

ANALYSIS OF THE IMPACT OF LEACHATE ON THE QUALITY OF GROUNDWATER AND RIVER WATER IN PUTRI CEMPO LANDFILL IN MOJOSONGO SURAKARTA INDONESIA

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ABSTRACT

Leachate which is the result of seepage from waste contains high organic pollutants. Therefore, leachate water needs to be treated first before disposal so as not to pollute the environment. Meanwhile, the leachate from the Putri Cempo landfill (TPAS) Mojosojo is discharged into the environment without being treated first because the existing installation is no longer functional. The general objective of this research plan is to analyze the impact of leachate from the Putri Cempo Mojosojo landfill (TPAS) on the quality of groundwater and river water. The specific objectives of this study were to measure the quality content of leachate water from TPAS Putri Cempo Mojosojo, to measure groundwater quality content (observation well-water), to measure river water quality before contamination with leachate water, to measure river water quality after contamination with leachate water, and to measure ground water quality of residents at a distance of 0-75 meters TPA; 76-150 meters; 156-225 meters; 225-300 meters; 301-375 meters; and 376-450 meters.

This type of research is observational research with measurements and direct observations into the field. Water sampling is carried out by considering the criteria for pollutant sources and the distance of the pollution. The required amount of sample water is taken based on the calculation of the volume of sample requirements. The types of data used include primary and secondary data. Leachate samples were taken from the trenches along the TPAS because the leachate storage pool was not functioning. Groundwater sampling was taken from the closest observation well water to the TPAS, while river water sampling was carried out at a distance of 50 m before and 50 m after the outlet. Sample examination was carried out at the Yogyakarta Center for Environmental Health and Disease Control Engineering. The results of this study indicate that the quality of leachate exceeds the standards for parameters BOD, COD, and TSS. The quality of river water still exceeds the quality standard both before and after being contaminated with leachate water. As for the water quality of observation wells 1 and 2, the conditions are still in accordance with the standards for all parameters, but in the resident wells in each 75meters distance there are still quality parameters that exceed the standard. The parameters include turbidity, organic matter, Mn, and NO₃. From these results, the leachate should be treated before disposal so that it does not pollute the surrounding environment.

Keywords: landfill, leachate water, groundwater quality

INTRODUCTION

An increase in the number of people in an area will always be accompanied by an increase in the amount of waste. The results of the recap of weighing waste in Surakarta City from 2012 to 2016 show an increase in the weight of waste each year, namely 88,656,350 kg, 92,435,720 kg, 96,210,050 kg, 100,267,400 kg, and 109,241,310 kg (City Government of Surakarta, 2016). The existence of a landfill (TPAS) which is also a place for final processing, greatly helps the process of waste degradation. The end result of this

decomposition process is leachate. Leachate produced from TPAS must be treated first before being discharged into the environment so as not to pollute the surrounding environment.

The entry of chemical substances contained in leachate into the aquatic ecosystem can also affect the existing biota. If in the aquatic ecosystem there is pollution, it can cause the death of biota or affect physiological activities, feeding processes, cell formation and the function of an organ's cell tissue (Connel and Miller, 1983). As a final solid waste disposal, it can cause the pollution of all environmental components. The negative environmental impact of landfills can be reduced by implementing appropriate solid waste protection and management technology, with leachate and landfill collection and treatment systems (Vaverkova et al., 2018).

The leachate treatment at Putri Cempo TPAS is still very simple, which is only in the form of sedimentation tanks so that the results are not optimal. This is indicated by the physical quality of the waste at the outlet which is black in color with a total suspended solid (TSS) value of 530 mg / l; biological oxygen demand (BOD₅) of 740 mg / l; chemical oxygen demand (COD) 7000 mg / l; and pH 8.7 (Astuti and Darnoto, 2006). Davis and Cornwell (1991) also stated that leachate from TPAS with the sanitary landfill system contained TSS 200-1000 mg / l; BOD₅ 2000-30,000 mg / l; COD 3000-45,000 mg / l; and pH 5.3 - 8.3.

In addition, the results of research by Astuti et al. (2010) indicate that the content of leachate parameters that exceeds the quality standard for wastewater include: BOD (657 mg / l); COD (3159 mg / l); NO₃ (900 mg / l); NO₂ (27 mg / l); CD (0.36 mg / l); TSS (549 mg / l); TDS (15755 mg / l); pH (8.67); PO₄ (0.95 mg / l); B (1.97 mg / l); NH₄ (168 mg / l); Al (4.1 mg / l); Mn (3.1 mg / l); Cl (837 mg / l); Cl₂ (1.41 mg / l); H₂S (0.096 mg / l); detergent (0.1782 mg / l); and oils and fats (1016 mg / l). Meanwhile, from the results of the leachate toxicity test, it was found that the LC₅₀-96 hours was 10-20%, which means that with only a concentration of 10-20% leachate could kill half of the tested animals. The results indicated that there were still many chemical parameters that exceeded the quality standard, so it was possible that they would affect the groundwater content around TPAS.

