Processing of Vegetable Waste to Produce Economic Biogas

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Abstract

Experiments on the processing of biogas from vegetable waste, this experiment was conducted to see the amount of gas in vegetable waste that can be utilized by humans. By making biogas from vegetable waste it is expected that many people depend on the government for household gas. But have another alternative by using this biogas.Waste is a material that is removed from the source of human activities and natural processes that do not have economic value (environmental aspect). Garbage is divided into two types: wet and dry garbage. The results of the biogas rendement measurements formed on the use of various ratios of waste to water (Fig. 4.3;) show on the first day of incubation (at 24 hours incubation time) only 1: 2 (w / v) waste / water ratio resulting in biogas with 240 rendement, 06 mg / liter, while the ratio of other waste / water does not produce biogas. On the second day, biogas has been formed on the ratio of waste / water 1: 2,5 and the ratio of waste / water 1: 3 each of 239.58 mg / liter and 211,23 mg / liter, while on the use of the ratio of waste / Water 1: 3,5 and 1: 4 has not been formed biogas.

Key Words : biogas, vegetable waste

Introduction

Indonesia's high population growth rate resulted in increased amounts of waste generated (Damanhuri, 1995). This condition becomes an important issue because waste management in Indonesia is still inadequate, where garbage is collected, transported and then disposed to final processing location (LPA) (Khair AM, 2009). Such waste management has the potential to pollute the environment and reduce the quality of life of the community. One of the long-term consequences that is not less important than the system in the LPA is the formation of gas emissions. Uncontrolled methane from aerobically and anaerobically decomposed piles of garbage, forming greenhouse gases and contributing to global warming 21 times greater than carbon dioxide gas (Deublein & Steinhauser, 2008).

Biogas is produced through process of fermentation involving the microorganism and the oil is also produce from the aquatic algae. These are the organisms belong to microorganism (Subandi,2014). Fermentation in the waste is a material that is removed from the source of human activities and natural processes that do not have economic value in the respect of environmental aspect(Subandiand Abdelwahab. 2014).

Garbage is divided into two types: wet and dry garbage. Wet trash is waste that can be broken down by microorganisms, whereas dry waste is garbage that can not be broken down by microorganisms (Mappiratu, 2011). Trash is one of the potential polluters and causes problems in all regions. Waste is residual or waste derived from industrial activities, markets, households, hotels, stations and terminals as well as hospitals and offices. The survey results on the contribution of activities to waste showed that 73% of the waste came from households (household waste), 14% from hotel (hotel garbage), 5% from the market (market waste), and 8% from terminal, Restaurant, and office (Kompas, 2008).

Until now, waste has been handled through the application of simple technology to advanced technology that is, from landfill, composting, burning to the incinerator. However, these methods have not produced satisfactory results. This is due to the large volume of waste per day which is not proportional to the waste handling capacity, consequently there are further decay problems that produce odor contamination, ground water contamination, landslide hazard, and disease source. The odor contamination causes the discomfort of the population. This has been experienced by Palu city residents whose city is still classified as a small town, therefore there should be other efforts that have the opportunity to prevent waste accumulation (Darmadji, 2000). One of the technology of waste management and alternative energy source which is big chance to be developed its utilization in Indonesia is biogas energy. This gas comes from various kinds of organic waste Such as biomass waste, human waste and animal waste that can be utilized into energy through the fermentation process of organic materials by anaerobic bacteria (bacteria living in airless conditions). Making biogas from animal waste, especially cow has the potential as an environmentally friendly alternative energy, because in addition to utilizing livestock waste, the rest of the biogas production in the form of porridge can be used as an organic fertilizer rich in the elements needed by plants (Sufyandi., 2001 in Herlina 2010).

Literature Review

Preparation Material The digester stuffing materials consist of vegetable and fruit waste (substrate), and rumen cow content (co-substrat), chopped for preliminary test, including ratio test C / N, substrate water content, and cosubstrate water content. Based on these data, calculated substrate and cosubstrate composition will be mixed as the stuffing material so as to meet the required C / N ratio for biogas formation, which is 20-30 (Fithry, 2010). Addition of water into the stuffing material aims to be able to meet the water content required for the formation of biogas, ie 91-93% (Ratnaningsih, 2009). Each stuffing material is then mixed in accordance with the composition of the calculation result and stirred so homogeneous. Before inclusion Into the digester, the C / N ratio and the water content of the mixed stuffing material Retested. The stuffing material is put into the digester as much as 2/3 of the part Volume digester, ie ± 30 liters. Thus, the digester still exists Room for ± 20 liters for stirring.

