THE THE NEW TRANSPORTATION SYSTEM FOR FFICIENCY AND SUSTAINABLE CITIES; UTILIZATION OF LOATING SHIPS OF GARBAGE POWER PLANTS FOR ELECTRICAL ENERGY DRIVING TRAINS

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Abstract
Garbage and air pollution from motor vehicle transportation have become a problem in big cities. Waste can be processed into electrical energy with plasma physics technology and to decrease dependence on expensive urban land use it can be made with a floating design structure on the sea. From the estimated calculation of electrical energy that can be generated from 7147.36 per day tons of waste obtained energy value of 217 megawatt-hour, from data of electrical energy needs for each tram circuit is 3.87 kilowatt-hour, then obtained total tram circuit that can be driven for the length of lane as far as 74 kilometers is equal to 620 series. if every electric tram can bring 6000 people every hour, then in every hour can move people as much as approximately 3.6 million people.
Keywords : *Waste; Tram; Electrical Energy; Plasma; Ship*

1. INTRODUCTION

One of the problems is increasingly an urban mounting garbage problem that bothers people of the city, in addition to other problems. Besides garbage very important role in human health effects that can lead to various diseases, such as diarrhea disease, cholera, leptospirosis, skin diseases and other ailments. Therefore bins need for special treatment to be prevented potentially devastating effects for mankind. Maybe better waste can be used as needs that are beneficial to humans, such as recycling or energy source for generating electricity. There are several concepts use of waste can be supplied into three, namely: the concept of reuse (recycle), reuse of materials (re-use) and energy recovery (energy recovery) contained in the garbage in detail explained as follows:

- Re-use Re-use is defined as an effort to extend the use of a product in the form of original or modified form. Re-use can be done by improving products that have been damaged or depleted of its useful life, such as retread tires. Re-use can also be done by using the packaging of a product to be used in another product packaging, such as bottles of mineral water which used to be a bottle of paint. Implementation of reuse does not return the product to the industry. Efforts to re-use more closely on efforts to reduce the amount of trash.

- Re-Cycle Waste that can not be used again starting to get into the flow of waste management. Some types of waste such as plastic and paper, with a particular technology, it can be reused as raw material for a product. A process that converts the waste into other industrial raw materials is called re-cycle or recycled.

- Recovery Energy Recovery (recovery) of material or energy can be done through various forms. In principle, the recycle and recovery have in common that is to return back to an industrial material, while the difference is recycled material that would require separation of recyclables from the garbage, while the recovery does not require the separation effort. One form of the concept of recovery is the use of waste to

energy. Rubbish containing organic material and inorganic material. The energy contained in the organic fraction can be recovered through a management pattern.

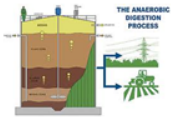
Public There are several waste management technologies such as thermochemical conversion process is used for waste that has a percentage of the non-biodegradable organic material of high and low water levels. Important technologies that are included in this category are: incineration and pyrolysis/gasification. As for the biochemical conversion chosen for the garbage that has the percentage of high biodegradable organic material and high water content. The main technology of this category is anaerobic digestion, or often called biometanisasi. The main parameters that determine the potential for energy recovery from waste, including municipal solid waste, is the amount/quantity of garbage and chemical-physical characteristics (quality) of waste. Actual energy produced will depend on the specific processing and characteristics associated with the main parameters above.

The physical characteristics referred to is the size (size of constituents), density (density) and water content. The smaller the size of the litter will accelerate the decomposition of garbage. Trash with high density reflects the biodegradable organic content and high moisture content. On the other hand, the low density shows the proportion of the presence of plastic, paper, and other combustible materials. High water levels resulting fractions biodegradable garbage decomposes faster than in dry conditions. It shows also that the garbage with a high moisture content is not good enough for the thermochemical conversion such as incineration and pyrolysis. Chemical parameters of decisive importance in view of the energy recovery potential and feasibility of processing through biochemical or thermochemical conversion efforts are volatile solid, carbon content, calorific value, C/N ratio and toxicity. Table 1 shows the parameters and range of values to determine the method of waste processing. This table is one way of beginning to analyze the consideration of technology selection.

