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The Study Quality of Compost with the Utilization of Leachate Water in Landfill as a Bioactivator

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ABSTRACT. Garbage can be a source of environmental pollution if its existence is not utilized and processed properly. The processing at the Final Processing Site (TPA) produces a residue in the form of leachate. The leachate comes from the waste degradation process which is known to contain nutrients, heavy metals, xenobiotics and organic matter. Therefore, it is necessary to use leachate at the Bandengan landfill located in Jepara Regency which is useful in composting organic waste. The process of making organic waste compost with the addition of leachate as a bio activator can effectively accelerate the compost maturation process and can reduce the C/N ratio, the percentage of sugar as a nutrient for bacteria, the process temperature and the size of the material. This study aims to determine the quality of the use of residues from waste management in the form of leachate and organic waste into compost that is safe for environmental media and agricultural media. The test samples were taken using purposive sampling at three locations, including: IPAL inlet channel, WWTP pond, outlet channel at the Leachate Security Installation (IPAL). The method that will be used in the utilization of organic waste into compost is the Open Windrow Method. Reviewing the quality of the compost, it was found that the optimum leachate for composting and safe for the soil as well as looking at the Germination Index (IP) came from the WWTP outlet channel. The Bandengan Jepara Wastewater Treatment Plant has a series of technologies to reduce the heavy metals contained in the leachate. so that,

Keywords: IPAL, Leachate, Open Windrow

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1. Introduction

Regulation of Law no. 18/2008 concerning Waste Management, defines waste management as a process of changing the form of waste with changes in the characteristics, composition, and amount of waste. Waste processing activities aim to utilize the value that is still contained in waste and waste residues.

Garbage can be a source of environmental pollution if its existence is not utilized and processed properly. Along with the convenience of consumers to get food, the impact on increasing waste generation. If waste generation and waste processing do not run-in balance, it will have an impact on increasing the amount of domestic waste that is transported to the Final Processing Site (TPA). An increase in the amount of uncontrolled waste generation will shorten the life of the landfill.

Final Waste Processing Site is a place to process and return waste to environmental media safely for humans and the environment. The increase in the amount of waste generated is transported to the TPA which is then processed by means of periodic stockpiling. Processing in the landfill produces residue in the form of leachate. The Sanitary Landfill method used in the management of the landfill is provided with Environmental Protection facilities in the form of Leachate Security.

The leachate comes from the waste degradation process which is known to contain nutrients, heavy metals, xenobiotics and organic matter (Mirwan, 2013; Kapelewska et al., 2019;

Aziz et al., 2010). According to Tarigan (2012), bioactivators are materials that contain microorganisms that can work effectively and actively in the decomposition process of organic waste. It is known that leachate can function to increase the activity of microorganisms in degrading types of organic waste (Mirwan, 2013). Based on Riansyah's research (2012), organic materials contained in leachate include: Nitrogen, Ammonium nitrogen, Nitrate, phosphorus, Iron which have the potential as basic ingredients in the manufacture of fertilizers in agriculture.

The quantity of leachate produced by each landfill is different and has a low flow rate, but if a proper treatment and utilization is not carried out, the leachate will become a pollutant for the environmental media. Therefore, it is necessary to use leachate from the Bandengan landfill located in Jepara Regency which is useful in composting organic waste.

Based on research by Novitasari (2016), the process of making organic waste compost with the addition of leachate as a bio activator can effectively accelerate the compost maturation process and can reduce the C/N ratio, the percentage of sugar as a nutrient for bacteria, the process temperature and the size of the material.

This study aims to determine the quality of the use of residues from waste management in the form of leachate and organic waste into compost that is safe for environmental media and agricultural media.

2. Materials and Methods

This research was conducted at the Bandengan TPA which is located in Bandengan Village, Jepara District, Jepara Regency, Central Java. The research was conducted in three stages, including: (1) Leachate Sampling, (2) Composting, (3) Analysis of compost quality. Sampling for leachate collection refers to the Indonesian National Standard (SNI 6989.59, 2008) regarding Water and Wastewater. The test samples were taken using purposive sampling at three locations in the Leachate Security Installation (IPAL).

Leachate samples from the Bandengan landfill were taken at three locations. The three leachate sampling points include: Point 1 at the WWTP inlet channel, Point 2 at the WWTP pond, Point 3 at the WWTP outlet channel. During the leachate sampling, measurements and recording of pH and temperature data were carried out at each sampling location.

The method used by TPA Bandengan in the utilization of organic waste into compost uses the Open Windrow Method. This method was chosen because of the easy composting process and low cost.

Sorting organic waste to be used as compost is important. The basic ingredients of compost used by the Bandengan TPA include vegetable waste, fruit waste, and dry leaf waste. Vegetable waste and fruit waste were obtained from market waste sources, while dry leaf waste was obtained from dry leaf sweeping activities on the protocol road of Jepara city.