From previous research, it was stated that the concentrations of heavy metals Pb, Cu, Zn, Cd and Mn in the Air Dingin Landfill area of Padang City ranged from 0.01-0.17 mg / L, 0.005-0.025 mg / L, 0.0-0.011 mg / L, 0.0-0.011 mg / L, and 0.0-0.966mg / L. Pb concentrations exceeded the quality standards of the Minister of Environment Decree No.51 of 1995 in leachate ponds, while in the water stream and monitoring wells the content of Pb metal also exceeded the quality standards of PP.RI.No.82 of 2001 and Mn metal outlets to rivers exceeded the PP RI.No.82 year 2001 quality standards. In the resident wells all heavy metals Pb, Cu, Zn, Cd and Mn were below the quality standard of PP.RI.No.82 year 2001 (Fatmawinira, 2015). The results of other studies also show that the concentration of heavy metal Iron (Fe) is the highest metal concentration found in the leachate wastewater of the Banda Aceh TPA which reaches 10.9191 ppm. Other heavy metals which are classified as essential, such as Zn, Cu, Fe, Co, and Mn were found with small concentrations (Irhamni, et al, 2017).

The content of parameters in leachate also affects groundwater quality. Based on research at the Alexandria TPA which has been operating since 2001, several parameters such as conductivity, total dissolved solids, chloride, sulfate, Mn and Fe in groundwater around the landfill increased. These results support the need for continuous monitoring of groundwater (El-salam& Abu-zuid, 2015). In addition, the results of the research on the quality of the waters of the Bengawan Solo River between Solo-Sragen and its surroundings were polluted with indications of low oxygen, high carbon dioxide, high COD, high phenol, high fatty oil. The content of heavy metals such as Cr, Cu, and Zn in the waters in several

locations has exceeded the threshold, the same is found in the heavy metal content of Cr, Cu, Pb, and Zn in broom fish (Utomo, et al, 2017) . This is possible as a result of the entry of industrial wastes into river water, including contamination from leachate water from TPAS Putri CempoMojosongo which is discharged into this river.

From these considerations, the researcher wants to do this research so that the current leachate water conditions, river water conditions, and groundwater conditions are represented by the observation wells around the TPAS Putri CempoMojosongo land.

THEORITICAL FRAMEWORK

A. Waste as a source of leachate water

Waste that has undergone decomposition will cause a foul odor to sting the nose that comes from H₂S, as well as methane which is toxic to the body (Masduki, 1986). Apart from the emergence of decomposition gases, waste also produces leachate which is formed due to seepage of rainwater in the garbage pile or the presence of high water content. This seeping water will cause a flow by carrying various substances contained in waste, so that leachate can contain nitrite, nitrate, methane, CO₂, sulfate, sulfide, water, and both pathogenic and non-pathogenic microorganisms (Masduki, 1986). Damanhuri (1993) explains that leachate is a liquid that seeps through waste and dissolves organic material in the waste.

B. Composition and Characteristics of Leachate Water

The composition and amount of materials commonly contained in leachate in sanitary landfills are as follows:

Table 2.1 General composition of materials in leachate in sanitary landfills

Composition	Value range (mg/l)
Alkalinity	1.000-10.000
pH	4,5-7,5
Total Hardness as CaCO ₃	300-10.000
BOD ₅	2.000-30.000
COD	3.000-60.000
TOC	1.500-20.000
Nitrogen : - Amonia	10-800
- Organic	10-800
- Nitrate	5-40
<i>Total Suspended Solid</i>	200-2.000
Calcium	200-3.000
Sodium	200-2.500
Sulfate	50-1.000
Chloride	200-3.000
Magnesium	50-1.500
Potassium	200-1.000
Total iron	50-1.200

Source: Tchobanoglous, et al, 1987

C. Adverse Effects of Wastewater and Leachate

Reksosoebroto (in Sugiharto, 2008), explained that wastewater that is left has an adverse effect on humans, namely: (1) Endangers human life because it can bring disease, (2) It is detrimental from an economic perspective because it can cause damage to objects or buildings, plants or livestock, (3) Damaging the ecosystem, namely killing life in the waters. Slamet (2000) states that leachate can endanger health and the environment because leachate contains pathogenic microbes, heavy metals and other types.

D. Lindi Water Causes Water Pollution

Davis and Cornwell (1991) explained that leachate from the TPAS sanitary landfill system contains: total suspended solids 200-1000 mg / l; BOD5 2000-30,000 mg / l; COD 3000-45,000 mg / l; and pH 5.3 - 8.3. Leachate in TPAS comes from the aerobic and anaerobic decomposition of waste, as well as an external source of liquid that enters it. Chen (1975) explained that initially the waste was decomposed aerobically, but after the oxygen in it was used up, it was decomposed anaerobically with the main microorganisms that worked were aerobic facultative microorganisms that produced methane gas.

The quality and quantity of leachate produced from landfill is influenced by several factors (Davis and Cornwell, 1991), namely: (1) External factors, in the form of liquids that enter the garbage pile, such as rainwater, groundwater, or surface water, (2) Factors in the landfill, including the type of waste (organic or inorganic, soluble or not) and the environmental conditions of the landfill (temperature, pH, humidity, and age of the waste), and (3) The age of the landfill. Landfill in an area where the bottom rock is porous and has a lot of cracks, it can cause groundwater contamination, because in the pile of garbage there can be a process of decay by microorganisms and when it rains the decomposing substances will be washed and dissolved into leachate. Todd (1980) explains that in areas with high enough rainfall, leachate becomes easy to form and the volume increases. Schneider (1970) explained that if the distance between the landfill and the groundwater level is closer, the faster the leachate reaches the groundwater, especially the porous and permeable properties of rocks such as limestone, sand and gravel.

