IJSES
International Journal of Scientific Engineering and Science
Volume 6, Issue 11, pp. 34-37, 2022.
ISSN (Online): 2456-7361

Potential of Household Waste as an Alternative Energy Source in Makassar Indonesia

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***Abstract*—** *Utilization of waste into alternative energy is still very minimal, in Indonesia it is estimated that only around 1600 MW or about 3.25% of the potential that exists. Several small-scale biogas installations already exist. However, the installation is still limited to sources originating from oil palm waste and livestock manure, while household waste is not optimally managed. The volume of waste in Indonesia ranges from 64 million tons per year. Until the year 2020, the volume of urban waste is expected to increase fivefold. Meanwhile, starting from the process of planting, production, shipping to final consumption, more than 40% of food becomes garbage. This is a big problem if it is not handled properly, even though garbage holds a large energy potential.*

***Keywords*—** *Household waste, biogas.*

I. INTRODUCTION

Waste is one of the fundamental problems experienced by the city government. In developing countries, waste management in general is still conventional in that garbage is transported from sources (houses, restaurants, traditional markets, modern markets, hotels, offices, etc.) and transported to landfills (garbage dump). This management process only produces more waste and spreads unpleasant odors without any added value. Actually the government realizes that urban waste, which is mostly household waste, is one of the potential renewable energy sources, so that it is used as a national priority in the field of new and renewable energy. But the utilization of waste into energy is still very minimal, from the existing potential (Development, 2014). Several small scale biogas installations are scattered in various corners of East Java and Central Java, while the largest electric propulsion installation is only in East Jakarta Cakung Animal Slaughterhouse with production of 20-35 KV. However, these installations are still limited to sources originating from oil palm waste and livestock manure (Arifin, Saepuddin, & Santoso, 2011) (Hanif, 2013) (Yusuf & Arfah, 2014). The management of household waste waste as an energy source has not been optimally touched.

The amount of waste produced in large cities is increasing, as a comparison in Makassar City itself, on average 700-800 tons / day (know data 2020), it can even reach 1,200-1,500 tons / day on certain days, while the volume the volume of waste in Indonesia ranges from 64 million tons per year. It is estimated that by 2024, the volume of urban waste in Indonesia is expected to increase fivefold. The final consumption of food contributes greatly to waste or waste (Oliveira & Doelle, 2015). In other words, food waste or household waste has a large portion. This is a big problem if it is not addressed, even though garbage holds a large energy potential. Household waste has the potential to be used as methane gas and is relatively high compared to several other types of organic material. This potential is measured by comparison of carbon and nitrogen levels (C/N N ratio). Levels of C / N ratio of domestic waste ranges from 12-30. For comparison C / N ratio for goat manure is around 12, chicken manure 15, horse manure 25, cow manure 18, while human feces are 6-10.

On the other hand, the search for alternative energy sources is increasingly urgent in line with increasing demand for energy. This is realized by the government so that the Minister of Energy and Mineral Resources of the Republic of Indonesia (ESDM) issued Ministerial Regulation No. 12 of 2017 concerning Utilization of Renewable Energy Sources (ESDM M., 2017). Biogas is a potential energy source and is recommended as an alternative energy source. The Ministry of Environment and the Ministry of Energy and Mineral Resources and USAID support the feasibility analysis, including investment financing, waste into energy for various types of waste utilization (USAID & OJK, ICED web site, 2016) (ESDM, 2016). However, currently the focus of management of biomass is only on industry waste, plantation biomass and oil palm industry (POME), cattle farming, and rice husk biomass. The overall research household waste is still rare, even though this source is very potential considering the abundant raw material. Besides that waste processing into alternative energy (waste to energy) has another positive impact, which can reduce emissions of methane (CH4) into the air and reduce environmental pollution (Ratnaningsih, Widyatmoko, & Yananto, 2015)

II. LITERATURE STUDY

Biogas

Biogas is produced by the fermentation process of organic materials such as vegetables, human or animal waste, domestic domestic waste and other biodegradable waste. This biogas content varies according to the ingredients it forms. However, generally it contains 50-70% CH_4 (methane), 25-50% CO_2 (carbon dioxide), 1-5% H_2, 0.3-3 N2 and H_2S (Sitthikhankaew, 2011) (Tien, mai, Hung, & Cong, 2010). Biogas is a potential energy source, especially in waste-producing areas, such as oil palm, urban plantations and so on (Jawurek, Lane, & Rallis, 2011) (Yulianto, Adi, & Priyambodo, 2010). Figure 1 shows the biological conversion of decomposition of organic matter into biogas.

