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ISSN 1462 2815

ANALYSIS OF GROUNDWATER POLLUTION AROUND TAMANGAPA LANDFILL

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DOI: 10.5281/zenodo.12204960

Abstract

Tamangapa Landfill (TPA) is one of the landfills that applies the Open Dumping system. This system has the potential to cause leachate water pollution to the environment, especially to groundwater. The purpose of this study was to test the characteristics of odor, pH, TDS, NH3, Pb Metal, COD, BOD, and Total Coliform in groundwater samples taken from 20 residents' wells and interview the perceptions of the community around the landfill. The sampling technique uses the SNI 6989.58: 2008 groundwater sampling method. The results of sample testing show that samples on odor characteristics 6 samples meet quality standards, 13 samples meet pH quality standards, 18 samples meet TDS quality standards, 20 samples meet NH3 quality standards, 20 samples meet Pb Metal quality standards, 20 samples meet COD quality standards, 20 samples meet BOD quality standards, and no samples meet Total Coliform quality standards. The negative perception of the community with the odor due to waste generation at Tamangapa landfill causes people to be less comfortable living around Tamangapa landfill.

Keywords: Groundwater, pH, TDS, NH3, Pb Metal, COD, BOD, Total Coliform.

I. INTRODUCTION

Tamangapa landfill in Makassar City is one of the landfills that does not meet the requirements of ministerial regulation PU N0. 19/PRT/M/2012. Tamangapa landfill has an area of 14.3 hectares which has been used since 1993 [1]. Tamangapa landfill is a close distance to the settlement so it influences the surrounding population, the development of residential areas around the landfill site is indicated as the influence of the presence of landfill as a triggering factor [2].

Makassar is one of the main cities in Indonesia with a population of 1.339 million people. This large population causes various problems, including an increase in the amount of waste generated every day [3,4]. Waste in Makassar City is collected at the Tamangapa Landfill (TPA), Antang. The Tamangapa landfill area is surrounded by many houses, and some residents even live on the landfill site [5,6]. This is a concern because it can endanger health from various factors, including seepage water from the landfill which can affect the quality of surrounding groundwater [7],[8].

The large population in Makassar city will certainly cause various problems [9]. One of the problems that arise is the increase in the amount of waste generated every day [10]. Waste in the city of Makassar is collected at the Tamangapa Landfill (TPA), Antang. Around the Tamangapa landfill, there are many settlements. There are even some residents who live in the Tamangapa landfill site. Of course, this is very worrying because it can endanger health from various factors. One of them is seepage water from the landfill that affects groundwater quality [3].

Water that comes from groundwater sources, such as dug well water or borehole water, is very vulnerable to pollution [9]. Dug well water can be contaminated through seepage from various sources of pollution such as septic tanks, human waste, animal waste, domestic waste, and so on [11,12]. In addition to the distance from pollutant sources, the construction of dug wells that do not meet the requirements also affects the content of contaminants in dug well water [13]. A pollutant source with a high potential to contaminate dug well water is landfills. Landfills have the potential to produce seepage water containing many contaminants that can contaminate dug well water [14].

2. METHODS

The samples tested were taken from 20 wells of the Tamangapa landfill community and its surroundings (Figure 1). Furthermore, the analysis of well water quality was carried out at the Laboratory of PT. SUCOFINDO Makassar Branch.

