

Study of Water Quality in Pluit Reservoir, North Jakarta and Determination of Organic Degradation

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p-ISSN 2579-9150; e-ISSN 2579-9207, Volume 1, Number 1, page 65 – 81, October 2017

**Indonesian Journal of
Urban and Environmental Technology**<http://www.trijurnal.lemlit.trisakti.ac.id/index.php/urbanenvirotech>**STUDY IN PLUIT RESERVOIR, NORTH JAKARTA AND DETERMINATION OF ORGANIC DEGRADATION****Sindi Rawi Hertin, Muhammad Lindu, Bambang Iswanto***

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*Corresponding author: biswanto@trisakti.ac.id**ABSTRACT**

Aim: This research is aimed to study of organic degradation in Pluit reservoir, that located in the Village Penjaringan, North Jakarta, between 6° 07' 28.6" S 106° 48' 07.6" E and 6° 06' 40.2" S 106° 47'51.1"E with a broad area of ± 80 Ha, depth 1-8 meter. Flow systems pluit reservoir is half continuous and water is disposed with 4 units pump with a capacity of 4.5 m³/s which operates 8 hours/day throughout 11 pumps available. From the results of research findings are then compared with quality standards inspection according to the Government Regulation No. 82/2001 Class II for a review of recreation, fisheries and agriculture. **Methodology and Result:** The 90% of the DO value is ≤ 2 mg/L. The phosphate value obtained overall is not complied to the standard quality (≤ 0.2 mg/L P). In Pluit reservoir is found organic compounds as raw COD which was not complied to the standard quality (≤25 mg/L COD) approximately 27.52 mg/L COD - 371.52 mg/L COD. A kinetics test was done in order to determine the decreasing rate of COD in two conditions, where the first aeration to initial DO reached 4.5 mg/L, and the second is without aeration. **Conclusion, significance and impact study:** The COD degradation towards time is then measured and shows that organic degradation rate towards time without aeration process shows no decreasing, while non-aerated condition shows that the reaction rate following first pseudo reaction is 0.096 hours⁻¹ – 0.133 hours⁻¹ with an average value of 0.1177 hours⁻¹.

MANUSCRIPT HISTORY

- Received June 2017
- Revised September 2017
- Accepted September 2017
- Available online December 2017

KEYWORDS

- Hydraulic retention time
- Kinetics test
- Reaction rate constant
- Reservoir
- Water quality

1. INTRODUCTION

Water that goes to Pluit Reservoir comes from various sources, namely the drainage of settlements, Kali Krukut and Ciliwung River flow. While the outlet is the Java Sea by pumping system. The function of the Pluit Reservoir is as a recreation space, rain water storage, flood control and water source for the surrounding community, and a fishing area as well. There are public facilities such as gas stations, shelters, apartments, schools, municipal offices, malls, hospitals, restaurants and so forth.

This research is aimed to study of organic degradation in Pluit Reservoir located at Jalan Pluit Timur Raya, Penjaringan Village, North Jakarta. Pluit Reservoir has an area of \pm 80 Ha with a depth of about 1-8 meters. The lakes and reservoirs are technically functioning as a source of raw water, living a variety of aquatic biota, regulators and water balance balers, flood controllers and river power plants and others. In addition, lakes and reservoirs are also multi-functional, ie ecological, economic, environmental, socio-cultural and religious functions (Syahrul et al., 2013). The western side of the Pluit Reservoir is a Green Open Space which is a City Park with shady trees, a children's playground, a sports facility. While in the east is filled by settlement residents. According to Badjoeri and Yayah (2012), the degradation rate (k) is the rate of removal of a contaminant in a water. One factor that can affect the rate of degradation is the hydraulic retention time.

2. RESEARCH METHODOLOGY

2.1 Time and Place

Water sampling in Pluit Reservoir North Jakarta was done 6 times for 2 months with 1 week interval. It was 2 times repetition (duplo) for each point. In 6 sampling times, there are 3 times taken on weekend and 3 times in the weekday of Monday, Tuesday and Wednesday. It aims to know the discharge and water quality of Pluit Reservoir in all day and see the difference between weekday and weekend. Location of water sampling point in Pluit reservoir can be seen in Figure 1.

2.2 Sampling Method

The method used in this research is the momentary method (Grab). Water sampling was conducted at 10 observation points taken by using Water Sampler at depth $\frac{1}{2}$ - $\frac{2}{3}$ from water depth. Water sample then put on a sample bottle for each observation point and then put into the cooler box to preserved. The measurement of each sample was done at Environmental Laboratory, Universitas Trisakti.



Figure 1 Location of water sampling point in Pluit reservoir

2.3 Analysis Method

The parameters and methods of water sample analysis used are listed in Table 1.

The data obtained then compared with the Quality Standard based on Government Regulation No. 82/2001 Group II on Water Quality Management and Water Pollution Control to identify the quality of Pluit Reservoir.

