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AUTHOR

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387.4KB

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2020, Vol. 01, No. 01, 1-5 | ISSN: 2745-4576, e-ISSN: In press

Horizontal Identification of Lindi Distribution Using Monitoring Wells*

Hudori[1], Nanang Saiful Rizal[2], Rusdiana Setyaningtyas[2], Ahmad Fajar Yusuf Efendi[2]
[1]Department of Graduate School of Engineering, Gifu University, Yanagido 1-1 Gifu, Japan
[2]Department of Civil Engineering, Faculty of Engineering, University of Muhammadiyah Jember, East Java, Indonesia
Email: hudori@uii.ac.id

ABSTRACT

Most of the waste is collected and managed in a landfill (TPA). The Pakusari Jember Final Processing Site (TPA) is an example of a TPA that implements the Open Dumping system. This TPA is one of the TPAs located in the City of Jember. This TPA service covers all waste in the city and its surroundings. Most of the waste disposed of in this place is organic waste originating from markets. This causes waste to decompose faster and produce pollutants that can pollute groundwater. Leachate water (leachate) that enters groundwater or rivers will cause dangerous pollution for the surrounding residents. If this is allowed, there will be wider problems for the population. For surveillance measures, it is necessary to conduct a survey to determine the types of pollutants and how wide they are spread. By monitoring 11 research wells and 1 pollutant source site, then the permeability test was carried out at several points, the distribution of leachate content was obtained up to 400 m to the southeast. It can be concluded that the Pakusari TPA has been polluted by leachate waste. Some of the content in the monitoring well is heavy metals such as lead (Pb), cadmium (Cd), copper (Cu) and iron (Fe). With a permeability value (K) = 2.61298E-07 cm / second, there has been a leachate flow propagation of 0.08127406 m / year with a leachate distribution area of 1.478.54 m^2.

Keywords: Contamination, Leachate, TPA, Monitoring Wells.

1. Introduction

Garbage is waste in the form of solids, which is a common pollutant that can reduce the aesthetic value of the environment, bring various types of diseases, reduce resources, cause pollution, clog waterways and various other negative consequences [1]. In developing countries, waste is generally collected at disposal sites using a Sanitary Landfill system. Sanitary Landfill is a waste management system that develops basin land with certain conditions, namely the type and porosity of the soil, at the base of the basin covered with geotextiles to withstand leachate infiltration on the soil and equipped with leachate channels [2]. The existing landfills in Indonesia have not fully implemented the Sanitary Landfill system and most of them still apply the Open Dumping system, in which garbage is piled up without any geotextile layers and leachate channels. The result is contamination of groundwater and air around the TPA [3], [4].

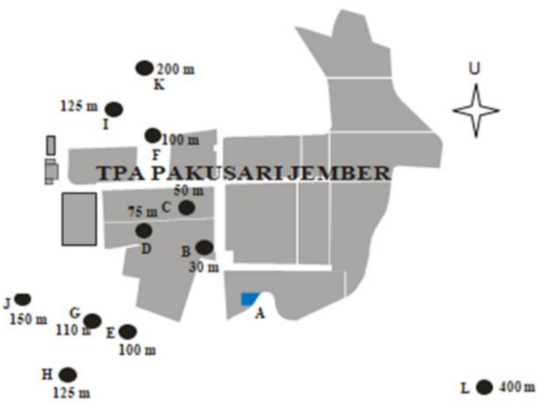
The Pakusari Jember Final Processing Site (TPA) is an example of a TPA that implements the Open Dumping system. This TPA is one of the TPAs located in the City of Jember. This TPA service covers all waste in the city and its surroundings [5]. Most of the waste disposed of in this place is organic waste originating from markets. This causes waste to decompose faster and produce pollutants that can pollute groundwater. Leachate water (leachate) that enters groundwater or rivers will cause dangerous pollution for the surrounding residents [6], [7]. If this is allowed, there will be wider problems for the population. For surveillance measures, it is necessary to conduct a survey to determine the types of pollutants and how wide they are spread.

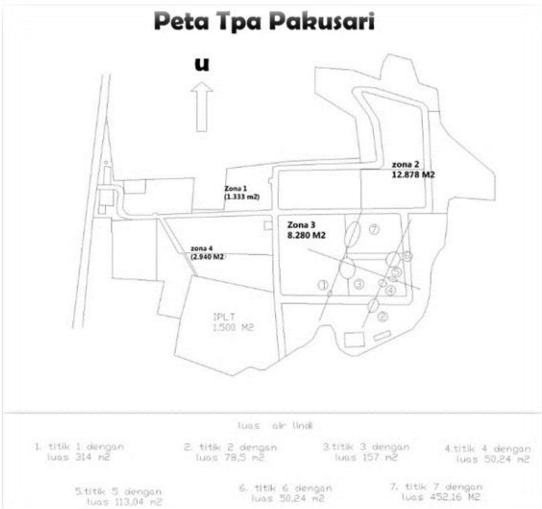
This TPA is precisely located in Kertosari Village, Pakusari District, Jember Regency, with an area of 6.8 hectares which is divided into 13 plots. This TPA is the only TPA in Jember Regency. Built since 1992, this TPA service covers all waste in the city and its surroundings, especially in ten (10) sub-districts namely Patrang, Sumbersari, Kaliwates, Arjasa, Mayang, Silo, Kalisat, Ledokombo, Sukowono, and Pakusari and even the Market Cape too. Every day there are about 51-56 trucks carrying garbage every day, in 1 truck there are 10 m^3 so that in a day there is about 520 m^3 of garbage per day. Based on the graph, the volume of waste at TPA Pakusari Jember is fluctuating. This can be seen by comparing the volume of waste between 2018, the average volume of waste each month is 18563.46 m^3, so it can be concluded that the average leachate distribution can be 1.3 and can be seen in Figure 1 and the point depth image [8]. The purpose of this research is to answer existing problems, including:

a. Analyzing the location of the leachate content in the Pakusari TPA using monitoring wells.
b. To identify the extent of leachate spread and the rapid spread of leachate around TPA Pakusari Jember.
c. Providing solutions to overcome leachate pollution at TPA Pakusari Jember.

2. Research Methods

In this study, a water sample was tested. This water sample test is secondary data obtained from the results of research by Lisa Nourma Junita, 2013 on the profile of the distribution of heavy metals in wells around TPA Pakusari Jember. There are 11 research wells and 1 leachate collection tank. To obtain the permeability value of the soil, tests were carried out at several points. Soil samples taken from the landfill using manual drilling method with a depth of 2 meters with a total of 4 points of the cardinal directions with the center of the TPA. Monitoring wells are used to determine the water content in the well. The monitoring well planning map is as follows:





Information:

(a) Leachate (b) Shelter Well

Figure 1. Monitoring well map at TPA Pakusari Jember

The calculation of the leachate well area is based on the location of the monitoring well which is connected to form a polygon which can be calculated its area using the Google Earth application [9]. [10]. Map of the results of the analysis of the possibility of leachate scattered in the Pakusari TPA area in Jember. Pakusari TPA is the only one in the town of Jember, Kertosari Village, 14 km east of Jember city, with an area of 6.8 hectares divided into 13 lots. Can be seen in figure 4.1, built since 1992. This TPA service covers all waste in the city and its surroundings, especially in ten (10) sub-districts namely Patrang, Sumbersari, Kaliwates, Arjasa, Mayang, Silo, Kalisat, Ledokombo, Sukowono, and Pakusari and even Pasar Tanjung. Leachate that arises after the operation is completed, can be estimated using a method called the Water Balance Method. This method is based on the assumption that leachate is only generated from rainfall which has managed to penetrate into the waste pile (percolation).

2020, Vol. 01, No. 01, 1-5 | ISSN: 2745-4576, e-ISSN: In press

Figure 2. Potential leachate distribution and well monitoring conditions in the field

3. Results and Discussion

With the coordinates and elevation above, the flow can be seen. Paskal's law states [2], [11] that water always flows to a lower place and fills the empty cavities, so it can be concluded that the leachate will flow to a lower place like in sample L with a height of 148 meters. The table above states that leachate is still present in monitoring wells 400 meters to the southeast with a Pb content of 0.7 and Cd 0.01 above WHO provisions. The largest leachate production is still in sample A, namely Pb (1.88), Cd (0.17), Cu (2.74), Fe (0.93) right in the leachate reservoir. Based on the table above, from a distance of 75 - 400 m, the Cu and Fe contents began to decrease or were under WHO provisions. The largest concentrations of heavy metals Pb, Cd, Cu, and Fe were contained in leachate water. The concentrations of Pb, Cd, Cu, and Fe in leachate were 1.88; 0.17; 2.74; and 0.93 ppm. The concentration of heavy metals contained in well water gradually decreases in proportion to the distance the well is from the TPA. The largest concentration of Pb contained in well water is in well B (30 m to the northwest) of 1.12 ppm then the value gradually decreases to 0.88 ppm in well C (50 m to the northwest) and 0, 7 ppm in wells D (75 m to the northwest) to L (400 m to the southeast). It can be said that the effect of leachate is possible up to well C (50 m to the northwest). Because the value of Pb metal concentration in wells D (75 m to the northwest) to L (400 m to the southeast) is the same, namely 0.7 ppm. The largest concentration of Cd contained in well water is in well B (30 m to the northwest) of 0.12 ppm. Then the value gradually decreases to 0.01 ppm in wells C (50 m to the northwest) to L (400 m to the southeast).