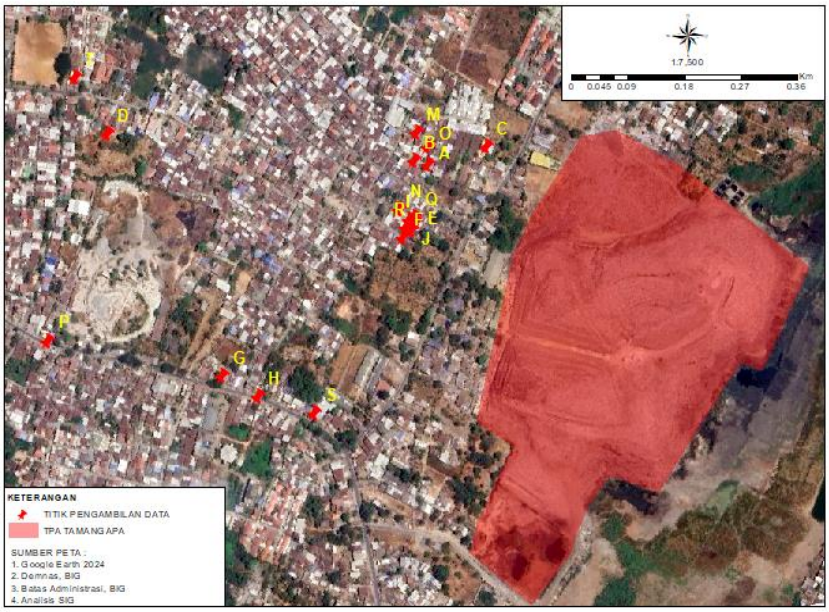

Figure 1: Location Map of Tamangapa Landfill and 20 Community Wells

The sampling method refers to SNI 6989.58.2008. Stages of well water sampling were carried out randomly around the Tamangapa landfill. In this study, the parameters tested were physical, chemical, and biological parameters, namely odor, pH, TDS (Total Dissolved Solid, NH3, Pb Metal, COD, BOD, and Total Coliform.

The analyzed data were then compared with the quality standards of water parameters for Hygiene and Sanitation Purposes of the Minister of Health Regulation Number 2 of 2023, Minister of Health Regulation Number 32 of 2017, and Minister of Environment and Forestry Regulation Number 68 of 2016.

3. RESULTS AND DISCUSSION

Groundwater quality is determined by comparing measured parameter concentrations with applicable quality standards. The following quality standard table is used.

Table 1: Quality Standard for Water Parameters for Hygiene and Sanitation Purposes (Minister of Health Regulation Number 2 of 2023).

No	Parameter	Value	Unit
1	Total Coliform	0	CFU/100 mL
2	TDS	< 300	mg/L
3	pH	6.5 – 8.5	-
4	NH_3 *	1.5	mg/L
5	Pb**	0.05	mg/L
6	COD***	100	mg/L
7	BOD***	30	mg/L

** Quality Standard for Drinking Water Special Parameters*

*** Minister of Health Regulation Number 32 Year 2017*

**** Environment and Forestry Ministerial Decree Number 68 of 2016*

Odor Parameters

Water that meets physical quality requirements is water that is odorless, colored, tasteless, not turbid, and has a water temperature below the surrounding air temperature [15]. The results of the odor characteristics test analysis using the Organoleptic method where the results showed that 6 well water samples did not meet the maximum allowable quality requirements.

Well, water in the analyzed samples is a source of water by the community around the landfill (TPA) which is used for daily life such as washing, but the surrounding community no longer uses well water for consumption this is because the water smells and if left overnight then on the surface of the water there will be a layer of oil [16].

pH Parameters

The results of the analysis of well water samples at 20 points 7 points do not meet the quality standards, namely at water points 1,3,5,6,13,14,16. The concentration of low pH values is due to the proximity of the landfill, and the possibility of leachate water entering the groundwater so that the pH of the water around the Tamangapa landfill is low.

The following are the results of pH analysis on well water samples from the community around Tamangapa Landfill.

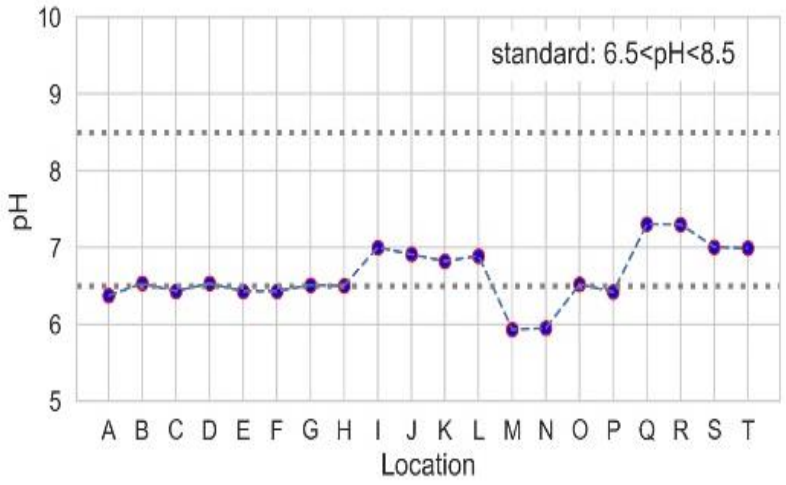

Figure 2: Results of Laboratory Test pH Value

The pH value is used as an indicator to predict water quality. Water with pH = 7 is classified as neutral. If pH <7 is classified as acidic, and if pH >7 is classified as basic [17].