Organic waste that has been separated and collected at one point is then enumerated organic waste using a chopping machine. Organic waste is chopped into smaller particles which aim to facilitate contact between microorganisms and organic matter (Kaleka, 2020). The raw materials that have been chopped and uniformed about 2-5 cm are divided into three parts with the addition of a bioactivator in the form of leachate samples obtained at three sampling points.

During the composting process, to determine the development and activity of microbes that play a role in the stages of composting and the level of maturity of the compost, maturation is carried out on changes in temperature, pH, reduction level, humidity, and observing the physical form of the compost.

During the compost cooking process, observations were made including the speed of composting and the quality of the compost produced. Compost quality tests were carried out, among others, on testing physical, chemical properties, and germination tests to determine the level of toxicity of the compost produced. Then do the germination index by germinating the kale seeds (*Ipomoea aquatica*) with the resulting compost media.

3. Results and Discussion

Leachate Water Characteristics

Leachate as a result of the decomposition process of organic material is known to contain a lot of organic and inorganic substances with concentrations 100 times higher than wastewater (Riansyah, 2012). Leachate treatment is an alternative to carry out waste management in an integrated and environmentally friendly manner (Raras, 2007). The Leachate Treatment Installation (IPAL) of Bandengan Landfill consists of: Anaerobic Tub, Facultative Tub, Maturation Tub, Aeration Pond, and Wetland. Although it has not run optimally, the presence of the Bandengan TPA WWTP is considered effective in absorbing heavy metal contamination and organic compounds so that it is safe for the environment.

Bandengan landfill leachate obtained at three sampling locations has characteristics, including:

Table 1
Characteristics of Leachate Water at Bandengan Landfill

Sampling Point	Parameter	
	pH	Temperature
Point 1	9.20	31
Point 2	7.80	27
Point 3	7.20	26.5

The optimum condition for the pH of leachate as a bioactivator is at numbers 4 - 8. At the three sampling locations, it is known that the first point has a high degree of acidity, namely 9.20, then for the second and third points the acidity of the leachate is lower due to the treatment of leachate. In the temperature parameter, it is known that the first point of leachate sampling is at the WWTP inlet channel which has a temperature value of 31 and at the next two points the temperature decreases because it has gone through the treatment process at the WWTP.

Compost Maturity Analysis

Analysis of compost maturity can be identified on several aspects, including: Humidity, temperature, and pH. Compost moisture is an important parameter, because basically the composting process is a reduction in water content by microorganisms to carry out metabolism which affects the supply of oxygen into the compost (Lestari, 2010; Kaleka, 2020).

Compost maturity can be identified on several aspects, including: humidity, temperature, and pH. It is necessary to know the moisture condition of the compost because basically the composting process occurs when the water content is reduced by microorganisms to carry out metabolism which affects the supply of oxygen into the compost (Lestari, 2010; Kaleka, 2020).

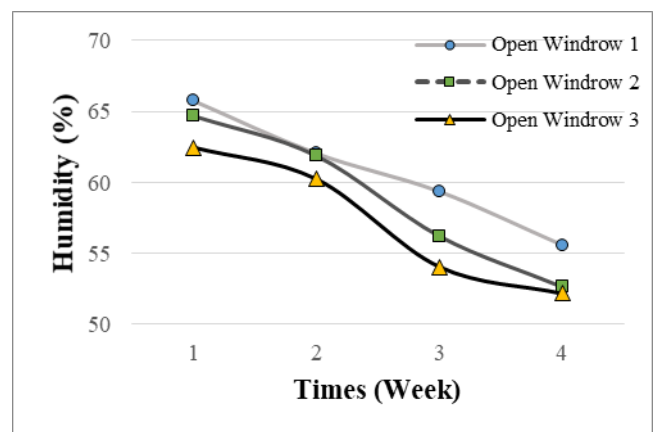


Fig. 1 Compost Moisture Chart

Based on the observation results, the humidity presented in table 2 above has a tendency to decrease during the composting process. This is related to the environmental temperature and to keep the humidity stable, stirring is needed so that the development of anaerobic microorganisms is inhibited (Kaleka, 2020). According to Gaur (1982), the optimum humidity for aerobic composting ranges from 50-60%, if the value is lower than 50%, the composting process will take place more slowly.

The composting process if done aerobically will produce energy (Kaleka, 2020). Temperature has been widely used as an important parameter to evaluate the stability of compost, because it is related to the activity of microorganisms and also the rate of decomposition during the composting process (Meunchang et al., 2005). At the activation stage of decomposing microorganisms, the temperature of the compost will increase so that it will have an impact on the high oxygen consumption by microorganisms.

