

# Comparison Study of Efficiency and Property of Fuel Briquette by Electrical Machine by Motor and Hand Machine Using Bicycle

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**Abstract.** Comparison study of efficiency and property of charcoal briquette by using electrical motor machine and bicycle machine was done. The size of electrical motor was 3.5 horsepower and wooden charcoal is grinded crushing machinery was used. The components were grinded charcoal 2,000 g: tapioca flour 500 g (ratio 4:1) and water. They were brought to grind by crushing machinery by using electrical motor and bicycle machine. The times were recorded and brought the charcoal to dry in the sun to get rid of moist. The heat energy was tested by using machine Cal 2k e2k (Bomb Calorimeter) and found mechanical properties of physics which was density of charcoal by calculating from ratio between mass of charcoal briquette per capacity of charcoal briquette. Moreover, the time of lighting fire was found and time of burning was also found by lighting and recorded time until charcoal was burnt. The result of research was found that working efficiency of charcoal briquette by using electrical motor machine took time for grinding average 4.29 minutes and using bicycle machine took time for grinding average 4.50 minutes. The time of grinding was different 4.79%. The value of heat of using electrical motor machine and using bicycle machine was 22.68 MJ/kg and 23.34 MJ/kg respectively. The value of heat was different 2.87%. The values of density were 907.43 kg/m<sup>3</sup> and 838.57 kg/m<sup>3</sup> respectively. The values of density were different 7.89%. Moreover, the times of lighting were average 6 minutes and 4.33 minutes respectively. The times of lighting were different 32.33%. The times of burning were average 5.17 hours and 4.24 hours respectively. The times of burning were different 19.76%

Keywords: Charcoal briquette by using electrical motor machine, charcoal briquette by using bicycle machine, charcoal briquette

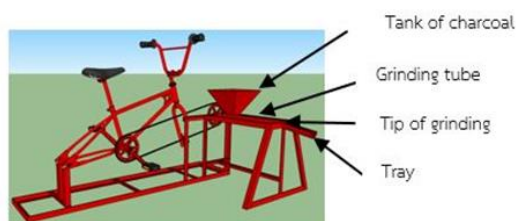
## 1. Introduction

Energy is key factor of developing country and quality life of population. In the past, human required energy for basic living but now human lifestyle has changed. The energy is brought to facilitate many things [1]. Thailand uses energy from biomass at 12,455 thousand tons and use charcoal 2,996 thousand tons and it is equal to crude oil. Moreover, charcoal briquette is imported and brought to use as fuel in industries and cooking. Now, the fuel for cooking is high even gas or charcoal briquette [2]. The behaviour of using energy now has changed from using charcoal to using gas and electricity [3-4].

However, some divisions in local area use firewood, charcoal as fuel for cooking and other activities and it is still necessary more than gas or electricity. Now there are many studies about charcoal briquette

For example Kittipong Lalun, et al [5] studied about developing charcoal briquette from biomass material. In their study, they brought charcoal from cassava's root, mixed charcoal and charcoal from coconut shell to test. The result of study was found that machine model worked properly at speed of putting 140 kg/h and speed of grinding 145 rpm. When the components of mixed charcoal, charcoal from cassava's root, and charcoal from coconut shell were put and water was added with ratio 0.5:0.5:0.15:1. The weight of working was average 131.5 kg/h. Specific energy used average 16.16 W-h/kg. Charcoal briquette had density 676.0 kg/m<sup>3</sup>, strength 0.235 MPa, heat 5,527.3 cal/g and efficiency of working was 27.79-29.56 % [6-7].

Therefore, the process of producing Charcoal briquette has importance as it helps to reduce cost and can produce in household level and community level. This research aimed to compare efficiency between using electrical motor machine and bicycle machine and to compare the properties of both machines.



**Figure 1.** Structure of Bicycle machine for charcoal briquette



**Figure 2.** electrical motor machine and Bicycle machine

## 2. Method

2.1 Tool and equipment used in research consist of

1. Charcoal, Water, Tapioca flour
2. Digital measurement machine 4 position, brand Metter Toledo series AL 204
3. Digital measurement machine, brand Metter Toledo series PL802-S
4. Charcoal briquette with electrical motor machine
5. Charcoal briquette with bicycle machine, grinding machine
6. Measurement of energy tool Cal 2k e2k, Hydraulic machine by hand (use to find heat)
7. Vernier Callipers, Clock, Container for mixing, Stove, Other equipment as per requirement

2.2 Method of study

1<sup>st</sup> Step Prepare materials

Find charcoal and tapioca flour from market and prepare clean water more than actual amount that we will use as there will be some loss during process

2<sup>nd</sup> Step Grinding charcoal

1. Bring charcoal to grind by putting in grinding machine in order to get powder of charcoal to be easy for grinding.
2. Bring grinded charcoal to measure at 2,000 g and Tapioca flour 500 g
3. Bring powder of charcoal to mix with tapioca flour by ratio 4; 1 which is grinded charcoal 2,000 g; tapioca flour 500 g and clean water is not specified. Mix grinded charcoal and tapioca flour very well then add water into them as if we add water immediately, tapioca flour will became lump and it will not mix with other things. Add proper amount of water in the container
4. Pressing to form the shape bring powder of charcoal to test with Charcoal briquette with electrical motor machine and Charcoal briquette with bicycle machine for 2 times per machine. Each time needs to test powder of charcoal 2,000 g which is mixed.
5. Select sample bring Charcoal briquette to select the most complete and bring them to measure to get 1 kg
6. Bring sample of charcoal briquette to dry in the sun to get rid of moist. The charcoal briquette will be dried until its weight is stable. The weight will be measure at 10:00 am. And 16:00 pm in every day. When charcoal briquette is dried for 3 -4 days, it can get rid of all moist.

