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***Research paper***

# The Eco-Friendly Technical Treatment Procedure of Garbage in The Garbage Dump in Semarang City

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**Abstract**

Of the total of garbage produced, not all garbage carried to landfill and left piled up in temporary disposal site (TPS). Garbage transport from temporary disposal site to the landfill affect the transportation routes because they increase traffic congestion. Not deficient garbage processor in landfill causing a heap the dump solid and mounting. If its left, so that this will disrupt the environment quality of the Semarang City, especially considering the condition of the final disposal site (TPA) Jatibarang who had been discharged the use time. This study aims to to handle the waste problem that is there Semarang, so as to diminish the garbage thrown by to the final disposal site (TPA) Jatibarang. Research methodology used is the method the qualitative study, because can explain problem in detailed so that it can be known handling exactly. Data is collected through direct observation in the field, interview, and documentation. The results is need to the landfill in every sub-district of Semarang with system burning high temperatures. Our team's invention of standing furnace incenerator is proven as an effective and efficient garbage dissolving and recycling system. This incenerator is an environmentally friendly technology because it is equipped with major component control pollutants, in order to reduce air pollution caused by exhaust gas. Thus, garbage problems within of the Semarang City can be reduced.

***Keywords***: *Garbage Treatment Procedure, Incenerator, Semarang City*

## 1. Introduction

Based on the Act No.18/2008 on garbage treatment, garbage is divided into household garbage, garbage similar to household garbage, and specific garbage. Household garbage is the one mostly produced. This garbage can be dangerous to the environment. According to the theory D.D Duncan was quoted as saying by Wardi (2011) stated that environmental problem especially in a city has a connection with demography, organization, and technology. The increased number of citizen leads to the increased social activity, the increased energy consumption, and the increased waste and garbage dumping. Most of the problems that appeared in big cities in Indonesia as Semarang City is pileup trash that continues to increase is not followed by the provision of facilities and infrastructure adequate garbage. Land of landfill which is fixed faced with volume of waste that continue to grow, so there pileup trash in landfill the mounting.

Based on data from the Central Bureau of Statistics Semarang (Badan Pusat Statistic Kota Semarang) in 2014 known that Semarang City with a population of 1.572.105 people capable of producing garbage of 1.207,45 tons on each day. The garbage was stacked in temporary disposal site who be within settlement, pollute the environment and becoming the place of breeding disease. After stacked in place in a long time, waste is transported to the landfill. The amounts of garbage produced in Semarang City, only 1.003,53 tons alone can transported to final disposal place that is at Jatibarang Landfill. Waste is transported use garbage trucks on public roads and spreading bad smell. This of course would affect road users other. Most of garbage brought to the Jatibarang Landfill still mingled and only discarded without further processing. Garbage be left accumulate and accumulates taint the air, water, and the ground in a wider scale.

At first, the final disposal site (TPA) Jatibarang use the sanitary landfill to process garbage, but as requiring a very large cost so the implementation did not function as intended. The scavengers that is at the final disposal site (TPA) Jatibarang is also just started sorting garbage still can be used only. The garbage is actually still can be processed back, but considered not benefit scavengers, only will be left alone. When be left continuous so will bring the negative impact of for health and environmental sustainability. For it, is required a technical handling of waste in final discharge in order to reduce the garbage thrown by to the the final disposal site (TPA) Jatibarang, let alone remember use time which has been exhausted since 2002.

Research aims to manage the garbage problem in Semarang City, so that it can reduce the volume of garbage dumped at the the final disposal site (TPA) Jatibarang. Approach that is used to achieve this aim is the approach with the methods the qualitative study. Thus, the problems faced by it can be seen handling proper. The data used in this research obtained through observation and documentation. Observation aimed to know the state polling stations in residential environment and the condition the final disposal site (TPA) Jatibarang.

