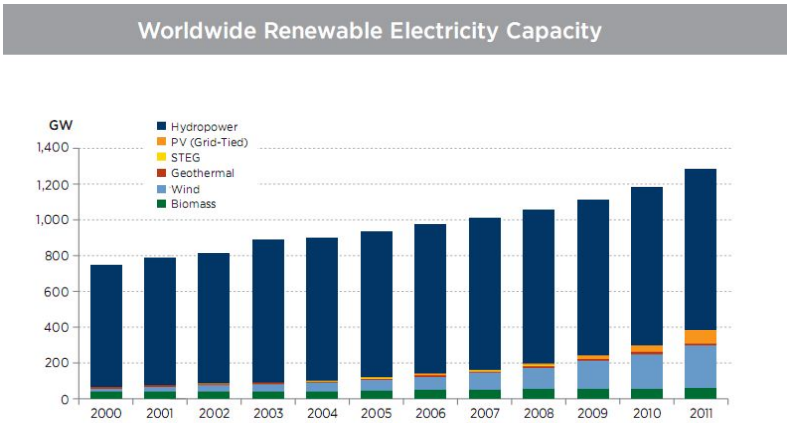

Figure 2.1: Worldwide renewable electricity capacity.

(Source: Bloomberg New Energy Finance, Global Renewable Electricity Installations)

2.1.2 Non-Renewable Energy

More than 85% from the energy utilized on the planet is actually through non-renewable supplies [10]. Nearly all developed nations are generally relying on non-renewable energy sources such as fossil fuel (coal and oil) and also nuclear power. These kinds of options are usually referred to as non-renewable since they cannot be renewed or perhaps regenerated swiftly adequate to help keep rate making use of their utilize. Industrialized communities rely on non-renewable energy sources. Fossil fuels are the mostly employed forms of non-renewable energy. They were formed when incompletely decomposed plant and animal matter was buried in the earth's crust and converted into carbon-rich material that is useable as fuel and this process take over millions of years. The three major varieties of fossil fuel are coal, oil, and natural gas. Pair of various other less used sources of fossil fuels is usually oil shales and tar sands [10].

2.2 BIOMASS

Biomass is defined as a renewable energy because it contains the energy which comes from the sun. Biomass is essentially an organic product made out of plants and animals. Throughout the technique of photosynthesis, chlorophyll seen in plant life absorbs the energy from the solar by means of renovating the carbon-dioxide present in fresh air and water from the ground in carbohydrates. The chemical energy that's contained in plants is actually handed on to the animals and human the ones which eat all of them. Whenever these plants and animals are burnt they will be converting to carbon dioxide and water as well as discharge the sun's energy they have [11]. Through replanting the actual plants, the new plants may use the carbon dioxide produced by the burnt plants. Therefore utilizing biomass as well as replanting allows close up the carbon dioxide cycle. Nevertheless, when the plants aren't replanted, biomass could emit carbon dioxide which will lead towards global warming [12]. There are some advantages by using biomass:

i. Less dependence on fossil fuels
ii. Easily available and inexhaustible fuel source
iii. It’s a renewable source of energy
iv. Relatively cheaper and reliable.
v. Have large resource
vi. Lots of different technology
vii. It can be converted into several forms of energy.

2.2.1 Types of Biomass

There are some types of biomass:

i. Wood and Agricultural Products

About 46% of biomass energy comes from logs, chips, bark, and sawdust [13]. Agricultural waste products like fruit pits and corncobs also be as biomass sources. Wood and wood waste, together with agricultural waste, are utilized to create electrical power. Much of the electricity is used by the industries making the waste; it is not distributed by utilities, it is cogenerated. Paper mills and saw mills make use of high of their own waste material to create vapor as well as electrical power for his or her make use of. Paper mills and saw mills make use of high of their own waste material to create steam as well as electrical power for their use. Nevertheless, given that they use lot of energy, they have to purchase extra electrical power through resources. Significantly, timber companies and companies involved with wood products are viewing the advantages of utilizing their lumber scrap and sawdust for power generation. By doing this step, companies can saves disposal costs and reduce the companies' utility bills. In reality, the particular pulp and also papers market sectors count on biomass to fulfill 63% of their energy wants [13]. Various other industrial sectors that use biomass include lumber producers, furniture manufacturers, agricultural businesses like nut and rice growers, and liquor producers.