Table 1 Parameters and measurement methods

No.	Parameter	Method	Unit
1	Temperature	Thermometer	°C
2	pH	Electrometric Method	-
3	DO	Winkler Titration Method	mg/L
4	COD	Reflux Titrimetry Method	mg/L
5	TDS	Gravimetry Method	mg/L
6	TSS	Gravimetry Method	mg/L
7	Nitrit	Spectrophotometry with Sulfanilate and Naftilamin Acid Reactant Method	mg/L
8	Nitrat	Spectrophotometry with Fenol-Sulfate Reactant	mg/L
9	Ammonia	Spectrophotometry (Nessler) Method	mg/L
10	N Kjeldahl	Kjeldahl Method	mg/L
11	Detergent	Spectrophotometry (MBAS)	mg/L
12	Phosphat	Spectrophotometry	mg/L
13	Cadmium (Cd)	Atomic Absorbent Spectrophotometry (AAS)	mg/L
14	Zinc (Zn)	Atomic Absorbent Spectrophotometry (AAS)	mg/L
15	Oil and Grease	Gravimetry	mg/L

3. RESULTS AND DISCUSSION

3.1 Surface Water Quality of Pluit Reservoir

The result of surface water quality measurement of Pluit Reservoir is shown in Table 2. In general, the water surface conditions in Pluit Reservoir is quite bad, since that almost all parameter has value exceeded the quality standard.

3.2 Temperature

Pluit Reservoir is a deep water but still constantly get the heat of the sun because it is in the coastal area of the Java Sea. The water temperature of the Pluit Reservoir has a range of between 27°-30°C and is still within normal limits, the highest temperature is at point 6 of 29.5°C. While the lowest average temperature is located at point 4 of 27.17°C. The highest temperature is found at point 6 of 29.5°C. While the lowest average temperature that is located at point 4 of 27.17°C. The sampling point 6 is the midpoint of the Pluit Reservoir. At this point the penetration of direct sunlight penetrates into the waters. While at point 4, the sunlight does not enter perfectly because it is blocked by the house residents.

3.3 pH

The degree of acidity is a description of the amount or activity of hydrogen ions in the water and it indicates whether the environment is still acid or alkaline. The average pH between the sampling points is in the range of 6.82 - 8.23. The highest water pH value was found at point 8 of 7.53 and the lowest average pH was found at point 1 of 7.17. This is caused by the waste disposal entering the flow of point 8 which came from the elite housing drainage and stream of the Ciliwung River. The waste contains a variety of chemical compounds, such as detergents that can increase the pH value of the Pluit Reservoir. While at point 1 the pH tends to be more neutral due to the sources of water entering at this point does not contain many chemical compounds or waste neither the activities around the reservoir is not high enough to give high influence on the pH content.

Compared with Government Regulation No. 82 Year 2001 Class II for Recreation, Fishery and Agriculture, the average pH concentration value of Pluit Reservoir is still within the standard quality limit of 6-9.

Table 2 Surface water quality Pluit reservoir

Parameter	Unit	Std	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Point 10
Physical												
Temperature	°C	±3	27.92±0.14	28.08±0.35	29.33±0.35	27.17±0.19	28.08±0.18	29.50±0.24	29.00±0.20	28.17±0.28	27.58±0.30	28.25±0.16
TDS	mg/L	1000	849.67±18.9 1	347.67±12.0 8	689.00±45.2 2	517.50±35.2 5	581.50±45.2 8	625.83±44.2 3	491.50±15.6 0	578.00±32.0 5	454.67±9.52	487.83±32.9 4
TSS	mg/L	50	71.50±19.37	39.00±9.46	39.50±5.83	45.00±5.59	50.17±7.60	60.83±9.35	44.33±8.34	58.50±15.79	40.17±11.53	55.67±13.02
Chemical												
pH		6-9	7.17±0.14	7.33±0.19	7.44±0.18	7.45±0.06	7.38±0.19	7.27±0.17	7.22±0.20	7.53±0.16	7.25±0.20	7.28±0.15
DO	mg/L	4	3.62±0.27	2.24±0.40	0.79±0.29	2.54±0.61	1.00±0.16	0.69±0.23	1.22±0.29	2.01±0.21	2.99±0.34	1.20±0.24
COD	mg/L	25	61.92±14.04	98.61±28.17	142.19±23.7 6	91.73±27.26	160.53±32.8 6	135.31±27.7 9	167.41±44.5 2	89.44±13.27	119.25±40.7 2	103.20±19.1 2
Nitrat	mg/L	10	0.712±0.18	0.567±0.15	0.473±0.14	0.673±0.15	0.594±0.17	0.397±0.12	0.536±0.12	0.594±0.12	0.688±0.14	0.600±0.14
Nitrit	mg/L	0.6	0.021±0.005	0.019±0.004	0.042±0.012	0.016±0.003	0.032±0.005	0.027±0.005	0.022±0.005	0.050±0.014	0.068±0.023	0.013±0.001
Ammonia	mg/L	0.02	0.282±0.09	0.361±0.06	0.415±0.08	0.321±0.08	0.0322±0.05	0.418±0.11	0.317±0.07	0.296±0.05	0.235±0.05	0.311±0.001
N kjedahl	mg/L	-	45.90±4.66	36.28±2.98	23.91±1.41	44.31±2.85	29.05±2.26	24.24±1.45	27.53±1.86	37.81±3.02	42.85±4.26	30.17±1.56
Phosphat	mg/L	0.02	0.642±0.02	0.607±0.01	0.538±0.01	0.652±0.03	0.693±0.03	0.527±0.01	0.660±0.02	0.802±0.03	0.620±0.03	0.549±0.01
Detergent	mg/L	0.02	0.202±0.05	0.235±0.06	0.157±0.02	0.207±0.05	0.187±0.03	0.139±0.02	0.153±0.02	0.263±0.06	0.238±0.06	0.147±0.03