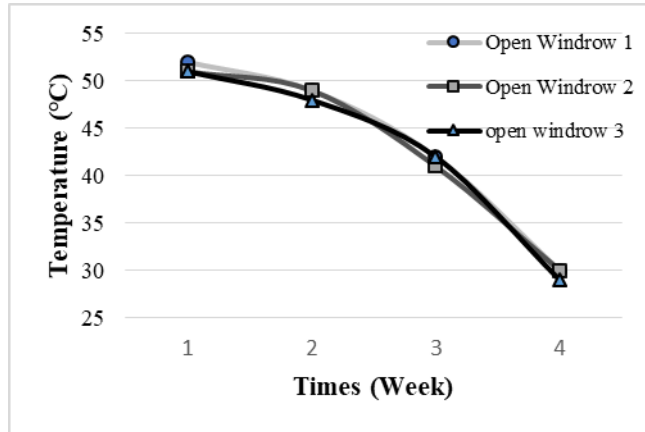


Fig. 2 Compost Temperature Graph

Results Observation of the temperature of the compost was carried out for four consecutive weeks. During the first two weeks there was an increase in the temperature of the compost due to the activation of microorganisms in the thermophilic phase. According to Ko et al (2008), the compost temperature parameter is determined by several factors, including the type of organic compost material, the composting procedure, and the season. The temperature of the compost gradually decreases until it approaches the ambient temperature because it has entered the compost maturation stage. The compost maturation stage occurs for two weeks with physical changes that occur in the form of volume of organic matter experiencing shrinkage from the initial volume. Volume shrinkage in the composting process is around 30 - 40% (Kaleka, 2020).

The degree of acidity or pH of the compost is an important factor that needs to be measured. The composting process runs well at pH 6 - 7.5 for optimal growth (Kaleka, 2020). During the composting process there is mineralization of basic cations such as K^+ , Ca^{2+} , and Mg^{2+} (Kusmiyati, 2013).

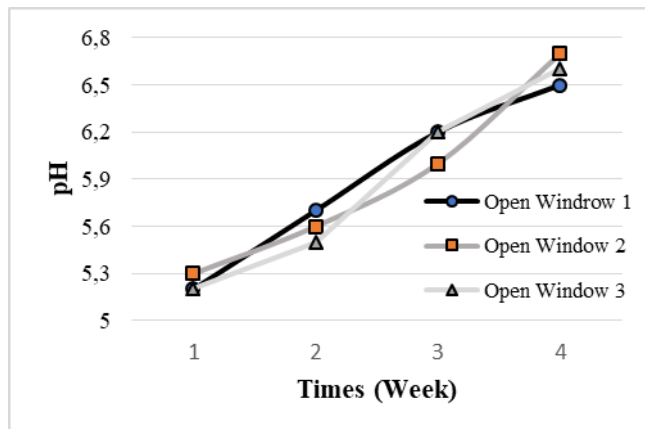


Fig. 3 Graph of pH compost

During the four weeks of the composting process, fluctuations occur in the degree of acidity or pH. Based on the results of pH observations carried out in the first week of the composting process, the pH of the compost was under acidic conditions due to the activity of microorganisms. However, gradually the pH goes to a neutral pH condition. The change in pH to a neutral condition occurs due to the enzymatic oxidation of inorganic compounds resulting from decomposition which produces H cations (Khan et al., 2009).

The three composts based on observations were known to have decreased in volume and the color of the compost to dark brown-black and humus formation occurred. Based on these observations, the compost has matured.

Compost Quality Analysis

Germination index (IP) was calculated based on the percentage of the number of kale seeds that grew in the planting media that had been added with compost. The germination results showed that the Germination Index values in the three composts produced were:

Table 2.
Germination Index

Compost Name	IP
Open Windrow 1	81
Open Windrow 2	87
Open Windrow 3	92

According to Brinton (2000), a Germination Index (IP) value above 80 can be said that the compost is not potentially toxic to plants. The three composts produced indicate that the compost produced in Open Windrow 3 by utilizing leachate at the IPAL Outlet Channel point with an IP value of 92 is safe for planting media.

4. Conclusion

Based on the results of testing the use of leachate into compost, it can be concluded that the leachate from the decomposition process of waste in the Bandengan landfill can be used as a bioactivator in compost. Reviewing the quality of the compost, it was found that the optimum leachate for composting and safe for the soil and seeing the Germination Index (IP) came from the WWTP outlet channel. The Bandengan Jepara Wastewater Treatment Plant has a series of technologies to reduce the heavy metals contained in the leachate. Thus, the leachate that will be passed on to the environment and water bodies is safe for the survival of living things in it. Open Windrow 3 at the WWTP outlet point shows perfect compost maturity and has a germination index value that is safe for use in agriculture and the environment.

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