The testing of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) of river water in Cipager Cirebon

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Abstract. This research was conducted to investigate the value of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) in river water of Cipager, Cirebon. The object of the study was the water which taken from 6 spots from Cipager River. This research belongs to descriptive research with quantitative approach. Purposive sampling was used in this research. Based on the result of BOD and COD test the data showed that BOD at point 1 was 0.78 mg / l, point 2 was 0.38 mg / l, point 3 was 1.17 mg / l, point 4 was 0.13 mg / l, point 5 of 0.26 mg / l, and point 6 of 0.65 mg / l. In the other hand the COD results at point 1 was 118.8 mg / l, point 2 was 118.8 mg / l, point 3 was 138.6 mg / l, point 4 was 138.6 mg / l, point 5 was 118.8 mg / l, and point 6 is 138.6 mg / l. The result of BOD and COD test shows that T3 was the highest value of BOD with 1.17 mg and COD and 138.6 mg. After the data was analyzed using the pollution index values showed that the level of pollution in the water of Cipager River for class IV water quality criteria was categorized as mild contamination.

1. Introduction
Water is the source of life for humanity. It is the most vital element among the natural resources, and is critical for the survival of all living organisms including human, food production, and economic development [1]. The river as a water source is one of the natural resources that has a versatile function for human life and livelihood. The function of the river is the source of drinking water, sources of irrigation, fisheries, etc. [2]. Cipager River is used as a landfill, single house waste, tofu factory waste, slaughterhouse waste, and batik factory waste. Most of the home industry activities in Kalibaru Village have not yet processed the wastewater. This condition worsens the existing environmental conditions around the factory, where the plant is located together with community settlements, besides that the Cipager river which is located along the Kalibaru Village still plays a vital role for the village community as a source of water for fulfilling the needs of life such as irrigation. COD and BOD are important in the control of the total content of pollution and the management of water environment. Both of them reflect the pollution degree of the water, and are the comprehensive index of the relative content of organics [3]. As the main comprehensive index of the organic pollution, COD and BOD are important in the control of the total content of pollution and the management of water environment.

So it is significant to farther research and develop the simple and rapid method for the determination of COD and BOD. In addition, discharge of municipal and industrial wastewaters as well as agricultural and industrial drainage containing organic materials in the water resource cause the reduction of dissolved oxygen (DO) Biochemical oxygen demand (BOD) is an empirical parameter that refers to the
amount of required oxygen for microorganisms to oxidize organic materials in wastewater, effluent, and polluted water samples [4].

The biochemical aspects that are commonly tested and can be used to determine the level of water pollution are by looking at the oxygen content dissolved in the water. The Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) are the most widely used criteria for water quality assessment [5]. Therefore, it provides information about the ready biodegradable fraction of the organic load in water. Testing related to the content of Oxygen in water can be divided into two, namely BOD stands for Biochemical Oxygen Demand, or biological oxygen needs to break waste material in water by microorganisms and COD stands for Chemical Oxygen Demand, or chemical oxygen requirements for oxidation reactions to materials discharge in water. Based on the description above, the author is interested in conducting research on "Test of BOD and COD on Cipager River Water in Kalibaru Village, Tengah Tani District.

2. Research method

The research method in this study is to use descriptive research analysis with a quantitative approach to the level of river water pollution seen from the biochemical parameters of BOD and COD by the Winkler titration method. Quantitative research is explaining phenomena by collecting numerical data that are analyzed using mathematically [6].

Data collection is done to obtain data as input material for the stages of analysis with the following techniques:

- Collect material or data by studying books related to the problem under study;
- Observation, which is observing directly the condition of the river and the activities of residents along the river such as Bathing, Washing, and Toilet. In addition to seeing directly the waste water of batik which is disposed of directly to the Cipager River which is located along Kalibaru Village;
- Interview with the village and one of the residents of Kalibaru Village regarding the program that has been carried out to overcome the problems in the Cipager River and the activities of residents in the river.

The research point was determined using a "sample survey method", which is a sampling method carried out by dividing the research area into points that are expected to represent the study population. Determination of sampling points is based on consideration of ease of access, costs, and time so that the points considered to represent the water of the Cipager river along Kalibaru Village are determined.

The initial step in determining the location of river water sampling is to know the geography of the river and the activities around the watershed. Location of river water sampling includes:

- Point 1: on the upstream before entering Kalibaru Village and not yet influenced by batik waste.
- Point 2: in the place of river water use for MCK.
- Point 3: in places that have the potential to be contaminated due to the activity of disposal of batik waste and domestic waste.
- Point 4: downstream after batik waste disposal activities and domestic waste.
- Point 5: at the meeting place of two rivers or the location of the entry of a creek.
- Point 6: on the downstream after Kalibaru Village.

