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Study of the chemical characteristics of leachate at several landfill stations in Palangka Raya

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Abstract

This study aims to examine the chemical characteristics of leachate at several landfill stations in Palangka Raya. The research was carried out at the lanfill in Palangka Raya City and at the Laboratory of the Banjarbaru Research and Industrial Standardization Center, in April 2021. The method used was purposive sampling method for leachate sampling. The leachate samples were grouped into four stations categories (L), there is, L1, sample sourced from active waste landfill leachate (age <5 years); L2, sample sourced from passive landfill leachate (aged 5 - 10 years); L3, the sample is sourced from leachate in the inlet pond of the Leachate Water Treatment Plant (LWTP); L4, the sample is sourced from leachate from the LWTP outlet pond. The research data were statistically analyzed comparatively from each station. Parameters observed were pH, DHL, Total Dissolved Solid (TDS), Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), NH3-N, Fel, Hg, Pb, and Cd. The results showed that the water leachate from lanfill in Palangka Raya City has chemical properties with content below the quality standard, namely the Pb value of 0.001-0.066 mg/L and Cd of 0.003 – 0.016 mg/, the value of Biochemical Oxygen Demand (BOD) in leachate in the inlet and outlet ponds of LWTP with a value of 105-144 mg/L. Total Dissolved Solid (TDS) in leachate in inlet ponds, LWTP outlets, and in passive landfill leachate (aged 5 - 10 years) with a value of 839-1,994 mg/L. Total Fe is 1.446 – 2.980 mg/L, Hg is 2.299-2.711 mg/L, Chemical Oxygen Demand (COD) is 347.45 – 4.290.2 mg/L and Total Ammonia (NH3-T) is 88.250-665.00 mg/L is above the quality standard. The pH value of the leachate is quite high and meets the quality standard (6-9), which ranges from 6.07 to 8.31.

Keywords: Landfill; Waste; LWTP; Water leachate

1. Introduction

The increase in the population of Palangka Raya City will affect the amount of waste generated from population activities. The waste generation of Palangka Raya City that enters the TPA is 746 m3 or 261 tons per day which will cause leachate. Therefore, integrated waste management is needed from upstream to downstream. The main problem of waste generation currently occurs downstream from waste management, namely at the final waste processing site (TPA) [1]. Piles of garbage in the landfill will produce leachate which has the potential to pollute the surrounding environment [2]. The Palangka Raya City TPA was built using a control landfill pattern, but its use pattern is still open dumping. This will affect the characteristics of the leachate, due to the entry of external water into the landfill which dissolves and rinses out dissolved substances [3].

The quantity and quality of leachate from landfills fluctuates because it depends on rainfall, the character and duration of waste in the landfill [4] and the pattern of use of the landfill [5].

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The composition of the leachate is influenced by several factors such as the type of waste deposited, the amount of rainfall in the landfill area and the specific conditions of the disposal site [6]. In line with the research results of [7] that the characteristics of leachate depend on the processes that occur in landfills at each landfill. Meanwhile, [8] stated that the age of the landfill will affect the characteristics of the landfill leachate.

According to [9] and [10] leachate has a high content of organic and inorganic materials which are characterized by BOD, COD, pH, NH3, Sulfate, TDS, DHL, Fe [11] and microorganisms [12]. In addition, [13] stated that TPA leachate also contains heavy metals. Furthermore, [14] that leachate from landfill has the potential to contain several heavy metals such as Hg, Cd, Pb, Cu, Cr, and Zn originating from human activities (anthropogenic) [15]. This study aims to examine the chemical characteristics of leachate at several stations in the landfill in Palangka Raya.

2. Research Methods

2.1. Time and Place of Implementation Research

The research was carried out in April 2021, during the rainy season, located at the final waste processing site in Bukit Tunggal Village, Jekan Raya District, Palang Raya City.

2.2. Materials and Tools

The materials used in this study were leachate from the Palangka Raya City landfill, ice cubes and a number of chemicals in the laboratory for analysis of leachate nutrients. While the tools used in this research are GPS, hoe, shovel, sample bottle, sample storage box, pH meter, Eh meter conductivity, camera, 20 l jerigan, 2 L jerigan, 10 L bucket, scoop, thermometer, funnel, filter tool, and camera.