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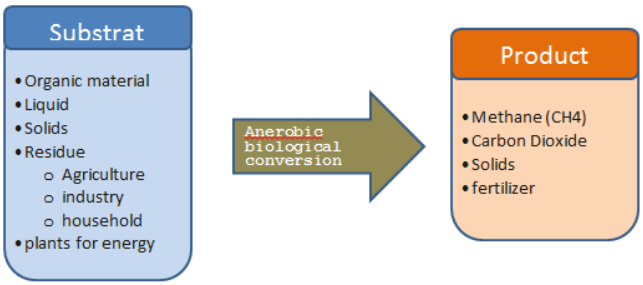

Figure 1. Anaerorobic biological conversion process, source (USAID, POME to Biogas Conversion Handbook)

Potential Biogas Content in Household Waste

Figure 2. Household waste

Household waste is in the form of scraps of vegetables, fruits, fruit skins and food scraps that do not eat (rice, vegetables, side dishes and so on). The survey results showed that the contribution of waste activities was 73% from households, 14% from hotels, 5% from markets and the other 8% from terminals, hospitals, restaurants and offices. Biogas production produced by household waste is high compared to other organic materials. According to national research conducted in EU countries, vegetables and fresh fruit contribute to nearly 50% of the food waste generally by household (Laurentiis, V. D., Corrado, S., & Sala, S, 2018).

One of the interesting characteristics of this biogas is that it is ideal for decentralized power plants around the point of consumption. On the other hand, biogas can be produced on a large scale from urban waste and can be used as an alternative energy source (Guo, Qin, & Schmitz, 2010). Biogas technology has been developing for a long time but its use as an alternative energy source has not developed significantly. This is caused by a lack of thorough assessment and poor management of raw materials so that the resulting biogas is not optimal (Widodo & Asari, 2006).

III. Research Methods

The methane gas (ammonia) content detection system consists of several electronic circuit blocks consisting of the MQ-135 sensor as a detection device, an Arduino circuit as a processor or circuit controller and display as an output device.

As a measurement object, a prototype of an organic waste bin is made filled with various types and types of household waste. To get the methane gas content that can be detected, the waste is left for one week. Measurements were made by measuring the levels of ammonia gas and the output voltage from the gas sensor conversion. Measurements are made using a spectrometer, picoscope and display that has been designed with the detector.

Figure 3. Detection of ammonia content

Figure 4. prototype organic waste bin

IV. Results and Discussion

The first measurement of the concentration of methane gas is carried out using a picoscope which is connected to the output of the designed detector. The initial stage is carried out measurements on free space (without bringing it closer to the trash bin). After that, the methane gas content was measured in the garbage bin. This is done to ensure that there is a change in the output voltage on the detection device before and after being brought to the garbage can. Thus, there is a high concentration of methane gas in household waste. Voltage changes can be seen from changes in PWM width (Pulse Width Modulation), the voltage expressed by pulses in one period.

