People's Electricity Program For Solving Overload Domestic Waste Issue By Converting Trash To Energy Utilizing Bio-Digester Method

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Abstract. Big Rubbish has always been an issue to most major cities in Indonesia. The need to solve, handling and reducing tons of waste has become very urgent. One of the solution is People's Electricity Program. The Idea is by converting domestic waste to energy in efficient, affordable and eco-friendly ways. The research started in Pondok Kopi RW 10, East Jakarta, converting domestic waste using bio-digester method, and thus experiments succeed turn the trash to compost leachate that can be use as fertilizer as well as forage ingredient. In this article, authors will focus on the detail of An-aerobic Digester known also as bio-digester method which is an alternative technology in The People's Electricity Program to manage waste, converting it as energy. While researching and developing for People's Electricity Program, The idea to create briquettes from waste came up. This waste-briquettes is being tested and checked in laboratory where its eventually having calorie level closed to coal's calorie level. By using the bio-digester method on People's Electricity Program, the waste-to-energy conversion can be built any where and become a solution to waste management, reducing the amount of junk while giving value provide an energy source for community.

Keywords: **bio-digester; briquettes; people's electricity; rubbish.**

1 INTRODUCTION

Big Rubbish has always been an issue to most major cities in Indonesia. The need to solve, handling and reducing tons of waste has become very urgent.

Without using the right strategies on waste management, reuse, recycle, millions tons of trash keep expanding. Based on Indonesia's Infrastructure book in year of 1995, estimated waste in Indonesia is 22.5 million tons and by 2020 will be 53.7 millions tons. Even now the capacity of trash being dumped is already overload for being manage by local government trash disposal facility.

As we know, rubbish is always there as long as we humans have activities. The volume of waste is increasing with addition of consume level. The increased of population and lifestyle also bring more and more waste. Domestic waste is not much compare to the industrial waste. But still is become an issue for us.

Every day a city resident produce 600 – 830 gram of trash, both organic and anorganic waste. Organic waste is waste that can be decay, the decomposition will produce smaller and odorless matter also known as compost. The Compost – a rich nutrient organic matter can be used as fertilizer and also for erosion control matter reducing topsoil loss, as a layer that can help the soil to hold water.

The composition of organic matter in citizen's waste is abundant. Around 70.69% in the rubbish. In the wet market like vegetable market, fruit market and fish market, almost 95% of waste is organic. Having this composition, handling the rubbish to be able to used it as alternative source as energy resource will be one of best solutions.

The Garbage Power Plant (Pembangkit Listrik Tenaga Sampah – PLTSa) built and designed for converting waste into energy. There are two ways of processing the garbage to become an energy resources, one is biological, fermented process that produce a bio-gas amd the other one is a thermal process that provide heat.

In this paper, authors will focus on the detail of An-aerobic Digester known also as bio-digester method which is an alternative technology in the communal electricity program to manage waste, converting it as energy.

2 ANAEROBIC DIGESTER

In the decomposition of organic waste to become compost, biogas occure. This combusted gas which produce from fermentation process of organic matter like animal waste, plants and human residues. The process

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done by bacteria that live in low oxygen environment depend upon anaerobic respiration, one of archeabacteria who breathe carbon dioxide and having methane as by-product called methanogen.

A large amount of biogas can be generate by creating a machine that have an environment which suit for anaerobic fermentation process, a biogas generator called bio-digester. An anaerobic digester can produce 50% to 70% methane (CH_4), 30% to 45% Carbon dioxide (CO_2) and other like Hydrogen Sulfide (H_2S) in small amount. A pure methane gas can have caloric value at 8900 Kkal/m^2, while the methane gas that being generated by a bio-digester can get 4800 to 6700 Kkal/m^2. That value is sufficient enough to use as fuel, to cook, light up, and many things that needs source energy. Biofuel will be optimized for being used after the bio-digester fully charged in 4 to 5 days and it reach the peak at 20 to 25 days.

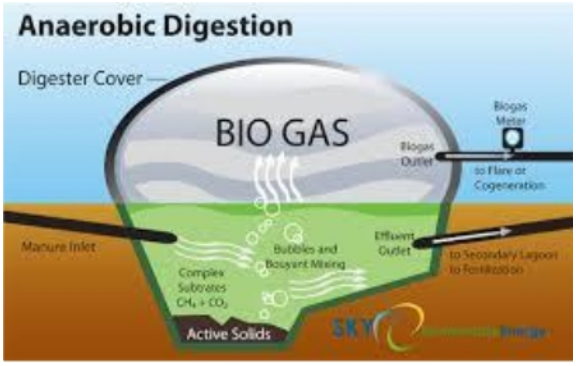

Fig 1. The Anaerobic Digestion Process.

