Relationship of Heavy Metal levels (Pb and Cd) on Leachate Jatibarang Waste and Water River end Disposal place raw materials Municipal Waterworks Semarang City

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ABSTRACT

Jatibarang Waste Disposal Site (abbreviated as landfill Jatibarang) is the final waste collection site in Semarang City, which is sourced from the fields of household, service, industrial, etc with various types of garbage, so that it can potentially cause pollution of the surrounding environment. One of them that might be affected is the River around landfill Jatibarang.

Pollution to river water can occur because of the process of decomposition of waste by rain water resulting in water leachate containing heavy metals such as lead (Pb) and cadmium (Cd). landfill Jatibarang is in hilly and bumpy area which in the lowest part flow the Kreo River connected to the Kaligarang River, where the water contained in the river is the raw water of the Tirta Moedal Drinking Water Company in Semarang City.

This studyaimed to determine the relation of leachate to heavy metal (Pb and Cd) contamination of landfill Jatibarang in raw material river water of Local water company in Semarang City. This study was an observational analytic study with cross sectional study design. Leachate sampling was carried out at leachate outlets, while river water samples were carried out at 29 points along the Kreo River to the Garang River.

The results of the research with the AAS method provided the Pb level in leachate water was 0.15 mg/lt, while the Cd content was 0.040 mg/lt. The results of the Rank-Spearman relationship test provided the relationship between the distance of the water leachate outlet and the Pb level in Kreo River water flow (p = 0.007), but there was no correlation between the distance of the water

leachate outlet and the Cd level in the Kreo River water flow (p = 0.304).

Furthermore, the Mann-Whitney test revealed that there was no difference between the type of river flow and Pb and Cd levels of the Kreo River flow with a significance value = 0.100 for Pb levels and 0.160 for Cd levels.

Keywords: Landfill leachate, Pb level, Cd level.

1. INTRODUCTION

The problems of municipal waste generally occur in landfills (waste dumps), especially in several large cities in Indonesia such as Semarang. Semarang is a complex city where one is produced from its activities, namely garbage from settlements, commercial areas, offices, and public facilities where in 2014 it amounted to 1229.21 m3 while those transported for disposal to the Jatibarang Waste landfill amounted to 1044.83 m3. From the amount of waste generated, organic waste was divided into 761.49 m3 61.95%) and non-organic waste was 467.71 m3 (38.05%) (Wibowo, 2002). Landfill Jatibarang waste has a garbage disposal system with the technique of sanitary landfill processing but in its implementation is not entirely based on the provisions, so it still uses modified control landfill techniques. Topographically, landfill Jatibarang Garbage is a hilly and bumpy area, has a slope of more than 24% (very steep) with varying heights between 63 - 200 m above sea level and the lowest part flows through the Kreo River connected by the Kaligarang River, where water which is found in the river is the raw water of the Tirta Moedal Drinking Water Company in the city of Semarang.

Of the various types and amounts of waste, the surrounding environment of landfill Jatibarang Trash has a pollution potential, one of which is the Kreo River near landfill Jatibarang Trash. Pollution to river water can occur because of the process of decomposition of waste by rainwater so that it produces leachate water which is suspended and easily soluble. Usually water leachate contains high levels of organic compounds (Error, Tanate, Sufat) and inorganic compounds such as heavy metals (Pb and Cd) (Wayuningsih, 2014). Leachate water that enters groundwater or rivers will cause pollution. Lead (Pb) is a metal that is toxic originating from natural sources and waste from human activities (Langmore, 1998). While cadmium (Cd) is found for example in the flow of waste water and landfill area which is toxic and can kill organisms because of the nature of acute and chronic toxicity (Paulson, 1997: 447-464).

The results of the study by Sudarwin in 2008, contamination of Cd and Pb heavy metals in sediments of the Kreo River water flow from landfill Jatibarang Garbage Semarang which sediment sample points 10 meters from the leachate outlet obtained