The pH value which tends to be low during the day is influenced by the photosynthesis reaction in plants, namely the reaction that absorbs CO^2 and produces oxygen. This causes an increase in CO^2 concentration in groundwater. This CO^2 concentration affects the acidity level because it combines with water to form H_2CO_3 which makes the water acidic. Water bound to CO^2 will enter the well along with leachate seepage or rainwater runoff and cause the pH of the water to become lower or tend to be acidic.

TDS Parameter

Well, water samples that exceed the quality standards in the TDS parameter indicate the presence of suspended solids, mud, clay, and other organic materials that increase water turbidity (Mariadi & Kurniawan, 2020).

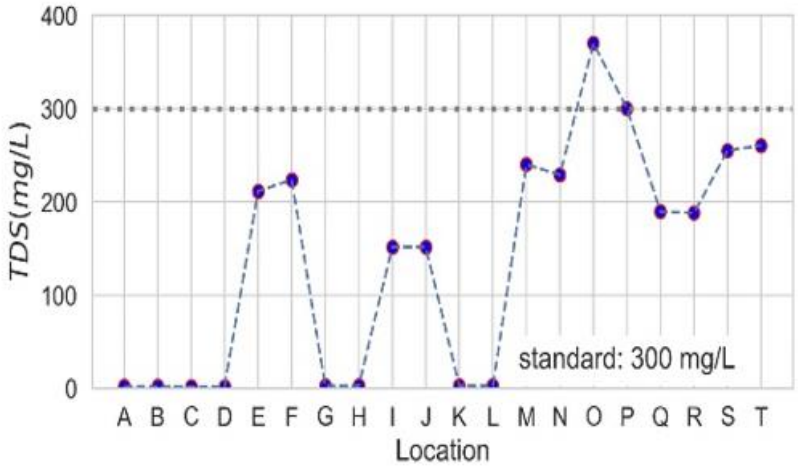

Figure 3: Results of Laboratory Test TDS Values

Total solute shows the number of solid particles contained in well water. In testing the amount of dissolved solids, the results obtained exceeded the quality standards, namely in water samples 15 and water 16. TDS is a solid dissolved in a solution in the form of both organic and inorganic substances. The cause of TDS is the presence of inorganic materials in the form of ions which are often found in water, such as household waste which contains a lot of soap and detergent [18].

NH3 Parameter

Ammonia levels in well water were analyzed using a UV-visible spectrophotometer with a wavelength of 640 nm. From the results of the study, ammonia levels in well water around Tamangapa landfill meet the quality standards of Minister of Health Regulation Number 02 Year 2023 at all 20 sample points.

The main source of ammonia is organic material resulting from the decomposition of waste by bacteria which cannot be oxidized into nitrites and nitrates so that together with rainwater the ammonia compounds will be transported and seep into shallow groundwater. During the microbiological decomposition process, these organic substances release nitrogen as ammonia (NH3) or more complicated compounds similar to ammonia (namely amines R-NH2, RR'-NH etc) [19].

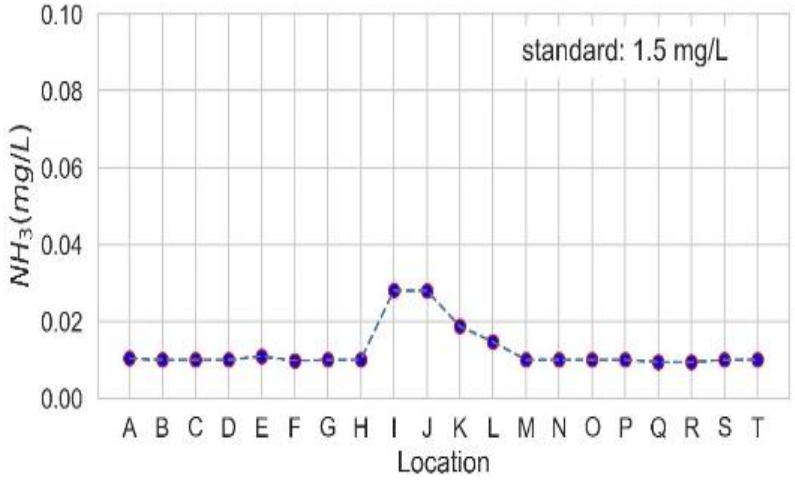

Figure 4: Results of NH3 Value of Laboratory Test

Pb Metal Parameters

One of the heavy metals in clean water and drinking water that is toxic to the human body is Pb (Lead) metal. The results showed that the results of Pb metal in the study did not exceed the maximum quality standard of metal in the Mandatory Drinking Water Parameters.