2.3. Implementation Method

This research is a quantitative descriptive study, using the purposive sampling method. Sampling was carried out in two stages, namely the first stage of determining the leachate source (station) and the second stage of determining the sampling point at each station. The leachate samples were taken from the TPA area in Palangka Raya City. Grouping of leachate samples into 4 (four) stations, namely L1 (station 1), samples sourced from active waste landfill leachate (age <5 years); L2 (station 2), samples sourced from passive waste-backfill leachate (aged 5 - 10 years); L3 (station 3), samples sourced from leachate in the inlet pond of the Leachate Water Treatment Plant (IPAL); L4 (station 4), the sample is sourced from leachate from the WWTP outlet pond. The station where the leachate sample is taken is shown in Figure 1.

Figure 1 Palangka Raya City Waste Land Leachate Assessment Station

Taking of leachate was carried out in sunny weather with a temperature of 32.10C. Leachate samples were taken using a long-handled dipper from the leachate flow at station 1 (L1) and station 2 (L2). Meanwhile, samples of leachate from station 3 (L3) and station 4 (L4) were carried out using a bucket from the WWTP pond. The leachate samples taken at each station were composited into 10 L volume buckets. Furthermore, the leachate samples to be tested in the laboratory were filtered and put into 2 L volume bottles and labeled according to the landfill station. All leachate samples were put into a sample box filled with ice and brought to the laboratory of the Research and Industrial Standardization Center (Baristand) Banjarbaru.

2.4. Observation Variable

The variables observed in this study were the chemical characteristics of the leachate consisting of pH, electrical conductivity (DHL), Total Dissolved Solids (TDS), Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Ammonia (NH3-N), Total Iron (Fe), Mercury (Hg), Lead (Pb), Cadmium (Cd).

2.5. Data analysis

The leachate measurement data were statistically analyzed using comparative analysis from each station. Observational data obtained were tabulated and presented in graphical form.

3. Results and discussion

The leachate quality test was carried out in situ and ex-situ at each station. In situ test (field test), namely pH, DHL, Total Dissolved Solid (TDS) Biochemical Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Ammonia (NH3-T), Total Iron (Fe), Mercury (Hg), Lead (Pb), and Cadmium (Cd). The results of the parameter test for the Leachate TPA of Palangka Raya City Garbage at the observation station are presented in Table 1.

Table 1 The results of the chemical characteristics of the TPA leachate in Palangka Raya

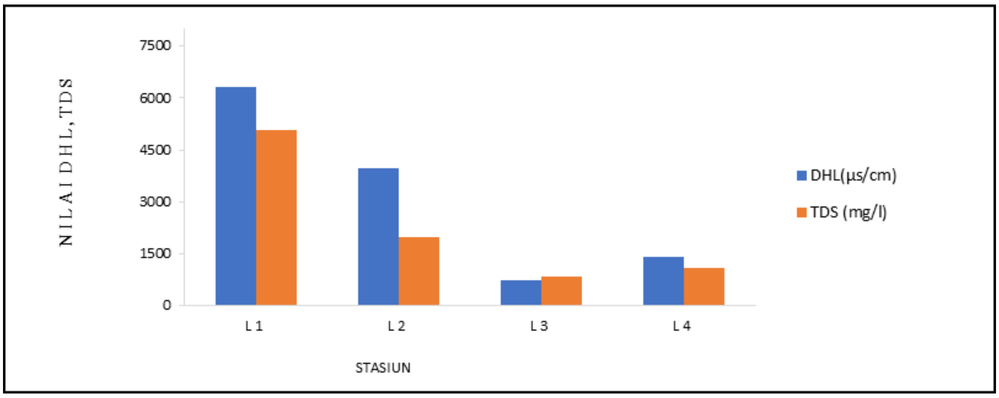
Parameter	Unit	Test Result Unit (Station)				Leachate Water Quality Standard
		L1	L2	L3	L4	
pH	-	6.07	8.31	7.45	7.73	6-9*
DHL	µs/cm	6308	3986	755	1418	-
TDS	mg/L	5.092	1.994	839	1.108	2000**
BOD	mg/L	1.650	312	144	105	150*
COD	mg/L	4.290.2	1.075.80	375.66	347.45	300*
NH3-N	mg/L	665.00	438.00	56.00	88.25	10**
Fe-Total	mg/L	2.980	2.084	1.464	1.523	5,0**
Hg	µg/L	2.711	2.666	2.573	2.299	0,005*
Pb	mg/L	0.066	0.023	<0.001	<0.001	0,1**
Cd	mg/L	0.016	0.011	<0.003	<0.003	0,1*

