



Utilization of Water Hyacinth as Acquired Biogas, Liquid Fertilizer and Control Its Spread

Agus Hadiyanto*, Alfiyanti, Deo Reynaldo Alwi, Indra Riadi, Istiana Norita Rahma, Noor Hanifah Angga Putra

Chemical Engineering Department Diponegoro University
e-mail: agushadi55@che.undip.ac.id

Abstract - Calombo hamlet, Semarang Regency has a population of 1,125 peoples, live at coast side of Rawapening Lake. Much of the water hyacinth covered Rawapening Lake thus decreasing fisheries production. The growth of water hyacinth has been decreased by using it as craft materials and compost, but not optimally. Need other efforts to reduce the density for example convert or utilize water hyacinth for biogas and liquid fertilizer. The objectives of the programs are approach the society by socializing about the benefits of water hyacinth convert to biogas and liquid fertilizer, to train skilled of people to build a biogas unit. The result of this programs makes a biogas unit MERCEDES (Mesophilic Reactor Anaerobic Digestion) which produces biogas and liquid fertilizer. The economic potential is obtained if all households apply them (equivalent with energy) about IDR 17.112 million per year, a liquid fertilizer about IDR 200.000 per household per day, the environmental potential reduction of water hyacinth growth about 6-15% per year, providing knowledge to the community to build a biogas unit and Mr. Musyafa has been utilize the biogas and fertilizer and have formed the structure of the organization to manage and develop the biogas unit for sustainability the program.

Keywords: Biogas, Liquid Fertilizer, Calombo Hamlet, Water Hyacinth, Rawapening Lake

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1. Introduction

Calombo vilage of Semarang Regency have population of 1,125 people (207 families) and stay on the land settlement at coast side of Rawapening lake (Shafii, 2015). Ninety per cent of the population as fishermen who rely economy to Rawapening. It's difficult to catch fish and shrimp with net because therea are water hyacinth growth on the surrounding surface of Rawapening. Lake of Rawapening consist of 30% water and 70% of water hyacinth (Abusbiha, et al., 2013).

Water hyacinth engender decrease of production in the fisheries sector so that the people of Calombo vilage expect new innovations technology to reduce its spread. Besides the issue of decline in fishery production, during this time many hamletrs still widely used wood for cooking, meanwhile LPG is a expensive fuel and that can not be renewed. Water hyacinth is contains of carbohydrate such as starch and cellulose that can be used as a substrate in biogas production. Organic substances are processed in anaerobic condition until produce biogas that can be used as fuel (Riyanti, et al., 2010). Biogas from water hyacinth is one way to control and utilization of this plant.

The advantage of biogas (fuel gas) from water hyacinth is a renewable energy that is produced by a very simple process. The illustration of the advantages of using biogas that 1 m³ of unit biodigester is able to provide gas for cooking about three days (Daugherty, 2001). From the biogas unit is also released bioslurry as a liquid fertilizer that have economic value too. Water hyacinth 30 kg can produce biogas for 7 days in batch digester and can be used for 90 minutes every day. Digesters can be made of drum and hold 100 kg of water hyacinth and 100 L of water (Ministry of Environment 2008).

Based on the description above, the community service aims to establishment of a unit of biogas with water hyacinth as raw material for biogas and liquid fertilizer and to show the economic potential of community-acquired and benefits the environment when all households in the Calombo hamlet build biogas unit. To realize the goals of this devotion, the target group has a strong relevance to the issues above are the farmers and fishermen in the hamlet Calombo Tuntang Semarang in particular as well as local residents in the Calombo Vilage of Semarang Regency.



Figure 1. (a) Wood conventional fuel; (b) Water hyacinth cover Rawapening Lake

2. Methods and Materials

Referring to the targets to be achieved from this program where the goal is a society, for the first we are conducted counseling so that the people understanding about biogas, benefits and potential water hyacinth is converted to biogas, decrease spread of water hyacinth on Rawapening lake, the economic potential of liquid fertilizer is produced from biodigester, the area and the time to “mesophilic anaerobic digestion reactor “ build, the material for construction is required, source of funds and community participation in the development of biogas units, practice building biogas unit and operate it.

The second to be built Biogas Unit (Mesophilic Anaerobic Digestion Reactor) with liquid capacity 6 m³ including piping systems, manometer gas and biogas stoves. The materials needed to build these units are sand, split, cement, iron columns 8 mm, bricks, PVC pipe, tool sets of manometer and stoves. After manufacture of biodigester is completed installation and then filling cow manure as a starter with the

composition of the water : cow manure = 1: 1. The water hyacinth (wet chopped size 0.5 cm -1 cm) inserted into the biodigester every day (around 100 kg/day) with the addition of water 100 liter. The utilization of biogas and a liquid fertilizer (bio slurry) after the digesting time (hydraulic retention time in the bio digester) at least 20 days.

3. Results and Discussion

This program began on February 24, 2016. The first phase of the program is beginning with the preparation of job descriptions and division of tasks to each member that refers to the program. The next phase is survey for the implementation of the program and has already obtained at Calombo Hamlet of Semarang Regency include plan site of of biodigester units to be built (the house of Mr. Musyafa) with an area of 5 x 3 m². The construction of biodigester was carried out by users of biogas, Mr Musyafa, Mr. Munjidi, and Mr. Harun began on April 14, 2016.