Preparing Biogas

The formation of biogas is done at local temperature of local which ranges from 22-31,7 ° C, so it does not require additional energy supply for temperature conditioning (Mayasari et al, 2010). The Padang City temperature range includes the mesophilic temperature range (20-40 ° C) with typical residence time required for biogas formation for 30 days. The parameters observed during the biogas formation process include:

A. pH

PH monitoring during the anaerobic process is performed with
Taking a small sample of the biogas stuffing material from the digester outlet then measured
Using pH paper. The pH measurement is done once in 5 days.
B. Temperatures during the anaerobic fermentation process
Temperature monitoring during the anaerobic process is performed once in 5 days using a thermometer.
C. Gas collection rate increase At this stage observed the increase of biogas collector drum every day.Determination of Volume and Composition
Biogas The volume of biogas is measured by calculating the rise of the collecting

aluminum drum Biogas every day, while the biogas composition is determined by the method as following:

A. Measurement of biogas composition quantitatively
Measurement of biogas composition was done by gas absorption method.
The biogas formed is accommodated in the gas container tank
Connected with digester. The accumulated gas is channeled into the absorbance
CO_2 (NaOH) and CH_4 absorbance
(alcohol). In this way, the compositions of CO_2 and CH_4 are present inside
Biogas can be determined. Measurement
Biogas composition was performed on day 16 and day 30.

B. Measurement of biogas composition qualitatively
Qualitative test on biogas composition was done by flame test
To know the quality of the gas by looking at the color of the flame
Produced at the time of combustion. If the gas is directly burned and the color of fire produced blue, then the gas produced good quality. If biogas contains more other impurity gases then the resulting fire color is likely to be reddish. If the flame is barely visible (not burning) it indicates that the methane content in the biogas formed is still very strong
a little.

Final Material Condition Determination (After 30 Days)
After 30 days of biogas formation, the C / N ratio and the water content of the filling material were tested to see changes in the filling material conditions after digestion in the digester.

Test

NO	Preliminary Test	Material		Optimum condition
		Waste vegetable and fruits (substrat)	Cow waste (ko-substrat)	
1	Rasio C/N	37.61	13.09	20-30
2	Water content (%)	55.38	58.46	91-93

Test Introduction The result of C / N ratio test and water content of each component of raw material of biogas, along with optimum condition to be achieved is shown in Table 1.

Determination of Digester Composite Material Composition

Based on the preliminary test results, it was found that the amount of substrate and water to be mixed as the stuffing material on the successive control digester was 22 liters and 8 liters, whereas the amount of substrate, co-substrate and water used on the test digester were 15 Liter, 7.1 liters and 7.9 liters. The total volume of each digester is 30 liters. The mixed stuffing material is then stirred so homogeneously and retested. On

Retesting, mixing of the stuffing material yields a C / N and C ratio

The water content as shown in Table 2. After it is determined that the C / N and

The mixed water content of the filling material meets the required conditions, the filling material is fed into each digester.

Methods

This experiment is carried out by utilizing vegetable waste or market waste by utilizing water hyacinth and done in private homes. And in making this biogas contained in several stages.

Result and Discussion

Making biogas is distracting some tools and materials **:**

Tools :

- Gallon
- Gallon cover
- Knight
- Baloon
- Hose connecting

Ingredients :

- Waste vegetables
- Water hyacinth
- Water
- Cauliflower

Steps :

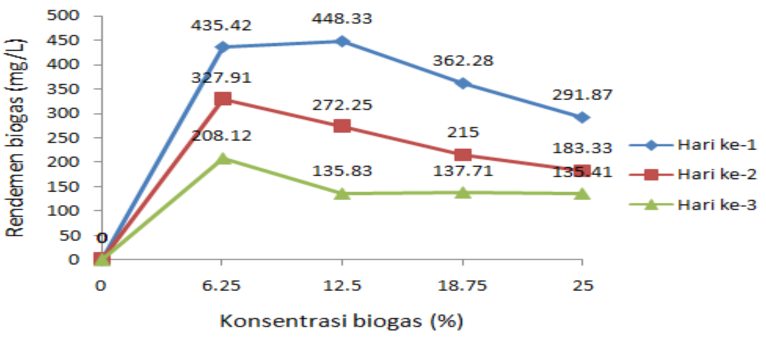
1. Prepare the tools and materials needed
2. Cut into small pieces of vegetable waste, water hyacinth, and cauliflower
3. Input into the gallon that has been provided
4. Fill gallons with water to vegetables, water hyacinth and cauliflower a little floating in the water.
5. Shake gallons until water with other ingredients mixed

