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Analysis of the Leachate Quality and Its Potential Distribution in the Banjarsari Landfill Environment, Bojonegoro Regency

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Abstract

Leachate treatment is one of the main problems at the Banjarsari landfill because leachate is only accommodated without any processing and can pollute the surrounding environment. This study determined the concentration of leachate quality for several parameters tested (pH, BOD, COD, TSS, Total N, mercury, and cadmium) and compared it with the applicable leachate quality standards, determined the distribution pattern of leachate and determined the effect of the presence of leachate on the surrounding environment. The method used in this study was the grab sample method obtained directly from the monitored leachate body. The test results obtained the average concentration of leachate pH value of 7.55, for the content of organic matter in the leachate for parameters BOD = 91.5 mg/L; COD = 264.5 mg/L and TSS = 83 mg/L, for a total N concentration of 48.5 mg/L, and mercury (Hg) = 0.092 mg/L; and cadmium (Cd) = 0.009 mg/L; The leachate distribution pattern from the Banjarsari landfill followed the ground elevation, that spread in almost all directions where the leachate appeared to lead to irrigation channels and rice fields. Leachate impacted the surrounding environment, such as soil, surface water, and plants.

1. INTRODUCTION

The Banjarsari Final Disposal Site locates in the Banjarsari Village, Trucuk District. This landfill accommodates waste from Temporary Disposal Sites throughout Bojonegoro Regency. Based on data from the Bojonegoro Department of Environment, the average amount of waste entering the landfill is 250 m^3/day. Thus, in a month, it can reach 7500 m^3, and 90,000 m^3 in a year. All waste comes from 31 TPS, namely 16 TPS in the city area and 15 TPS outside the city.

The Bojonegoro Regency Environmental Service provides data that in 2020 the waste generation is estimated to reach 195,508.61 tons/year. Meanwhile, the National Waste Management Information System provides data in 2020, which consists of 275 regencies or cities in Indonesia, that the amount of waste generated is 33,113,277.69 (tons/year). Judging from the increasing population, the amount of waste produced is also increasing. This is a serious problem for Bojonegoro Regency.

This issue also has an impact on the lack of public awareness of waste management for the available landfill requires management to be able to accept the increasing amount of waste piles. For this reason, the Bojonegoro Regency Environment Agency in waste management requires a strategy. Thus, the available landfill can be managed and accept the number of waste heaps.

Garbage piles produce many leachates, which have the potential to cause water pollution, both ground and surface water, thus, it needs to be handled properly (Ali, 2011). Leachate will occur when there is external water that infiltrates into the waste heap, for example, from surface water, rainwater, groundwater, or other sources. The liquid then fills the cavities in the waste. If its capacity exceeds the water pressure capacity of the waste, the liquid will come out and extract organic and inorganic materials resulting from physical, chemical, and biological processes that occur in the waste (Yatim et al., 2013). Leachate contains much organic matter (biodegradable, but also resistant to biodegradation), such as ammonia-nitrogen, heavy metals, inorganic salts, and chlorinated organics, which pose a large threat to the surrounding soil, groundwater, and even water bodies (Huboyo, 2009).

Based on this description, it can be stated that leachate is very dangerous for the environment around the Banjarsari landfill. Then the purpose of the study is to test the parameters tested in accordance with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 59 of 2016 concerning Leachate Quality Standards with parameters (pH, BOD, COD, TSS, Total N, Mercury, and Cadmium) so that they can be compared. With the applicable leachate quality standards, to determine the distribution pattern of leachate to the environment around the Banjarsari landfill, and to determine the effect of the presence of leachate from the Banjarsari landfill on the surrounding environment.

In a previous study conducted by (Fitri, 2012), leachate quality has been tested and compared with the applicable leachate quality standards, while in this study, leachate samples are obtained using the Grap Sample method. Then, it is tested using the Atomic Absorption Spectrophotometer (AAS) method, and also mapped the potential of leachate distribution in the area of the Banjarsari landfill.

