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Utilization of Goat Manure Towards PLTB (Biogas) Prototypes in Simple Way

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Abstract

Biogas is a gas that can be processed using the combustion method and the process of anaerobic (without oxygen) digester activity derived from organic materials such as leaves, cattle manure, agricultural waste and household waste. The high methane content in biogas makes biogas very potential as a new renewable energy source at this time. Biogas can be formed on days 4^{th} -5^{th} after the digester and it is able to reach its peak on days 16^{th} -20^{th}. 5 kg of goat manure can produce methane gas of 0.493181 m^3 which can generate electricity for approximately 10 minutes. The peak power that can be generated within 10 minutes is 0.057240 Watt and it can turn on LED lights. Current, voltage, and electric power will automatically go down and off when the biogas as fuel runs out of the gallon.
Keywords: biogas, goat, electricity

1 Introduction

Along with the times and technology, a lot of energy used is non-renewable energy and tends not to change. Energy is an important component in human life, especially in helping human work and as a source of modern human life as it is now. The use of non-renewable energy is getting out of control and gradually tends to run out of non-renewable energy. The uncontrolled use of non-renewable energy is what drives and creates alternative energy such as biogas. Biogas is a fuel with alternative materials which can utilize kerosene and natural gas as fuel. Biogas is a type of bioenergy that comes from organic materials such as human waste, straw, leaves, animal waste that undergo a methanization process or a fermentation process.

Biogas is clean energy that can reduce greenhouse emissions. Biogas contains methane (CH_4) and the calorific value is quite high ranging from 4,800 – 6,700 kcal/m^3 biogas has the potential to be a new source of renewable energy to replace fossil energy such as natural gas, coal and gasoline (Wahyuni, 2009). Methane gas (CH_4) has one carbon in each chain which makes combustion more environmentally friendly. Biogas methane gas also contains H_2S gas which needs a purification process because it can act as an impurity and if it is burned or released in the air it can become SO_2 and SO_3 which are corrosive (Nurkholis Hamidi, 2011).

Many studies have been carried out in analyzing the potential of biogas power plants such as what Nahdia has done in the title "Analysis of Biogas Power Plants Based on the Green Technology Concept, case study in Puter Kembangbahu Village" The results of this study show that 23 m^3/day of biogas potential can be converted into electrical energy of 1,0005 KWh (Nahdia, 2018). For other studies, such as from Kurniawan who examined the conversion of biogas energy into electrical energy and the results of his research showed the potential for the dung of 300 goats or sheep to produce electrical energy of 32.4 kWh/day (Kurniawan, 2019).

Therefore, in this study, an analysis of the potential of goat waste will be carried out on the prototype of PLTB (Biogas) using 5 kg of goat/sheep dung which is converted into methane gas through a digester process. Where for methane gas its potential will be analyzed to see how much power can be obtained from 5 Kg of goat or sheep dung.

2 Methodology

The method used is based on field research and relies on the literature and references used to support research. Broadly speaking, there are several stages carried out that is :

1. **Design of Biogas Production and Prototype of PLTB (Biogas)**
   The design for making biogas is simply made by collecting 5 Kg of goat manure mixed with 5 L of water, 300 mL of sugarcane juice, and 40 mL of EM4 then mixed until mixed and then put into a container and then compressed or vacuumed for 14-20 days until the methane gas is released. The methane gas produced is indicated by the expansion of the Gas Indicator Tube. Furthermore, the output of the gas is reprocessed into fuel for the PLTB Prototype (Biogas) as an indicator to see the potential of the biogas produced to generate electrical energy. For the design figure, it can be seen through the configuration figure as follows.

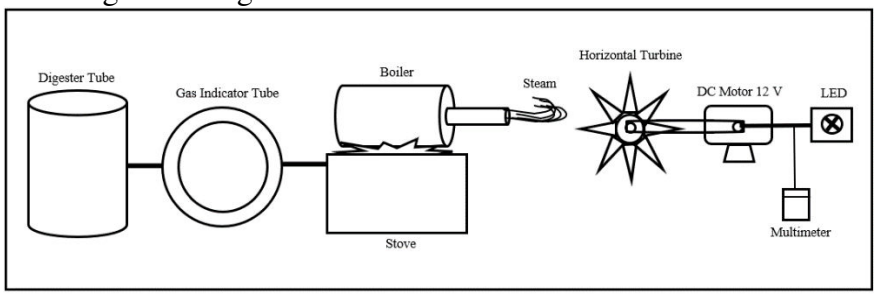

Figure 1. PLTB Prototype System Configuration (Biogas)

The PLTB (Biogas) prototype works on the principle of using steam pressure from the combustion of a boiler with biogas energy fuel, the steam pressure from the boiler will rotate the turbine, causing rotation on the turbine shaft which will make the generator rotate to produce electrical energy. The boiler tube used has a size of 700 mL with a horizontal turbine model with a diameter of 4 cm, and a 12V DC Motor as the generator. The measuring instrument used to see the value of the voltage and current generated by a DC motor is a Multimeter