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# 2. Literature Review

## 2.1. Waste and Waste Management

Waste as a waste product of human activity continues to increase in number as the number of inhabitants. According to Wahyu (2014), the average waste generation will typically vary depending on the number of population and its growth rate, survival rate, season and climate, way of life, as well as the mobility of people. The emergence of the problem of waste is generally triggered by two factors, namely internal and external factors (Safitri, 2002). In this case the internal factor is the lack of awareness of citizens and the poor quality of human resources and the use of technology. For external factor is the lack of landfill, waste management has not been included in development priorities, and the absence of laws capable of coordinating between the government, civil society and the business world. Therefore, it needs the attention of all parties in the handling of garbage problems are increasingly alarming.

Waste management must be done by all parties, for waste management, according Tchobanoglous (1993) is an act of control on waste generation, collection, storage, transfer and transportation, processing and disposal of garbage, in a way that is in accordance with the principles relating to public health, economics, engineering, environmental protection, beauty, society at large, as well as other environmental considerations. One waste management efforts to reduce the volume of waste is to use at a high temperature combustion technology called incinerator. Application of this technology can reduce waste volume by 80% of the total waste and 20% from the combustion can be exploited further. From the results of research conducted by Nemathaga et al (2007) note that a well-designed incenerator must really burn garbage and leave a minimum of rest in the form of ashes and must be equipped with a scrubber to catch air pollution emitted.

## 2.2. Technology Incenerator Environmentally Friendly

The difference in the number population and level its growth, and way of life, the level of life, people mobility, and climate will cause variety the average pileup trash are produced (Wahyuni, 2014). The development of population occurred in Semarang City caused the amount of trash produced increase, so that require special handling through the use of waste processing technology. One of technology an alternative that has been developed to handle the garbage problem is a technology incenerator or tools the combustion of waste. Incenerasi are essential components of integral garbage management solid urban involving the combustion of organic with change garbage to ashes, gas the rest of the results of burning, particulate, and heat (Forteza , 2004). Whereas incenerator is a tool that can destroy garbage by combustion at high temperatures. Use of processing garbage incenerator as junk or is already done in some countries since the first. This is due to the use of incenerator can change the junk that has no value into something that can be used again. From research conducted by Forteza (2004) known that in the United States the results of burning garbage incenerator used as mixture in asphalt and building construction. In the United Kingdom, the rest of the burning results are usually stored in a salt mine or used for waste acid neutralizer (Nixon et al., 1995).

Latief (2010) explains that the benefits derived from the use of this technology is able to reduce the volume of garbage by up to 80% of the garbage that enters and leaves 20% residual burning which must be disposed of to landfill or exploited further. Research also indicates that the health risks from burning trash five times lower than with the final disposal site (TPA) (Moy et al., 2008). Incenerator operating in Europe conducted under the strict emissions regulations so that can radically reduce the harmful emissions, even from research results Papageorgiou et al (2009) known if under certain conditions of combustion waste can reduce greenhouse gas emissions. Basically, the use of incenerator can provide many benefits, it's just that until now there has not been able to overcome the waste incenerator en masse with the cost of investment and operation. Wahyono (2001) said that design incenerator imperfect would cause performance incenerator become not optimum and will cause air pollution by exhaust gas and pollution land and water by disposal residue.

Based on this, then one of the members of our research team created a standing furnace incenerator (Incenerator Dapur Tegak) can control the pollutants thus reducing air pollution due to exhaust gas. In general, incenerator circulating in the field using a technique directly combustion, good one level and two levels by the use of fuel oil land, solar, nor gaseous. While standing furnace incenerator (Incenerator Dapur Tegak) adopt technology the standing furnace for smelting iron ore/ metal be iron/ metal castings. The standing furnace incenerator (Incenerator Dapur Tegak) is an environmentally friendly technology because it is equipped with a major component control pollutants consisting of two units of cyclone catcher dust, a unit of scraber neutralizing pollution the exhaust gases, a unit of vacuum pumps air, the control component, and devices sensors air pollutants automatic. In addition, building terminator garbage made closed to the dump smell not out and pollute the environment. The illustration the construction of standing furnace incenerator (Incenerator Dapur Tegak) is presented in Fig. 1 below.