3.4 Total Dissolved Solid

Concentration of TDS is shown at Figure 2. The total dissolved solid is the total number of soluble charged ions, including minerals, salts or metals dissolved in a certain volume of water in mg/L. TDS is directly related to water purity and water quality (Sunita, et al, 2015). The amount and source of dissolved matter present in water varies greatly. Water in nature contains dissolved solids derived from minerals and dissolved salts when water flows underground or on the surface.

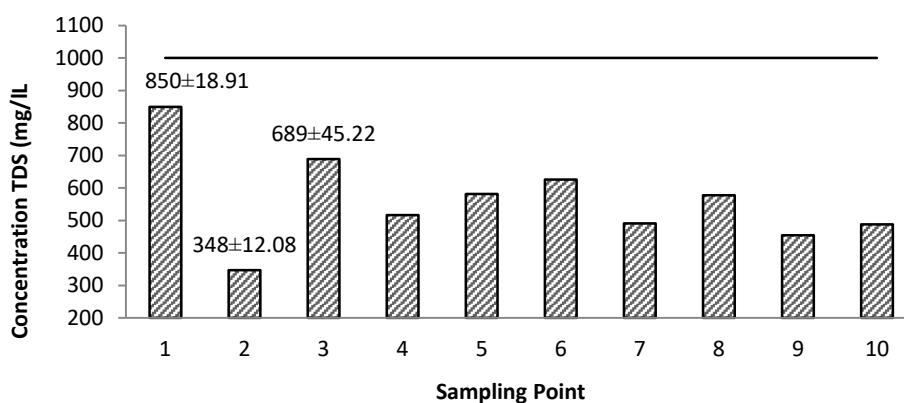


Figure 2 Concentration of TDS reservoir Pluit

TDS of Pluit Water Reservoir ranges from 166-960 mg/L. The highest mean TDS was at the sampling point 1 of 850 mg/L and the lowest was at the sampling point 2 of 348 mg/L. A high mean value of TDS at point 1 of 850 mg/L can be caused by the inlet source, Krukut River carrying dissolved salts derived from the groundwater consumption of residents around the stream of times and around the inlet 1. And also the largest inlet that has the largest flow velocity in the Pluit Reservoir so that the erosion of the inlet base stream is also greater than that of other sampling points that automatically erode and carry dissolved minerals and salts with rocks along the Krukut River stream and carry into the reservoir. The activities of residents who like to dispose of waste into Pluit Reservoir can also influence the value of TDS. The disposed water is thought to have high salt content. While the lowest TDS value is at point 2 that is 348 mg/L, this can be caused by the source at the point of sampling 2 is the drainage of the elite housing that allegedly uses PAM water so it does not bring much TDS into the Pluit Reservoir.

Compared with Government Regulation No. 82 Year 2001 Class II for Recreation, Fisheries and Agriculture, the concentration of TDS of Pluit Reservoir is still below the standard quality threshold of 1000 mg/L.

3.5 Total Suspended solids

Concentration of TSS can be seen in Figure 3. Suspended solids (TSS) are solids that cause water turbidity, are insoluble and cannot be deposited directly, consisting of particles of lesser size or weight than sediments, eg clay, certain organic materials, microorganism cells, And so on (Nasution, 2008).

