Potential Kota Tua

by Annisabhi FTI

Submission date: 24-Aug-2024 10:48PM (UTC+0700)
Submission ID: 2437256652
File name: BIS-1-_Kota_Tua_Annisa_Bhikuning.pdf (177.01K)
Word count: 2623
Character count: 13387

Potential Waste to Energy in Kota Tua - Jakarta

Annisa Bhikuning[1, a)], Bambang Priambodo[2, b)], Tono Sukarnoto[3, c)]

[1, 3] *Mechanical Engineering Department, Universitas Trisakti, Jakarta, Indonesia*
[2] *PT EMKA Rekayasa Energi*

[a)] Corresponding author: annisabhi@trisakti.ac.id
[b)] *priambodomsme@yahoo.com*
[c)] *tsukarnoto@trisakti.ac.id*

Abstract. Kota tua which used to be called Batavia, is a city located in DKI Jakarta. The area of the city is around 1.3 kilometers covering North Jakarta and West Jakarta. Currently, Kota Tua - Jakarta is one of the tourist destinations that can attract many visitors. The advantage of this area is that it can increase the potential tourism in Jakarta-Indonesia because tourism drives the economy and empowers communities. However, one of the disadvantages is the increasing volume of waste in Kota Tua. From data collected in 2020 (before the COVID-19 pandemic) it was shown that every New Year eve the waste increases near to 10 tons for one night. These data do not include the waste from nearby areas of Kota Tua-Jakarta. Therefore, it is a possibility to build a potential energy from waste (waste to energy) in Kota Tua and around it. The potential energy can be used to generate the electricity in the local train station and also around it. In this study, it is assumed that the organic waste taken from West Jakarta is around the amount of 1.084,58 tons/day. Therefore, the potential energy that can be generated from the waste is around 31,51 MW.

INTRODUCTION

Public waste is one of the problems in a big city that must be solved. In 2020, Jakarta contributes for waste around 7.424 tons per day [1]. This number is still growing in the following year. Figure 1 shows the majority waste in DKI Jakarta in 2020. In 2020, the majority of waste in DKI Jakarta will be from households around 37,33 %, followed by market 16,35%, area 16%, others 14%, commerce 7,29%, public facility 5,25%, and office 3,22% [2].

Kota Tua which used to be called Batavia is located in West Jakarta. The area is around 1.3 Kilometers covering North and west Jakarta. It is one of the places for tourist destinations that can attract many visitors. It contributes for potential tourism in Jakarta- Indonesia, however, it contributes also for increasing the waste. From data collected before pandemic COVID19, it was shown that every new year eve the waste produces around 10 tons per night [3]. These data have not included the waste nearby Kota Tua. This waste can have a potential to convert energy. Energy can be produced from waste, biodiesel [4-8], solar system [9] and others. This potential energy can be used to generate the electricity to the local and nearby from the waste power company.

Table 1 shows the waste from West Jakarta in many districts [10]. Table 1 shows that Tambora produced the biggest waste from others. The waste can be produced per day was about 1253 m^3 and only 1241 m^3 can be taken, so that uncollected waste was 8 m^3. And then follow by Cengkareng district that produced the waste for 1086 m^3 per day. However, the waste that can be taken was only 1067 m^3. Therefore, uncollected waste was 19 m^3. Besides that, Grogol Pertamburan district can produce the waste 1046 m^3 per day and only 1035 m^3 are taken per day. Therefore, there was 11 m^3 uncollected waste per day. From Table 1 can be concluded that not all waste can be taken in every district thus resulting the pollution for environment. This waste can be used to build energy that can be used by local residents and also can also benefit to reduce the pollution.