6. Cover to the meeting so no air enters the gallon
7. Let stand at least 2 weeks for the material to produce gas.

1. Starter Concentration For Biogas Production From Wet Household Waste

The starter used in the production of biogas from household waste (food waste) is cow dung mixed with water at a ratio of 1: 1 on a weight / volume basis (w / v). The use of cow dung as a starter is based on the biogas production process from cow dung that does not use microbial cultures or starter or cultivators. The circumstances provide information in cow dung has contained microbes that play a role in biogas production process. The use of a mixture of water to 1: 1 cow dung is also based on the biogas fermentation condition of cow dung whose production reaches optimal on the use of water / cow dung 1: 1 (Herlina Dewi. , 2010).

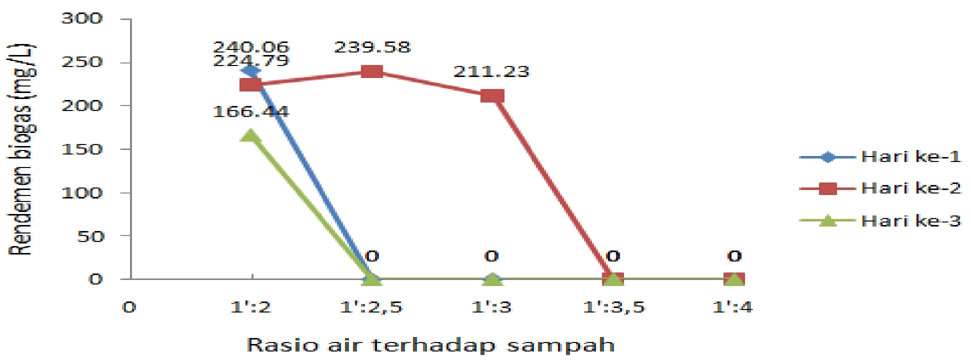
Microbial content of household wastes in the form of food waste is very likely, but microbes that play a role in methane production may be present and may be absent. To know the presence or absence of microbial content of household wet waste treatment required without using a cow dung starter. With this mindset, applied treatment of starter concentration influence with 5 levels of concentration respectively 0% (A), 6.25% (B), 12.5% (C), 18.75% (D), and 25% (E). Observations were made daily for three days. Results of observations of biogas rendement for the first day until the third day (Fig. 4.1 Appendix Table 5,6 and 7) showed that biogas did not form on a fermentor tub that did not contain cow dung starter until the third day of observation. This situation indicates that household wet waste used as a fermentation medium does not contain methane-producing microbes. In addition, the results also show that cow dung can be used as a source of microbes for biogas production from household wet waste.



2. Water Ratio to Household Wet Waste on Biogas Production

The results of the first stage showed that the concentration of cow dung starter influenced the production of biogas with the best concentration found at 6.25% and the worst concentration was found at 0% concentration. With reference to these findings, there is a biogas production presumption of household wet waste also influenced by the ratio of waste to water or the concentration of household wet waste in the fermentation medium. To prove these preconceptions apply the effect of the ratio of waste / water with five levels of ratio, each 1: 2, 1: 2,5, 1: 3, 1: 3,5 and 1; 4 (waste: water). The treatment aims to determine the yield of biogas that is formed if the concentration of household wet waste is lowered or reduced.