Description: * = Permen LH P.59/2016 regarding leachate quality standards; ** = Permen LH No. 5/2014 concerning waste quality standards that have not been determined; L1 (station 1), which is a sample of active waste backfill leachate (age <5 years); L2 (station 2), samples of passive waste backfill leachate (aged 5 - 10 years); L3 (station 3), samples of leachate from the inlet pond of the Leachate Water Treatment Plant (WWTP); L4 (station 4), sample of leachate from IPA outlet pond

Based on Table 1 shows that the content of heavy metals Lead (Pb) and Cadmium (Cd) in leachate from the area where the final waste processing is located in Palangka Raya City is below the quality standard with values ranging from 0.001-0.066 mg/L and 0.003 – 0.016 mg/L. Total Fe and Hg were above the quality standard with values ranging from 1,446 – 2,980 mg/L and 2.299-2,711 mg/L, respectively. The content of Chemical Oxygen Demand (COD) and Total Ammonia (NH3-T) is above the quality standard with values ranging from 347.45 to 4,290,2 mg/L and 88.250-665.00 mg/L, respectively. The pH value of leachate is high enough to meet the quality standard (6-9), which ranges from 6.07 to 8.31. The content of Biochemical Oxygen Demand (BOD) is below the quality standard only for leachate in the inlet and outlet ponds of WWTP with a value of 105-144 mg/L, while Total Dissolved Solid (TDS) is below the quality standard for leachate in the inlet and outlet ponds. WWTP, as well as in passive backfill leachate (aged 5 - 10 years) with a value of 839-1,994 mg/L. As a result, the overall chemical properties of leachate in several waste final processing sites in Palangka Raya City are still above the quality standard, which means the condition of leachate is very dangerous and can pollute the environment if not managed, so it needs to be managed properly.

3.1. Electrical Conductivity (DHL) and Total Dissolved Solid (TDS)

Electrical conductivity (DHL) is a numerical description of the ability of water to continue the flow of electricity, it can be used to quickly detect the distribution of leachate in the environment around the landfill [3]. The DHL leachate measurement aims to describe the conductivity value of the leachate at the Palangka Raya TPA at several observation stations. The distribution of DHL and TDS leachate from landfill in Palangka Raya is presented in Figure 2.



Notes: L1 (station 1), which is a sample of active waste backfill leachate (age <5 years); L2 (station 2), samples of passive waste backfill leachate (aged 5 - 10 years); L3 (station 3), samples of leachate from the inlet pond of the Leachate Water Treatment Plant (WWTP); L4 (station 4), sample of leachate from the WWTP outlet pond

Figure 2 Distribution of DHL and TDS leachate from landfill in Palangka Raya

Figure 2 illustrates that the value of DHL electricity at the Palangka Raya TPA location ranges from 755 S/cm-1 to 6308 S/cm-1. The amount of leachate at the Palangka Raya TPA location indicates that the leachate at each station has a fairly large difference in the DHL value range. The DHL value for electricity at station 1 is 6308 S/cm-1, which is the highest DHL value from all observation stations, while the DHL value for leachate electricity at station 2 is 3986 S/cm-1 or there is a decrease in the value of DHL by 37% from station 1 (active backfill). Stations 3 and 4, which are the inlet and outlet ponds of WWTP, the leachate DHL values are 755 S/cm-1 and 1418 S/cm-1, respectively, or a decrease of 88% and 78% from station 1. The high DHL value at station 1. 1 is suspected to be caused by leachate originating from active waste that produces easily decomposed organic matter such as protein, carbohydrates, generally from food waste and agricultural by-products. This organic material is decomposed into simpler organic materials and inorganic materials such as salts that dissolve in leachate and increase the value of DHL [16]. In line with [5] leachate is water formed from the decomposition process of waste from the landfill cell, so it has a higher content of ions and cations. Station 2 the DHL value decreased presumably because the leachate from passive backfill (5-10 years) dissolved salts in the leachate decreased with the increase in waste decomposition time in the backfill. According to [17], the dissolved inorganic salts in waste such as carbonates and phosphates cause an increase in conductivity. In line with [6] the value of DHL is determined by the type, amount, and mobility of ions, in total. That is, the DHL value is related to the concentration and type of dissolved ion, not the dissolved solid. The high value of DHL usually indicates the level of pollution in the environment. indicated that it contains a lot of dissolved acids, bases, and salts so that they split into anions and cations which increase the value of DHL [7]. An increase in DHL will be followed by an increase in TDS and vice versa