2. Collection of Tools and Materials

Tools and materials needed for the manufacture of biogas and PLTB Prototype (Biogas) can be described in Table 1 as follows

Table 1 Tools and materials

Tools and materials (Biogas)		
No	**Component**	**Specification**
1.	Digester Tube	19 L
2.	Goat Dung	5 kg
3.	Water	5 L
4.	Small Hose	5 m
5.	Tap/ faucet	2 buah
6.	EM4	40 mL
7.	Sugarcane water	300 mL
Tools and materials (Prototype PLTB)		
No	**Component**	**Specification**
1.	Boiler	700 mL
2.	Stove	-
3.	Water	230 mL
4.	Dynamo (12 V)	12 V DC
5.	Wire	50 cm
6.	LED Lamp	0,036 Watt

3. Assembling of Biogas and PLTB Modeling (Biogas)

When the necessary tools and materials have been collected, all are then assembled according to the design figure that have been made. Biogas Production equipment and PLTB modeling are adjusted to the Design figure which, if actualized, is as shown in Figure 2 below

Figure 2 PLTB Modeling Assembly (Biogas)

4. Observing and Analyzing the Results of Biogas Production

Observations were made to see whether the biogas produced had emitted methane gas and could be used for combustion or not. Analysis is also carried out to find out how much potential is produced by biogas for PLTB (Biogas) prototypes.

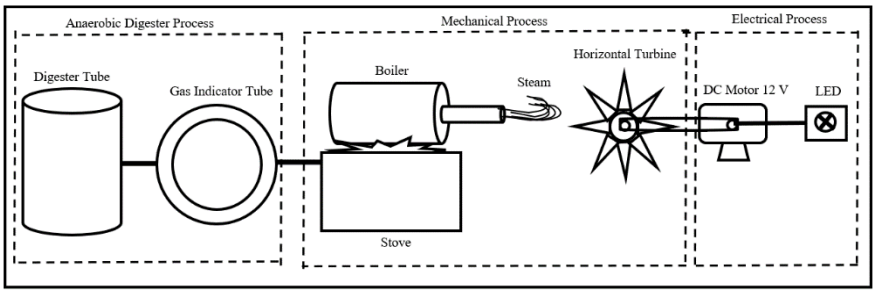

Figure 3. Configuration of PLTB Prototype System Testing (Biogas)

3 Results and Discussion

In conducting the test of making biogas and the prototype of PLTB (Biogas), the first thing to analyze is the potential for methane gas that can be produced from 5 Kg of Goat Manure. From the Center for Agricultural Mechanization Development, Agency for Agricultural Research and Development, Ministry of Agriculture, source of BBKMP in 2008, it was found that 1.48 Kg of dry-based Goat Manure with a percentage of dry matter content of 26% resulted in a yield of 0.04 – 0.059 m^3/Kg.BK (Kurniawan , 2019). The composition of biogas produced from goat manure is as follows:

Table 2 Goat Manure Biogas Composition

No	Element	Composition (%)
1	CH4	64,3
2	CO2	12,5
3	O2	6,2
4	BAL	17,0

For the calculation of the electrical power that can be produced 5 kg of goat dung

- The dry matter content of goat manure with a percentage of 26%
  BK = 5 Kg X 0,26 = 1,3 Kg .BK
- Potential Biogas that can be produced from 5 Kg of Goat Manure is
  Potential = 1,3 X 0,059 = 0,0767 m^3
- The potential for methane gas produced from goat manure is
  CH_4 = 0,0767 m^3 X 64,3 % = 0,0493181 m^3
- Conversion of 1 m^3 of biogas is equivalent to 0,62 L of kerosene, 0,48 Kg of LPG gas fuel, 5,5 Kg of Firewood and 1,64 Kg of charcoal (Kosman, 1997).
  Potensi LPG = 0,0767 m^3 x 0,48 = 0,037 Kg LPG

In the biogas production test, it was found that the biogas potential produced was 0,0767 m^3 with a methane gas content of 0,0493181 m^3 or equivalent to 0,037 Kg LPG. Based on

observations of 0.22 Kg of LPG capable of burning for 110 minutes, for 0.037 Kg of Biogas it is able to produce combustion for approximately 18 minutes, so for this test we conducted a sample for 10 minutes.

Current and voltage are measured using a digital multimeter every 1 minute to calculate the power generated. The test was carried out for 10 minutes and the research results were obtained as shown in Table 3 below.