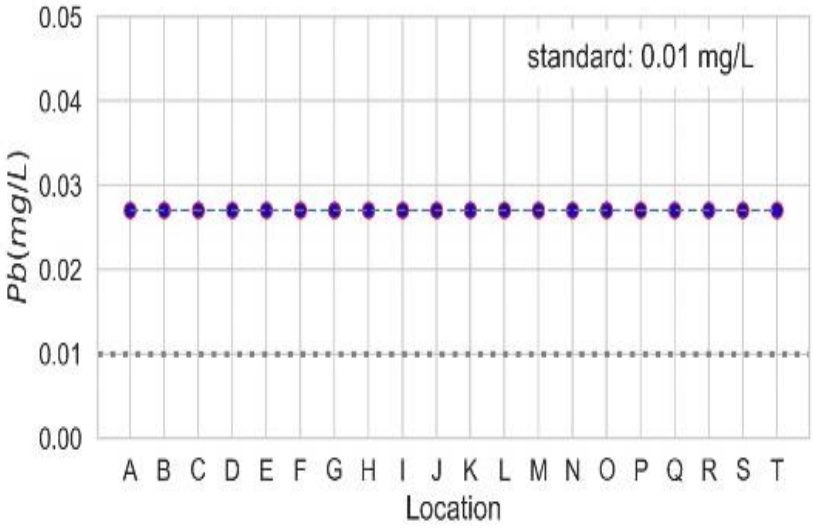

Figure 5: Results of Laboratory Test Pb Metal Values

Lead is a type of heavy metal that has the highest toxicity. This heavy metal is reported to have acute and chronic toxicity effects. Acute lead toxicity is rarely found in the wider community, but chronic toxicity is very likely to occur unnoticed as sources of lead exposure increase in the environment. One source of lead exposure can occur through water sources contaminated with leachate from waste landfills [20].

The content of heavy metals in this water is relatively very small, but this must still be watched out considering the toxicological effects on the body and its nature can accumulate in the body. Pb (Lead) metal can cause nervous system disorders, cause bleeding, carcinogens, and brain damage [21].

COD Parameter

The results of the Chemical Oxygen Demand (COD) parameter analysis at 20 sample points showed that all samples met the required quality standards. The Chemical Oxygen Demand (COD) analysis graph can be seen in the figure below.

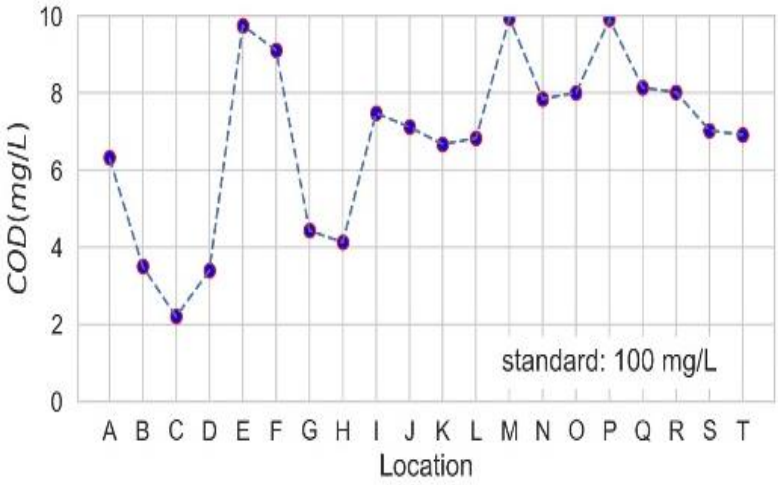

Figure 6: Results of Laboratory Test COD Values

The decomposition of organic substances is a natural event, if a body of water is polluted by organic matter, bacteria will be able to use up the dissolved oxygen in the water during the biodegradable process, which can result in the death of water biota and conditions in the water body can become anaerobic, which is characterized by the appearance of a foul odor. . If oxygen consumption is high, which is indicated by the smaller remaining dissolved oxygen, it means that the content of waste materials that require oxygen is also high. So high BOD and COD are the most important indicators of pollution to determine the strength or polluting power of waste water.

BOD Parameter

The results of the Biological Oxygen Demand (BOD) parameter analysis at 20 sample points showed that all samples met the required quality standards. The Biological Oxygen Demand (BOD) analysis graph can be seen in the figure below.