E. Framework

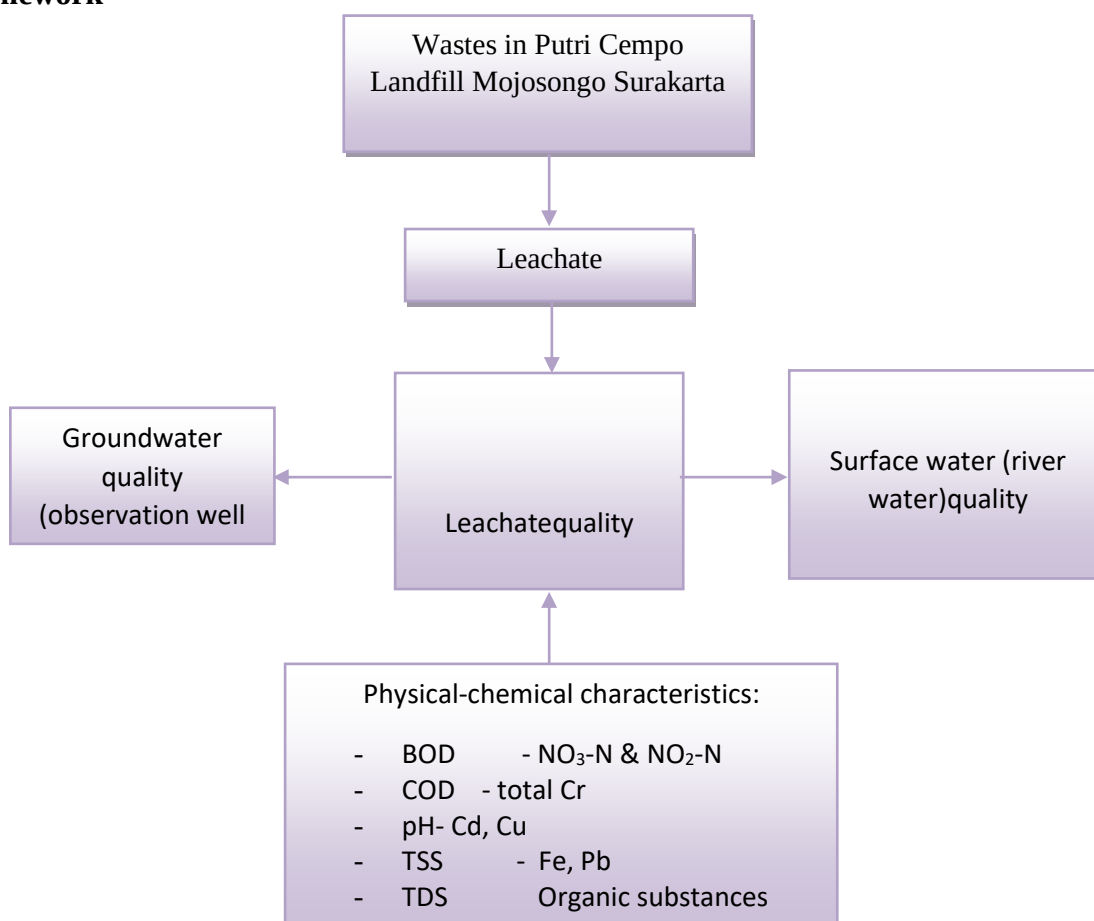


Figure 1. Framework

METHODS

A. Types and Research

The type of research used is observational research by taking direct measurements and observations in the field at one time.

B. Population and Research Sample

1. Research Population

The population in this study was leachate water from TPAS Putri Cempo Mojosoong Surakarta.

2. Research Sample

Samples in the form of leachate as much as 250 liters were taken from the outlet. The sampling method was quota sampling.

C. Concept Definition

1. Parameters Leachate is liquid that comes from infiltration of solid waste in landfills. Leachate is taken from TPAS Putri Cempo Mojosoong.

2. Groundwater quality is the quality of groundwater, in this case taken from the observation well water which is located closest to the TPAS Putri Cempo Mojosoong.

3. River water quality is the quality of river water in the area before the outlet and after the outlet which is taken at a distance of 50 m before the outlet and 50 m after the outlet.

D. Location and Time of Research

Leachate samples were collected at TPAS Putri Cempo Mojosoong Surakarta, sample examinations were carried out at the Yogyakarta Center for Environmental Health and Disease Control Engineering.

E. Research Materials and Tools

1. Material

a. Leachate from TPAS Putri Cempo Mojosoong Surakarta.

b. Groundwater (observation well water).

c. River water

d. Chemicals for inspection using the SSA method, with water parameters in Central Java Provincial Regulation Number 5 of 2012 concerning Wastewater Quality Standards.

2. Tools

a. Sample bottles

b. Atomic Absorption Spectrophotometer (AAS)

c. Ropes and weights

F. The course of research

1. Leachate, observation well water, and river water were collected by using a sample bottle with a rope and a weight.

2. The quality of leachate is checked, including the waste quality parameters required in the Central Java Provincial Regulation Number 5 of 2012 concerning Wastewater Quality Standards.

3. The quality of ground water is checked, including the parameters required in the Minister of Health Regulation No. 416 / Menkes / IX / 1990 concerning Clean Water and Drinking Water Quality Standards.