Data analysis is intended to find out easily and quickly in proving the research hypothesis, among others, by classifying data in tables, making graphs and calculating mathematically. Data analysis with mathematical calculations in this study is to calculate the Pollution Index (IP).

2.1. Determination of pollution index (IP)

This index has a concept that is different from the Water Quality Index (Water Quality Index). Pollution Index (IP) is determined for a designation, then it can be developed for several allotments for all parts of a water body or part of a river. Management of water quality on the basis of the Pollution Index (IP)
can provide input to decision makers to be able to assess the quality of the water body for an allotment and take measures to improve quality in the event of quality degradation due to the presence of pollutant compounds. IP covers a variety of independent and meaningful quality parameter groups. Determination of the status of water quality using the Index method. Pollution according to the Decree of the State Minister of Environment No.115 of 2003 Appendix II concerning Guidelines for Determining the Status of Water Quality.

In the Pollution Index method is used a variety of water quality parameters, then the use of the average value of the overall Ci / Lij value is used as a benchmark for pollution, but this value will not be meaningful if one of the Ci / Lij values is> 1. So this index must include the maximum Ci / Lij value.

3. Results and discussion
Data from BOD and COD test on Cipager river water along Kalibaru Village, Tengah Tani District, Cirebon Regency, which were carried out in 6 sampling locations were presented in the following table.

### Table 1. BOD determination data.

| No. | Sample | Volume (ml) | N NaSO | Volume TitracijaNa₂S₂O₃ (ml) | DO₄ (mg/l) | DO₅ (mg/l) | BOD (mg/l) |
|-----|--------|-------------|--------|-------------------------------|------------|------------|------------|
| 1.  | T1     | 50          | 0,016  | 1,6                           | 1,4        | 1,2        | 3,89       |
| 2.  | T2     | 50          | 0,016  | 1,0                           | 1,0        | 0,8        | 2,59       |
| 3.  | T3     | 50          | 0,016  | 1,6                           | 1,4        | 1,0        | 3,89       |
| 4.  | T4     | 50          | 0,016  | 1,1                           | 1,3        | 1,0        | 3,11       |
| 5.  | T5     | 50          | 0,016  | 1,1                           | 1,1        | 1,2        | 2,85       |
| 6.  | T6     | 50          | 0,016  | 1,3                           | 1,2        | 1,0        | 3,24       |

Source: (Results of analysis, 2018)

### Table 2. COD determination data.

| No. | Sample | Volume (ml) | N FAS | Volume TitracijaFAS(ml) Blanko | Volume TitracijaFAS(ml) Sample | COD (mg/l) |
|-----|--------|-------------|-------|-------------------------------|-------------------------------|------------|
| 1.  | T1     | 2           | 0,099 | 0,6                           | 0,3                           | 118,8      |
| 2.  | T2     | 2           | 0,099 | 0,6                           | 0,3                           | 118,8      |
| 3.  | T3     | 2           | 0,099 | 0,6                           | 0,2                           | 138,6      |
| 4.  | T4     | 2           | 0,099 | 0,6                           | 0,3                           | 138,6      |
| 5.  | T5     | 2           | 0,099 | 0,6                           | 0,3                           | 118,8      |
| 6.  | T6     | 2           | 0,099 | 0,6                           | 0,2                           | 138,6      |

(Sources: Analysis Result, 2018)
Table 3. Test results of BOD and COD on Cipager river water.

| Parameter | Unit   | T1    | T2    | T3    | T4    | T5    | T6    |
|-----------|--------|-------|-------|-------|-------|-------|-------|
| BOD       | mg/l   | 0.78  | 0.38  | 1.17  | 0.13  | 0.26  | 0.65  |
| COD       | mg/l   | 118.8 | 118.8 | 138.6 | 138.6 | 118.8 | 138.6 |

(Sources: Analysis Result, 2018)

Information:
T1: on the upstream before entering Kalibaru Village and not yet influenced by batik waste.
T2: in the place of river water utilization for MCK.
T3: in places that have the potential to be contaminated due to the activities of batik waste disposal and domestic waste.
T4: downstream after batik waste disposal activities and domestic waste.
T5: at the meeting place of two rivers or the location of the entry of a creek.
T6: on the downstream after Kalibaru Village.

To find out the level of river water pollution can be done by Calculation of Pollution Index. This method can directly link the level of pollution with the presence or absence of the river used for certain uses with certain parameter values. This research was conducted in 6 sampling locations using 2 parameters, namely BOD and COD. The quality standard used refers to the water quality criteria according to the water class in Government Regulation Number82 of 2001 concerning Management of Water Quality and Water Pollution Control. The following is the calculation result of the Cipager River Water Pollution Index in 6 sampling locations: T11,09Pij, T21,08Pij, T31,40Pij, T41,35Pij, T5 1,09 Pij, and T61,36.