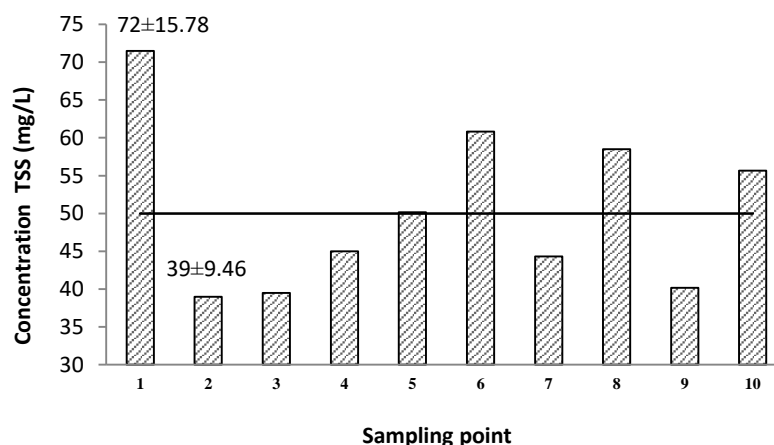


Figure 3 Concentration of TSS reservoir Pluit

Water TSS Pluit Reservoir ranges from 10-155 mg/L. The highest TSS is at the sampling point 1 that is 72 mg/L and the lowest TSS is found at point 2, which is 39 mg/L. This can happen because point 1 is the largest inlet so that the flow rate from Krukut River and drainage around this point can erode and bring more organic matter than other sampling points. While the flow velocity of the sampling point 2 is very inversely proportional to the sampling point 1. Therefore, the sampling point 2 has the least TSS value. In addition, TSS also undergoes deposition. Compared with Government Regulation No. 82 Year 2001 Class II for Recreation, Fisheries and Agriculture, the average concentration of TSS of Pluit Reservoir is still below the standard quality threshold of 50 mg/L. TSS concentration values that exceed the average quality standard are found on the fourth to sixth sampling in May or in the rainy season

3.6 Dissolved Oxygen

Concentration of dissolved oxygen is shown in Figure 4. Oxygen is one of the dissolved gases in natural waters with varying levels that are affected by temperature, salinity, water turbulence and atmospheric pressure. Besides necessary for the survival of organisms in the waters, oxygen is also required in the process of decomposition of organic compounds into inorganic compounds. The source of dissolved oxygen comes mainly from the diffusion of oxygen present in the atmosphere.

The DO concentration ranges from 0.28 mg/L to 4.58 mg/L. DO was the lowest average at sampling point 6 of 0.69 mg/L, whereas the highest DO test result was highest on sampling point 1 i.e 3.62 mg/L. The low average DO level at sampling point 6 is caused by this point of sampling being the point in the middle of the Pluit Reservoir so that it can cause high oxygen consumption, or faster oxygen uptake than the oxygen entry into the water at the sampling point. And because of the increase, accumulation, and accumulation of organic and inorganic waste both derived from human activities in the vicinity of the lake as well as those derived from activities in the water bodies itself. While the sampling point 1 that has the highest average DO value is caused by the sampling point which is the largest inlet of the Pluit Reservoir and has a large flow velocity so that turbulence on the surface of the water to allow the rapid diffusion of oxygen into the water.

Compared with Government Regulation No. 82 Year 2001 Class II for Recreation, Fishery and Agriculture, the concentration value of DO Pladuk Pluit is still below the standard quality threshold of 4 mg/L. The DO concentration values that reach the average quality standard are found on the fourth to sixth sampling in May or in the rainy season.

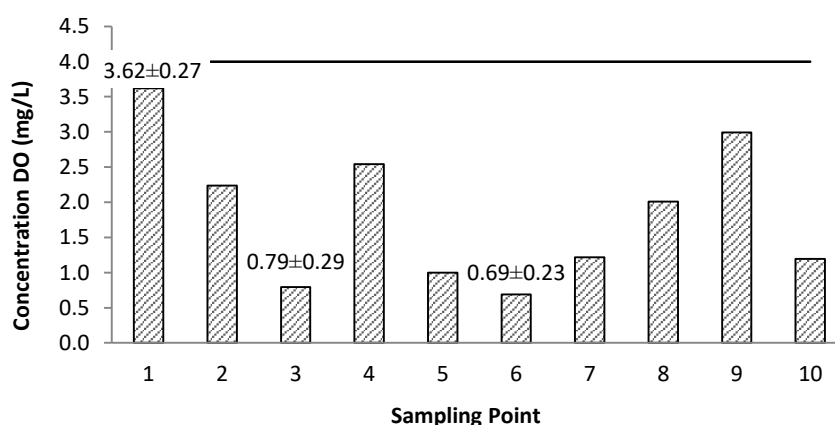


Figure 4 Concentration of DO reservoir Pluit

3.7 Nitrate, Nitrite and Ammonia

Nitrate is the main source of nitrogen in the water. Nitrate levels greater than 5 mg/L indicate that the waters have been polluted by manure, animal waste or human activities. Result of Nitrate concentration measurement can be seen in Figure 5.