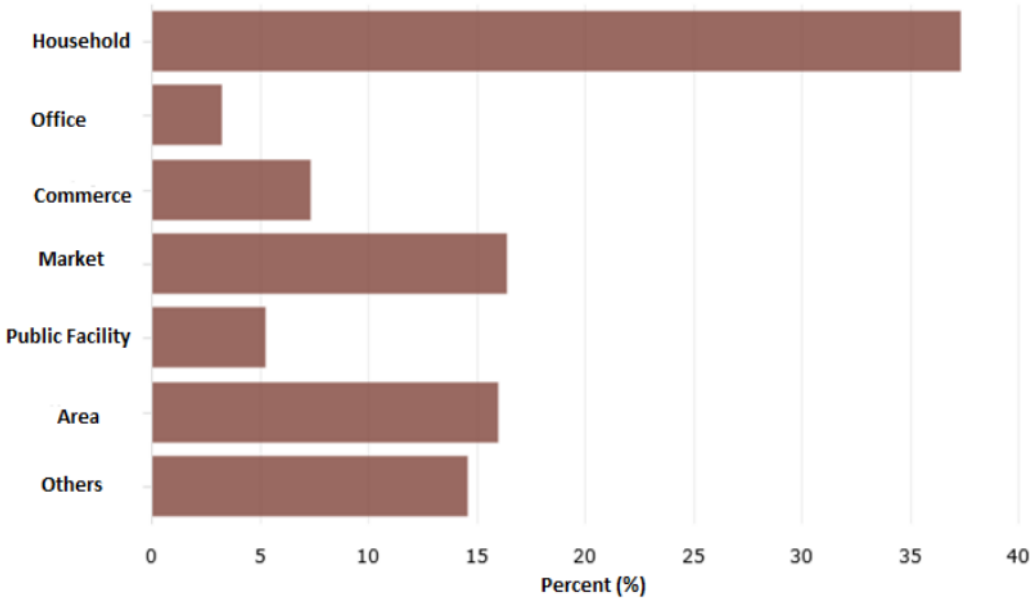

FIGURE 1. Majority Waste in West Jakarta the Year of 2020 [2]

TABLE 1. Data on waste transported in West Jakarta the Year of 2016 [10]

District	production per day (m^3)	Waste taken per day (m^3)	Uncollected per day (m^3)
Kembangan	621	612	10
Kebon jeruk	867	853	15
Palmerah	722	718	4
Grogol petamburan	1046	1035	11
Tambora	1253	1241	8
Taman sari	858	853	6
Cengkareng	1086	1067	19
Kalideres	756	741	16

Building energy from waste to electricity have been studied by many researchers. Djamain and Putri designed a simulation of the occurrence of electricity with multimedia-based power sources using a case study at the Bantar Gebang waste energy plant, so as to get an overview of the comparison of the amount of gas and electricity generated [11]. Tansa et al. made the design of a waste energy plant prototype, where the results obtained were that the average power produced by the generator was 8.92 W and tree branches were the most effective as fuel [12]. Monice and Perinov studied the analysis of the potential for waste that can be used as raw material for waste energy plant in Pekan Baru which finally has 9MW of electricity potential that can be generated [13]. Rajaguguk studied the design of a 20

MW waste power plant. Research from Rajaguguk aims to determine the potential for landfill gas (LFG) generated from the Bantar Gebang landfill waste, Bekasi Regency [14]. Faruq analyzed a potential of waste from Singkawang city to be energy. He calculated that the waste can produce electricity 24833.76 kWh per day and if operating for one year amounted to 9,064,322.4 kWh per year or 9064.32 MWh per year [15]. Rosyadi et al. made an initial design of a power plant from waste with a capacity of 2 MW. The results obtained are waste that is used as fuel has as much moisture as 50% [16]. Besides that, Novita and Damanhuri calculated the caloric value from urban waste based on composition and characteristics because the existence of fundamental differences in the composition and characteristics of urban waste makes the processing technology not run effectively and efficiently. Therefore, technology that supports the waste to energy concept is very concerned with the calorific value of the waste to be processed [17].

This study is to aim a purpose of developing the potential waste to energy in Kota Tua, Jakarta. The waste from Kota Tua can be used to generate the electricity in the Kota Tua Station and nearby and to calculate the estimation of waste to energy in Kota Tua. Therefore, the electricity can be purposed to generate around the town and for train station Kota in Kota Tua, Jakarta.

METHOD

In this study, analysis of waste power energy in Kota Tua was taken from waste data in Jakarta. Method of collecting data is divided into primary and secondary. Primary data was taken from the primary source and secondary data was collected from literature study, journal and thesis. Analysis of waste in Kota Tua was taken from data in West Jakarta due to the location and nearby the Kota Tua-Jakarta. Moreover, DKI Jakarta are divided into 5 parts. There are Central Jakarta with area 47,90 km^2, North Jakarta with area 142,20 km^2, West Jakarta with area 129,54 km^2, South Jakarta with area 145,73 km^2, and East Jakarta with area 187,73 km^2. Moreover, research methods are using qualitative and quantitative. Qualitative data was taken from literature studies on existing waste energy plant from various sources such as journals, theses or from the websites. This literature study is very important because it is the basis for the application and development of this study. Quantitative method is to analyze the data obtained. These data are taken from literature studies or from the interview process and finally analysis and make the conclusion.

