Global Journal of Engineering and Technology Review

Journal homepage: www.gjetr.org

Global J. Eng. Tec. Review 3 (2) 7 – 11 (2018)

The Fuel Briquette Compressed Machine from Palm Residue

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ABSTRACT

The objectives of this thesis were designed and build the fuel briquette compressed machine from palm residue for the fuel briquettes have the standard shape. Because of PALM meat and fiber which is tough to make fuel therefore the design and building of fuel briquette compressed machine were used hydraulic. The fuel briquette compressed machine from palm residue was divided of motor 3 Hp, hydraulic pump, cylinder, and forming mold set. The ratios of ingredient for testing of fuel briquette extrusion (palm residue : water : cassava starch) were 1:1:1, 2:1:1, 3:1.5:1, and 4:1.5:1 kg. The experimental pressures were 11, 15, and 20 kgf/m2. The suitable pressure and ratio were kgf/m2 and 4:1.5:1 kg, respectively. The testing results of fuel properties of density value, calorific value, and compression strength were 970.58 kg/m3, 4,297.87 MJ/K and 0.55 MPa, respectively.

Type of Paper: Conceptual / Empirical/other.

Keywords: Palm Oil; Fuel Briquette; Compressed Machine.

1. Introduction

Palm oil production normally involves the following four production steps: 1) Stopping the lipolysis reaction process by using steaming palm clusters with high pressure steam or by baking palm clusters directly; 2. Sorting fruits from palm clusters; 3. Extracting palm oil with a pressing process and 4.Cleaning raw palm oil. There are many by-products from the palm oil production process and one of the by-products is palm meal. Normally, palm oil production factories sell palm meal to animal feed factories or use the palm meal to create energy or fuel. Palm oil production at the community level usually does not have a palm steaming process, but uses the method of baking palm clusters instead of steaming. This process is simple and does not create a wastewater requiring treatment after the dry baking process, and palm meal may be sold at low prices. Apart from the aforementioned benefits, palm meal is an alternative energy that provides thermal energy at 4,700 kcal/kg.

* Paper Info: Revised: February 17, 2018

Accepted: April 05, 2018

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Therefore, palm meal from the oil pressing process can be used as biomass fuel. However, because palm kernel shells that passed through the oil pressing process and the dry baking process are difficult to separate, it is difficult to use a palm mealto produce fuel pellets [1,2]. According to previous studies, many researchers have designed and created a biomass fuel compression machines with characteristics dependent on the material to be compressed [3-10]. Therefore, the researcher had a concept to design and construct a fuel briquette compression machine for palm meal obtained from a community palm oil production process that involves dry baking palms.

2. 2. Machine Design and Construction

According to studies of preliminary data for use in designs based on convenient use to compress biomass fuel briquettes with palm shells and seeds as waste from palm oil obtained from the dry baking process, the dry baking process caused palm flesh and shells to be inseparable as shown in Figure 1. In addition, briquette characteristics need to meet briquette standards (Ministry of Energy and Kaset University) [11]. Briquettes must have a length of 20 – 25 centimeters with a circumference of 5 – 7 centimeters. Pellets will have a length of approximately 30 centimeters, a diameter of 5 – 15 millimeters and a pressure value before the breaking of no less than 0.375 MPa. The researcher designed a palm meal fuel briquette compression machine divided into three parts consisting of:

- A transmission set to drive the hydraulic pump functions with a compression force of 1 ton obtained from Equation 1 uses a 3 HP motor as a source.

$$P = \frac{F}{A} \qquad)1($$

Where: P is pressure in the cylinder from the system or pump.

F is force from the cylinder (kg).

A is the profile of the cylinder)cm^2(. The cylinder's profile area is 50.26 cm^2.

- The hydraulic system consists of a hydraulic pump with a screw for adjusting pressure, a 5/2 valve, a 350-bar gauge for measuring hydraulic pressure, a hydraulic cylinder and hose.
- The palm meal fuel briquette compression mold was designed to compress fuel from the bottom up to allow fuel to be taken out easily. The fuel exits from the bottom of the block, which has a length of 30 centimeters, a diameter of 5 centimeters and a compression axis of 2 centimeters

a) Palm meal from fresh compression. b) Dried palm meal.