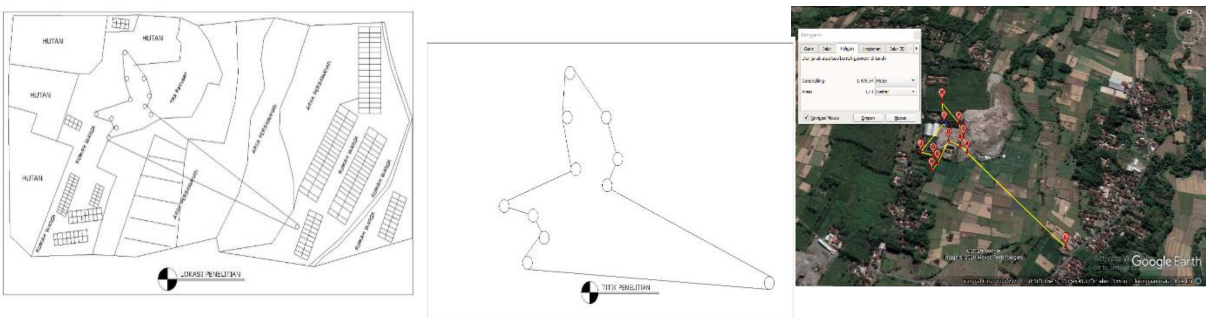


Figure 3. Layout of research location and position of monitoring wells

It can be said that the influence of leachate is possible up to well B (30 m to the northwest). Because the value of Cd metal concentration in wells C (50 m to the northwest) to L (400 m to the southeast) is the same, namely 0.01 ppm. The largest concentration of Cu contained in well water was in well B (30 m to the northwest) of 1.16 ppm. Then the value gradually decreases to 1.00 ppm in well C (50 m to the northwest), 0.79 ppm in well D (75 m to the northwest), and 0.63 ppm in well E (100 m southwestward) to L (400 m to the southeast). It can be said that the influence of leachate is possible up to well D (75 m to the northwest). Because the concentration value of Cu in wells E (100 m to the southwest) to L (400 m to the southeast) is the same, namely 0.63 ppm. The largest concentration of Fe contained in well water is in well B (30 m to the northwest) of 0.42 ppm. Then the value gradually decreases to 0.33 ppm in well C (50 m to the northwest), and 0.27 ppm in wells D (75 m to the northwest) to L (400 m to the southeast). It can be said that the influence of leachate is possible up to well C (50 m to the northwest). Because the value of Fe metal concentration in wells D (75 m to the northwest) to L (400 m to the southeast) is the same, namely 0.27 ppm. Based on the coordinates and elevation of the monitoring well location in table 1, it can be seen that the form of leachate distribution in the form of polygons using the Google Earth application can be calculated the area of leachate distribution, namely 1.478.54 m^2 or 1.11 hectares.

Table 1. Value of P (mm), I (mm), AET, PERC from the calculation result of Thornt White's water balance

	Jan	Peb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nop	Dec
Presipitasi (mm)	337.8	298.5	295.9	212.5	112.9	83.5	41.0	24.4	46.1	84.4	210.4	242.9
I (mm)	295.5	261.2	258.9	185.9	98.8	73.1	35.9	21.3	40.4	73.8	184.1	212.5
AET	195.5	161.2	158.9	85.9	-1.2	-5.9	-23.1	-18.7	12.4	-26.2	84.1	112.5
PERC	285.5	252.8	250.4	176.0	88.8	87.1	50.4	33.7	42.9	60.6	173.6	201.8

Source: calculation results

From the results Table 1 shows the highest Percolation, Precipitation, AET, and I in January. The highest leachate production was in January followed by the following months, namely February, March and December. Based on the results of this study, it can be seen that there is a spread of leachate in a radius of 400 m with a absorption rate of 0.00000021 cm/second. This shows that there are indications of groundwater contamination by leachate around the TPA Pakusari Jember, which is feared that it will also pollute the well water of residents around the site [7]. Fast propagation in one year is based on table 2 with the following results:

Table 2. Average K values by year

Coefficient permeability				Unit
Nort	West	East	South	
3.19462E-07	2.3733E-07	2.47058E-07	2.41341E-07	cm/sec
9.936545167	7.38189948	7.68450245	7.506676952	cm/year
0.099365452	0.07381899	0.076845024	0.07506677	m/year

Source: Calculation Results

4. Conclusion

Based on the soil permeability coefficient in the data above, it is obtained an average of 0.081274 m/year, which means that the permeability is classified as very slow. Based on the results of research on identifying the horizontal distribution of leachate using monitoring wells at TPA Pakusari, the following conclusions can be drawn:

1. Around the Pakusari TPA, there is a distribution of leachate content up to 400 m to the southeast, which means that the land in the Pakusari TPA area contains leachate. Some of the content in the monitoring well is heavy metals such as lead (Pb), cadmium (Cd), copper (Cu) and iron (Fe).
2. The results of the analysis of the distribution of leachate at Pakusari TPA have been polluted as far as 400 meters to the southeast with a permeability value (K) = 2.61298E-07 cm/sec, it means that

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the annual propagation can be calculated as 0.08127406 m / year with a leachate distribution area of 1.478.54 m^2.

3. There must be a drain under the pile of garbage so that the leachate can enter the leachate storage tank properly, thereby minimizing the risk of leachate spreading around the landfill. The leachate storage tank must also be re-functioned as it should so that leachate processing can run as expected.

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