There are four factor need to be consider for deploying bio-digester system. **The First** one is a crucial factor for considering to apply an anaerobic digestion system is the organic matter that will be used for the fermentation process. The organic matter should be have more enough substrat which can be converted to methane by the anaerobic archeabacteria. High level of biogradibility of the substrat will be a key factor for having a successful application of anaerobic digestion system produce methane gas at optimal rate. **Second** one is the water content on the substrat, the moist level of organic matter will determine which method of digestion that will be used. **Third** one is the ratio of carbon compare to nitrogen known as C/N ratio of the organic matter, The C/N ratio will determine whether the "food" for archeabakteria is good or not, so the organism can live and reproduce. The optimum ratio for anaerobic digestion system is 20:1 to 30:1 (Verma, 2002). If C/N ratio lower than 20:1 will causing the amonia accumulated dan increasing the PH level more than 8.5 thus creating a toxic enviroment for the methanogen archeabacteria. Higher ratio of Carbon:Nitrogen than 30:1 indicates faster the nitrogen being consume by the organism and the methan gas that produced will be minimum. The **Last** one is the contamination level on the solid waste will also be important parameter. If the contamination on the raw material that used in bio-digester has much plastic, glass, and metal then the digester won't be able to work efficiently.

3 RESEARCH & CONCLUSION

The research started in Pondok Kopi RW 10, East Jakarta, converting domestic waste using bio-digester method.

There are three main by-product of Anaerobic digester method:

1. Biogas; a mixed gas containing most of its part are methane and carbon dioxide, with a small amount of hidrogen and hidrogen sulfide. The methan in biofuel can be used as combusted source to produce electricity, usually using a riciprocating machine or microturbine engine.
2. Anaerobic Digestate; the digestation process produce a solid and liquid residue known as digestate which can be use as soil nutrient. The amount of biofuel and digestate's quality varied depend on the waste that being fermented. It will have more gas if the rubbish easily decay.
3. Waterwaste; the last by-product of anaerobic digestion system is water. This water came from the liquid of the rubbish but also the water that occure during the process of anaerobic digestion. The liquid can be release by dewatering the digestate.

Fig 2. The product results from anaerobic digester

While researching in People's Electricity Program using the bio-digester method, there is a question that pop-up, "what if we don't separate the organic and unorganic material at first?". From here, the idea to develop a method of natural fermented process by using bamboo's crate where it can converse both organic and un organic matter to become a solid fuel energy source. This method called "Peyeumisasi", taken from an indonesian term of a natural fermented cassava process.

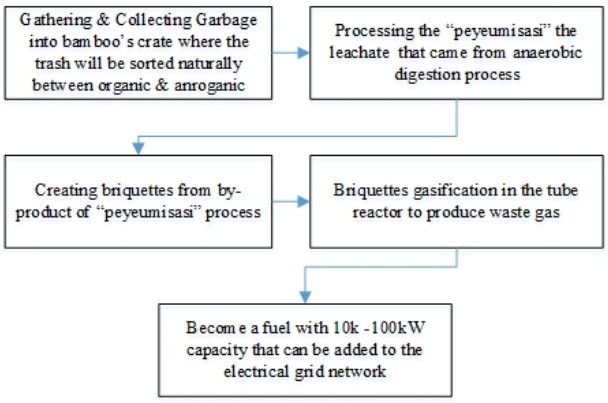

Fig 3. The process of converting waste into energy

Table 1. Utilization of Domestic Waste & Biodiversity as Solid Fuel (Source : Processed data)

Comparation		
Genset diesel Consumption	:	~ 2.5 kWh/liter
Conversion		
Synthetic gas from briquettes	:	2.185 m^3 * equivalent to 3.16 kWh heat, equivalent to 0.837 kWh mechanical power on the motor axis, equivalent to 0.754 kWh electric power (10,000 Bitu)
Solid fuel / briquettes		
Water content	:	15 – 25 %
compression	:	75 – 225 kg/cm^2
Heating value	:	2.500 kkal/kg
Gasification		
Gas producer	:	4,500 – 5,200 kJ/m3
Eff of electric motors	:	72%
Needs briquettes	:	1.50 kg/kWh
Electrical Productivity		
Waste volume	:	30 ton of biodegradable waste / day
Content of organic matter	:	80% or 24 ton / day
Potential of briquette products	:	21.0 ton of dry waste / day
Generation potential	:	450 – 500 kWh / ton briquette (77% - 80% effectivity) * equivalent 180 – 200L/hour (130 – 144 kL/month) minyak diesel

By having this solid energy source, we can get a zero waste concept where all the rubbish can be used as fuel. The by-product of "Peyeumisasi" method then being packed as briquettes so it will have a better homogenous energy density.

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