Table 1. Technical Parameters Method for Determination of Solid Waste

Waste Processing Method	Basic Method	Waste Important Method	Determined Value Range
Thermo chemical Conversion: Incineration, Pyrolisis, Gasification	Decomposition of organic material by heating	Water content Material Organic Fix Carbon Net Caloric Value	< 45% > 40% < 15% > 1200 Kcal/kg
Bio chemical Conversion: Anaerobik digestion/ Biometanizaion	Decomposition organic material	Water content Material Organik C/N ratio	>50% >40% 25-30

Table 2. Alternative Waste Into Energy Utilization Technology

	Dry waste Water content (< 20%): - Household waste - Office waste - Commercial area waste - Industrial waste	The resulting product - Steam - Electricity - Dust
	Dry waste tends to damp Water content (< 50%): - Household waste - Leftovers - Agricultural waste	Low Med BTU - Gas - Charcoal
	Moist waste tends to wet Water content (> 50%): - Household waste - Leftovers - Agricultural waste	Medium BTU - Gas - Compost

Based on table 2 above for the condition of waste in Indonesia is relatively wet, then energy recovery technologies are applied is Anaerobic Digester (AD). The AD is a biological process that frequently occurs/is used in wastewater treatment to degrade and stabilize the sludge. Generally, AD has long been used, especially in rural areas, for which the results emproduction biogas is used for cooking and lighting. In China and India, the small-scale AD has been widely used to treat household waste as well as to obtain biogas. As for the large scale (urban), it's been a lot of developed countries in Europe applying this method to manage their urban garbage and obtain a byproduct in the form of biogas which is used to drive an electric generator. Biodegradation of organic elements are common occurrences in nature, this process always involves microorganisms. When the organic materials are broken down by aerobic bacteria then the process is called oxidation and produce CO2 and H2O. If the process is carried out by anaerobic microorganisms, without the presence of oxygen, the organic material degraded by microbes into CO2 and methane AD on organic material carried by a collection of microorganisms synergistically. Digestion process consists of four stages: Hydrolysis, Acidogenesis, Acetogenesis, and methanogenesis, these stages are shown in Figure 2.

The first is the hydrolysis process, the proteins are large macromolecule, such as lipids and polymeric carbohydrates (sucrose and starch) are broken down through a process hydrolysis into amino acids, fatty acids, and sugars. Next, a substance/ingredient is fermented hydrolysis process results in acidogenesis process to form a three, four and five carbon volatile fatty acids, such as lactic, butyric, propionic and Volaric acid. The next stage is acetogenesis. In this process, bacteria consume fermented and produce acetic acid, carbon dioxide, and hydrogen. Finally, organisms consume methanogenetic acetate, hydrogen, and carbon dioxide to produce methane. There are 3 biochemical compounds that occur in methanogenesis stage when producing methane, the pattern is:

1. Acetotrophic methanogenesis : $4\ CH_3COOH \rightarrow 4\ CO_2 + 4\ CH_4$
2. Hydrogenotrophic methanogenesis : $CO_2 + 4\ H_2 \rightarrow CH_4 + 2\ H_2O$
3. Methylotropicmethanogenesis : $4\ CH_3OH + 6\ H_2 \rightarrow 3\ CH_4 + 2\ H_2O$

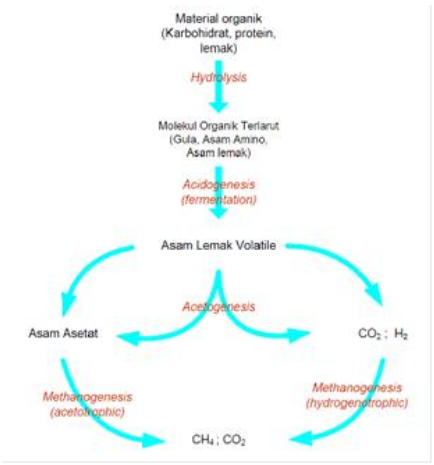


Fig. 1. Anaerobic Digestion Processes and Patterns

Here we as researchers will try to help the government in the handling by creating a waste treatment technology that can be harnessed into electricity that can be used by urban communities. One such technology is the use of waste plasma technology as it has been conducted by researchers Umberto Arena [1] which discusses the plasma gasification process technologies for waste processing. In this study, we focused on a ship or an object floating in the water that can serve as waste processing equipment which is converted into an energy that eventually converted to electricity. Ship's garbage power plant which is the application of New and Renewable Energy (EBT), which is planned this electrical output of the generator on the ship power plant will be used to supply power to the electric trams as urban transportation.