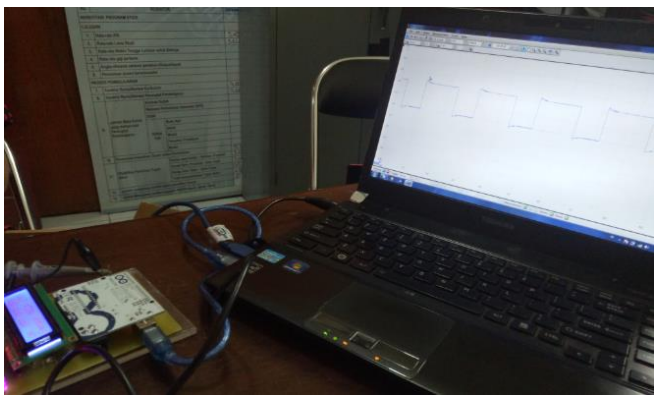

Figure 5. measurements using picoscope

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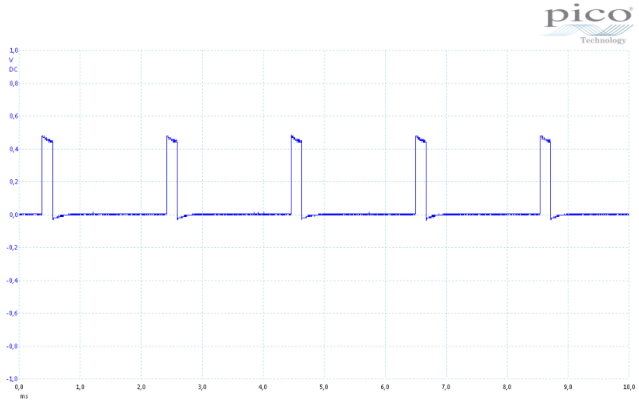

Figure 6. Monitor output before the use of methane gas

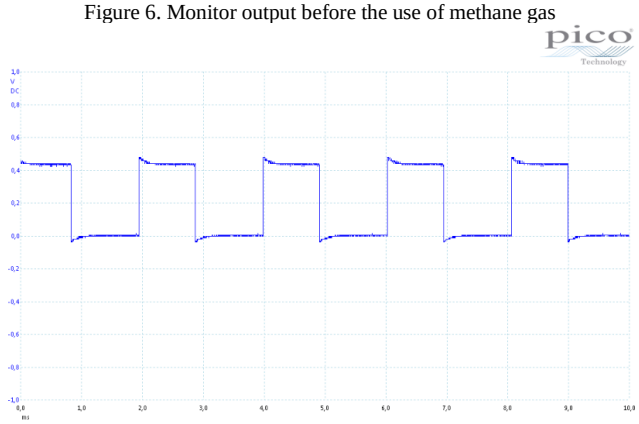

Figure 7. Monitor output after the use of methane gas

The second measurement is carried out through a display which is part of the methane gas detection device. Measurements were made by applying several types of household waste. As a result, the concentration of various types of household waste is obtained.

Figure 8. Display Output

TABLE 1. Measurement of methane gas content in household waste

No	Type of household waste	Digital sensor data MQ 135 (ppm)
1	Spoilage of vegetable waste	28
2	Household waste in the form of liquid	18
3	Residu from household waste mixture	16

From these results it can be seen that the waste from vegetable decay has a higher methane content. However, mixed waste is still a concern considering that it is impossible to sort household waste production.

Next, measurements were taken using a spectrometer. As a result, there is a linear comparison between the output voltage and the ammonia content in the measured rubbish object. The higher the ammonia content, the higher the voltage produced

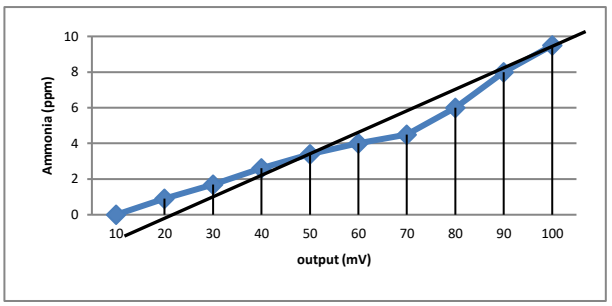

Figure 9. Graph of the relationship between output voltage and ammonia level

From the three measurement results, it can be seen that the ammonia (methane) gas content in household waste is quite high. This indicates that the potential for household waste is very large to be used as an alternative energy source.

V. CONCLUSION

Household waste has a high potential to be used as an alternative energy source in addition to other alternative energy sources.

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