2. METHOD

The research was conducted at the Banjarsari TPA located in Banjarsari Village, Trucuk District, Bojonegoro Regency (Figure 1), from June 2022 – August 2022. The method used in this study was the Grap sample method, namely samples obtained directly from the agency the leachate was monitored (Figure 2). After taking the leachate sample using the Grap sample method, the researcher tested the leachate sample using the Atomic Absorption Spectrophotometer (AAS) method in the laboratory.

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Testing pH used a pH meter, the BOD test method referred to SNI 06-6989.14-2004 concerning Iodometric Dissolved Oxygen Test Methods. The COD test method referred to SNI 06-6989.2-2004 concerning Methods of Testing Chemical Oxygen Demand with Closed Reflux Spectrophotometrically. The test method TSS referred to SNI 06-6989.3-2004 concerning Test Method for Total Suspended Solid (TSS) gravimetrically used to calculate the number of metallic elements and metalloids based on the radiation absorption by free atoms in the gas phase testing parameters using the ASS method were N-total, heavy metals (mercury, and cadmium).

The data collection carried out in this study used primary data (primary data collection through observation, interviews, documentation, and measurement of leachate water quality at the Banjarsari landfill) and secondary data (from the Bojonegoro Regency Environmental Service and relevant literature for research). After all the data was obtained, the potential distribution of leachate in the Banjarsari landfill was mapped.

Figure 1. Research Location

Figure 2. Leachate Sampling

3. RESULTS AND DISCUSSION

Leachate Water Quality Test Results

Banjarsari landfill is operated using the sanitary landfill method, where the waste disposal system is carried out by piling it at a location. Garbage that is disposed of and piled up is then compacted and backfilled with soil (Afdal, 2016). Banjarsari landfill is a place to store various kinds of waste so that various types of pollutants pose environmental and human health risks (Ali, 2011). Leachate water can seep into the ground, or flow on the soil surface, and empties into river water (Zubair et al., 2015). Banjarsari landfill has implemented a collection tank system for leachate where waste from various sources is a treatment system and a storage tank specifically designed to treat the resulting leachate. The average value in the leachate sample test can be observed in Table 1.

Table 1. Results of Leachate Water Quality Testing at Banjarsari Landfill

No	Parameter	Test Result	Leachate Quality Standard (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 59 of 2016)
1	pH	7.55 mg/L	6 – 9
2	BOD	91.5 mg/L	150 mg/L
3	COD	264.5 mg/L	300 mg/L
4	TSS	83 mg/L	100 mg/L
5	Total N	48.5 mg/L	60 mg/L
6	Mercury	0.092 mg/L	0.005 mg/L
7	Cadmium	0.009 mg/L	0.1 mg/L

Based on Table 1, the concentration tested on leachate samples had a value below the quality standard number set by the government in Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 59 of 2016 concerning Leachate Quality Standards for Business and/or Activities of Waste Final Processing Sites. The low pH value, organic matter content (BOD, COD, and TSS), N-Total, and heavy metals (mercury and cadmium) were tested using the Atomic Absorption Spectrophotometer (AAS) method. This method is used to calculate the number of metallic elements and metalloids based on the absorption of radiation absorption by free atoms in the gas phase. The test results showed that the leachate did not contain too much organic matter and heavy metals from the decomposition of waste.

Compared with research by Fitri (2012) at the Tejun TPA, the results of the leachate quality test have a value above the quality standard. This is because the leachate directly pollutes the soil without any stabilization ponds, aeration ponds, and filtration ponds. While at the Banjarsari TPA, a leachate collection system has been implemented by channeling pipes from the waste pile to the stabilization pond, aeration pond, and filtration pond so that the leachate quality test results have a value below the quality standard according to the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 59 of 2016 concerning Leachate Quality Standards for Business and/or Activities of Waste Final Processing Sites.

Potential for Leachate Spread

The potential for leachate distribution is intended to determine the direction of the leachate flow coming out of several points in the Banjarsari landfill area. As is known, the Banjarsari landfill is located in a hilly area with an altitude between 60-100 meters above sea level, where below the landfill, there are rice fields and residential areas. The mapping image of the potential distribution of leachate in the Banjarsari TPA can be seen in Figure 3.

