Study of The Use of Biogas Into Electrical Energy by The Farmer Group Dulur Ganjar, Langse Village, Margorejo District, Pati Regency, Central Java.

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Abstract. Processing of agricultural and livestock waste produces biogas which is then used by the community to substitute natural gas energy and substitute electricity for clean water supply and produce organic fertilizer for farming purposes. This research was conducted using descriptive methods, by describing how to treat agricultural and livestock waste. Then a quantitative approach is used which aims to describe or explain the conversion of biogas energy into electrical energy. Biogas has good prospects as an alternative energy substitute for non-renewable energy in Indonesia which is experiencing an energy crisis which is characterized by increasingly scarce and high fuel prices which have an impact on the higher costs of generating electricity. In the Ganjar Farmers-Farm Group, the use of biogas by using goat / sheep dung is very potential, from 300 goats / sheep has the potential to produce electrical energy of 32.4 kWh / day. Most of the power plants that supply the Pati Regency region still use energy sources made from non-renewable energy materials. The depletion of fuel for these non-renewable plants, power plants with renewable fuels are absolutely necessary.

Keywords: Biogas, Electrical Energy, Conversion, Pati

1 Introduction

Pati Bumi Mina Tani is a nickname for one of the small cities in Central Java, namely Pati Regency. This term is pinned to Pati Regency, because the majority of the population works in agriculture. Even 70% of the regency's regency area is paddy fields. Located in Margorejo Subdistrict, Pati Regency, Langse Village which has an area of 148.2 hectares with a percentage of 83.82 percent agricultural land. [7] Organic waste generated from agriculture

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and livestock turns out to be able to produce a new bioenergy that can wait for the position of fossil fuels that have been almost irreplaceable as the main fuel in power plants in Indonesia. One alternative energy source is biogas. This gas comes from a variety of organic wastes such as biomass waste, human waste, animal waste can be utilized as energy through anaerobic digestion process. Cow dung is the most efficient manure used as biogas producer because every 10-20 kg of manure per day can produce 2 m3 of biogas. Where the energy contained in 1 m3 of biogas is 2000-4000 kcal or can meet the cooking needs of one family (4-5 people) for 3 hours [6].

2 Materials and Methods

2.1 Biogas as an Alternative Energy Source

Biogas is a process of producing bio-gas from organic material with the help of bacteria. The process of degradation of organic material without Biogas as an Alternative Energy Source Biogas is a process of producing bio-gas from organic material with the help of bacteria. This degradation process of organic material without involving oxygen is called anaerobic digestion gas, which is produced mostly (more than 50%) in the form of methane. organic material collected in the digester (reactor) will be broken down into two stages with the help of two types of bacteria. The first stage organic material will be degraded to weak acids with the help of acid-forming bacteria.

This bacterium will break down waste at the level of hydrolysis and acidification. Hydrolysis is the breakdown of complex compounds or long chain compounds such as fats, proteins, carbohydrates into simple compounds. While asifdification is the formation of acids from simple compounds. After the organic material turns into acidic acid, the second stage of the anaerobic digestion process is the formation of methane gas with the help of methane-forming bacteria such as methanococus, methanosarcina, methano bacterium. Biogas mainly contains methane (CH4) and carbon dioxide (CO2) gas, and some small amounts of it include hydrogen sulfide (H2S) and ammonia (NH3) and hydrogen and (H2), nitrogen which is very small in content. The energy contained in biogas depends on the concentration of methane (CH4). The higher the methane content, the greater the energy content (heat value) of biogas, and vice versa the smaller the methane content the smaller the heat value. The quality of biogas can be improved by treating several parameters, namely: Eliminating hydrogen sulfur, water content and carbon dioxide (CO2) [5].