Fig. 2. Waste Processing Ship Design

Fig. 3. Electric Trains (INKA)

2. METHODOLOGY

2.1. Material Preparation

Calculations were performed using block diagrams respectively with efficiency energy conversion devices each as shown in Figure 4. Assumptions garbage boiler efficiency is based on the typical price of a coal boiler operating with the same system. This assumption is considered unrealistic because of considerations of efficiency of conventional coal boilers which can reach 85%. While the efficiency of the steam turbine is based on Rankine cycle efficiencies ranging from 25% -30%. Then have the 25% safety factor in the calculation and the efficiency of the generator been 90%. For the level of efficiency of the boiler or steam boiler efficiency levels ranged from 70% to 90%.

Fig. 4. Process Block Diagram

The amount of waste that goes into landfill every day amounted to 7147.36 tons / day and Value NCV result of calculation of 3490 kcal / kg. Calculation of Potential Energy Electricity generated from waste is as follows.
Thermal energy that goes into Boiler (E)
= Caloric value x the amount of garbage
= [(3490 kcal/kg) x (7147.36 ton/day)] x (1000 kg/ton x 1 day / 24 hours))/860,42
= 217431,18 kW

Where 860,42 is a unit conversion
Net power = E x x ηb x ηt x ηg
= 217431,18 x 0,8 x 0,25 x 0,9
= 39137,61 kW
= 29,14 MW

3. RESULTS AND DISCUSSION

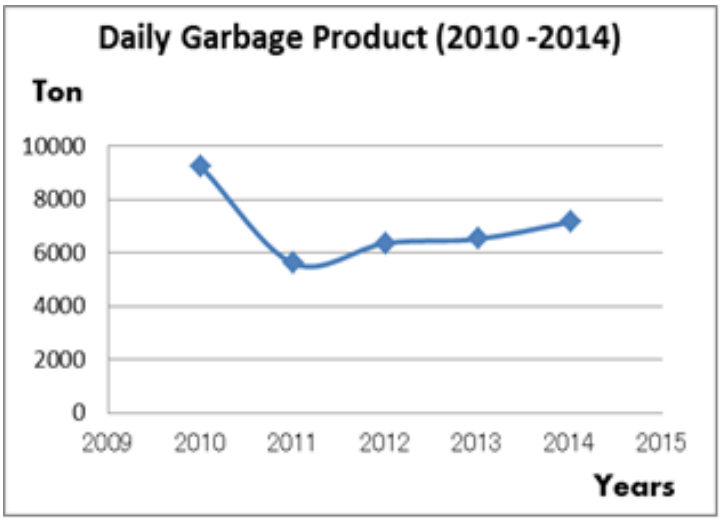


Fig. 5. Waste Production (2010-2014)

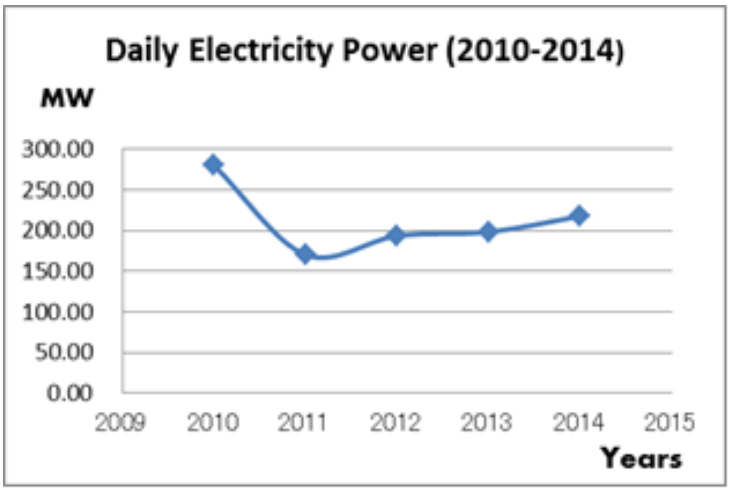


Fig. 5. Electricity Production (2010-2014)

4. CONCLUSIONS

Based on data from the years 2010 - 2014 the amount of waste per day is produced on an urban-volume 7147 tons per day can generate electric power generated by the ship garbage to meet the electricity needs on a train Trams of between 102 MW - 168 MW per day.

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