3<sup>rd</sup> step Comparison of quality

1. Continue process of number 4 in 2nd step, bring grinded Charcoal to mix with Tapioca flour and form the shape. When the test is begun with electrical motor machine, the time will be recorded. When the machine work and powder of charcoal mix with tapioca flour well, record time since starting putting powder of charcoal until bring it to out from machine and do the same process with bicycle machine

2. Bring the result of both tests to compare

2.3 Analyse information

1) Test Density

$$\rho = \frac{m}{v} \quad (1)$$

When  $\rho$  density of Charcoal briquette and its unit is kilogram per cubic (kg/cm<sup>3</sup>)

$m$  is mass of charcoal briquette its unit is kilogram (kg)

$v$  is capacity of briquette when charcoal is formed shape its unit is cubic meter (m<sup>3</sup>)

2) Difference of percentage

$$(1) \text{ Test density} = \frac{\text{density of motor} - \text{density of bicycle}}{\text{average}} \times 100 \quad (2)$$

$$(2) \text{ Test value of heat} = \frac{\text{heat energy of motor} - \text{heat energy of bicycle}}{\text{average}} \times 100 \quad (3)$$

$$(3) \text{ Test time of lighting} = \frac{\text{Time of lighting of motor} - \text{Time of lighting of bicycle}}{\text{average}} \times 100 \quad (4)$$

$$(4) \text{ Test time of burning} = \frac{\text{Time of burning of motor} - \text{Time of burning of bicycle}}{\text{average}} \times 100 \quad (5)$$

### 3. Analytical results

3.1 Compare working efficiency of Machines. Bring wood and burn to be charcoal and grind it to be powder in ratio Powder of charcoal 2,000 g : Tapioca flour 500 g (Ratio 4 :1) and form it by using motor machines to increase density and took time 4.29 minutes and using bicycle machine took time 4.50 minutes. The time was different 29 seconds. Percentage of time of grinding was different 4.79% showed in table 1

**Table 1.** Show comparison working efficiency between charcoal briquette with electrical motor machine and bicycle machine, density and heat energy between motor machine and bicycle machine

Machine	1 <sup>st</sup> Test (Minute)	2 <sup>nd</sup> Test (Minute)	3 <sup>rd</sup> Test (Minute)	Average (Minute)	Density ( kg/m <sup>3</sup> )	Heat energy (MJ/kg)
Motor machine	4.20	3.47	4.00	4.24	907.43	22.68
Bicycle machine	4.45	4.55	4.50	4.50	838.57	23.34



**Figure 3.** Charcoal briquette from motor machine and bicycle machine

3.2 Comparison property of density. When density of charcoal briquettes from both machines were compared, it was found that motor machine provided density at 907.43 kg/m<sup>3</sup> and bicycle machine provide density at 838.57 kg/m<sup>3</sup> Using motor machine and bicycle machine had different percentage of density at 7.89%. The information showed in table 1

3.3 Comparison property of heat energy. When heat energy of charcoal briquettes from both machines were compared, it was found that motor machine provided heat energy at 22.68 MJ/kg and bicycle machine provided heat energy at 23.34 MJ/kg. Using motor machine and bicycle machine had different percentage of heat energy at 2.87. The information showed in table 1

3.4 Comparison time of lighting fire and time of burning. When time of lighting fire and time of burning of charcoal briquettes from both machines were compared, it was found that motor took time to light fire average 6 minutes and took time for burning average 5.17 hours. Bicycle machine took time to light fire average 4.33 minutes and took time for burning average 4.24 hours. The time of

lighting fire was different 1.67 minutes or 32.33% and time of burning was different 1.33 hours or 19.76%. The information showed in table 2

**Table 2.** Show comparison of time of lighting fire and time of burning

Test	1 <sup>st</sup> Time		2 <sup>nd</sup> Time		3 <sup>rd</sup> Time	
	Time of Lighting (Min)	Time of Burning (Hour)	Time of Lighting (Min)	Time of Burning (Hour)	Time of Lighting (Min)	Time of Burning (Hour)
Motor machine	6	5.11	7	5.23	5	5.18
Bicycle machine	3	4.18	4	4.35	6	4.20



**Figure 4.** lighted charcoal briquettes and all burnt

#### 4. Conclusion

The objective of this research is to compare working efficiency between charcoal briquette by using motor machine and bicycle machine and to compare properties of charcoal briquette by using both machines

1. The result of comparison of working efficiency between motor machine and bicycle machine helps to increase density had different percentage and time consuming at 4.79%
2. The result of comparison of property of density of charcoal briquette between using motor machine and bicycle machine was found that percentage was different at 7.89%
3. The result of comparison of property of heat energy of charcoal briquette between using motor machine and bicycle machine was found that percentage was different at 2.87%
4. The result of comparison of time of lighting fire of charcoal briquette between using motor machine and bicycle machine was found that percentage was different at 32.33% and time of burning was different at 19.76%

#### Acknowledgments

Thank you to National Research Council of Thailand (NRCT) and Research and Development Institute of Rajabhat Maha Sarakham University for supporting the research budget, and editing and improving the work with care from the beginning until the research is completely finished.

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