The highest value of Nitrate concentration was found at point 1 of 0.712 mg/L and the average value of the lowest Nitrate concentration was found at point 6 of 0.397 mg/L. This can be caused at the point of sampling. One source of water flowing from Krukut River brings domestic waste and waste from activities around sampling point 1 such as gas stations, workshops, schools and food stalls. The value of NH_3 at this point is relatively low because it could be at the time of sampling that this compound has been oxidized and turned into Nitrate so that the Nitrate value at this sampling point is high compared to the other sampling point.

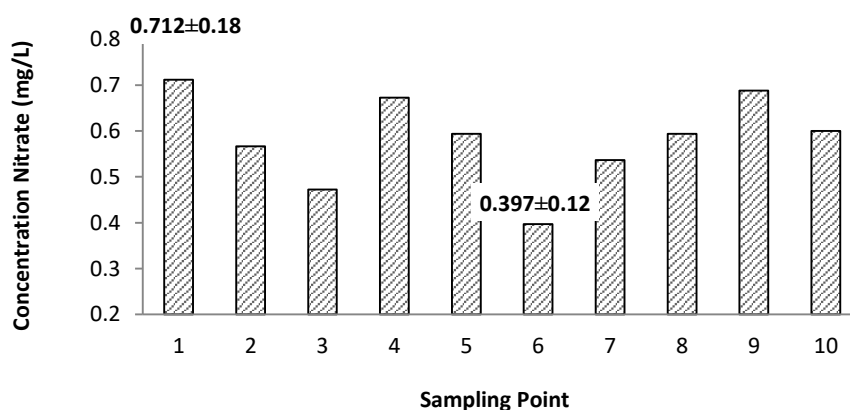


Figure 5 Concentration of Nitrate reservoir Pluit

Nitrates at high concentrations can stimulate the growth of infinite algae, so water dissolves dissolved oxygen which can cause fish death. While at point 6 is the point with the lowest Nitrate concentration value. This may be due to this point being the midpoint of the Pluit Reservoir which has been mixed from various inlets and this point has a low DO value so there is no perfect nitrogen oxidation process.

Figure 6 shows measurement result of Nitrite concentration. The highest average Nitrite concentration was found at point 9 that was 0.07 mg/L. While the average value of the lowest Nitrite concentration is at point 10 that is equal to 0.01 mg/L. The high Nitrite content at sampling point 9 can be derived from household waste input because point 9 is an inlet originating from the elite housing of Pulit Reservoir. Closely related to organic materials present

in this sampling zone, (whether nitrogen-containing or not), such as the decomposition of organic matter by microorganisms requires large amounts of oxygen.

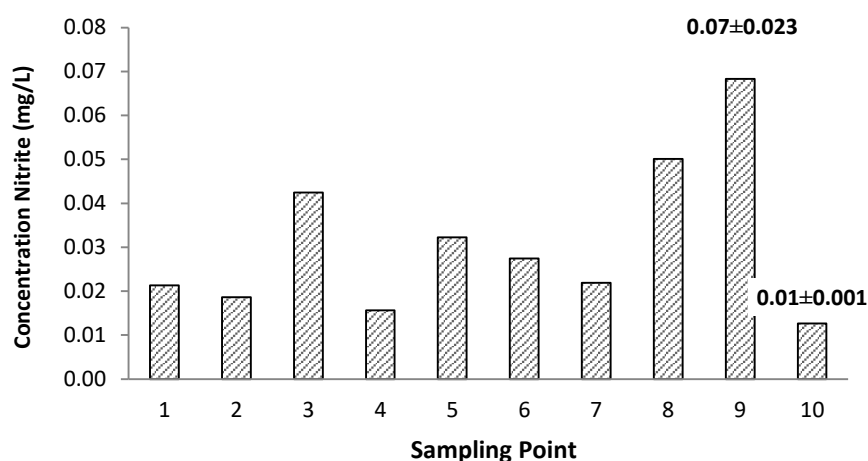


Figure 6 Concentration of Nitrite reservoir Pluit

Ammonia is a nitrogen compound that turns into NH_4 ions at low pH. Ammonia comes from domestic waste and fish feed waste. Ammonia in reservoir waters can be derived from organic nitrogen and inorganic nitrogen present in soil and water derived from the decomposition of organic matter by microbes and fungi. In addition, ammonia also comes from denitrification in the decomposition of waste by microbes in anaerobic conditions.

The highest average ammonia concentration was found at sampling point 3 and 6 that was 0.42 mg/L. While the average value of the lowest ammonia concentration is at the sampling point 9 that is equal to 0.24 mg/L. The high concentration of ammonia at point 9 because of the high organic material that can be derived from the domestic waste of elite housing and waste disposal from street vendors around the point 9. While the low ammonia value at point 3 and 6 that is because the 3 and 6 are both points The middle of Pluit Reservoir which has undergone mixing from various inlet at Pluit Reservoir.