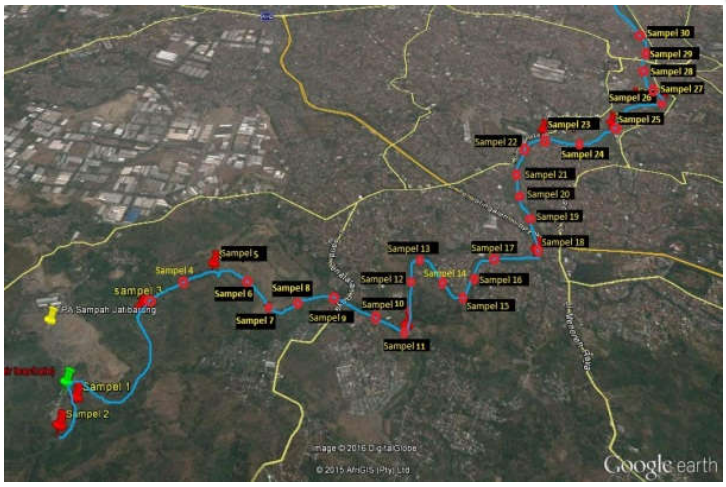
high pollution class results for Cd = 0.19 mg / kg and Pb level = 2.319 mg / kg (Paulson, 1997: 447-464).

Several factors that can influence the level of Pb and Cd in the waters are the distance taken from the leachate outlet and the type of flow. The proximity of the leachate outlet will have a higher concentration of Pb and Cd than at a longer distance. This type of flow includes turbulence and lamination where turbulent flow causes easier mixing of compounds in the flow. Conversely, laminar flow occurs in the process of mixing chemical compounds more slowly (Parsons, 2002).Based on the above problems, it is necessary to conduct research on the relationship of Pb and Cd contamination levels in the Jatibarang landfill leachate of Semarang and raw material river water of Local water company Tirta Moedal, Semarang City.

2. METHOD

This study was an analytic observational study with a cross sectional study design. The target population is river water flowing on the Kreo River to the Garang River in Semarang City. Affordable population is the surface water of the Kreo River before the Jatibarang landfill Leachate outlet reaches the raw water inlet of the Tirta Moedal water of Local Water Company on the Garang River. The sample used was surface water as many as 29 samples flowing in the Kreo River to Garang River by taking each point carried out only once and analyzed by chemical laboratory tests for Pb and Cd parameters at the Semarang Laboratory of Health Laboratory, Central Java Province.

Univariate analysis produces a frequency distribution in the form of averages, maximum, minimum and standard deviations of each variable. Bivariate analysis used the Rank-Spearman and Mann-Whitney tests with a confidence degree of 95% and α = 5%.



3. RESULTS

3.1 Univariate Results

a) Levels of Pb and Cd on leachate in Jatibarang landfill

b) The Pb level in leachate is 0.06 mg / lt and the Cd leachate level is 0.051 mg / lt. The levels of Pb and Cd in the leachate have exceeded the quality standard according to PP No. 82 of 2001 where the PAB NAB whose water for drinking water is 0.03 mg / lt and for Cd having a NAB is 0.01 mg / lt.

c) Pb and Cd levels of Kreo River water

d) The water level of Kreo River has an average of 0.015 mg / lt and the average Cd = 0.027 mg / lt with a minimum Pb level of 0,000 mg / lt and a maximum of 0.13 mg / lt. While minimum level of Cd is 0.003 mg / lt and a maximum of 0.25 mg / lt.

e) Type of Kreo River water flow

f) The type of Kreo River water flow is taken up to 29 points. At point 2 taking the Kreo River sample is a type of laminar flow, while at point 3 to point 30 is included in the type of turbulent flow.

g) Distance

The sampling distance from the leachate outlet starts from point 1 within 5m, up to point 30 within 8650 of the leachate outlet, can be seen in the table

Table 1 Results of measurements of Pb and Cd levels, type of flow and measurement distance in the Kreo River flow, 2016

No.	Take point Sample	Level Pb Pb point Kreo river (mg/lt)	Cd level in flow water Kreo River (mg/lt)	Flow type	distance (m)
1.	Point 1	0,06	0,051	Laminer	5
2.	Point 2	0,05	0,040	Laminer	10
3.	Point 3	0,13	0,040	Turbulent	65
4.	Point 4	0,00	0,016	Turbulent	140
5.	Point 5	0,00	0,003	Turbulent	225
6.	Point 6	0,02	0,022	Turbulent	280
7.	Point 7	0,00	0,003	Turbulent	750
8.	Point 8	0,00	0,003	Turbulent	1200
9.	Point 9	0,04	0,020	Turbulent	1350
10.	Point 10	0,05	0,250	Turbulent	1700
11.	Point11	0,05	0,039	Turbulent	1850
12.	Point12	0,00	0,003	Turbulent	2300
13.	Point13	0,02	0,012	Turbulent	2500
14.	Point14	0,03	0,025	Turbulent	2750
15.	Point15	0,00	0,003	Turbulent	3900
16.	Point16	0,00	0,025	Turbulent	4225