4. The quality of river water before and after the outlet is checked as required in Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control.

5. The results of the measurement of the quality parameters of leachate, groundwater, and river water are interpreted according to the appropriate quality standards.

G. Data Analysis

1. Comparing the results of the inspection of leachate water quality which includes the parameters of the quality of waste as required in the Central Java Provincial Regulation Number 5 of 2012 concerning Wastewater Quality Standards.
2. Comparing the results of groundwater quality inspection which includes the waste quality parameters as required in the Minister of Health Regulation No. 416 / Menkes / IX / 1990 concerning Clean Water and Drinking Water Quality Standards.
3. Comparing the results of river water quality checks before and after the outlet as required in Government Regulation Number 82 of 2001 concerning Water Quality Management and Water Pollution Control. Statistical analysis was performed using the one sample t test.

DISCUSSION

A. Research Results

1. Water Quality Leachate TPAS Putri Cempo Mojosoongo

The results of the examination of the quality of the TPAS Putri Cempo Mojosoongo leachate water against the 16 parameters are listed in Table 4.1.

Table 4.1 Results of Testing of Leachate Water Quality Parameters

No.	Parameter	Unit	Test result	Test method	Maximum concentration
1	pH*	-	8,0	SNI 06-6989.11-2004	6,0-9,0
2	BOD*	mg/L	4.040,0	SNI 6989.72-2009	150
3	COD*	mg/L	10.106,3	SNI 6989.2-2009	300
4	TSS	mg/L	1.020	In-house Method	100
5	TotalN	mg/L	-	In-house Method	60
6	Mercury	mg/L	-	SNI 6989.78-2011	0,005
7	Oil and fat	mg/L	-	SNI 6989.10-2011	5
8	Cadmium*	mg/L	<0,0034	SNI 06-6989.38-2005	0,1
9	NO ₃ -N*	mg/L	24,07	APHA 2012, Section 4500-n03-B	-
10	NO ₂ -N*	mg/L	<0,0004	SNI 06-6989.9-2004	-
11	Cr total*	mg/L	0,2080	SNI 6989.17-2009	-
12	TDS	mg/L	9.560	In-house Method	-
13	Iron*	mg/L	0,061	SNI 6989.4-2009	-
14	Lead (Pb)*	mg/L	<0,0161	SNI 6989.8-2009	-
15	Organic substances	mg/L	5.629,54	SNI 06-6989.22-2004	-
16	Copper (Cu)*	mg/L	0,2607	SNI 6989.6-2009	-

Based on the Regulation of the Minister of Environment and Forestry Number P.59 / Men LH / Setjend / Kum.1 / 7/2016 concerning Leachate Quality Standards for Businesses and / or Activities for Final Waste Processing Sites, it can be seen that there are 3 (three) parameters that contain exceed the standards, i.e. BOD, COD, and TSS.

2. River water quality before and after contaminated by leachate water

The following are the results of measuring the quality of river water in the parts before and after being contaminated by leachate. In the section before leachate contamination, sample water is taken at a distance of 50 meters upstream from the leachate outlet, while the sample water in the section after being contaminated with leachate is taken at a distance of 50 meters downstream from the leachate outlet.

Table 4.2 Testing Results of River Water Quality Parameters Before and After Contamination of Leachate Water

No	Parameter	Unit	Test result		Test method	Class I
			Before	After		
1	Temperature*	°C	26,0	26,0	SNI 06-6989.23-2005	Deviation 3
2	Dissolved residue (TDS)	mg/L	416	814	In House Method	1000
3	Suspended residue (TSS)	mg/L	10	74	In House Method	50
4	pH*	-	7,3	7,8	SNI 06-6989.11-2004	6-9
5	BOD*	mg/L	13,4	108,0	SNI 6989.72-2009	2
6	COD*	mg/L	60,22	354,2	SNI 6989.2-2009	10
7	DO*	mg/L	5,43	0,02	APHA 2005, Section 450-OG	6
8	Total phosphate as P	mg/L	0,682	1,908	APHA 2005, Section 4500pb.5&4500-PD	0,2
9	Nitrate (NO ₃ -N)*	mg/L	0,58	13,64	APHA 2005, Section 4500-NO3-B	10
10	Ammonia(NH ₃ -N)	mg/L	0,3083	2,1207	SNI 06-2479-1991	0,5
11	Arsenic (As)	mg/L	<0,005	<0,005	In House Method	0,05
12	Cobalt (Co)*	mg/L	<0,0093	<0,0093	SNI 6989.68-2009	0,2
13	Barium	mg/L	<0,0042	<0,0042	APHA 2005,Section 3120-B	1
14	Boron	mg/L	<0,0120	<0,0120	APHA 2005,Section 3120-B	1
15	Cadmium (Cd)*	mg/L	<0,0034	<0,0034	SNI 6989.16-2009	0,01
16	Chromium (Cr ⁶)	mg/L	<0,0014	<0,0014	APHA 2005,Section 3500-CrB	0,05
17	Copper (Cu)*	mg/L	<0,0069	<0,0069	SNI 6989.6-20049	0,02
18	Iron (Fe)*	mg/L	0,5877	0,9400	SNI 6989.4-2009	0,3
19	Lead (Pb)*	mg/L	<0,0161	<0,0161	SNI 6989.8-2009	0,03