Overall, the nitrite and Nitrate levels in the waters of Pluit Reservoir are still below the quality standard, while the ammonia content obtained is very high and exceeds the quality standard set by PP. 82 of 2001 with nitrite content of 0.06 mg/L, Nitrate of 10 mg/L, and 0.02 mg/L for ammonia levels.

3.8 Phosphate and Detergent

Phosphates are present in natural or waste water as orthophosphoric compounds, polyphosphates and organic phosphates. Each of these phosphate compounds is present in a soluble, suspended or bonded form in the cell of the organism in water.

The phosphates in the waters of the Pluit Reservoir range from 0.506 – 2.111 mg/L. The highest average concentration of phosphate concentration is found at the sampling point 7 that is 0.885 mg/L. While the average value of the lowest concentration of phosphate is at the sampling point 6 that is equal to 0.527 mg/L. The high concentrations of phosphate concentrations present at point 7 can be caused by the disposal of elite housing waste containing detergents, together with nitrogen and phosphate derived from other domestic waste materials will stimulate the growth of aquatic plants and algae to grow rapidly (Paytan & Mclaughlin, 2007 in Susana and Suyarso, 2008). While at point 6 the value of low phosphate concentration because point 6 is the midpoint of Pluit Reservoir and has the lowest concentration of detergent as well.

Overall, phosphate levels in Pluit's Reservoir are not in accordance with standard quality standards that have been established based on PP. 82 Year 2001 that is 0.2 mg/L.

The phosphate and detergent values of the Pluit Reservoir look directly proportional. This can mean phosphate derived from detergent, and high phosphate means high surfactant as well. Phosphate plays an important role in detergent products, as a water softener.

Detergent is a cleaning agent commonly used by industry or household. Detergent is a compound of various compounds wherein the main component of the compound is surface active agents or surfactants. The most commonly used detergent surfactant is LAS or Linear Alkylbenzen Sulfonate (Supriyono et al., 1998).

The detergent content in the waters of Pluit Reservoir ranges from 0.103 to 0.568 mg/L. The highest average detergent concentration value was found at sampling point 8 that is 0.263 mg/L. While the average value of the lowest detergent concentration is at the sampling point 6 that is 0.139 mg/L. The high concentration of detergent at the sampling point 8 can be caused by the waste entering the inlet stream 8 is discharged from the Pluit Reservoir drainage housing. The high concentration of detergents from this point can also be seen from many foam floating on the surface of the water at this point. While at point 6 is the midpoint of the Pluit Reservoir which causes detergent has been mixing with water from other inlet thus causing detergent concentration value at 6 is very small.

It can be seen clearly that the greatest detergent concentration value at each sampling point is in the first, third and fifth sampling or when the sampling activity is done on holidays ie Saturday and Sunday. While the smallest detergent concentration value at each sampling point is in the second, fourth and sixth sampling or when the sampling activity is done on active day i.e. Monday and Wednesday. This can happen because on holidays, the average population around the Pluit Reservoir many activities at home and can affect the amount of water use and the number of use of detergents such as washing clothes, washing dishes, washing vehicles, bathing and others then disposal flow To Pluit Reservoir.

Compared with Government Regulation No. 82 Year 2001 Class II for Recreation, Fishery and Agriculture, the concentration of Pluit Reservoir detergent concentrations is mostly below the quality standard threshold of 0.2 mg/L. Detergent concentration values that exceed the average quality standard are in sampling conducted on holidays or Saturdays and Sundays.

3.9 Oil and Grease

After the DO chart is made, the DO value on the surface is small, since oxygen is allowed on the surface to be obstructed by a water-oil emulsion coating. The points 3 and 6 are the midpoint of the Pluit Reservoir. Oil may be suspected to originate from a kind of excavator such as an excavator operating in Pluit Reservoir. While at point 5 the oil can be derived from the surrounding activities that is the disposal of food stalls and the like. This shows that in the presence of water-oil emulsions will affect in the bottom of the waters, thereby into an anaerobic life. On the surface layer of the reservoir contains a water-oil emulsion and can block the O₂ and sunlight (U.V) into the river liquid as a result O₂ does not enter, into anaerobic condition and does not occur photosynthesis. To reduce the emulsion of water oil there are three ways, namely by coagulation of PAC, NaOH and activated carbon (Judge, 2016).

3.10 Alternative Water Quality Control Reservoir

In this research, it is recommended to manage or control the water quality of reservoirs that have undergone a process of Reservoir age to the quality of the reservoir, with indication that the reservoir has experienced heavy pollution due to high organic content with an average COD value of 112.58 mg/L - 196.39 mg/L, and low DO. Therefore, almost all sampling points throughout sampling during April-May, none of the DOs meet the requirements for aquatic life with DO above the minimum above 4 mg/L.