The TDS value at the Palangka Raya TPA location ranged from 839 mg L-1 to 5092 mg L-1. The magnitude of the leachate TDS value at the Palangka Raya TPA location indicates that the leachate at each station has a fairly large difference. The TDS value at station 1 is 5092 mg L-1, which is the highest TDS value from all observation stations, while the TDS value of leachate at station 2 is 1994 mg L-1 or there is a decrease in TDS value by 61% from station 1 (active backfill) . Stations 3 and 4, which are the inlet and outlet ponds of WWTP, the leachate TDS values are 839 mg L-1 and 1108 mg L-1, respectively, or there is a decrease of 84% and 80%, respectively, from station 1.

The high value of TDS station 1 is suspected to be active waste landfill producing organic and inorganic compounds as well as ions in the leachate. While the TDS value at station 2 is lower, it is suspected that the organic material in passive backfill has been decomposed for a long time. and [2] stated that the high level of TDS in waste leachate was due to the accumulation of decomposition of organic and inorganic waste that was piled up in the landfill every day. The longer the age of the landfill, the lower the TDS in the waste leachate at the TPA [18]. In accordance with the statement of [19], TDS is caused by inorganic materials in the form of ions, among others; Sodium, Calcium, Magnesium, Bicarbonate, Sulfate, Chloride, Iron, Potassium, Carbonate, Nitrate, Fluoride, Strontium, Boron and Silica [20]. [21] stated that DHL and TDS are directly proportional to landfill leachate. The DHL value can be estimated by multiplying the TDS value by a constant number 0.55-0.75.

3.2. Degree of acidity (pH), Iron (Fe) and Mercury (Hg)

The pH value is a very important factor in organic waste decomposition. The value of the degree of acidity (pH) of the leachate in several locations of the Palangka Raya Waste Landfill is presented in Figure 3.

The solubility and deposition of iron in water occurs at a pH that is almost the same as its presence in the soil, i.e. iron dissolves at an acidic pH and settles at an alkaline pH [22]. Added by [23] that this causes the interaction of iron and hydroxide ions to be higher so that the amount of iron hydroxide deposits increases. [19] argue that the result of the interaction between OH- and these metals forms flocs in solutions that are easy to precipitate. The distribution of Fe and Hg leachate from the landfill in Palangka Raya is presented in Figure 3.

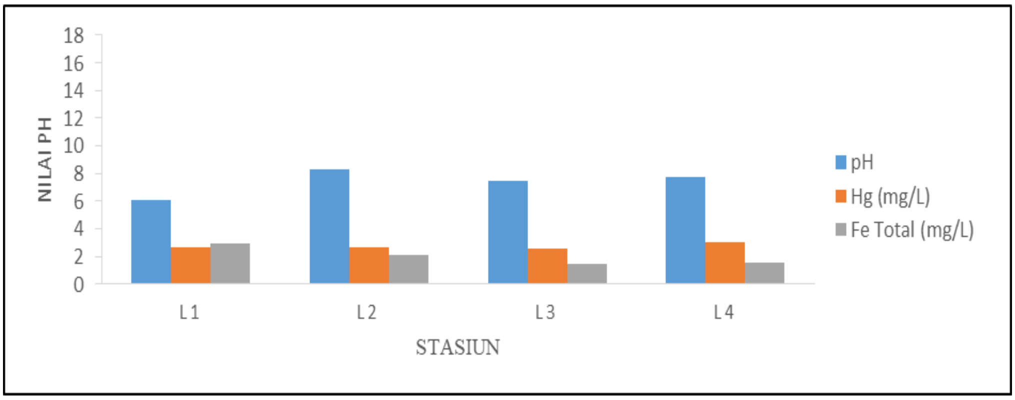


Figure 3 The distribution of the pH, Fe and Hg of the landfill leachate in Palangka Raya

Figure 3 shows that the pH of the leachate in the Palangka Raya TPA at the four observation stations ranges from pH 6.07 to 8.31. Station 1 leachate has the lowest pH value of 6.07 from all observation stations. At station 2 the leachate has the highest pH value of 8.31. Meanwhile, Station 3 (IPAL inlet pool) has a pH value of 7.45 and the leachate at station 4 (IPAL outlet pool) has a pH value of 7.73. The pH value of the Palangka Raya TPA leachate can still be classified as slightly acidic at station 1, station 2 slightly alkaline, while station 3 and station 4 are closer to neutral.