20	Mangan (Mn)*	mg/L	0,4369	0,5247	SNI 6989.5-2009	0,1
21	Zink (Zn)*	mg/L	0,3776	0,5867	SNI 6989.7-2009	0,05
22	Cyanide (CN)	mg/L	Not detected	Not detected	In-House Method	0,02
23	Fluoride (F)	mg/L	0,7328	0,8802	SNI 06-6989.29-2005	0,5
24	Nitrite (NO ₂ -n)*	mg/L	4,4025	1,8320	SNI 06-6989.9-2004	0,06
25	Sulphate (SO ₄)	mg/L	79	6	SNI 6989.20-2009	400
26	Free chlorine	mg/L	0,20	0,20	SNI 06-1664-2005	0,03
27	Sulphur as H ₂ S	mg/L	<0,0046	0,0035	SNI 6989.70-2009	0,002
28	Detergent (MBAS)	µg/l	101,60	819,00	SNI 06-6989.51-2005	200
29	Phenolic compounds	µg/l	0,0435	<0,0215	SNI 06-6989.21-2004	1

Based on the standards of the Government of the Republic of Indonesia Number 82 of 2001 concerning Water Quality Management and Water Pollution Control, there are 5 parameters that exceed the standards at the location after being contaminated with leachate only and 10 parameters that exceed the standards at the location both before and after being contaminated with leachate water.

3. Water Quality of Observation Well 1 and Observation Well 2 at TPAS Putri CempoMojosongo

In the area of the Putri CempoMojosongo landfill, there are 2 (two) observation wells that are used to control the quality of well water from leachate contamination that enters it. The results of water quality measurements for observation wells 1 and 2 can be seen in Table 4.3.

Table 4.3 Results of Observation Well Water Quality Parameters Test

No	Parameter	Unit	Test result		Test method	Maximum concentration**)
			Observation well 1	Observation well 2		
A. Physical						
1	Smell	-	No smell	No smell	In house method	No smell
2	TDS	mg/L	258	210	In house method	1000
3	Turbidity*	NTU	1	1	SNI 06-6989.25-2005	25
4	Taste	-	Tasteless	Tasteless	In house method	Tasteless
5	Temperature*	°C	26,0	25,0	SNI 06-6989.23-2005	Temperature ± 3 °C
6	Color	TCU	<1	<1	In House Method	50
A. Chemical						
1	pH*	-	6,5	6,6	SNI 06-6989.11-2004	6,5-8,5
2	Iron (Fe)*	mg/L	<0,0162	<0,0162	SNI 6989.4-2009	1
3	Fluoride (F)	mg/L	0,0524	0,1403	SNI 06-6989.29-2005	1,5
4	Hardness as CaCO ₃ *	mg/L	223,76	138,61	SNI 06-6989.12-2004	500
5	Mangan (Mn)*	mg/L	<0,0101	<0,0101	SNI 6989.5-2009	0,5

6	Nitrate (NO ₃ -N)*	mg/L	2,39	3,81	APHA 2005,Section 4500-NO3B	10
7	Nitrite (NO ₂ - N)*	mg/L	0,0020	0,0023	SNI 06-6989.9-2004	1
8	Cyanide (CN)	mg/L	Not detected	Not detected	In-house method	0,1
9	Detergent	mg/L	0,0405	<0,0002	SNI 06-6989.51-2005	0,05
10	Total pesticide	mg/L	-	-	In House Method	0,1
11	Mercury (Hg)	mg/L	-	-	SNI 6989.78-2011	0,001
12	Arsenic (As)	mg/L	<0,005	<0,005	In House Method	0,05
13	Cadmium (Cd)*	mg/L	<0,0004	<0,0004	SNI 06-6989.38-2005	0,005
14	Chromium (Cr ⁺⁶)	mg/L	<0,0014	<0,0014	APHA 2012, 3500-CrB	0,05
15	Selenium (Se)	mg/L	-	-	APHA 2012,Section 3120-B	0,01
16	Zink (Zn)*	mg/L	0,0087	<0,0083	SNI 6989.7-2009	15
17	Sulphate (SO ₄)*	mg/L	15	22	SNI 6989.20-2009	400
18	Lead (Pb)*	mg/L	<0,0008	<0,0008	SNI 6989.46-2005	0,05
19	Benzene	mg/L	-	-	In House Method	0,01
20	Organic compounds (KMNO ₄)	mg/L	0,31	0,94	SNI 06-6989.22-2004	10

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, the measurement results indicated that all measured parameters still met the standards.

- Well water quality for residents with a distance of 0-75 meters from the landfill
Well water samples from residents who live at a distance of 0 to 75 meters from the landfill were taken from 4 (four) points at a distance of 46 meters, 50 meters, 61 meters, and 75 meters. The results of the measurement of the water quality parameters for the resident's wells can be seen in Table 4.4.