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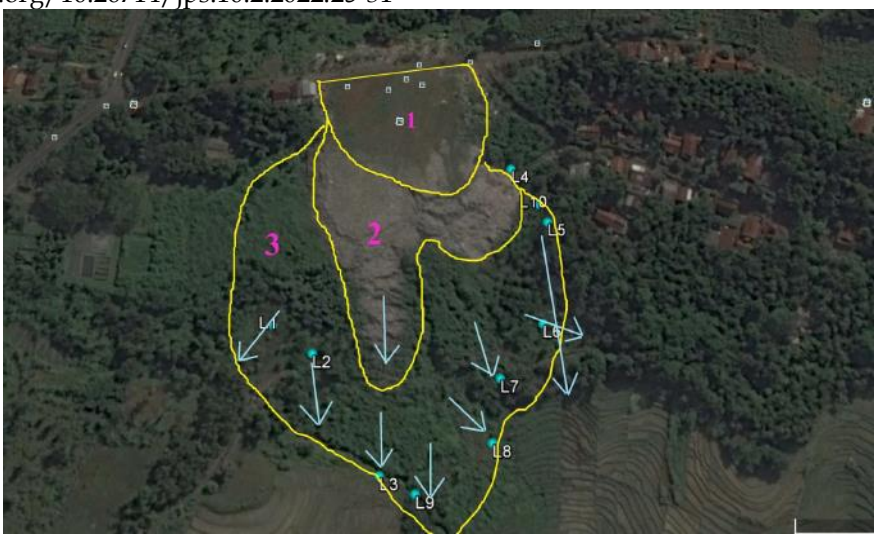

Figure 3. Potential For Leachate Distribution in Banjarsari Landfill

Banjarsari landfill is divided into three parts. The first part is the topmost part, which is the soil cover, the second part is the avalanche of garbage that is still open, and the third part is the part of the avalanche of garbage that has been covered with weeds. This is because the landfill area is located in a hilly area, the direction of leachate flow will follow the topography of the area.

The leachate produced by the Banjarsari landfill will certainly have an impact on the surrounding environment, such as soil, surface water, and plants. The leachate from the Banjarsari landfill is more or less polluting the surrounding environment. Some of the leachates that emerge from the pile of garbage will seep-in and accumulate in the ground. Some will flow to the lower topography and join irrigation canals, which are then used to irrigate rice fields. From there, the heavy metal pollutant content from the leachate will be up-taken by rice plants and then distributed and stored in all parts of the plant, especially in the grain section. However, there is a possibility that the pollutants contained in the rice plant may not come entirely from leachate contamination, given the use of fertilizers and pesticides to spray crops. And there is also the possibility that the heavy metal content in rice plants comes from the soil, that accumulates metal contaminants.

4. CONCLUSION

Based on the results of the analysis and discussion of this study, it can be concluded that the average concentration of pH value in the Banjarsari TPA was 7.55, for the organic matter content in Banjarsari leachate for the BOD parameter = 91.5 mg/L; COD = 264.5 mg/L and TSS = 83 mg/L, for a total N concentration of 48.5 mg/L, and mercury (Hg) = 0.092 mg/L; and Cadmium (Cd) = 0.009 mg/L. The leachate distribution pattern from the Banjarsari landfill followed the elevation of the land surface. Therefore, it spread in almost all directions where the leachate that appeared lead to irrigation channels and lead to rice fields; and leachate produced by the Banjarsari TPA would impact on the surrounding environment, such as soil, surface water, and plants.

It is suggested that further and more accurate research are needed to discover how much leachate contaminates surface water, groundwater, and surrounding plants as well as the

leachate distribution pattern. It is expected that there will be follow-up from the Bojonegoro Regency Government to the Banjarsari TPA, either by improving the TPA area, leachate management, or repairing irrigation canals that are affected by landslides. It is also expected that the government will pay more attention to the community and environment around the Banjarsari TPA, particularly regarding the condition of public health and environmental conditions.

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7. Environmental Science student at University of Bojonegoro.

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