According to [1], the increase in the age of the waste in the garbage heap will be followed by a methane fermentation phase as a result of anaerobic biological decomposition with a pH value of 7-9. This leachate pH indicates that aerobic and anaerobic bacteria will develop and decompose complex organic compounds into simpler compounds in the leachate that have the potential as a source of nutrients for plants. The leachate in the WWTP ponds (stations 3 and 4) was higher than station 1, presumably due to a further decomposition process and entering the methanogenesis phase. This condition is thought to affect the pH value in the WWTP pond.

The low pH value at station 1 is suspected to be a process of waste fermentation (acidogenesis phase) which is more dominant and results in a low pH value of leachate. Station 2 has the highest leachate pH value of 8.31. It is suspected that the leachate from passive waste has entered the methanogenesis phase which produces methane gas. According to the statement of [24] the increase in pH value occurs because the population of methanogenic bacteria that play a role in converting organic acids into methane has begun to dominate. Under these conditions the amount of methane produced will also increase. [3] The pH value of waste leachate increases to alkaline with increasing age of waste.

Figure 3 shows that the total Fe concentration at the Palangka Raya landfill site ranged from 1,464 mg L-1 to 2,980 mg L-1. The highest total Fe concentration at station 1 was 2,980 mg L-1, while the total Fe concentration at station 2 was 2,084 mg L-1. There was a 30% decrease from station 1. The total Fe concentration of leachate at station 3 and station 4 was relatively the same, 1.464 mg L-1 and 1.523 mg L-1, respectively, or a 49% decrease from station 1. The leachate samples at station 1 showed that the highest total Fe value is where the leachate comes directly from organic and inorganic waste such as ferrous metal. It is suspected that the total Fe in the leachate to the TPA originates from inorganic waste. In line with [20] state the main source of total Fe in leachate apart from organic materials as well as components of building materials and furniture. Station 2 experienced a decrease in the total Fe concentration, it is suspected that some of the Fe source material in the landfill has decreased. While the total Fe concentration of leachate at station 3 and station 4 is relatively less, the reduced concentration of total Fe is thought to be suspended at the bottom of the landfill leachate management installation pond as colloidal granules (<1µm diameter) or larger, such as Fe_2O_3, FeO, $Fe(OH)_3$ and so on [23].

The concentration of Hg in the landfill leachate of Palangka Raya City ranged from 2.299 g L-1 to 2.711 g L-1 as shown in Figure 6. Hg was detected at all stations, with the highest Hg concentration at station 1, namely 2.711 g L-1, while the concentration of Hg leachate in station 2 is 2,666 g L-1 lower than station 1 or a decrease of 1.7%. The concentration of Hg at station 3 and station 4 was lower at 2,573 g L-1 and 2,299 g L-1, respectively, or a decrease of 15% from station 1 (rukuna aktiv). It is suspected that the factor of decreasing the concentration of Hg in the WWTP pond is due to suspension to the bottom of the pond, the transfer and transformation of mercury can be carried out by bacteria. [25] stated that in WWTP ponds Hg is absorbed in particulate materials and undergoes precipitation in the waters. Mercury is influenced by the presence of microbes, organic matter, organic mercury content, pH, and temperature [14].

The Hg compounds in the landfill are thought to have come from agricultural by-products using fungicides, as well as insecticide containers, paint cans, and electrical components that have accumulated in the landfill. According to [10] Hg is used in agriculture in the manufacture of fungicides, which can be accumulated in agricultural by-products into waste. In agriculture, mercury compounds are widely used for the manufacture of biocides, especially fungicides and bactericides [14]. [10]) stated that in aquatic systems, mercury metal will undergo oxidation so that it turns into Hg2+ which then allows sulfate reducing bacteria (SRB) in aquatic sediments to convert Hg2+ into methyl Hg (Hg-CH3). High water pH can reduce metal solubility in water [4].