Table 4.4 Test Results for Population Well Water Quality Parameters with Distance Range of 0-75 Meters from the TPA

No.	Parameter	Unit	Test result				Test method
			46 m	50 m	61 m	75 m	
1	Turbidity*	NTU	1	29	1	2	SNI 06-0989.25-2005
2	Color	TCU	<1	24	<1	6	APHA 2012,Section 2120-C
3	TDS	mg/L	409	109	306	357	In-house Method
4	Nitrate*	mg/L	7,54	2,51	10,76	7,73	APHA 2012,Section 4500-NO ₃ -B
5	Organic compound	mg/L	1,58	66,36	0,63	53,72	SNI 06-6989.22-2004
6	Arsenic	mg/L	0,005	0,0005	-	0,005	APHA 2012,Section

							3500-As
7	Cd*	mg/L	<0,0004	<0,0004	-	<0,0004	SNI 6989.16-2009
8	Cr*	mg/L	<0,0213	<0,0213	-	<0,0213	SNI 6989.17-2009
9	Pb*	mg/L	<0,0008	<0,0008	-	<0,0008	SNI 6989.8-2009
10	Fe*	mg/L	-	0,1393	-	0,1989	SNI 6989.4-2009
11	Mangan*	mg/L	-	4,9752	-	21,5390	SNI 6989.5-2009
12	Hardness*	mg/L	-	428,00	-	494,00	SNI 06-6989.12-2004

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, from the measurement results of 4 (four) wells examined, there are 3 (three) wells with 6 (six) parameters whose content exceeds the standard.

- Well water quality for residents with a distance of 76-150 meters from the landfill
Sampling of community well water quality at a distance of 76 to 150 meters from the landfill, taken at a distance of 86 meters, 105 meters, 117 meters, and 118 meters. The results of measuring these quality parameters can be seen in Table 4.5.

Table 4.5 Results of Testing for Population Well Water Quality Parameters with a Distance of 76-150 Meters from the TPA

No	Parameter	Unit	Test result				Test method
			86 m	105 m	117 m	118 m	
1	Turbidity*	NTU	1	1	10	1	SNI 06-0989.25-2005
2	Color	TCU	<1	<1	4	<1	APHA 2012,Section 2120-C
3	TDS	mg/L	349	388	287	414	In House Method
4	Nitrate*	mg/L	16,04	33,72	15,94	9,65	APHA 2012,Section 4500-NO ₃ -B
5	Organic compound	mg/L	1,58	1,58	9,48	1,58	SNI 06-6989.22-2004
6	Arsenic	mg/L	0,005	0,005	0,005	-	APHA 2012,Section 3500-As
7	Cd*	mg/L	<0,0004	<0,0004	<0,0004	-	SNI 6989.16-2009
8	Cr*	mg/L	<0,0213	<0,0213	<0,0213	-	SNI 6989.17-2009
9	Pb*	mg/L	<0,0008	<0,0008	<0,0008	-	SNI 6989.8-2009
10	Fe*	mg/L	-	-	0,0488	-	SNI 6989.4-2009
11	Mangan*	mg/L	-	-	0,1316	-	SNI 6989.5-2009
12	Hardness*	mg/L	-	-	222,00	-	SNI 06-6989.12-2004

From the results of these measurements, there are 3 (three) wells with nitrate content that still exceeds the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pool, Solus per Aqua, and Public Baths.

6. Well water quality for residents with a distance of 151-225 meters from the landfill
Sampling for a distance of 151 to 225 meters from the landfill was taken at distances of 152, 155, 155 and 216 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.6.

Table 4.6 Test Results of Population Well Water Quality Parameters with a Distance of 151-225 Meters from the Landfill

No.	Parameter	Unit	Test result				Test method
			152 m	155 m	155 m	216 m	
1	Turbidity *	NTU	1	1	2	9	SNI 06-0989.25-2005
2	Color	TCU	<1	<1	<1	<1	APHA 2012,Section 2120-C
3	TDS	mg/L	331	591	383	416	In House Method
4	Nitrate *	mg/L	35,36	3,74	7,12	61,77	APHA 2012,Section 4500-NO ₃ -B
5	Organic compound	mg/L	3,79	11,69	2,21	7,27	SNI 06-6989.22-2004
6	Arsenic	mg/L	0,005	0,005	-	0,005	APHA 2012,Section3500-As
7	Cd *	mg/L	<0,0004	<0,0004	-	<0,0004	SNI 6989.16-2009
8	Cr *	mg/L	<0,0213	<0,0213	-	<0,0213	SNI 6989.17-2009
9	Pb *	mg/L	<0,0008	<0,0008	-	<0,0008	SNI 6989.8-2009
10	Fe *	mg/L	-	-	-	-	SNI 6989.4-2009
11	Mangan *	mg/L	-	-	-	-	SNI 6989.5-2009
12	Hardness*	mg/L	-	-	-	-	SNI 06-6989.12-2004

From the results of these measurements, there were 3 (three) wells with nitrate and organic substances that exceeded the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene Needs, Sanitation, Swimming Pools, and Solus per Aqua, and Public Baths.

7. Well water quality for residents with a distance of 226-300 meters from the landfill
Sampling for a distance of 226 to 300 meters from the landfill was taken at distances of 228, 232, 234, and 280 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.7.