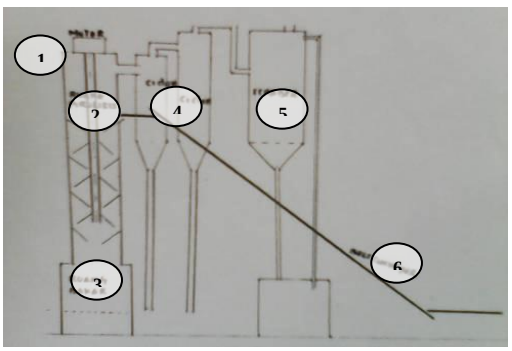



**Fig. 1:** The Illustration of Construction of Standing Furnace Incenerator (*Incenerator Dapur Tegak*)
Source: Sardjuri, 2014.

Note:

1. Three units of motors
2. Pyrolisys chamber in standing cylindrical shape minimally 8 meters in length
3. Combustion chamber with 2 meters in diameter and 2 meters in length
4. Two units of cyclone
5. A unit of scrubber
6. Three units of belt conveyor, 0.75 meters wide and 30 meters length

# 3. Discussion

## 3.1. Waste Management Concept

Based on the survey results and interviews known that the development of population occurred in Semarang City caused the amount of trash produced increase, while the final disposal site (TPA) Jatibarang as final disposal place for Semarang City only has a capacity of of 4,15 million $m^3$ just. From interviews known if the daily the final disposal site (TPA) Jatibarang must receive at 1.003,53 tons coming from all districts in the Semarang City. At first the processing of waste in the final disposal site (TPA) Jatibarang do with the sanitary landfill system, but because it requires a very large cost that implementation was not working as it should. This makes garbage dumped at the final disposal site (TPA) Jatibarang increasingly accumulate and accumulates. Garbage piled up gonna rot and spreading bad smell. Some garbage like plastic waste and metal even difficult to decompose by the environment so that require special handling.
The final disposal site (TPA) Jatibarang located in urban village Kedungpane who having distances 11.5 km from the city center. The nearest distance of temporary disposal site (TPS) is 4 km and the distance farthest from temporary disposal site (TPS) is 25 km. To those distances it takes a long time to go to the final disposal site (TPA) Jatibarang and need the operational budget which high. In addition, the distance tpa that are quite far also can interfere with their activities because facilities garbage collector of garbage truck can add traffic congestion in the road that is trough as well as result in of air pollution caused by bad smell which inflicted by garbage. The condition of garbage at the final disposal site (TPA) Jatibarang who accumulate and accumulates need to overcome as soon as not to bring the negative impact of for the environment and health. One way that you can do is with spread the final disposal site (TPA) in several locations. Of that location was then placed Standing Furnace Incenerator (*Incenerator Dapur Tegak*) to process rubbish with capacity of 27.5 tons per hour.

## 3.2. The Distribution of TPA's Area

Placement location Standing Furnace Incenerator (Incenerator Dapur Tegak) will be spread in each sub-district as seen in Fig. 3. In determining the location of of course we must watch out some requirement as outlined in Government Regulation No. 101 Year 2014 about Waste Management Hazardous Materials And Poisonous as follows remote (a) locations of a populated area; (b) location free from flood; (c) location is the that is geological expressed safe , not prone disaster , and not conservation areas; (d) location is not a catchment area ground water, especially one used for drinking water.