Tabel 3 Potensi Daya listrik yang Dihasilkan

Time	Rotating Turbine (Yes/No)	Current (A)	Voltage (Volt)	Power (Watt)	LED Light On (Yes/No)
1 Minute	**No**	0	0	0	**No**
2 Minute	**No**	0	0	0	**No**
3 Minute	**Yes**	0,0115	0,852	0,009798	**No**
4 Minute	**Yes**	0,0137	1,233	0,016892	**No**
5 Minute	**Yes**	0,0152	1,586	0,024107	**No**
6 Minute	**Yes**	0,0185	1,688	0,031228	**No**
7 Minute	**Yes**	0,0213	1,742	0,037104	**No**
8 Minute	**Yes**	0,0221	1,823	0,040288	**No**
9 Minute	**Yes**	0,0246	2.13	0,052398	**Yes**
10 Minute	**Yes**	0,0265	2.16	0,057240	**Yes**
Average		**0,019175**	**1,65175**	**0,033631**	

From Table 3 it can be seen that the power value from minutes 1 - 8 experienced an unstable turbine rotation due to the boiling of the boiler is still very small and has not reached its maximum boiling point so that the output issued is the LED light does not turn on as an indicator. At 9-10 minutes, the turbine rotation starts to stabilize so that the turbine rotation starts to increase in power which makes the maximum power generated which is indicated by the LED light as an indicator.

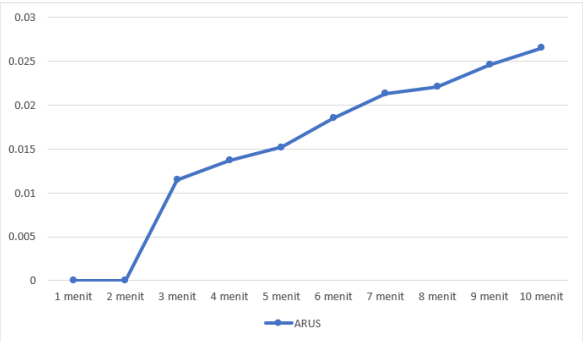

Figure 4 Electric Current Graph

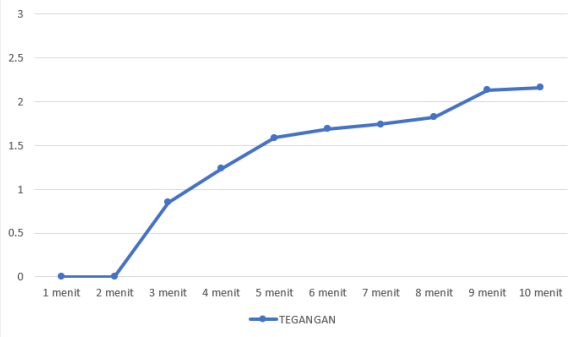

Figure 5 Electric Voltage Graph

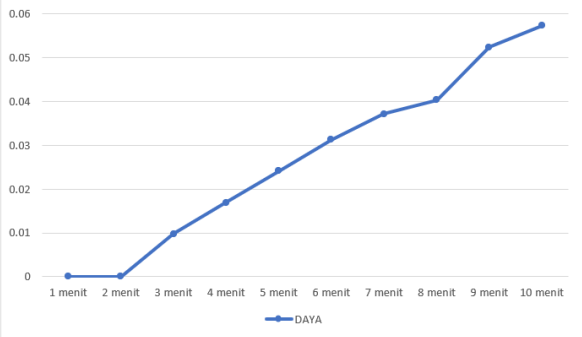

Figure 6 Electric Power Graph

From graphs 3, 4 and 5 it can be said that the current, voltage and power values are directly proportional to the turbine operating time. This is because the longer the turbine is operated, the water temperature in the boiler will continue to increase until it reaches the maximum temperature which causes the volume of water in the boiler to decrease, resulting in a large steam pressure to drive the turbine. In addition, the current and voltage values that continue to increase are evidence that these values have reached a steady state or are already in a stable state if we look at the 9 and 10 minutes the resulting voltage value has a very small difference and increases. This proves that the Prototype of the Biogas Power Plant has begun to stabilize and can deliver power plants.

The influencing factor in making observations is the leaking of the digester tube which makes the research not maximal. In addition, external factors such as wind can cause the fire to not focus when burning or boiling the boiler

4 Conclusions

The conclusions obtained from the testing and manufacture of biogas and the prototype of the PLTB (Biogas) generator are

- The test results of a simple power plant prototype with biogas energy converted from goat dung waste takes a minimum of 20 days. Biogas production is carried out for 20 days with activities to make tools for biogas production and biogas formation.

- From 5 kg of goat manure can produce gas of 0,0767 m^3 or equivalent to 0,037 Kg of LPG Gas
- The methane gas produced is 0,493181 m^3 and is capable of burning for approximately 10 minutes.
- For the PLTB Prototype (Biogas) it produces no maximum power in 1-8 minutes with the output not turning on the LED lights and for maximum power generation in 9 and 10 minutes when the turbine has reached stability and can turn on the LED
- The average power generated is 0.033 Watt with an average voltage and current of 1.65 V and 0.033 A.

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