The results of the biogas rendement measurements formed on the use of various ratios of waste to water (Fig. 4.3;) show on the first day of incubation (at 24 hours incubation time) only 1: 2 (w / v) waste / water ratio resulting in biogas with 240 rendement, 06 mg / liter, while the ratio of other waste / water does not produce biogas. On the second day, biogas has been formed on the ratio of waste / water 1: 2,5 and the ratio of waste / water 1: 3 each of 239.58 mg / liter and 211,23 mg / liter, while on the use of the ratio of waste / Water 1: 3,5 and 1: 4 has not been formed biogas. On the third day, biogas treatment only used the ratio of waste to water 1: 2 with decreased yield to increase incubation time or observation time, while other treatment did not produce biogas. This situation provides a dilution information to lower the yield of biogas that is formed. It is thought to be caused by decreased nutrient concentrations with increasing water use in the fermentation medium. The presumption is supported by the statement of Ved et al. (2010) in Lutfianto (2012) who believe that biogas production will decrease with the decrease of nutrient content of medium and soluble solids content of fermentation medium.



Waste / water with observation time of one to three days. Biogas production for each use of the ratio of waste to water is the total amount of production. To know the production of biogas relativ to the ratio of waste / water calculation of the total rendement of biogas for three days incubation. The results obtained (Fig. 4 and Table Appendix 12) show that the yield of biogas production on the waste / water ratio of 1: 2 reached 631.29 mg / liter, about twice the yield of biogas production in the use of the ratio of waste / water 1: 2,5 and About three times the biogas rendement on the use of the ratio of waste / water 1: 3 on the basis of weight per volume (w / v). The decline in biogas production in the use of increased waste / water ratio or increased water use is thought to be due to a decrease in nutrient concentrations or biogas-forming feedstocks such as carbohydrates, lipids and proteins, even possibly vitamins and minerals. In addition, the decrease in the yield of biogas production may also be due to the decrease of medium soluble solids

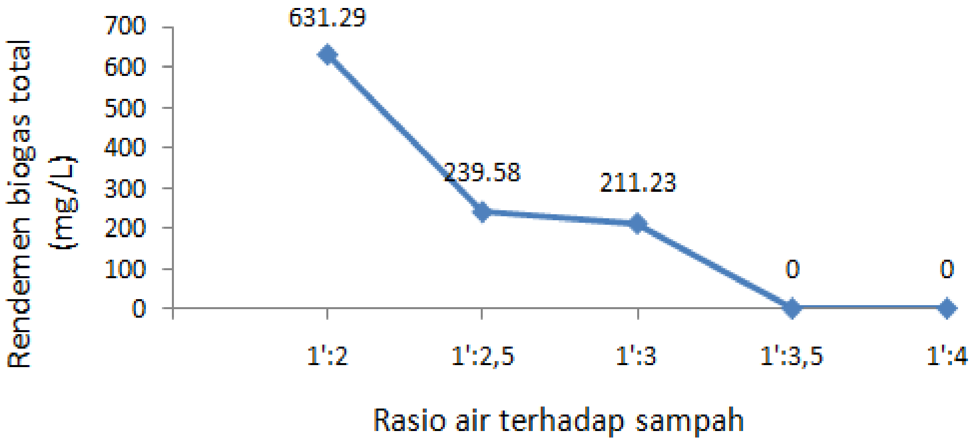


Figure 5. Total biogas rendement measurement results in various waste / water ratio From Duncan test with BNJ test (Beda Realata Jujur) at 5% level presented in Appendix 15, 16 and 17, showing the differences of each group can be seen from the value of harmonic mean that Each group is produced in the same or different subset columns. In the test results showed the sample group treatment was in different subset columns. The result of observation of the rendement of biogas for the first day until the third day on the ratio of water to waste, where the ratio of 1: 2,5, 1: 3, 1: 3,5 and 1: 4 entered into column 1 and ratio 1: 2 entered in column 2. For the treatments contained in different columns identify significant differences, and the treatment contained in the same column identifies differences that are not significant or different are not real. The use of 1: 2 ratio gives a

significantly different effect on the ratio of 1: 2,5, 1: 3, 1: 3,5 and 1: 4. To determine whether the gases formed contain methane gas, a flame test is performed. The results obtained show that the resulting gas contains methane gas because the flame generated is blue with a large flame. In general, if this methane gas is burned it will be blue and generate a lot of heat energy (Pambudi, 2008 in Lutfianto 2012).

Conclusion

The situation indicates that household wet waste used as a fermentation medium does not contain methane-producing microbes.To meet the needs of biogas households made from cheap and affordable vegetable waste and can reduce household waste in the environment. It isbelieved that biogas production will decrease with the decrease of nutrient content of medium and soluble solids content of fermentation medium.The results obtained show that the resulting gas contains methane gas because the flame generated is blue with a large flame.

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