PRESSURISED PYROLYSIS OF RICE HUSK

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ABSTRACT

Malaysia produces every year huge quantities of agro residue such as rice husk, palm shell, sugar cane and etc. Pusat Tenaga Malaysia reported that the estimating potential energy of biomass around 834.305 PJ in year 2002. Rice husk has a potential energy around 7.536 PJ. Raw rice husk is not suitable used as fuel due to low density, low calorific value, high volatile matter, moisture and ash content. However, these characteristics can be improved by converting it into solid fuel through pressurised pyrolysis technology. Compressing and carbonisation process is applied simultaneously in pressurised pyrolysis to produce biocoal under pressure 3-6 MPa and heating temperature of 250°C. Experiments are carried out the thermo-chemical properties, density and compressive strength of biocoals. The calorific value and density of biocoal are increased to 20.12 MJ/kg and 1150 kg/m^3 respectively. The biocoal has compressive strength of 3.49 MPa.

ABSTRAK

Malaysia mengeluarkan sisa tani dalam jumlah yang besar setiap tahun seperti sekam padi, tempurung kelapa sawit, hampas tebu dan sebagainya. Pusat Tenaga Malaysia melaporkan pada tahun 2002 anggaran potensi tenaga dari biomas adalah sekitar 834.305 PJ. Potensi tenaga dari sekam padi adalah sekitar 7.536 PJ. Sekam padi mentah tidak sesuai digunakan sebagai bahan api disebabkan oleh ketumpatan dan nilai kalori yang rendah, manakala kandungan jirim meruap, kelembapan dan habuk yang tinggi. Walaubagaimanapun, ciri-ciri boleh dipertingkatan dengan memampatnya melalui proses pyrolisis bertekanan. Proses pemampatan dan perkarbonan dilakukan serentak di dalam proses pyrolisis bertekanan untuk menghasilkan *biocoal* dibawah tekanan 3-6 MPa dan suhu pemanasan, 250°C. Beberapa ujikaji dilakukan ke atas *biocoal* untuk menentukan sifat haba kimia, ketumpatan dan kekuatan mampat. Nilai kalori dan ketumpatan *biocoal* adalah meningkat kepada 20.12 MJ/kg dan 1150 kg/m^3. *Biocoal* juga mempunyai kekuatan mampat 3.49 MPa.

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LIST OF SYMBOLS

T		Temperature
r	-	radius
m	-	Weight
η	-	Efficiency , %

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CHAPTER 1

INTRODUCTION

1.1 Overview

At present, the per capita generation of solid waste in Malaysia varies from 0.45 to 1.44 kg/day depending on the economic status of an area. In general, the per capita generation rate is about 1 kg/day. Malaysian solid wastes contain very high organic waste and consequently high moisture content and bulk density of above 200 kg/m^3. A recent study conducted in Kuala Lumpur has revealed that the amount of organic wastes for residential area range from 62 to 72%. Disposal of solid waste is done almost solely through landfill method. There are about 177 disposal sites in Peninsular Malaysia. In most cases, open dumping is being practised and takes place at about 50% of the total landfills. In the Seventh Malaysia Plan (1995-2000), the Federal government had spent RM20.9 million to build 9 sanitary landfills and upgrade 27 existing landfills in 34 local authorities. The government had also spent RM17 million to purchase 7 mini-incinerators with a capacity of 5 to 20 ton/day to be operated in the resort islands in Langkawi, Labuan, Tioman and Pangkor [MCR, 2001]. The government relaunched its recycling campaign on 2 December 2000. It has targeted 22% of waste to be recycled by 2020.

Malaysia’s energy sources primarily comprise oil, natural gas, hydro power and coal, although renewable energy sources such as solar power and biomass are currently being exploited. The government is emphasising the use of natural gas and also planning to develop hydro power in East Malaysia in the foreseeable future. Initiatives have been taken towards careful usage of energy resources and developing renewable energy sources. Renewable energy has been developed to varying degrees. While some knowledge and efforts in renewable energy development have already reached advanced level, they are insufficient and fragmented in general. The most extensive study on the use of biomass has been on palm oil wastes, which are used to meet the energy requirement of the palm-oil mills and the electricity needs of the workers. The energy potential of biomass is estimated to be about 440 PJ/year in 1996. The total contribution of biomass to the primary energy supply of Malaysia has been estimated to be at least 90 PJ. At present, the main contribution is from palm-oil wastes (about 80 %), while the use of other wastes is rather inefficient. However, the total technical potential of biomass in Malaysia is around 130 PJ. It is about 5 % of the national energy requirement.