RESULTS AND DISCUSSION

Analysis of Population and Waste

In 2020, the total population in DKI Jakarta was 10,56 million. Compared to the results of the previous census, the population of DKI Jakarta continues to increase. In a period of ten years since 2010, the population of DKI Jakarta has increased by around 954 thousand, or an average of 88 thousand people every year [18]. However, in the west part of Jakarta (West Jakarta) the total population in 2020 was 2.569.462 people with a total area of 129,54 km^2 and a population density of 19,835,00/km^2 [19]. From data collected it is shown that West Jakarta can contribute for waste around 719.768.000 tons per year or 1.971,97 tons per day [20]. Figure 2 shows the source of waste from West Jakarta in 2020. The highest source of waste was coming from households about 53%, then waste from offices around 27%, area was 9%, commerce was about 5%, market was 4% and others was 2% [20]. This data is still growing every year and the solution for waste become energy must be applied.

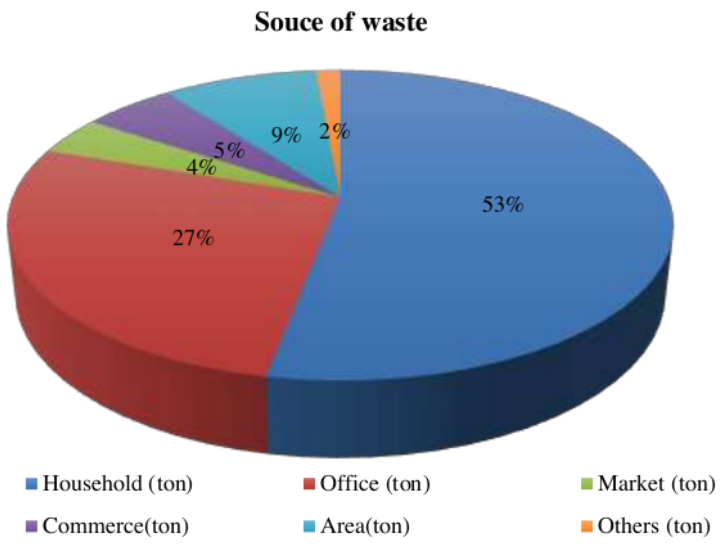

FIGURE 2. Source of Waste in West Jakarta [20]

In order to calculate the energy from the waste, the caloric value from waste must be applied. In West Jakarta, caloric value was assumed for 6000 BTU/lb or 3.333,3 kkal/kg [21]. This assumption due to West Jakarta has produce a lot of waste and it is a big city. From data collections in Figure 1 shows that households have contributes the highest waste than others around 53%, this can be assumed that the organic waste from the total waste in west Jakarta is around 55% (from households and others). Therefore, the calculation of organic waste in west Jakarta is 1.084.580 kg/day.

Analysis of Waste Energy

The use of waste into electrical energy has many benefits. The benefits are the waste can be controlled because decreasing the waste can result good environment. Moreover, the waste can be energy and become electricity and can be use for the people located nearby the electrical waste company.

In order to calculate waste to energy, it is important to analyze the total waste in the city, then analyze the caloric value in waste, after that calculating the boiler capacity for analyzing the total heat generated to determine the boiler capacity and quantity water to be heated to become steam, then calculating turbine capacity to turn the generator, after that calculate the generator capacity [13].

The assumption for calculating waste to energy can be shown in Figure 3. Waste from West Jakarta is around 1.971, 97 tons per day and organic waste is 1.084.580 kg/day and thermal energy can be supplied is around 3.614.9905.140 kkal/day or 175.055,125 kW. Then the boiler efficiency assumption made based on typical waste boiler prices operating on the same system is 80% then the boiler output power is 140.044,100 kW. For steam turbine efficiency, it is based on cycle efficiency Rankine which ranges from 25 – 30%. Then 25% is chosen for the safety factor in the calculation. Therefore, the output of a steam turbine is 35.011,025 kW. Then the efficiency generator was chosen for 90% and net power output multiple with generator efficiency factor, resulting in 31.509,922 kW. Therefore, the utilization of waste using combustion technology direct or incineration capable of generating output power from the generator is around 31.509,922 kW. Therefore, the estimation of electrical waste power is 31,51 MW. Moreover, the estimated electrical waste power after distribution to generator internal needs (10%) is around 28,359 MW.