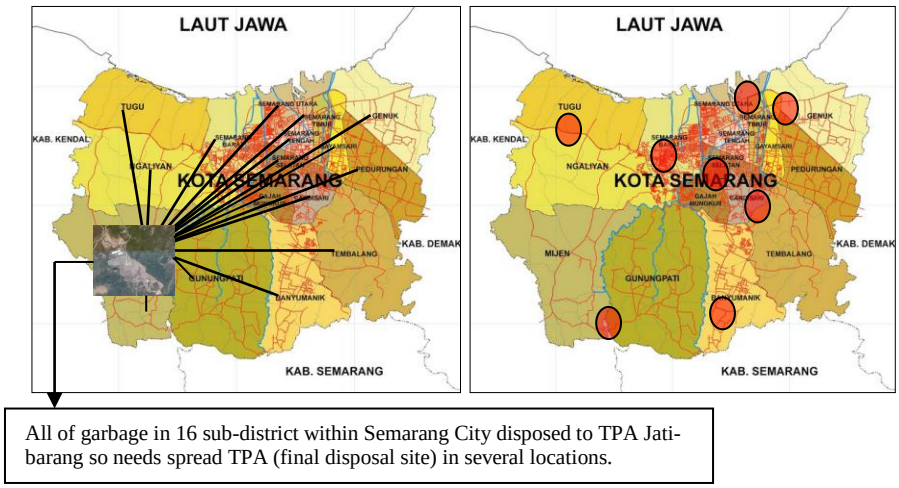
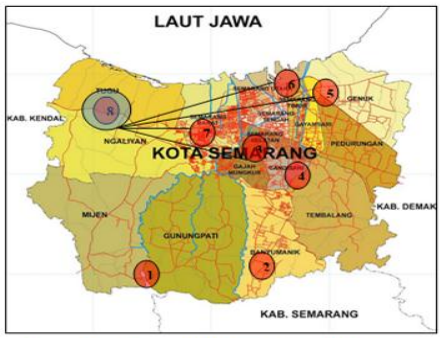



**Fig. 3**: Distribution of TPA (the garbage dump)
Source: Results of Analysis

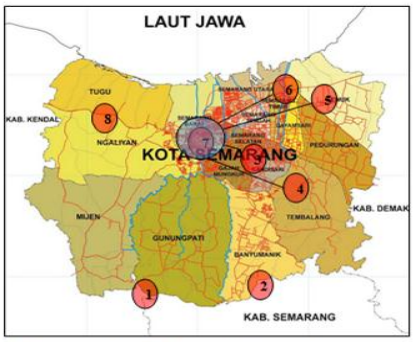
In **Fig. 3**, the distribution of garbage dumps from 16 sub-districts in Semarang is located on 8 sites:

a) Location 1 is the garbage dump for Mijen and Gunung Pati sub-district.
b) Location 2 is the garbage dump for Banyumanik sub-district.
c) Location 3 is for the garbage dump Gajahmungkur and South Semarang sub-district.
d) Location 4 is the garbage dump for Candisari and Tembalang sub-district.
e) Location 5 is the garbage dump for Pedurungan and Genuk sub-district.
f) Location 6 is the garbage dump for East and North Semarang sub-district.
g) Location 7 is the garbage dump for Central and West Semarang.
h) Location 8 is the garbage dump for Tugu and Ngaliyan sub-district.

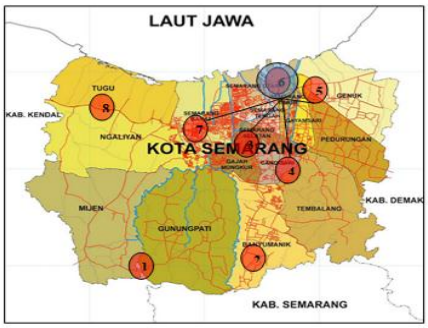
To prolong its endurence, every six months the incenerator needs to maintain. Within maintaining time, the garbage processing will be transferred to nearest site as seen in figure below.



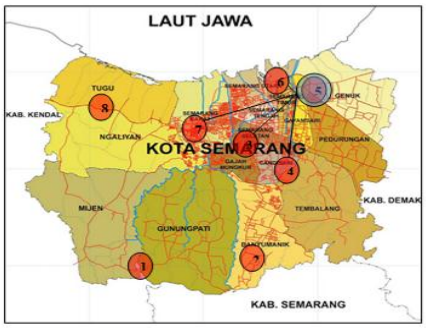

Location 8 is designated TPA for Tugu and Ngaliyan. In maintaining time, the garbage at this site is transferred into location 3, 5, 6, 7.