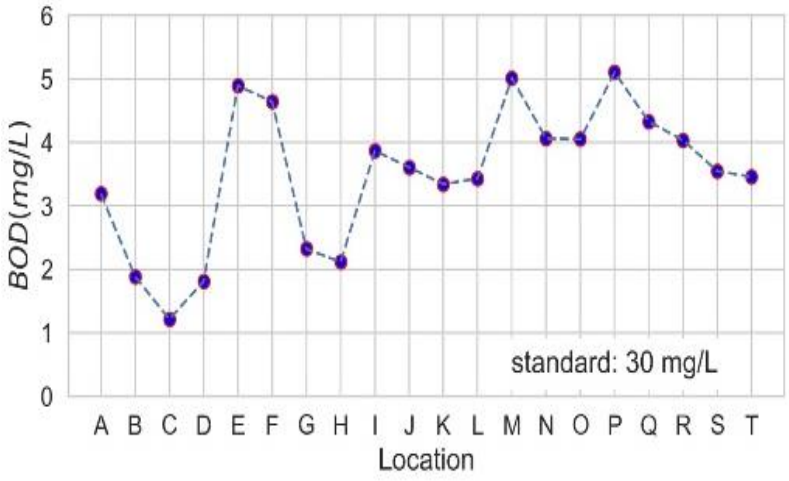

Figure 7: Results of Laboratory Test BOD Values

The higher the BOD value, the lower the water quality. This high BOD value indicates a high amount of organic material so that more oxygen is needed for the biological decomposition process. The BOD value in the sample indicates the presence of organic pollutants in the water, which is possibly caused by seepage from leachate. Biochemical Oxygen Demand (BOD) is usually used to determine wastewater pollution. Determination of BOD is very important to trace the flow of pollution from upstream levels to the estuary.

Total Coliform Parameters

The results of the Total Coliform parameter analysis at 20 sample points showed that all samples exceeded the required quality standards. This shows that the well water samples around the Tamangapa landfill have been polluted with leachate water. The graph of Total Coliform analysis can be seen in the figure below.

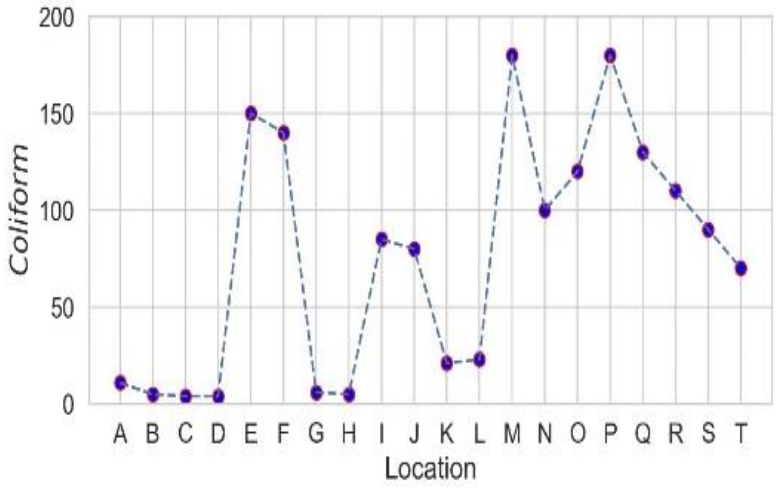

Figure 8: Results of Total Coliform Laboratory Test Values

Potential Impact on Public Health

The impact of waste generation at the Tamangapa landfill on the health of the surrounding community is quite serious. The strong odor can cause respiratory problems, shortness of breath, and lung problems. Insects such as flies and mosquitoes can also transmit various diseases such as diarrhea, dengue, cholera, and typhoid due to bacteria and viruses that come from waste [6].

However, from interviews with some residents around Tamangapa landfill, the majority of whom work as scavengers, only a small number of them are bothered by the smell of garbage and experience health problems such as diarrhea, itching, ARI, and DHF. However, despite the limited response, they show a good level of social interaction, providing each other with information about the arrival of garbage trucks, and blending in their daily lives [6].

4. CONCLUSION

In the study of physical and chemical tests of residents' well water around the Tamangapa Makassar Landfill (TPA), it can be concluded that 20 samples of well water around Tamangapa landfill that were examined for odor characteristics, 6 samples met the quality standards, 13 samples met the pH quality standards, 18 samples met the TDS quality standards, 20 samples met the NH3 quality standards,

20 samples met the Pb Metal quality standards, 20 samples met the COD quality standards, 20 samples met the BOD quality standards, and no samples met the Total Coliform quality standards.

Acknowledgments

Thanks to all those who helped in this research, especially to residents around the landfill who have given the author permission to conduct research around the Tamangapa landfill.

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