Figure 1. Palm Meal Sample

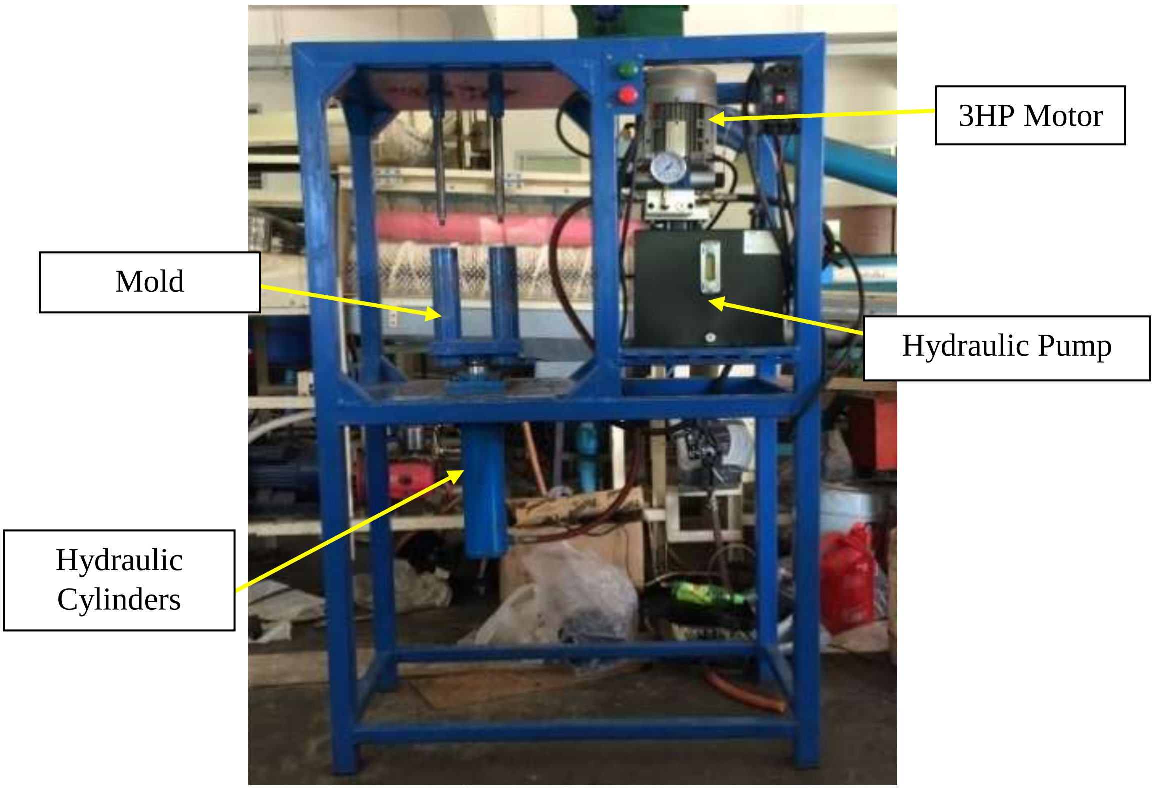

Figure 2. Palm Meal Fuel Briquette Compression Machine

3. 3. Palm Meal Fuel Briquette Compression Machine Testing Methods

- Palm meal used in testing was prepared by drying palm meal obtained from the palm pressing process in the sun for 2 – 3 days until the palm meal was completely dry. The palm had moisture before entering the mixing and compression process of 11.11% d.b. Moisture was calculated in Equation 2.

$$\text{\% of Moisture} = \frac{(w_1 - w_2)}{w_1} \times 100\% \quad)2($$

% of Moisture = Standard dry moisture, dry standard fractions
w_1 = Dry material mass (kg) baked by a hot air oven for 3 days at a temperature of 105ºC.
w_2 = Wet material mass (kg)
Palm Meal Mass before Baking = 0.20 kg
Palm Meal Mass after Baking = 0.18 kg