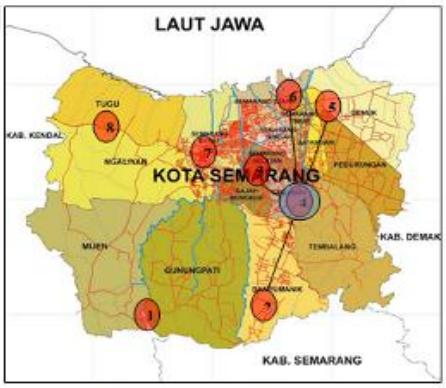

Location 7 is designated TPA for Central Semarang and West Semarang. In maintaining time, the garbage at this site will be transferred into location 3, 4, 5, 6.




Location 6 is the designated TPA for East Semarang and North Semarang. In maintaining time, the garbage at this site will be transferred into location 3, 4, 5, 7.



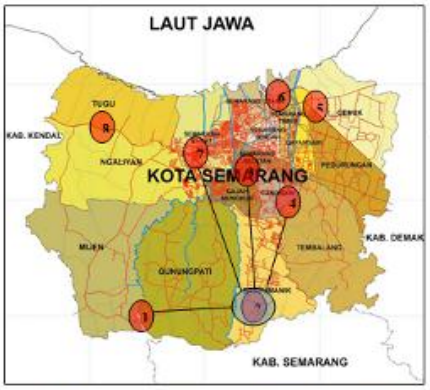

Location 5 is the designated TPA for Genuk dan Pedurungan. In maintaining time, the garbage at this site garbage will be transferred into location 3, 4, 6, 7.



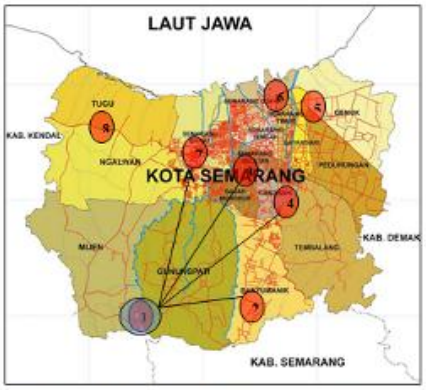

Location 4 is the designated TPA for Candisari and Tembalang. In maintaining time, the garbage at this site garbage will be transferred into location 2, 3, 5, 6.




Location 3 is the designated TPA for South Semarang and Gajahmungkur. In maintaining time, the garbage at this site garbage will be transferred into location 4, 5, 6, 7.




Location 2 is the designated TPA for Banyumanik. In maintaining time, the garbage at this site will be transferred into location 1, 3, 4, 7.




Location 1 is the designated area for Mijen and Gunungpati. In maintaining time the garbage at this site will be transferred into location 2, 3, 4, 7.

### 3.3. Application the Operation of Standing Furnace Incenerator

The operation of standing furnace incenerator (*Incenerator Dapur Tegak*) integrated safe for the environment as output emission produced environmentally sound and meet the requirements of Government Regulation No. 101 Year 2014 about Waste Management Hazardous Materials And Poisonous. As for the process of working standing furnace incenerator (*Incenerator Dapur Tegak*) consisting of:

a) Preparation Process

- Dump trucks entrance to a building terminator garbage
- Dump trucks be weighed in a weigh bridges
- The garbage is poured into garbage bin
- The garbage is loaded to conveyor belt
- Unpacking the garbage bags on conveyor belt
- Sorting the garbage from conveyor belt
- Cutting up process so the garbage can be easily pressed
- Collecting metals, woods, and any other useful materials for recycling process
- Garbage pressing process
- Pressed garbage enters the last cutting machine
- Cut up garbage is ready to enter pyrolisys process

b) Incenerating Process

- Charcoal or coconut shell, as the fuel, is burnt in the combustion chamber. The temperature of the chamber is set above 1000 C
- Once the temperature of the combustion chamber passed 1000 C, the blower is closed and the cut up waste is sent into 15 meter high pyrolysis chamber
- Once the combustion chamber is full of the waste that has gone through pyrolisys process, the lid is closed and the blower is turned on to begin the combustion (Sardjuri , 2014). The process of combustion waste can be presented in **Fig. 2** below.