3.3. Chemical Oxygen Demand (COD), BOD (Biochemical Oxygen Demand) and Ammonia (NH3)

Chemical Oxygen Demand (COD) describes the total organic compounds in the waters, both those that are easily decomposed (biodegradable) and those that are difficult to experience (non-biodegradable). Wastewater containing organic matter will increase the population of microorganisms thereby increasing the COD value. for high COD values are proteins, carbohydrates, oils, fats, detergents and surfactants [9].

The BOD5 value is used to estimate the amount of organic matter in wastewater that can be oxidized and will be decomposed by microorganisms through biological processes. [13] BOD is an indicator of biodegradation of biodegradable organic compounds in leachate. BOD5 only describes organic matter that can be decomposed biologically (biodegradable) [26]. The COD and COD values in landfill leachate in Palangka Raya City are presented in Figure 4.

The main source of ammonia is the presence of organic matter resulting from the decomposition of waste by bacteria which cannot be oxidized to nitrite and nitrate so that together with rainwater, ammonia compounds will be transported with leachate [13]. The distribution of NH3-N leachate from landfill in Palangka Raya is presented in Figure 4.

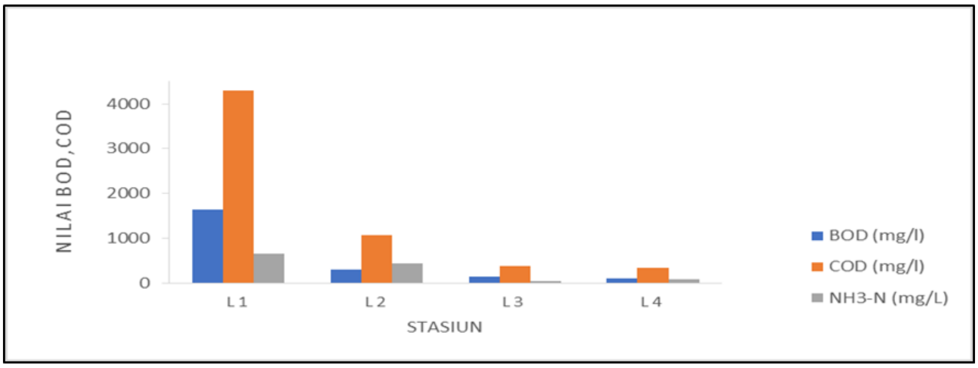


Figure 4 Distribution of COD, BOD, and NH3-N Lachate for landfill leachate in Palangka Raya

Figure 4 shows that the COD value of the waste leachate from the Palangka Raya landfill at several observation stations. Station 1 showed the highest COD value, namely 4290.2 mg L-1, while station 2 had a COD value of 1075.8 mg L-1 or experienced a 75% decrease in COD value from station 1. This decrease indicated that station 2 organic matter was difficult or easily degraded at station 2 decreases with increasing age of the fill. According to Naveen et al., 2016 COD provides an overview of the total amount of organic matter that is easily decomposed and that is difficult to degrade.

The COD value at the TPA may vary at the sampling station, due to the different availability of oxygen. This difference causes variations in the decomposition of organic particles from the solid phase into the air phase in the form of simpler compounds such as CO2, H20 and NH3. Monomer compounds from the hydrolysis reaction include acids, free fats, amino acids, glucose which are very beneficial for the growth and development of bacteria [13,19]. Backfilling of aged waste (5-10 years) produces leachate with lower organic matter content so that it is lighter to increase that efficient degradation of dissolved organic matter can be achieved. Meanwhile, backfill for less than 5 years still experiences the phrase acetogenic and organic matter is still high, resulting in a large process of degradation of waste material [4, 27].

Microorganism acclimatization process can be declared successful if there is a decrease in COD value. The decrease in the concentration of the COD pollutant parameter indicates the existence of a biodegradation process carried out by microorganisms well. The acclimatization process can be said to be complete if the COD concentration reduction is in a steady state and the pollutant removal efficiency reaches 50% of the initial concentration [28].

COD values (Figure 3) at station 3 and station 4 were 375.66 mg L-1 and 347.45 mg L-1, respectively, decreased COD by 8% from station 3 and 92% from station 1. The COD value at station 4 decreased It is suspected that the oxidation of organic compounds in the leachate water, as well as the deposition of organic compounds into mud at the bottom of the WWTP pond. Another assumption is that the reduced value of COD in WWTPs is because the leachate flowing from the source decomposes and mixes with surface runoff water from the landfill and rainwater, which can lead to a hydrolysis reaction [29].