Table 4.7 Test Results of Population Well Water Quality Parameters with a Distance of 226-300 Meters from the Landfill

No	Parameter	Unit	Test result				Test method
			228 m	232 m	234 m	280 m	
1	Turbidity *	NTU	1	1	1	<1	SNI 06-0989.25-2005
2	Color	TCU	<1	<1	<1	<1	APHA 2012,Section 2120-C
3	TDS	mg/L	414	402	562	466	In House Method

4	Nitrate *	mg/L	11,38	11,95	32,92	25,08	APHA 2012,Section 4500-NO ₃ -B
5	Organic compound	mg/L	1,90	0,95	1,26	2,21	SNI 06-6989.22-2004
6	Arsenic	mg/L	-	<0,005	<0,005	<0,005	APHA 2012,Section 3500-As
7	Cd *	mg/L	-	<0,0004	<0,0004	<0,0004	SNI 6989.16-2009
8	Cr *	mg/L	-	<0,0213	<0,0213	<0,0213	SNI 6989.17-2009
9	Pb *	mg/L	-	<0,0008	<0,0008	<0,0008	SNI 6989.8-2009
10	Fe *	mg/L	-	-	-	-	SNI 6989.4-2009
11	Mangan *	mg/L	-	-	-	-	SNI 6989.5-2009
12	Hardness*	mg/L	-	-	-	-	SNI 06-6989.12-2004

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, from the measurement results of 4 (four) wells with nitrate content that is still exceeded standards.

8. Well water quality for residents with a distance of 301-375 meters from the landfill Sampling at a distance of 301 to 375 meters from the landfill was taken at distances of 336, 336, 366, and 368 meters. The results of measuring of the water quality parameters for the resident's wells can be seen in Table 4.8.

Table 4.8 Test Results of Population Well Water Quality Parameters with a Distance of 301-375 Meters from the Landfill

No	Parameter	Unit	Test result				Test method
			336 m	336 m	366 m	368 m	
1	Turbidity *	NTU	1	1	1	<1	SNI 06-0989.25-2005
2	Color	TCU	<1	<1	<1	<1	APHA 2012,Section 2120-C
3	TDS	mg/L	612	417	482	445	In House Method
4	Nitrate *	mg/L	81,66	21,68	35,11	18,58	APHA 2012,Section 4500-NO ₃ -B
5	Organic compound	mg/L	2,84	3,16	3,48	2,53	SNI 06-6989.22-2004
6	Arsenic	mg/L	<0,005	-	<0,005	<0,0005	APHA 2012,Section 3500-As
7	Cd *	mg/L	<0,0004	-	<0,0004	<0,0004	SNI 6989.16-2009
8	Cr *	mg/L	<0,0213	-	<0,0213	<0,0213	SNI 6989.17-2009
9	Pb *	mg/L	<0,0008	-	-	<0,0008	SNI 6989.8-2009
10	Fe *	mg/L	-	-	-	-	SNI 6989.4-2009

11	Mangan *	mg/L	-	-	-	-	SNI 6989.5-2009
12	Hardness *	mg/L	-	-	-	-	SNI 06-6989.12-2004

9. Well water quality for residents with a distance of 3376-4505 meters from the landfill Sampling at a distance of 376 to 450 meters from the landfill was taken at distances of 402, 407, 407, and 436 meters. The results of measuring of the water quality parameters for the resident's wells can be seen in Table 4.9.

Table 4.9 Test Results of Population Well Water Quality Parameters with a Distance of 376-450 Meters from the Landfill

No	Parameter	Unit	Test result				Test Method
			402 m	407 m	407 m	436 m	
1	Turbidity *	NTU	2	2	1	1	SNI 06-0989.25-2005
2	Color	TCU	<1	<1	<1	<1	APHA 2012, Section 2120-C
3	TDS	mg/L	392	404	231	231	In House Method
4	Nitrate *	mg/L	12,04	48,76	60,51	9,20	APHA 2012, Section 4500-NO ₃ -B
5	Organic compound	mg/L	2,53	2,21	1,90	1,26	SNI 06-6989.22-2004
6	Arsenic	mg/L	<0,0005	<0,0005	-	<0,0005	APHA 2012, Section 3500-As
7	Cd *	mg/L	<0,0004	<0,0004	-	<0,0004	SNI 6989.16-2009
8	Cr *	mg/L	<0,0213	<0,0213	-	<0,0213	SNI 6989.17-2009
9	Pb *	mg/L	<0,0008	<0,0008	-	<0,0008	SNI 6989.8-2009
10	Fe *	mg/L	-	-	-	-	SNI 6989.4-2009
11	Mangan *	mg/L	-	-	-	-	SNI 6989.5-2009
12	Hardness *	mg/L	-	-	-	-	SNI 06-6989.12-2004

From Table 4.9, there are 4 (wells) wells with nitrate content that still exceeds the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pools, Solus per Aqua Needs, and Public Baths.

1. Quality of Leachate TPAS Putri Cempo Mojosoongo

From Table 4.1 it is known that the test results for the parameters BOD, COD, and TSS exceed the standards of the Minister of Environment Regulation No. P.59 / Men LHK / Setjen / Kum.1 / 7/2016 concerning Leachate Quality Standards for Business and / or Activities of Waste Final Processing Sites, it can be seen that there are 3 (three) parameters whose contents exceed the standard. The three parameters are BOD, COD, and TSS.

The conditions of leachate quality that were measured in all parameters, it was known that the three main parameters of wastewater in the form of BOD, COD, and TSS exceeded the set standards. The high level of BOD in leachate was 4,040 mg / l exceeding the maximum allowable level (150 mg / l). The high BOD content indicates that the pollutant content in the form of organic matter in leachate is high and requires a lot of dissolved oxygen to decompose these organic substances into simpler substances. This can cause the environmental conditions around the landfill

to be polluted if the leachate treatment is not carried out before it is discharged into the environment. Leachate needs to be treated in order to reduce BOD and the mixed particles in it. In addition, additional processing is also needed to remove nutrients, toxic components, and non-degradable materials so that the concentration is low. Therefore, it is necessary to process in stages so that these materials can be reduced. In sewage treatment, the BOD parameter is the main parameter of wastewater so that if waste water treatment has been carried out, the BOD level will decrease and it is hoped that the levels of other wastewater parameters will also decrease.