Based on the characteristics of the Pluit Reservoir is physically green, then the high organic content with high COD values, low DO, high oil and fat, and high phosphate levels, is indicated because it is contaminated by domestic waste. These polluted compounds should be removed and expected before discharge to the next water body. If the reservoir is considered to be a reactor site, the reservoir should be able to remove the contaminant prior to disposal. To eliminate it by determining how long it takes to remove these pollutants. To see how much and how long it takes to decompose the pollutant compound it is necessary to determine the speed of the reaction. These steps have been done by increasing the oxygen content by supplying oxygen and without giving oxygen. Then done the determination of the rate of COD decline with time, the result Obtained as shown in Table 4 based on samples from points 1 and 2 inlets. From the data it can be concluded that water given oxygen by the initial aeration process indicates the process of organic decline, whereas without aeration does not occur.

Table 4 Beginning and end concentration at point 1 and point 2 with aeration

T(time)	With Aeration (Aerobic)				Without Aeration (Anaerobic)			
	C	C/Co	Ln(C/Co)	Co-C	C	C/Co	Ln(C/Co)	Co-C
0	55.04	1	0	0	55.04	1	0	0
1	41.28	0.75	-0.28768	13.76	55.04	1	0	0
2	41.28	0.75	-0.28768	13.76	55.04	1	0	0
4	41.28	0.75	-0.28768	13.76	55.04	1	0	0
6	27.52	0.5	-0.69315	27.52	55.04	1	0	0
8	27.52	0.5	-0.69315	27.52	55.04	1	0	0

Table 5 Degradation rate constants with order 1 and order 0

Point	Orde 1		Orde 0	
	K (hour ⁻¹)	R ²	K (mg/L/hour)	R ²
1	0.112	0.828	4.687	0.844
2	0.126	0.899	10.43	0.851
4	0.111	0.861	6.955	0.898
5	0.128	0.889	13.15	0.853
8	0.096	0.844	5.292	0.838
9	0.133	0.875	12.24	0.804
Average	0.1177		8.792	

From the result of kinetics test analysis with algebraic method, there is a correlation between time concentration, based on Table 5, it is found that the reaction speed follows order first because the coefficient of determination at first order is bigger than the zero order. In pseudo order one value of the average constant is 0.1177 hours⁻¹. The highest degradation rate was found at the sampling point 9 with the degradation rate constant rate of 0.133 hr⁻¹,

indicating that at point 9 contained an easily degradable organic compound. At the 9th sampling point in the Pluit Waste Reservoir many come from the elite housing drainage channel. Reservoirs are stagnant waters, so the decomposition rate will occur more slowly. The existence of a fairly strong wind and capable of making waves in the waters to assist the degradation process. And the presence of turbulence or movement of water flow will also help the process of degradation. While the least degradation rate is found at point 8, that is 0.096 hours⁻¹, it shows that at point 8 contained organic compounds that are difficult to decompose because point 8 is a big enough inlet and the flow water comes from Ciliwung River and the drainage of housing around the reservoir Pluit.

3.11 Hydraulic Retention Time

Below are calculation steps for Hydraulic Retention Time in Pluit Reservoir.

$$K_{\text{average}} = 0.1177 \pm 0.0021; K = K_{\text{average}} \pm G = 0.1177 - 0.0021 = 0.1156$$

$$K = 0.1177 + 0.0021 = 0.1198$$

So the value of K is 0.1177, 0.1156, and 0.1198.

Assume:

$$C_0 = 380 \text{ mg/L (Highest initial concentration); } C_t = 25 \text{ mg/L (quality standards)}$$

a. Detention Time for $K = 0.1177 \text{ hour}^{-1}$

$$\ln \frac{C}{C_0} = -k.t$$

$$\ln \frac{25}{380} = -0.1177.t$$

$$t_d = 23.12 \text{ hour}$$

b. Detention Time for $K = 0.1156 \text{ hour}^{-1}$

$$\ln \frac{C}{C_0} = -k.t$$

$$\ln \frac{25}{380} = -0.1156.t$$

$$t_d = 23.54 \text{ hour}$$

c. Detention Time for $K = 0.1198 \text{ hour}^{-1}$

$$\ln \frac{C}{C_0} = -k.t$$

$$\ln \frac{25}{380} = -0.1198.t$$

$$t_d = 22.72 \text{ hour}$$

If the reservoir receives an organic load of 380 mg/L, then to degrade the organic to 25 mg/L (standard quality) in an aerobic atmosphere with DO at 4.5 mg/L, a reaction time of 22.72 - 23.12 hours is needed.

3.12 Calculation of Natural Retention Time of Pluit Reservoir in April May

Pumping conducted in April and May is only done for 8 hours using a pump located in the middle of the reservoir with a capacity of 4.5 m³ / sec.