Figure 2. (a) Biodigester Unit; (b) Biogas Stoves

Furthermore, the procurement of materials such as sand, split, cement, bricks, iron columns and acrylic waterproofing paint. Construction was completed on May 6, 2016, then left to ensure that construction has been strong and the paint is dry.

The next phase entering starter (cow manure) with water (1:1) about of 3 m³ and insert the chopped water hyacinth and water in the ratio 1:1 about of 3 m³. This work has been conducted on May 22, 2016, then left the system for a adaptation and decomposition process at

least 20 days. Finally, on June 8, the biogas has been production but manometer still height difference of 20 cm. For a while newly installed one stove at the house of Mr. Musyafa subsequently by Mr Musyafa family has been utilized. The program is funded by the Ministry of Research and Higher Education was also supported by the foundation Mitra Biru and received appreciation from Expert Staff of the Governor of Central Java Province and Environmental Agency of Central Java Province.

4. Economic Aspects

The energy consumption of each household is 3kg LPG or IDR 18,000/month (Yovanda.Y., 2016) or IDR 216,000 per year. For the 207 families in the Calombo hamlet equivalent with IDR 44.712 million.

If all of household fully utilize biogas energy, will get saving money of IDR 216,000/year/ household. The equipment cost required to create 69 units of biogas = $69 \times \text{IDR } 12.000.000/\text{unit} = \text{IDR } 828$ million. If equipment cost for built the biogas unit is subsidized 50 % from government so the costs required (in the form of manpower & material) = $\text{IDR } 414$ million carried by 207 households. These costs will be further reduced when labor costs are fully carried out by residents. Energy costs to be incurred by the citizens per year, equivalent to $\text{IDR } 44.7$ million. When administered in the form of interest-free loans, it will take to pay off during the ($\text{IDR } 414$ million / $\text{IDR } 44.712.000/\text{year}$) = 9 years. Assuming a biogas plant can survive at least 15 years, so the residents Calombo hamlet can save $\text{IDR } 44.712$ million - $\text{IDR } 27.6$ million = $\text{IDR } 17.112$ million per year. In addition, the biogas unit produces liquid fertilizer as a side product about 200 litres per day worth of $\text{IDR } 3000$ per litre, with big gross potential economic of $\text{IDR } 600.000/\text{day}$ ($\text{IDR } 200.000/\text{household per day}$)

5. Enviromental Aspect

Biodigester volume is 6 m^3 need a 100 kg/day chip of water hyacinth (moisture content 90%). Mass of 1 m^2 area of water hyacinth is $20 - 30.5 \text{ kg}$, so that 100 kg/day of water hyacinth will decrease the plant about $3-5 \text{ m}^2/\text{day}$. One unit of biodigester supply biogas for 3 households. If the 207 households in the Calombo hamlet has a biogas unit, so the cover area of water hyacinth on Rawapening lake would be reduced by =

$(207/3) \times (3-5) \text{ m}^2 = 226-345 \text{ m}^2$ per day. If the rate of uptake is faster than the rate of growth, so the program possible to reduce the spread of water hyacinth = $365 \text{ days/year} \times (226-345) \text{ m}^2/\text{day} = 8-13 \text{ ha}$ per year. Rate of growth of water hyacinth in Rawapening lake $66.1-162.8 \text{ ha /year}$. If every day and every unit of biogas requires about 4 m^2 water hyacinth, so Calombo hamlet with 207 family or households would reduce the spread of water hyacinth area of 10 hectares per year. When compared to the rate of spreading, the Calombo hamlet have potential to reduce the spread of water hyacinth in Rawapening lake = 6% to 15% per year.

6. Conclusions

This program to make a biogas unit mesophilic Reactor Anaerobic Digestion (Mercedes) to produce biogas as an renewable energy and bioslurry as liquid fertilizer. Economic potensial is obtained if all households in the Calombo hamlet apply biogas energy is $\text{IDR } 17.112$ million/year and liquid fertilizer worth $\text{IDR } 200.000$ per household per day and have potential to reduce spread of water hyacinth cover on Rawapening lake up to 15% per year.

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References

- Abusbiha, M. et al., 2013. *Dampak Aktivitas Pertanian terhadap kualitas air Danau Rawapening*, Semarang.
- Kementerian Lingkungan Hidup, 2008. *Program Menuju Indonesia Hijau*, Indonesia.
- Daugherty, E., 2001. *Biomass Energy System Efficiency: Analyzaed through a Life Cycle Assessment*, Land University.
- Riyanti, F. et al., 2010. Pembuatan Instalasi Untuk Biogas Dari Enceng Gondok. *Jurnal Pengabdian Sriwijaya*, pp.215–221.
- Syafi'i, 2015. *Data Papan Monografi Dusun Calombo Desa Lopait Kecamatan Tuntang Kabupaten Semarang*, Semarang.
- Yovanda, Y., 2016. Masyarakat Miskin Terancam Tak Bisa Nikmati Elpiji 3 kg. *Sindo News*. Available at: <http://ekbis.sindonews.com/read/1123435/34/masyarakat-miskin-terancam-tak-bisa-nikmati-elpiji-3-kg-1468495895> [Accessed July 20, 2016].