The COD level in leachate was 10,106.3 mg / l exceeding the allowed standard (300 mg / l). The high levels of COD are in line with the high levels of BOD, which means that the need for oxygen to oxidize pollutants and oxygen needed to degrade leachate is very high due to the very high content of pollutants in leachate. The TSS level of leachate water was 1,020 mg / l and exceeded the permissible standard of 100 mg / l. The process of reducing BOD, COD, and TSS parameters in leachate can be done using aerobic coagulation and biofilter models (Susanto, et al, 2004).

2. River Water Quality Before and After Contaminated Leachate Water

The following are the results of measuring the quality of river water in the parts before and after being contaminated by leachate. In the section before leachate contamination, sample water is taken at a distance of 50 meters before the leachate outlet to the river body, while the sample water in the section after being contaminated with leachate is taken at a distance of 50 meters after the leachate outlet to the river. Based on the standards of Government Regulation of the Republic of Indonesia Number 82 of 2001 concerning Management of Water Quality and Control of Water Pollution, there are 5 parameters that exceed the standards only at the location after being contaminated with leachate water and there are 10 parameters that exceed the standards at the location both before and after being contaminated with leachate water.

3. Water Quality Observation Well 1 and Observation Well 2 at TPAS Putri CempoMojosongo

In the area of the Putri CempoMojosongo Garbage Final Disposal Site, there are 2 (two) observation wells that are used to control the quality of well water from leachate contamination that enters it. The results of water quality measurements for observation wells 1 and 2 can be seen in Table 4.3.

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, the measurement results indicate that all measured parameters still meet the standards.

4. Well water quality for residents with a distance of 0-75 meters from the TPA

Residential well water samples taken at a distance of 0 to 75 meters from the landfill are those located at a distance of 46, 50, 61, and 75 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.4.

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, from the measurement results of 4 (four) wells that were

examined there were 3 (three) wells with 6 (six) parameters whose content exceeds the standard.

5. Well water quality for residents with a distance of 76-150 meters from the TPA

Well water samples with a distance of 76 to 150 meters from the landfill, were taken at a distance of 86 meters, 105 meters, 117 meters, and 118 meters. The results of measurements of the water quality parameters of the resident's wells can be seen in Table 4.5. From the results of these measurements, there are 3 (three) wells with nitrate content exceeding the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pools, Solus per Aqua Needs, and Public Baths.

6. Well water quality for residents with a distance of 151-225 meters from the TPA

Sampling ranges from 151 to 225 meters from the landfill, taken at distances of 152, 155, 155, and 216 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.6.

From the results of these measurements, there are 3 (three) wells with nitrate and organic substances that exceed the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene Needs, Sanitation, Swimming Pool, and Solus. per Aqua, and Public Baths.

7. Well water quality for residents with a distance of 226-300 meters from the TPA

Sampling with a distance of 226 to 300 meters from the landfill, taken at a distance of 228, 232, 234, and 280 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.7

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Needs, Swimming Pools, Solus per Aqua, and Public Baths, from the measurement results of 4 (four) wells with nitrate content that is still exceeded standards.

8. Well water quality for residents with a distance of 301-375 meters from the TPA

Sampling ranges from 301 to 375 meters from the landfill, taken at distances of 336, 336, 366, and 368 meters. The results of the measurement of the water quality parameters for the resident's wells can be seen in Table 4.8

From the results of these measurements, there are 4 (wells) wells with nitrate content that still exceeds the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pools, Solus per Aqua Needs, and Public Baths.

9. Well water quality for residents with a distance of 376-450 meters from the TPA

Samples with a distance of 376 to 450 meters from the landfill, were taken at a distance of 402 meters, 407 meters, 407 meters, and 436 meters. The results of measuring the water quality parameters of the resident's wells can be seen in Table 4.9.

From Table 4.9, there are 4 (wells) wells with nitrate content that still exceeds the standards stipulated in the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pools, Solus per Aqua Needs, and Public Baths.

The presence of leachate in the environment can not only pollute the waters but also pollute the soil. This condition will continue and even the number of pollutants will increase if the amount of garbage piled up increases. Meanwhile, the increasing amount of waste is in line with the increasing population. Therefore, it is necessary to make efforts to tackle waste from its source with the 3R program (Reduce, Reuse, and Recycle). Reduce is an effort to reduce or reduce the waste that will be formed, for example by bringing your own basket when shopping, using a handkerchief as a substitute for tissue so that waste can be reduced. Reuse is a program to reuse waste that has been formed such as the use of plastic materials or used paper for souvenirs, used tires for pots or garden chairs, refilled empty drink bottles, and others. Recycle is somewhat different from the previous two programs, in this case the waste before it is used needs to be recycled first. Materials that will be recycled such as used paper or plastic, broken glass or glass, iron or glass metal and organic waste from the kitchen or market can be recycled into compost (fertilizer). This recycling process can convert waste into heat energy.

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