Based on Figure 3, it shows that the BOD value of the landfill leachate at Station 1 shows the highest BOD_5 value, namely 1,650 mg L-1, while Station 2 has a BOD5 value of 312 mg L-1, which has a BOD5 value of 81% decreased from Station 1. This indicates that biodegradable organic materials at station 1 are still more widely available. Meanwhile, at station 2, the giodegradable organic matter decreased with increasing age or had entered the methagonesis phase. The BOD values for station 3 and station 4 were 144 mg L-1 and 105 mg L-1, respectively, a 27% decrease in BOD_5 from station 3 and 94% from station 1. It can be seen that the decomposition process of organic matter in leachate takes place well so that the BOD value is greatly reduced. According to [30] most of the organic carbon is converted into gas, so that the concentration of BOD and COD is low, in this phase the pH increases by about 7.8 - 8.2.

BOD_5 values vary widely depending on the age of the landfill. For new landfills or under a year old, the BOD5 values generally range from 2,000 – 30,000 mg L-1, while for mature landfills, it will range from 100 – 200 mg L-1. Therefore, the leachate from the Sampak TPA in Palangka Raya City is still relatively low [28]. [13] argue that the value of BOD_5 is influenced by the age of the waste material and the type of waste material in the backfill. [11] suggests that in general, leachate from a new landfill will have a high BOD and then it will decrease gradually over 10 years. BOD shows a picture of organic matter levels, namely the amount of oxygen needed by aerobic microbes to oxidize organic matter to carbon dioxide and water [31].

The ratio of BOD/COD is a key factor to understand the rate of biodegradability of organic matter in water [13]. In line with [28], states that the BOD/COD ratio is between 0.1-1.0, including the biodegradable zone group, whereas if the value is 1.0, it is said that the organic material in the landfill leachate can be biodegraded [8]. The decomposed organic matter functions as a nutrient for bacteria. [32]. [28] in their research stated that COD and BOD are indicators to determine the quality of leachate. This indicates that there are many organic compounds in the water. The value of COD is always higher than BOD, this is because many organic substances are oxidized chemically but cannot be oxidized biologically [30]

Figure 4 shows that the concentration of NH3 in the leachate at the Palangka Raya City TPA observation station ranged from 56,000 ml L-1– 665,000 ml L-1. The highest concentration of NH3 in leachate at station 1 was 665,000 ml L-1, followed by leachate at station 2 with a concentration of 438,000 ml L-1, station 4 with a concentration of 88,250 ml L-1, and station 3 with a concentration of 56,000 ml L-1. There was a decrease in the concentration of NH3 at station 2 by 34%, station 4 by 87% and station 3 by 92%. [33] stated that waste containing organic nitrogen will be decomposed by bacteria into ammonia, so that the concentration of ammonia is influenced by the content of organic compounds in leachate. It is suspected that microbial activity in aerobic active landfill decomposes waste containing organic nitrogen, especially from biodegradable waste and produces leachate with the highest ammonia concentration at station 1. Meanwhile, station 2 leachate comes from passive landfill which has entered the methanogenesis phase. and it is assumed that most of the organic compounds have decomposed. Ammonia concentrations at station 3 and station 4 decreased very significantly by 92% and 87% respectively from station 1. The decrease was thought to be due to the dilution of leachate in the WWTP pond and partially suspended. [19] stated that ammonia can be absorbed into suspended and colloidal materials so that it settles. According to [34] Ammonia in the WWTP pool will form an equilibrium with ammonium through hydrolysis where pH affects the equilibrium. Added by [33] that the ammonia liberated by the decomposition process of organic compounds will form an equilibrium reaction with ammonium ions (NH4+). This ammonium then undergoes a nitrification process to form nitrite and nitrate. [35,36] in [37] stated that ammonia can form metal ion complexes.