Area of Pluit Reservoir = 80 Ha = 800,000 m²

Average depth = 6 m

Volume of Pluit Reservoir = 4,800,000 m³

Q pump = 4.5 m³/s = 16,200 m³/hour

Pump operation = 8 hour / day

Number of pumps = 4 pumps

16,200 m³ / hour x 4 pumps = 64,800 m³ / hour

Q = 64,800 m³/hour x 8hour/day = 518,400 m³/day

$td = v/Q = \frac{4,800,000m^3}{518,400 m^3/hari} = 9.3 \text{ day} = 9 \text{ day}$

So the natural retention time of Pluit Water Reservoir which is semi continuous is for 9 days. This means 9 times much greater than the reaction time required to decrease organic pollutants (highest COD 380 mg/L to 25 mg/L in accordance with the quality standard) ie only for 23.12 hours if done in aerobic conditions with DO amounting to 4.5 mg/L.

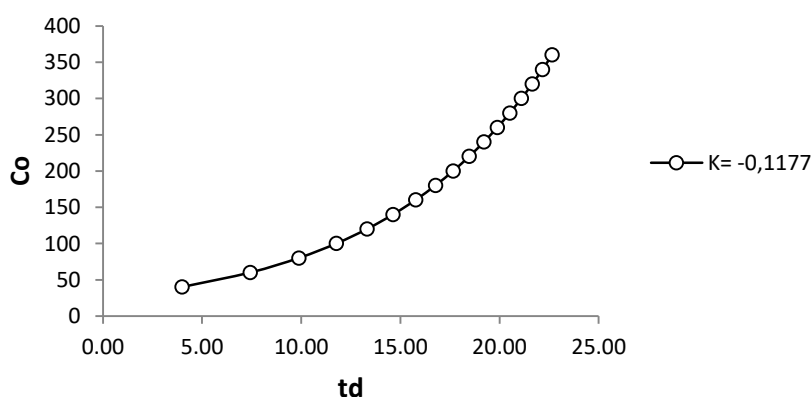


Figure 7 Curve relation of initial concentration of COD with time required to achieve quality standard (25 mg/L)

Figure 7 shows the relationship of initial concentration of COD with the time needed to degrade organic pollutant so that according to the standard quality of 25 mg/L with the value of $K = 0.1177 \text{ hours}^{-1}$. Based on the figure, it can be known that the time needed to degrade the COD concentration value in the Pluit Reservoir. For example if the initial concentration of COD is 100 mg/L on the line that intersects the curve, then the time required is for 11.57 hours. The highest initial COD concentration was 380 mg/L. The time it takes to degrade organic pollutants to the desired value is 23.12 hours or less than 1 day.

4. CONCLUSION

Pluit Reservoir is a deep enough water but still constantly receive the heat of the sun because it is in the coastal area of the Java Sea. Some parameters that still meet the quality standard that has been determined by PP. 82 Year 2001 is TDS ranged from 166 mg/L - 960 mg/L with standard quality 1000 mg/L, pH between 6.22 - 8.23 with the standard quality 6-9 while Nitrate ranged from 0.055 to 1.309 mg/L with a standard quality of 20 mg/L. Parameters that do not meet the quality standard stipulated by PP. 82 of 2001, among others, DO ranged from 0.28 mg/L - 4.58 mg/L, the value of DO existed below 2 ppm indicating there are some conditions that anaerob. Nitrite values ranged from 0.005 mg/L - 0.172 mg/L with a standard quality of 0.06 mg/L. TSS value ranged from 10 mg/L to 155 mg/L with standard quality 50 mg/L, while COD ranged from 27.52 mg/L - 371.52 mg/L with the standard quality 25 mg/L. In some aerated area in Pluit Reservoirs shows the process of COD decrease with time. The order of the reaction follows a first order pseudo with a constant of 0.096 hours^{-1} - 0.133 hours^{-1} with an average value of degradation constant of $0.1177 \text{ hours}^{-1}$. Based on these values, assuming a batch reactor, a reaction time of 23.12 hours is needed to reduce COD from the highest concentration of COD in Pluit Reservoir, that is 380 mg/L to 25 mg/L. To restore water conditions Pluit Reservoir that contaminated with organic matter can be done by adding oxygen solubility without increasing the retention time in the reservoir water which is currently for 9 days for the highest concentration of organic pollutants. Water of Pluit Reservoir should not be polluted and the value of organic pollutant as COD coming out of Reservoir does not exceed the quality standard of 25 mg/L. This could happen when DO reservoirs concentration maintained at least 4 mg/L by aeration. There is necessary to manage the wastewater that generated from the housing activity around the Pluit Reservoir before the wastewater is discharged into the water body. Besides, it need to be made screen on inlet of Pluit Reservoir so that solid waste can be

separated and not enter into Pluit Reservoir. The government needs to make routine and continuous extension programs to the people around Pluit Reservoir to not dispose wastes into water bodies and to raise public awareness of the importance of reservoir ecosystem and its functions. Therefore, Pluit reservoir can be utilized as it requirement

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