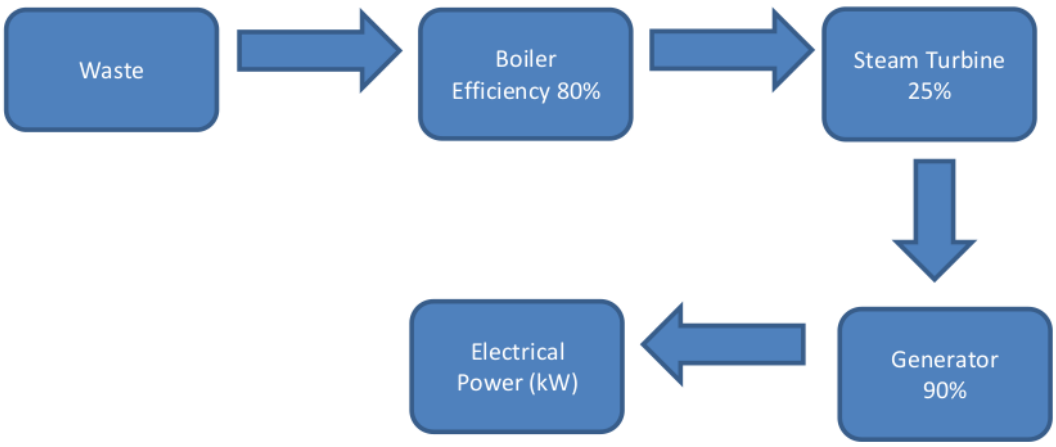

FIGURE 3. Energy Conversion Flowchart [22]

CONCLUSION

The waste from Kota Tua and nearby can be generated to become an electrical power. The electrical waste power is one of the solutions to reduce waste in the city. From data collected shown that waste in West Jakarta is around 1.971,97 ton per day or 719.768 ton per year and the organic waste is 1.084.580 kg/day and thermal energy can be supplied is around 3.614.9905.140 kkal/day or 175.055,125 kW. Therefore, the estimation of electrical waste power is around 31,51 MW. This electrical waste power can be distributed to the electricity use in Kota train station in Kota Tua-Jakarta and also generating the electricity to hotels and local residents nearby.

ACKNOWLEDGEMENT

The authors would like to thank you to PT.KAI, Trisakti University and Faculty of Industrial Technology, Trisakti University and Mechanical Engineering Department for their support.

REFERENCES

1. https://kumparan.com/kumparanbisnis/ganti-bahan-bakar-52-pltd-dengan-gas-pln-butuh-rp-22-triliun-1smvbTYi83L cited on 7th August **2021**.
2. Mayoritas Sampah di Jakarta Berasal dari Rumah Tangga pada 2020 | Databoks (katadata.co.id). Cited on December 24th, 2021.
3. https://kumparan.com/kumparannews/libur-tahun-baru-sampah-di-kota-tua-capai-10-ton-1546400380532390885. Cited on May 24th 2021.
4. Bhikuning, A.; Sugawara, R.; Matsumura, E.; Senda, J. Investigation of spray characteristics from waste cooking oil, bio-hydro fined diesel oil (BHD) and n-tridecane in a constant volume chamber. *Case Studies in Thermal Engineering*. **2020**, 21, 100661.
5. Bhikuning, A.; Li X.; Koshikawa, S.; Matsumura, E.; Senda, J. The Experimental Investigation of the Performance and Emissions Characteristics of Direct Injection Diesel Engine by Bio-Hydro Fined Diesel Oil and Diesel Oil in Different EGR, *SAE Technical Paper*, 2019-32-0595