3.4. Cadmium (Cd) and Lead (Pb)

Sources of Cd come from waste in the form of used plastic, paint residue, batteries, plastic, soldering processes and the ceramics industry [10]. [15] argue that rubber, soap, fireworks, textile printing and colorants for glass can produce Cd. [38] stated that lead is a heavy metal because it has a specific gravity of five times the specific gravity of water. 95% lead is inorganic (inorganic salts) which are generally less soluble in water. The distribution of Cd and Pb leachate from the landfill in Palangka Raya is presented in Figure 5.

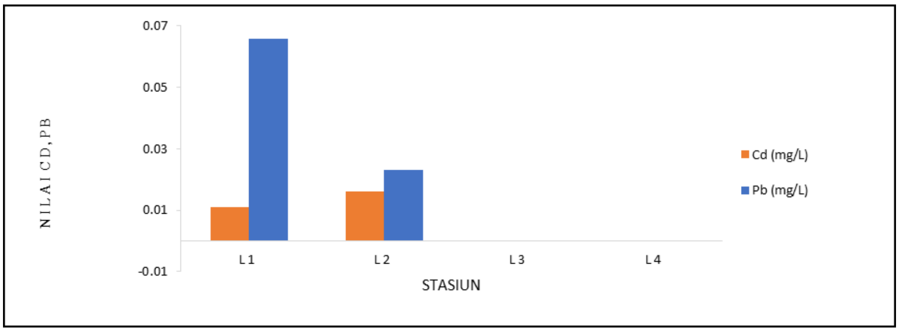


Figure 4 Distribution of Cd and Pb leachate from landfill in Palangka Raya

The concentration of Cd at all stations ranged from <0.003 to 0.016 mgL-1 as shown in Figure 4. The highest concentration of Cd was in the passive landfill leachate of Palangka City Raya (station 1), which was 0.016 L-1, the concentration in the leachate samples of active landfill landfill leachate Palangka Kota Raya (station 2), which is 0.011 mgL-1, the Cd concentration is slightly lower than station 2. Meanwhile, the Cd concentration at station 3 and station 4 is very low, each <0.003 mgL-1 or decreased by 81%. The decrease in the concentration of Cd at station 3 and station 4 (the WWTP pool of the Palangka Raya City waste landfill) occurred at the bottom of the pool. According to [10] that the presence of phosphate and sulfide will form a precipitate of cadmium carbonate, cadmium phosphate, cadmium sulfide which is insoluble or has very small solubility and settles [39].

The concentration of Pb at all stations ranged from <0.001 to 0.066 mg L-1 as shown in Figure 5. The highest Pb concentration in the leachate at station 1 was 0.066 L-1, while the Pb concentration at station 2 was 0.023 mg L-1, a decrease of 65%. Meanwhile, the Pb concentrations at station 3 and station 4 (WWTP ponds) were < 0.001 mg L-1, respectively, or a 98% decrease. The occurrence is thought to be caused by the occurrence of precipitation into the bottom of the pond. [40] stated that the condition of the Pb mass is greater than water so that the potential for suspension is higher at the bottom of the leachate pond. [15] stated that in the Sanitary Landfill, Malaysia, the Pb concentration in the leachate sample was 0.03 mg/L, higher than the Pb concentration in the Palangka Raya TPA. Lead concentrations in the environment depend on the level of human activity. Solid waste in the form of black plastic, used batteries and paint cans that are in the landfill leaves lead metal [14]. In line with [40] the source of Pb in leachate is from various human wastes such as used batteries, cigarette packs and pesticide packaging.

4. Conclusion

The results of this study can be concluded that leachate from the area where the final waste processing site in Palangka Raya City has chemical properties with a content below the quality standard, namely the value of heavy metal Lead (Pb) ranges from 0.001-0.066 mg/L and Cadmium (Cd) ranges between 0.003 – 0.016 mg/L. The content of Biochemical Oxygen Demand (BOD) in leachate in the inlet and outlet of WWTP with a value of 105-144 mg/L, Total Dissolved Solid (TDS) in leachate in the inlet pond, WWTP outlet, and in the leachate water of passive landfill (age 5 - 10 years) with a value of 839-1994 mg/L. Total Fe is 1,446 – 2,980 mg/L, Hg is 2,299-2,711 mg/L, Chemical Oxygen Demand (COD) is 347,45- 4,290,2 mg/L and Total Ammonia (NH3-T) is 88,250-665.00 mg/L is above the quality standard. The pH value of leachate is quite high and meets the quality standard (6-9), which is in the range of 6.07 – 8.31.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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