- Mix palm meal with starch and water according to the proportions specified in the scope.
- Add palm meal to the printing mold.
- Hydraulically compress fuel briquettes by setting pressure at 11, 15 and 20 kg/cm^2.
- Bake compressed fuel briquettes in hot air at temperatures of 50 - 60ºC to drive out moisture for 2 – 3 days.
- Test compressed palm meal fuel briquettes for density, pressure resistance and fuel heat)C_V) as in Equation 3 along with residence time

$$C_V = \frac{W\Delta T - \sum R}{G} \quad)3($$

C_v = Heat of different types of fuel (j/g).

W = Water equivalent of bomb calorimeter = 10,700 (j/ºC(.

$\sum R$ = Heat deducted from combustion and heat from sulfur and nitrogen 12.6 x length of combusted firing wire. Unit: cm.

ΔT = Difference in water temperature before and after fuel combustion.

$T_F - T_i$ (Final Temp – Initial Temp))ºC(

G = Weight of different types of fuel (g).

4. 4. Test Results on Properties of Cassava Starch Briquette Compression

Tests with cassava starch, water and palm meal in the proportions specified in the scope, compressed palm meal fuel briquettes with a cassava starch, water and palm meal weight mix ratio (kg) of 1:1:3 and 1:1:4 were found to not be compressible. The compressed palm meal fuel briquettes were not cohesive and broke. Mix ratios of 1:1.5:4 and 1:1.5:3 kg were found to be compressible with even palm surface while the mix ratios of 1:1:1 and 1:1:2 kg were compressible with high moisture and would solidify after leaving to dry in the sun for 5 – 7 days. When the palm meal fuel briquettes were tested for fuel briquette properties in Table 1, the study of palm meal physical properties found density and residence time in the same mix ratio of the pressure force of 11, 15 and 20 kgf/cm2 to be similar because the residence time depended on the amount of palm meal. In addition, the high density palm meal was found to have a longer residence time than low density palm meal due to a larger amount of combustion material. When pressure resistance was compared at the same mix ratio, pressure resistance was found to increase with higher pressure.

Figure 3. Optimal Fuel Compression Ratio at 1:1.5:3 with Pressure at 20 kgf/cm2

Figure 4. Fuel with High Starch Components from a Ratio of 1:1:1 with a Pressure of 20 kgf/cm2

5. 5. Summary of Test Results

According to the fuel briquette testing of components by using cassava starch as a binder, components can be used to compress fuel briquettes. Appropriate ratios for palm meal fuel briquette compression in the hydraulic fuel briquette compression machine capable of compressing fuel briquettes by using cassava starch as a binder consisted of 1:1:1, 1:1:2, 1:1.5:3 and 1:1.5:4 kg (starch: water: palm meal). When density was calculated, the formula with the lowest density on the table at 849.26.kg/m3 was 1:1.5:4 kg, while the formula with the highest density on the table at 1,122.23.kg/m3 was 1:1:1 kg. Density was obviously not dependent on hydraulic compression force and was dependent on higher palm meal components, which would reduce the density. Vertical and horizontal resistance was 0.417 MPa and 0.589 MPa. The 1:1:2 kg formula was considered to have equal pressure resistance to the compressed goal of 0.40 MPa and 0.58 MPa. Pressure changed with hydraulic pressure. Higher hydraulic pressure would increase pressure. According to calorific value tests, the formulas of 1:1:2, 1:1.5:3 and 1:1.5:4 kg had pressure weights of 11, 15 and 20.kgf/cm2, respectively, and mean calorific values of 3,824.24.kcal/kg,.4,021.34.kcal/kg and4,297.88.kcal/kg, respectively. When calorific values were compared, the heat was found to have increased with palm meal components and a mean temperature of 349 ºC. Test results from the comparison of test values found the most appropriate ratio for compressed palm meal fuel briquettes to be pressure of 20 kgf/cm2.

Acknowledgements

The author would like to express their appreciation to King Mongkut's University of Technology North Bangkok for providing financial support for this study.

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