6. Bhikuning, A.; Li, X.; Koshikawa, S.; Matsumura, E.; Senda, J. An Experimental Investigation of Bio-Hydro Fined Oil and Waste Cooking Oil in Direct Injection Diesel Engine. *Harris Science Review Doshisha*. **2019**, 60 (3), pp. 133-140.
7. Bhikuning, A.; Senda, J.The Properties of Fuel and Characterization of Functional Groups in Biodiesel -Water Emulsions from Waste Cooking Oil and Its Blends. *Indonesian Journal of Science and Technology*. **2020**, 5. 95-108. 10.17509/ijost.v5i1.23103.
8. Bhikuning, A. Analisa Performa Mesin dengan Biodiesel Terbuat dari Virgin Coconut Oil pada Mesin Diesel. *Jurnal Energi dan Manufaktur*. **2013**, 6 (2), pp. 123-128.
9. Delsanti, A.; Jewitt, D. The Solar System Beyond The Planets.**2006**. 10.1007/3-540-37683-6_11.
10. https://data.jakarta.go.id/dataset/data-volume-sampah/resource/efa85514-c68e-4e78-aa00-c369b60a1673. Cited on 20th August 2021.
11. Djamain, Y.; Putri, I, F. Rancang Bangun Simulasi Terjadinya Listrik dengan Sumber Daya Sampah Berbasis Multimedia (Studi Kasus: TPST Bantar Gebang). *Jurnal Pengkajian dan Penerapan Teknik Informatik*. **2016**, 9 (1), pp. 81-87.
12. Tansa, S.; Asmara, B, P.; Tolago, A, I.; Mohamad, Y. Rancang Bangun Prototype Pembangkit Listrik Tenaga Sampah (PLTSa). *Prosiding Seminar Nasional Teknik Elektro (FORTEI 2017)*, Fakultas Teknik Universitas Negeri Gorontalo, 18 Oktober **2017**.
13. Monice & Perinov. Analisis Potensi Sampah Sebagai Bahan Baku Pembangkit Listrik Tenaga Sampah (PLTSA) di Pekan Baru. *SainETIn (Jurnal Sain, Energi, Teknologi & Industri)*. **2016**, 1 (1), pp. 9–16.
14. Rajaguguk, J, R. Studi Kelayakan Desain Pembangkit Listrik Tenaga Sampah (PLTSa) Sebagai Sumber Energi Listrik 200 MW (Studi Kasus TPA Bantar Gebang Kabupaten Bekasi). *Media Ilmiah Teknik Lingkungan*. **2020**, 5 (1), pp. 51-61.
15. Faruq, U.I. Studi Potensi Limbah Kota Sebagai Pembangkit Listrik Tenaga Sampah (PLTSa) Kota Singkawang. *Jurnal Teknik Elektro Universitas Tanjungpura*. **2016**, 2 (1).
16. Rosyadi, I.; Yusuf, Y.; Satria, D.; Haryadi.; Aswata.; Ardian, R. Desain Awal Pembangkit Listrik Menggunakan Bahan Bakar Sampah Kota Cilegon Dengan Kapasitas 2 MW. *Fly wheel: Jurnal Teknik Mesin Untirta*. **2018**, 4 (1), pp. 65-70.
17. Novita, D, M.; Damanhuri, E. Perhitungan Nilai Kalor Berdasarkan Komposisi dan Karakteristik Sampah Perkotaan di Indonesia dalam Konsep Waste to Energy. *Jurnal Teknik Lingkungan*. **2010**, 16 (2), pp.103-114.
18. https://jakarta.bps.go.id/pressrelease/2021/01/22/541/jumlah-penduduk-hasil-sp2020-provinsi-dki-jakarta-sebesar-10-56-juta-jiwa.html. Cited on 27th December 2021.
19. https://id.wikipedia.org/wiki/Kota_Administrasi_Jakarta_Barat. Cited on 27th December 2021.
20. https://sipsn.menlhk.go.id/sipsn/public/data/timbulan. Cited on 14th December 2021.
21. Tchobanoglous, G, Theisen, H, Vigil, S, **1993**. Integrated Solid Waste Management. Singapore: Mc Graw-Hill Book Co.
22. Wibowo, A, B. Kajian Awal Pembangunan Pembangkit Listrik Tenaga Sampah di Kota Bandung. Tugas Akhir Institut Teknologi Bandung. **2007**.

Potential Kota Tua

ORIGINALITY REPORT

7%	6%	2%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	iccd.asia Internet Source	2%
2	www.javatourism.com Internet Source	1%
3	Submitted to University of Glasgow Student Paper	1%
4	www.neliti.com Internet Source	1%
5	voi.id Internet Source	1%
6	bidinvest.ru Internet Source	1%

Exclude quotes	On	Exclude matches	< 10 words
Exclude bibliography	On		