

The study on the self-purification based on BOD parameter, Situ Gede Tangerang City, Banten Province

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The study on the self-purification based on BOD parameter, Situ Gede Tangerang City, Banten Province

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Abstract. Situ Gede is a natural small lake located in Kelapa Indah, Tangerang District, Tangerang City, which has an area of 5.07 hectares. The decreasing in water quality is characterized by the number of pollutants such as BOD (Biochemical Oxygen Demand), which are closely related to human activities such as the disposal by organic waste from domestic activities surrounding. The purpose of this study is to analyse the self-purification of water body in degrading of organic matter. The average of retention time of Situ Gede is 3.05 hours and a mixed concentration is 16.12 mg/l. The calculation results, the degradation rate at Situ Gede is 0.19/day. These results are stated as the composition of BOD in the Situ Gede situation not degraded perfectly. Alternative strategies for water pollution control can conduct by aeration to increase the oxygen for aerobic microorganism's growth to process the organic matter degradation.

1. Introduction

Situ (small lake) have a very important role in the environment. The role there is as groundwater recharge areas, helping to improve surface water, irrigation, recreation, fisheries and supporting marine biodiversity. Situations in the Tangerang City generally experience pollution problems, decreasing the quality of water there, decreasing water discharge especially during the dry season and silting up there.

Increased community activities tend to cause pollution and disrupt the sustainability of the waters there. Domestic waste comes from the surrounding community settlements which carry out various activities, such as bathing, washing, urinating and disposing of garbage on the banks of Situ Gede. Nature actually has the ability to overcome pollution problems that occur. This mechanism, called self-purification. Self-Purification is efforts to purify water from pollutants contained in it by natural processes without the influence of human activities [1].

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To achieve or maintain the quality of Situ Gede water so that it can be used continuously in accordance with the expected water quality standards, it is necessary to control and or preserve water there. One of the management steps taken is to calculate the degradation rate in Situ Gede waters.

2. Literature review

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Lakes, ponds and reservoirs are used for domestic and irrigation purposes, providing ecosystems for aquatic life, especially fish. Which has important social and economic benefits as a result of tourism and recreation. In addition, it has an equally important role in flood control [2]. At present, lakes and reservoirs are in various levels of environmental degradation, due to encroachment, eutrophication (from



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domestic and industrial waste) and sludge deposits [3]. Disposal of garbage and other waste around it occurs, which not only pollutes it but also damages its beauty. There are a number of layouts (residential are) around it, which can affect water both quantitatively and qualitatively [4].

Self-Purification capability occurs in conditions where pollution does not exceed the threshold or carrying capacity of nature. The mechanism of purification naturally is limited to organic parameters which can be degraded under aerobic conditions by microorganisms. The ability of water bodies to purify themselves is the ability to remove organic matter, or other pollutants from a lake by biological activity. Self-purification is often related to the oxidation of organic matter by aerobic organisms. The oxidation process causes deoxygenation from water and the deoxygenation level depends on the strength of the wastewater, the level of dilution given by the mixture with water and the flow rate [5]. Situ conditions that are relatively flat show a relatively calm and no-flow pattern (turbulence) which causes the air reaeration process to be reduced so that the self-purification capacity of the Situ is not optimal [6]. The concentration of pollutants entering the waters has three types, namely dilution (dilution), spread (dispersion), and decomposition reactions (decay or reaction) [7].

3. Research methods

3.1. Location and time of research

This research was conducted during 3 months, from May to July 2018 in Situ Gede waters, which is located in Kelapa Indah Village, Tangerang District, Tangerang City, Banten Province. This location is a natural site with an area of 5.07 Ha.

3.2. Determination of sampling points

Situ Gede is research determined 8 sampling points as locations for taking water samples. The point of water sampling is divided based on the characteristics of the waters that are affected by the presence of activities or activities to use the surrounding area. The method of water sampling which is carried out directly using the grab sampling method is the method of instantaneous sampling in accordance with SNI 6989.57: 2008. Sampling from the water surface at a depth of 1/2-2/3 from water depth. Sampling was conducted the morning at 07.00a.m - 13.00 p.m.

Table 1. Water sampling coordinate.