2.2 Conversion of Biogas into Electrical Energy

Energi biogas sangat potensial untuk dikembangkan karena produksi biogas peternakan ditunjang oleh kondisi yang kondusif dari perkembangan dunia peternakan sapi di Indonesia saat ini. Disamping itu, kenaikan tarif listrik, kenaikan harga LPG (Liquefied Petroleum Gas), premium, minyak tanah, minyak solar, minyak diesel dan minyak bakar telah mendorong pengembangan sumber energi alternatif yang murah, berkelanjutan dan ramah lingkungan [8].

Biogas energy conversion for electricity generation can be done using gas turbines, microturbines and Otto Cycle Engine. The choice of technology is strongly influenced by the potential of existing biogas such as methane gas concentration and biogas pressure, load requirements and the availability of funds [2]. As a power plant, the energy produced by biogas is equivalent to 60-100 watt lights for 6 hours of lighting [10]. Biogas equality compared to other fuels can be seen in Table 1.

Table 1. Value of equality of biogas and the energy produced

Application	1m^3 biogas equal to
1m^3	LPG 0,46 kg Kerosene 0,62 liter Diesel oil 0,52 liter Firewood 3,5 kg

In the book Renewable Energy Conversion, Transmission and Storage, Bent Sorensen, that 1 Kg of methane gas is equivalent to 6.13 x 107 J, while 1 kWh is equivalent to 3.6 x 107 J. The density of methane gas is 0.656 kg / m. So that 1 m3 of methane gas produces electrical energy of 11.17 kWh [9]. The conversion of methane gas energy into electrical energy is as in Table 2.

Table 2. Conversion of methane gas energy into electrical energy

Energy Type	Energy Equivalent	Reference
1 kg of methane gas	6,13 x 10^7 J	*Renewable energy Conversion, Transmisision and Storage,* Bent Sorensen
1 kWh	3,6 x 10^6 J	
1 m^3 of methane gas The density of methane gas is 0.656 kg / m^3	4,0213 x 10^7 J	
1 m^3 of methane gas	11,17 kWh	

2.3 Research methods

Broadly speaking, this research stage is divided into 4 stages, namely the identification stage, the stage of data collection, the stage of data processing and analysis, and the conclusion stage.

1) Identification stage
   The field identification phase in this study was conducted to find out how the mechanism of integrated farming systems in Langse Village, Margorejo District, Pati Regency.
2) Literature Study.
   Some supporting theories that will be used include the theory of biogas formation, biogas digesters and biogas energy conversion.
3) Identification of data / case study locations
   In conducting research on biogas power conversion, data and location are needed as examples. The chosen location is Langse Village, Pati Regency.
4) Data collection
   a). Primary Data, it is data obtained from field surveys through observations of livestock waste management with reactor installations which then produce biogas and socialize the conversion of biogas energy into electrical energy.
   b). Secondary data is data obtained from related libraries: (Gas production data, biogas energy conversion data into electrical energy).

3 Result and Disscusion

3.1 Biogas as an Alternative Energy Source

In a biogas installation, there is always a reactor or digester. The reactor is a closed chamber

Type	Lots of Feces (Kg/day)	Dry ingredients BK(%)	Biogas Produced (m^3/kg.BK)

which is used as a storage medium for impurities for several days to produce gas that is stored with impurities which is then called biogas. Of the several types of biogas digesters that are often used are fixed dome types and floating drum types. Biogas production systems are distinguished by the way they are filled with raw materials, namely bulk filling and continuous filling. What is meant by a bulk filling system (SPC) is a method of replacing material that is carried out by removing the remaining digested material from the digestive tank after biogas production stops, and then filling new raw materials. Whereas what is meant by continuous filling (SPK) is the filling of raw materials into the digestive tank carried out continuously (every day) three to four weeks from the initial filling, without having to remove the digested material.