It is a widely accepted Malaysian policy to save foreign currency by producing and using local products wherever possible. By using domestic fuels such as biomass instead of imported coal or oil, the country becomes the benefits significantly in terms of foreign exchange savings. Since biomass power plants are relatively smaller than conventional fossil fuel power plants, it is reasonable to assume that a larger part of the investment in biomass plants can be undertaken by local companies [EPU, 1999].

In addition to the foreign exchange savings, the increased use of biomass creates additional employment for Malaysian workers, and hence profits Malaysian businesses, instead of creating employment in foreign countries that export the coal/oil to Malaysia. There will be greater employment opportunities in two new distinct areas: collection, treatment and handling of local biomass; and the erection, operation and maintenance of biomass power plants

Bioenergy systems require sufficient, reliable, sustainable, and affordable biomass supplies. These supplies must be grown, harvested, gathered, and transported to the energy conversion plant, sometimes from a large number of dispersed suppliers. They must usually be stored and perhaps dried to avoid deterioration. In many cases the biomass must be chopped, pelletized or otherwise prepared for use as a biofuel [Sivan, Gerald and Sudhir, 2005].

The interest in renewable energy sources has increased in the last decades because of the negative environmental impact caused by the consumption of fossil fuels, the raising prices of conventional fuels, the dependence on foreign oil, and the decrease in fossil fuels resources. The problem with burning fossil fuels is that the carbon absorbed by the “old” biomass is released after millions of years as “new” carbon dioxide, placing the carbon cycle out of balance. The use of fossil fuels not only depletes a nonrenewable resource, but also contributes to the greenhouse effect.

The main contaminants from fossil power plants are:

i. Sulphur oxide – main cause of acid rain

ii. Nitrogen oxides – causes respiratory illnesses

iii. Carbon oxides – contributes to thermal pollution or global warming

iv. Particulate matter – decreases visibility, increases soiling and corrosion and respiratory illnesses [El-Wakil (1998)]

In spite of some negative public perceptions based on misconceptions, biomass energy represents one of the most promising options, as it is a renewable source that can be produced and used in a clean and sustainable way. Moreover, it provides significant benefits to the environment, the local socioeconomic development, and the national energy security. While environmental concerns, like carbon dioxide emissions and global warming, have encouraged industrialized countries to use modern biomass energy systems; socioeconomic considerations, such as equity for low-level income communities and their necessity for fuel, have encouraged developing countries to improve traditional biomass energy uses [Koh and Hoi, 2002].

The general waste hierarchy accepted by industrialized countries is comprised of the following order:

i. reduce
ii. reuse
iii. recycle
iv. recover waste transformation through physical, biological, or chemical processes (e.g., composting, incineration)
v. landfilling

1.2 Objective

The aim of this project is to produce biocoal materials from solid wastes particularly biomass, as a source of fuel for combustion process using the improved method of briquetting which is known as pressurised pyrolysis. With this method, the briquetting of raw biomass is done without using a binder and adhesive.

1.3 Scopes of Work

The scopes of this project are as follow:-

i. Identification and selection of raw biomass material for pressurized pyrolysis process. In this case, it is feasible to select a raw biomass material which is widely abundant, easy to get and easy to transport.

ii. Set-up and development of pressurized pyrolysis process methodology and equipment.

iii. Characterization of biocoal (briquetted product after undergoing pressurized pyrolysis) in order to determine their thermo-chemical properties including the calorific value, moisture content, ash content etc. via proximate analysis, calorimeter test, compressive strength and density measurements.

iv. Comparison study of biocoal materials produced throughout the pressurised pyrolysis process with low rank United State coal (Lignite).

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