Sampling Point	Coordinate Point	Information
1	6°11'57.80"LS; 06°38'15.82"BT	Inlet originating from a pool of shelter, runoff flow, apartment and domestic activities
2	6°12'0.60"LS; 106°38'14.76"BT	The point that receives water input comes from food / beverage businesses and sports recreation centres
3	6°11'56.59"LS 106°38'11.98"BT	The middle part is the mixing point (point 1 and point 2)
4	6°11'58.13"LS 106°38'9.14"BT	The middle part is the continuation of point 3
5	6°11'47.68"LS 106°38'8.37"BT	The point that receives water input from shopping centres, runoff flow and domestic activities
6	6°11'47.27"LS 106°38'4.62"BT	The middle part is the mixing point of point 5
7	6°11'44.33"LS 106°38'2.02"BT	The point that receives water input from the education centre, runoff flow and domestic activities
8	6°11'44.40"LS 106°38'0.86"BT	The Outlet section which is the last area of Situ Gede waters towards the Cisadane River

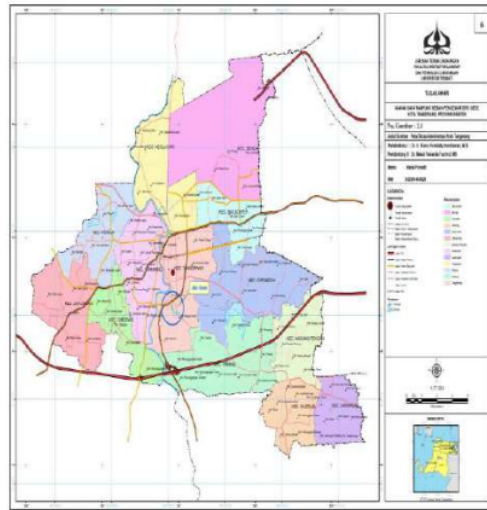


Figure 1. Sampling point of Situ Gede.

3.3. Data analysis

Measured water quality results are then compared with environmental quality standards based on Government Regulation No. 82 of 2001 on Management of Water Quality and Water Pollution Control in accordance with its designation applies the Standard Criteria for Class II Water Quality, in accordance with the water criteria set by the City Government of Tangerang City for Situ Gede which is for recreation [8].

The rate of degradation is the speed of removal of pollutants in the water. The rate of degradation in Situ Gede Waters, Tangerang City, is done by calculating the water residence time and the division of Situ Gede segment. The parameters measured are only BOD parameters, BOD (Biochemical Oxygen Demand) is a characteristic that shows the amount of dissolved oxygen needed by microorganisms (usually bacteria) to decompose or decompose organic matter in aerobic conditions. BOD is important to know the amount of oxygen that will be needed to stabilize organic matter. Then a BOD value will be obtained which will give an idea of the ability of the waters to degrade organic matter. In addition, it can be seen that the ability of the waters to degrade organic matter is still quite good or low. If it is low, it means that the ability to recover water has decreased.

The degradation rate is influenced by residence time (td), mixture concentration and microorganism. The residence time of pollutants in water is one of the factors that can affect the value of the degradation rate. The hydraulic residence time can show the average time or speed of degradation of organic matter. While the waters with stagnant flow, have a faster degradation rate, due to a decrease in oxygen levels. And the speed of decomposition will occur more slowly.

To calculate the hydraulic residence time of each sampling point using a formula Davis and Cornwell [9]:

$$td = V / Q \quad (1)$$

Where:

td = Hydraulic residence time (seconds); V = Volume (m³); Q = Debit (m³/second)

Whereas to calculate the degradation rate Situ Gede uses formulas Davis and Cornwell [9]:

$$Ct = Co. e^{-kt} \quad (2)$$

Where:

C_t : Final concentration (mg/l) t : Hydraulic residence time (seconds)

C_o : Initial concentration (mg/l) k : The degradation rate coefficient (days)

The concentration of the mixture aims to calculate the concentration of pollutant load at each point. The following formula is used to calculate mixed concentrations [9]:

$$C_{\text{camp}} = \frac{(C_1Q_1) + (C_2Q_2) + C_3Q_3 + \dots + (C_nQ_n)}{Q_{\text{total}}} \quad (3)$$

Where:

C_{camp} : Mixture concentration (mg/l) Q_1 : Water discharge at point 1 (m³/second)

C_1 : Concentration at point 1 (mg/l) Q_n : Water discharge at point n (m³/second)

C_n : Concentration at point n (mg/l) Q_{total} : Overall debit (m³/second)

In general, situ and other water reservoirs are described as bodies of water which are perfect mixing sites horizontally and vertically. Where this is based on wind pressure above the water surface which helps mixing in water. The concentration of various materials will remain in situ waters.

4. Results and discussion

4.1. Pollutant source in Situ Gede

Activities around Situ Gede are settlements, food and beverage businesses, laundry, salons, apartments, educational facilities, hospitals, recreation areas and shopping places. These activities have the potential to be sources of pollution. For inorganic waste, the surrounding population does not throw it into Situ Gede. As for the garbage around it comes from food wrap and drinks brought by anglers who are dumped around Situ Gede while fishing. The flow that goes into Situ Gede waters through 4 inlets.