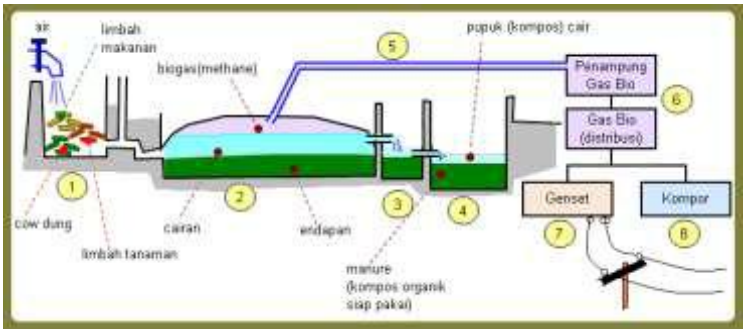

Figure 1. Submarine Bioreactor Scheme.

In the picture above can be seen Submarine Bioreactor Scheme produces compost, Liquid Organic Fertilizer, and Biogas which is then used for domestic, agricultural and as a source of electrical energy.

3.2 Biogas Capacity as Fuel for Electric Generators in Langse village

At Dulur Ganjar Ranch, Langse Village there are no less than 300 goats / sheep. So that the handling of waste both solid and liquid waste in the form of feces and urine that is discharged has the potential to cause environmental pollution:

It is known that a goat / sheep can produce waste in the form of feces and urine of approximately 1.5 kg per day. And to find out the process of converting cow dung into biogas can be seen from the following table obtained from the Indonesian Center for Agricultural Mechanization Development Agency, Ministry of Agriculture:

Table 4. The content of dry matter and the volume of gas produced by each type of impurities [1].

Elephant	30	18	0,018-0,025
Cow / Buffalo	25-30	20	0,023-0,040
Goat / Sheep	1,48	26	0,040-0,059
Chicken	0,18	28	0,065-0,116
Duck	0,34	38	0,065-0,116
Pig	7	9	0,040-0,059
Human	0,25-0,4	23	0,020-0,028

From the above table, it can be seen the amount of potential biogas that can be produced by goat / sheep manure that resides in the Dulur Ganjar Farmer Group Farms through calculations as follows:
The number of goats / sheep in the farm of the Dulse Ganjar Farmer Group in Langse Village is 300.

- Which is capable of producing 1.5 kg of dirt per day.
- Therefore, the production of goat / sheep dung per day at Dulur Ganjar Ranch is: 300 X 1.5 = 450 kg / day
- The dry matter content for goat / buffalo dung is 26%, so the total dry matter content is: 450 X 0.26 = 117 kg.BK
- Therefore, the potential of biogas from goat / sheep manure at the Dulur Ganjar Farmers Group Farm in Langse Village is: 117 X 0.059 = 6.9 m^3 / day

Based on Ministry of Agriculture sources, to find out the conversion of biogas to other energy, it can be seen in the following table:

Table 6. Biogas Conversion and Its Use [3, 6]

Use	**Energy 1 m^3 Biogas**
Lighting	Lights 60-100 Watt for 6 hours
Cooking	Cook 3 types of food for 5-6 people
Power	Run 1 HP Motor for 2 hours
Electricity	

Thus the potential electrical energy generated from goat / sheep dung waste in the Dulur Ganjar Ranch in Langse Village is:
6.9 m3 / day X 4.7 kWh = 32.4 kWh / day with an output power = 32.4 / 24 = 1.35 kW.

With a capacity of 32.4 kWh / day, biogas from goat / sheep manure can be used as a renewable energy source around the Dulur Ganjar Farmers Group, Langse Pati Village for isolated electricity generation.

4 Conclusion

Based on the results of calculations and analyzes that have been made, several conclusions can be drawn including:

1) Biogas has good prospects as an alternative energy substitute for non-renewable energy in Indonesia which is experiencing an energy crisis that is characterized by increasingly scarce and high fuel prices which have an impact on the higher costs of producing electricity. In the Ganjar Farmers-Farm Group, the use of biogas by using goat / sheep dung is very potential, from 300 goats / sheep has the potential to produce electrical energy of 32.4 kWh / day.
2) Most of the power plants that supply the Pati Regency region still use energy sources made from non-renewable energy materials. The depletion of fuel for these non-renewable plants, power plants with renewable fuels are absolutely necessary.

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