The data analysis process in this study uses descriptive statistical data analysis and pollution index calculation based on the Minister of Environment Decree No. 115 of 2003. Descriptive statistics are fields of statistics that study the ways of collecting, compiling and presenting a summary of research data. These data must be summarized properly and regularly, either in the form of tables or graphical presentations, as a basis for various decision making [7]. The results obtained from the data analysis is that the total BOD of 6 points has a minimum yield of 0.13; maximum 1.17; average 0.5617; standard deviation 0.38364. Total COD of 6 points has a minimum yield of 118.80; maximum 138.60; average 128.70; standard deviation of 10.22468. If the mean value> standard value is deviated, then it means that the mean value can be used as a representation of the whole data and if the mean value <standard deviation value the mean value is a bad representative of all data. For the average BOD of 0.5617 with a standard deviation value of 0.38364 and the average COD of 128.70 with a standard deviation value of 10.22468 means that the average value of BOD and COD can be used as a representation of the whole data.

From the results of testing the Cipager river water with BOD biochemical parameters, the highest BOD result is at point 3 of 17 mg / l, where the point is a waste disposal site. Domestic and batik factory waste. The high BOD results are caused by the activities of domestic waste disposal in the river more than the batik factory waste, the location is the place most often used by the community to defecate and waste so that there is an increase in organic matter in river water. The more organic matter content in river water, the more aerobic microorganisms contained in the water so that the oxygen needed by these microorganisms to oxidize organic matter, cell synthesis, and cell oxidation will increase and the BOD value will increase. While the lowest BOD value is at point 4 of 0.13 mg / l, where the point is downstream after the activities of batik and domestic waste disposal so that inorganic waste is antiseptic or toxic, such as phenol, kreolin, detergent, Cyanide acid, insecticides and so on enter the river water which causes microorganisms in the water to die and the number of microorganisms becomes small so that the oxygen needed by microorganisms is also small and the BOD value will be small [8]. The low
BOD value in this study indicates that the contamination of organic matter that is easily dissolved in river water is small.

In COD testing, it was found that the COD results were almost the same at each point, namely at point 1, 2 and 5 at 118.8 mg/l and at point 3, 4, and 6 at 138.6 mg/l. In general, the COD value obtained from the test results because the number of chemical compounds that can be oxidized chemically is greater than biological oxidation. The existence of waste disposal activities adds to the COD pollution load on the Cipager river. This can be seen from the increase in COD at point 3. At point 5 the COD value decreases due to the addition of water flow from the tributary, where point 5 is the meeting place for two rivers or the location of creek entry. The results of the BOD research on 1 to point river water from point Cipager 6 results that meet the class IV water quality standards, while the COD value for class IV water quality criteria is 12 mg/l and maximum COD value of 100 mg/l. Judging from the graph of Pij value for class IV water quality criteria, namely the water for which the designation can be used to irrigate crops and/or uses which require the same water quality. 6, meaning that there has been a decrease in quality Cipager river water from upstream to downstream. This pollution index can provide input to decision makers in order to assess the quality of the water body for a designation. Calculation of pollution index on water for class IV Cipager water quality criteria in this study using two parameters, namely BOD and COD with a maximum BOD value of 12 mg/l, maximum COD value of 100 mg/l. The worst river water quality occurs at point 3, which is located in potentially contaminated areas due to batik waste disposal and domestic waste with mild polluted water conditions. At point 3 there is an increase in pollution index value when compared to point 2. This condition is related to community in segment 2, namely the segment between point 2 and point 3. In segment 2, there is community activity that uses Cipager river water as a bath, wash and defecate. These community activities cause increase in organic matter in river water. From the results of the pollution index calculation above, it is obtained Pij value> 1.0 for the class IV river water quality criteria, meaning that the level of the river Cipager river that is located along Kalibaru Village is included in the category of mild pollution.

4. Conclusion
Based on the results and discussion, it can be concluded as follows:

- BOD results obtained at point 1 of 0.78 mg/l, point 2 of 0.38 mg/l, point 3 of 1.17 mg/l, point 4 of 0.13 mg/l, point 5 of 0.26 mg/l, and point 6 of 0.65 mg/l. While the COD results at the point.
- 1 was 118.8 mg/l, point 2 was 118.8 mg/l, point 3 was 138.6 mg/l, point 4 was 138.6 mg/l, point 5 was 118.8 mg/l, and point 6 of 138.6 mg/l.
- The level of pollution in Cipager river water is seen from BOD and COD tests based on pollution index values according to the Minister of Environment Decree No. 115 of 2003 for class IV water quality criteria categorized as mild pollutants.

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