4.2. Water quality of Situ Gede

The following results of BOD concentration for 3 sampling times can be seen in Table 2 below:

Table 2. Results of BOD concentration in Situ Gede waters.

Sampling	BOD (mg/l)							
	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8
1	32,98	35,79	34,10	25,15	8,42	4,30	11,46	20,76
2	7,02	9,82	7,02	9,82	5,61	8,42	5,61	9,82
3	18,24	15,44	15,44	8,42	7,02	7,02	14,03	19,64
Average	19,41	20,35	18,85	14,46	7,02	6,58	10,37	16,74

One indicator of pollution in the waters can be based on the BOD value, where the higher the BOD value the more polluted waters [10]. BOD is a parameter that can be used to describe the presence of organic matter in the waters. The BOD value in Situ Gede waters ranges from 4 mg / l-36 mg / l. The lowest value of 4 mg / l is at point 6 (middle situ), the lower concentration in the middle part describes the occurrence of dilution and degradation in accordance with the residence time there. While the highest value is 36 mg / l measured at point 2 (near restaurants and swimming pools). In sampling 2 the BOD value is relatively smaller than sampling 1 and sampling 3, this is due to the presence of rain so that precipitation occurs and causes the BOD level to decrease. Based on the water quality standard the required BOD value is ≤ 3 mg / l. Thus it is concluded that Situ Gede waters have been polluted by easily decomposed organic matter, which is caused by the density of domestic settlement activities, food and beverage businesses, apartments located around Situ Gede waters so that as seen during monitoring that Situ Gede's physical condition looks cloudy and smell.

4.3. Water degradation rate of Situ Gede

Table 3 shows the results of the Situ Gede Aquatic Degradation Rate calculation. From the table it can be seen that, the average residence time of Situ Gede is 3.05 hours and the mixture concentration is 16.12 mg / l. The calculation results, the degradation rate in Situ Gede is 0.19 / day.

Table 3. Results of pollutant degradation rate in Situ Gede Waters.

Segment	Mixed concentration (mg/l)	Outlet concentration (mg/l)	Td (second)	degradation constant (/days)
A (Inlet)	18,88	19,54	11.264	-0.26
B (Middle)	15,93	13,67	10.755	1,23
C (outlet)	13,56	11,84	10.915	1,07

In accordance with the results of the calculation of the mixture concentration, it can be seen that the concentration of BOD getting closer to the outlet will decrease its concentration. This shows the degradation process of BOD compounds in Situ Gede waters. To find out the residence time in segment Gede, you must first know the volume and debit volume. Hydraulic residence time is influenced by the amount of discharge. The bigger the discharge, the smaller the hydraulic residence time.

A situation with a small outlet flow can have a long detention time. While the larger the outlet discharge, the hydraulic residence time will be smaller. And hydraulic residence time can show the speed of degradation of organic matter that occurs in the waters. In segment A, the constant degradation rate is -0.26 / day with mixed concentrations of 18.88 mg / l, outlet concentration of 19.54 mg / l and residence time of segment A is 11.264 / sec. Segment B, has a degradation rate constant value of 1.23 / day with a mixture concentration of 15.93 mg / l, outlet concentration of 13.67 mg / l and residence time of segment B is 10.755 / sec. Furthermore, segment C, has a degradation rate constant value of 1.07 / day with a mixture concentration of 13.56 mg / l, outlet concentration of 11.84 mg / l and residence time of C segment is 10.915 / sec.

However, in segment A, the constant value of the degradation rate is -0.26 / day, because there is no complete degradation in Situ Gede. In addition, it can be influenced by a short hydraulic residence, so that the process of degradation of organic materials has not run perfectly. The longer the hydraulic residence time in the waters, the greater the allowance for organic materials. This happened because of the addition of waste water in each inlet to the direction of the outlet originating from the activities around Situ Gede.

Situ is inundated waters, then the speed of the waters will occur more slowly and the decomposition process is very dependent on the wind which is strong enough to be able to make waves in the waters, thus helping the degradation process. With the entry of oxygen in the waters will help the growth of aerobic microorganisms that will help the process of reforming organic matter.

5. Conclusion

The conclusions obtained from the study at Situ Gede were that the average residence time of Situ Gede was 3.05 hours and the mixture concentration was 16.12 mg/l. The results of the calculation, the degradation rate at Situ Gede is 0.19/day.

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