**Fig. 2**: Incenerating Process in Standing Furnace Incenerator (Incenerator Dapur Tegak)
Source: Sardjuri, 2014.

## 4. Conclusion

Garbage is a problem that should receive proper treatment so as not to adversely affect the environment. Developments in Semarang also give effect to the increase in waste generation. But the increase in waste generation is not supported by a good waste management, due to limited funds and human resources. Based on the analysis presented in the previous chapter, it is known if all the waste taken to the final disposal site (TPA) Jatibarang which serves as a landfill for the city of Semarang. Based on the analysis presented on the previous chapter, it can be concluded that all of garbage brought to the final disposal site (TPA) Jatibarang that serves as final disposal site for Semarang City. Jatibarang garbage dump, which has been used since 1992, is designed only for 10-year-period of service. However, Jatibarang operates as the garbage dump in Semarang until now. The waste treatment in Jatibarang garbage dump is carried out through the sanitary landfill system. However, the system is run ineffectively due to high cost. The waste in this landfill area has not been separated properly. Without proper processing system, it is difficult to handle the increasing volume of waste. In order to reduce the waste volume, it is imperative to use the incinerator technology. This technology will destroy the waste through high temperature combustion. Our team's invention of standing furnace incinerator is proven as an effective and efficient garbage dissolving and recycling system, as well as environmentally friendly because it is equipped with control among the main components of pollutants , thus reducing air pollution caused by exhaust gas. It can be placed in 8 garbage dumps (landfill sites) in 16 sub-districts of Semarang. By placing the incinerator in those 8 dumps, it is expected that 80% of total waste transported will be reduced.

## References

[1] Forteza, R., M. Far, C. Segui, V. Cerda. (2004). Characterization of Bottom Ash in Municipal Solid Waste Incinerators for Its Use in Road Base. Waste Management, 24, 899-909.
[2] Government Regulation No. 101 Year about Waste Management Hazardous Materials and Poisonous.
[3] Latief, A. Sutowo. (2010). Benefits and Environmental Impact Against Incinerator Use. Technical Journal, Volume 2010.
[4] Ministry of Environment. (2015). Law of the Republic Indonesia Number 18 Year 2008 on Waste Management. Jakarta. Indonesia.
[5] Moy, P., Krishnan, N., Ulloa, P., Cohen, S., Brandt-Rauf, P.W., (2008). Multi-objective optimization of solid waste flows: environmentally sustainable strategies for municipalities. Waste Management, 28, 2202-2212.

[6] Nemathaga, Felicia, Sally Maringa, Luke Chimuka. (2007). Hospital Solid Waste Management Practices in Limpopo Province, South Africa: A Case Study of Two Hospitals. Waste Management, 28, 1236-1245.
[7] Nixon, J.D., D.G. Wright, P.K. Dey, S.K. Ghosh, P.A. Davies. (2013). A Comparative Assessment of Waste Incinerators in the UK. Waste Management, 33, 2234-2244.
[8] Papageorgiou, A., Barton, J.R., Karagiannidis, A. (2009). Assessment of the Greenhouse Effect Impact of Technologies Used for Energy Recovery from Municipal Waste: A Case for England. Journal of Environmental Management, 90, 2999-3012.
[9] Sardjuri, Harsisto. (2014). Teknoekonomi Domestic Waste Environmental Destruction. Metallurgical Research Center - LIPI, Tangerang.
[10] Tchobanoglous, George, Theisen, Hilary, Vigil. 1993. Integrated Solid Waste Management. Singapura: Mc Graw Hill.
[11] Wahyono, Sri. (2001). Aspects of Organic Waste and Sanitation. Journal of Environmental Engineering,2 (2).
[12] Wahyuni, Endah Tri, et al. (2014). Optimization of Waste Management Through Community Participation and Assessment of Extended Producer Responsibility (EPR) in Magetan. Journal EKOSAINS, VI (1).
[13] Wardi, I Nyoman. (2011). Socio-Culture-Based Solid Waste Management: Efforts to Overcome Environmental Problems in Bali. Journal of Sustainable Earth, 11 (1).