ii. Solid Waste

Burning trash transforms waste in to a workable kind of energy. One ton (2,000 pounds) of garbage contains about as much heat energy as 500 pounds of coal [13]. Garbage is just not most biomass; probably 50% of their energy content emanates from plastics, which in turn are made from petroleum and natural gas [13]. "Waste-to-energy plants" are refer to power plant that burn garbage to get energy. Making electricity from garbage is much cheaper than coal and other energy sources. The benefit of burning solid waste is actually it decreases the quantity of garbage dumped in landfills through 60% to 90%, which decreases the cost of landfill

disposal [13]. In addition, it also makes use of the energy in the garbage, rather than burying it in a landfill, where it remains unused.

iii. Landfill Gas and Biogas

Bacteria and fungi eat dead plants and animal, that causes them to decay. A fungus on the decaying log is transforming cellulose to sugar in order to give food to by itself. Even though this technique is slowed down inside a landfill, a new chemical named methane gas is generated for the reason that throws away decays [13]. Fresh restrictions demand landfills to collect methane gas with regard to security as well as environment factors. Methane gas is colorless and odorless, but it is not dangerous. The gas can cause fires or explosions if it seeps into nearby homes and is ignited. Landfills could accumulate the methane gas, purify it, and use it as fuel. Nowadays, a little part of landfill gas can be used to supply energy. Many will be burned off on the landfill. With today's low natural gas prices, this kind of higher-priced biogas will be seldom cost-effective to get. Methane, nevertheless, is really a stronger greenhouse gas compared to carbon dioxide. It is far better to burn landfill methane and change it into carbon dioxide compared to discharge this to the environment. Methane may also be created utilizing energy through agricultural and human wastes. Biogas digesters are usually airtight storage containers or pits layered together with metal or bricks. Waste materials put in the containers will be fermented without air to generate a methane-rich gas. This kind of gas used to generate electricity, for cooking and lighting. It's a secure as well as clean-burning up gasoline, generating minor carbon monoxide and out smoking. Biogas digesters are usually low-cost to construct and gaze after. They can be constructed as family-sized or community-sized units. They require reasonable temperatures and moisture for the fermentation process to occur. Regarding developing countries, biogas digesters might be among the best solutions to a lot of the energy requirements. They will guide slow this wild deforestation attributable to wood-burning, decrease polluting of the environment, fertilize over-used areas, and also generate clear, risk-free energy for rural communities [13].

2.2.2 Converting Biomass Method

There are many ways of transforming biomass in to energy. These methods include burning, alcohol fermentation, pyrolysis, and anaerobic digestion.

i. Burning

Direct burning of biomass is the simplest method of energy production. The human race features burned up solid wood and also other varieties of biomass for thousands of years to maintain comfortable, to cook food, and eventually to forge weapons and other tools. The energy launched through direct combustion requires takes the form of heat, and can be used to directly influence the temperature of a small environment or to power steam-driven turbines to generate electricity. Regrettably, the burning of biomass is the reason for a lot of air pollution and it has led towards the so-called "greenhouse effect" and global warming. A completely new subject connected with exploration would be the progress connected with high energy crops manufactured for being used intended for electric power creation. Only about 5% of any plant's mass is usually edible, this likelihood of large-scale biomass generation can be reasonably wonderful [14]. Currently, on the other hand, expanding a lot involving crops remains to be quite expensive. As a result, various other methods of biomass energy production are being pursued with somewhat greater success. These kinds of procedures include alcohol fermentation, anaerobic fermentation, and pyrolyis.

ii. Alcohol Fermentation

Within alcohol fermentation, the starch in organic matter can be transformed into sugars through heating process. This particular sugars next fermented by yeast (as within the manufacturing of beer and wine). The resulting ethanol (also called