17.	Point17	0,00	0,031	Turbulent	4400
18.	Point18	0,01	0,022	Turbulent	4600
19.	Point19	0,00	0,025	Turbulent	5000
20.	Point20	0,00	0,003	Turbulent	5300
21.	Point21	0,00	0,022	Turbulent	5500
22.	Point22	0,00	0,003	Turbulent	5750
23.	Point23	0,00	0,003	Turbulent	6100
24.	Point24	0,00	0,022	Turbulent	6300
25.	Point25	0,00	0,003	Turbulent	7100
26.	Point26	0,01	0,028	Turbulent	7600
27.	Point27	0,00	0,025	Turbulent	8300
28.	Point28	0,00	0,015	Turbulent	8350
29.	Point29	0,00	0,010	Turbulent	8550
30.	Point30	0,00	0,003	Turbulent	8650

3.2 Bivariate Results

1. Distance from leachate outlet with Pb level and water level of Kreo River flow

The analysis was carried out by the Rank-Spearman test. The results of the statistical test obtained a value of p = 0.007 so that there is a relationship between the sampling distance from the outlet of the leachate water and the Pb level in the water of the Kreo River. These results are consistent with the results of Sudarwin's 2008 study that there was a relationship between the leachate outlet and the Pb levels in the Kreo River flow with p value = 0,0001.

While the results of the p-value Cd level = 0.304 (p> 0.05) so that there is no relationship between the distance of the leachate water outlet and the Cd level. The absence of a relationship may be caused by disturbing factors, such as the pH difference at each sampling distance on the river. When water has a pH <4.5, it makes the solubility of Cd high and will result in an increase in water levels because the solubility of Cd also increases with decreasing pH.

The direction of the relationship between the distance from the leachate outlet and the levels of Pb and Cd has a negative direction, which means that the smaller / nearer the distance from the outlet of the leachate, the greater the levels of Pb and Cd in river water. In theory, the proximity of the leachate outlet will have a higher concentration of Pb and Cd than at a longer distance. This is because the leachate levels are more concentrated than at a longer distance so that it will result in large concentrations of Pb and Cd.

2. Types of river flow with Pb levels and levels of Cd of Kreo River water flow

Analysis of the relationship between the type of river flow and the Pb level of water in the Kreo River was carried out using the Mann-Whitney test. There are 2 types of flow found in the Kreo River which includes turbulent and laminar flows. The process of mixing Pb and Cd metal will occur faster on laminar type flow. Conversely, turbulent flow can cause slow mixing of Pb and Cd metals. In turbulent flow will also result in the re-fragmentation of metals that have been formed, which makes the Pb and Cd levels decrease.

However, in this study it was found that there was no difference between the type of river flow and Pb levels and Cd levels in the Kreo River with a significance value for Pb levels of 0.100 and for Cd levels of 0.160 ($p > 0.05$). The absence of this difference may be due to almost all streams at the sampling point being the type of turbulent flow which is from 29 samples, 28 of which are turbulent flow types and the remaining 1 are laminar flow, modern ways of information management. The olden day's academic libraries seems not been able to meet the information need of the patrons, and not only that technology make life easy today, but also it is an all-round world sectors economic best driver. Therefore, the need for technology-driven information creation, access, storage and dissemination in academic libraries in Nigeria cannot be overemphasized.

4. CONCLUSION

Pb levels in leachate water are 0.15 mg / lt and Cd levels in leachate water are 0.040 mg / lt. There is a correlation between sampling distance from water leachate outlet and Kreo River water Pb level ($p = 0.007$) but there is no correlation between sampling distance from water leachate outlet and Cd level in Kreo River water flow ($p = 0.304$). There was no difference between the type of river flow and Pb level and the level of Cd of Kreo River flow ($p = 0.100$ and $p = 0.160$).

SUGGESTION

It is necessary to carry out processing, repair and regular supervision of leachate water before leachate water enters the Kreo River so that the levels of pollutants found in leachate water can drop. As well as the need for community efforts to sort out the waste before the garbage is disposed of to the polling station which is continued to Jatibarang LANDFILL. Further research needs to be done by including other variables including pH, sediment, suspended solids, and temperature.

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