Case study

WATER QUALITY STATUS OF RIVER DONAN DUE TO OPERATIONAL REFINERY PERTAMINA UNIT IV CILACAP-CENTRAL JAVA-INDONESIA

ABSTRACT

Objective:Indonesian State Oil Company processes crude oil into fuel oil, non-fuel fuel and petrochemical, this activity produces waste that allows pollution of the Donan river. Therefore, this study aims to analyze the quality of donan streams based on water chemical - physical quality, and the plankton and benthos diversity conditions, due to the impact of waste discharged from the installation of wastewater treatment units from cilacap state oil companies.

Methodology: This research was conducted by analyzing water samples with Atomic Absorption Spectrophotometer method. Water sampling is done at point 2 sampling points is at sampling point A = holding basin output 39 and B = holding basin output 66 - 49.**Results**: Based onBiological Oxygen Demand (mg / L) analysis between 5.5 ppm (mg/L) - 7.2 ppm (mg/L),Chemical Oxygen Demand concentration (mg/L) between 33.6 ppm (mg/L) - 33.7 ppm (mg/L). While the concentration of Dissolved Oxygen (mg/L) between 6.0 ppm (mg/L) - 5.9 ppm (mg/L). The results of heavy metal chromium analysis with concentrations between 0.04 ppm (ml/L) - 0.05 ppm (ml/L). Free chlorine concentration with concentration of 0.04 ppm (ml/L) - 0.05 ppm (ml/L). While the concentration of H_2S was 0.2 ppm (mg / L) and the fluoride concentration was 0.88 ppm (mg/L) - 1.01 ppm (mg/L). Based on the quality standards stipulated by Regulation of the Minister of Environment No. 19 of 2010 and Regional Regulations of Central Java, No. 5 of 2012 shows that the Donan river on the verge of polluted. Plankton analysis was found as the dominant species of *Coscinodiscus sp* and *Nitzschia sp* which is a bio-indicator of pollutant.the waters are contaminated lightly

Keywords: Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) Atomic Absorption Spectrophotometer (AAS), *Nitzchia sp, Coscinodiscus sp*

Competing Interests: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

ABSTRACT

Objective:State Oil Company of Indonesia - Unit IV Cilacap Refinery which process crude oil into fuel oil, non-fuel and petrochemical fuel, the activity produces waste that will make possible contamination on the Donan river body. Therefore this study aims to analyze the quality of donan rivers due to the impact of waste discharged from the installation of waste water treatment plant unit IV of the State Oil Company of Indonesia.

Methodology: This research was conducted by analyzing water samples with Atomic Absorption Spectrophotometer method. Water sampling is wasdone at point 2 (two) sampling points that is A = holding basin output 39 and B = holding basin output 66 – 49.

Result: Based on the analysis of BOD (mg / L) between 5,.530 (mg / L) - 7,.188 (mg / L). The concentration of COD (mg / L) between 33.64 (mg / L) - 33.73 (mg / L). While the DO

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concentration (mg / L) between 6.01 (mg / L) - 5.90 (mg / L). The results of heavy metal analysis detected chromium with a concentration of between 0.04 ml / L - 0.05 ml / L. Free chlorine concentration with concentration of 0.04 ml / L - 0.05 ml / L. H_2S concentrations +/- 0.2 (mg / L) and Fluoride concentrations between 0.878 (mg / L) - 1.007 (mg / L). Based on the quality standard set by the Government in Per. Men. LH No. 19 of 2010 and the Regional Regulation of Central Java. No. 5 of 2012that the Donan river on the verge of polluted medium.The plankton analysis was found to be the dominant species of *Coscinodiscus sp* and *Nitzschia sp* which is a pollutant bioindicator

Keywords: Biological Oxygen Demand (BOD), Dissolved Oxygen (DO),Chemical Oxygen Demand (COD) Atomic Absorption Spectrophotometer (AAS), *Nitzchia sp, Coscinodiscus sp*

Competing Interests: The authors have declared that no competing interest exists.
Data Availability:All relevant data are within the paper and its supporting information files.

INTRODUCTION

Oil and Gas Refinery Unit is an Indonesian owned company located in cilacap city, the company is processing crude oil into petroleum and petrochemical fuel. In the process would produce waste that could disrupt the ecological balance to the surrounding environment, especially the donan river (Directorate General of Water Resources 2015). The entry of the remaining production can cause disturbance to the ecological balance, in this case the reduced oxygen content in the donan river water body, the dissolved oxygen content and the amount of oxygen required to oxidize the organik substances, this causes an ecological imbalance in the river body.(Directorate General of Water Resources 2015).Water pollution is the entry or inclusion of living things, substances, energy or other components into the water by human activities, resulting in quality waters down to a certain extent that cause water can not function in accordance with its designation . From the formula can be it is said that water pollution is the decrease of water quality due to its entry pollutant components of human activities or natural processes, so the water is not eligible or even disturbing utilization. (Government of the Republic of Indonesia, 2001)`

Biological components (dissolved oksigen, biochemical oxygen demandand Chemical Oxygen Demand) are often used as an indicator due to changes in water quality so that the biological component can adapt to the occupied environment.among others, benthos because it has three properties that are very helpful in indicating the level of pollution of a waters, namely: a) Has a different level of sensitivity to various types of pollutants and provide rapid reactions to changes that occur. b) Have a low mobility , so it is very easily influenced by the circumstances surrounding environment. c) Easy to catch and identified.Therefore, these indicators are often used to assess a quality of river water(Wilhm, J.L.1975)

Benthic invertebrates are one of the groups of animals that can survive in a bad environment and where pollution buildup of water. Therefore, this group of animals other than a component to balance the aquatic animal community, can also be used as an indicator of water quality of aquatic.. Similarly Plankton is a marine organism whose existence can be serve as an indicator of changes in biological quality of river waters. Plankton which has the nature of always moving can also be used as indicators of pollution waters. It is therefore the diversity and dominance of plankton on river waters is very important. Plankton diversity in a spray shows the quality of a river waters. (Shuh-Sen Young *et al.* 2014)

Oil and Gas Refinery Unit is an Indonesian owned company in accordance with the EPA Standard Industry Classification can be defined as a company engaged in producing gasoline, kerosene, distillate fuel oil, spent fuel oil, and lubricants, by fractionation, crude oil refining, unfinished petroleum derivatives redistilation. The EPA is also considering and selecting the Petroleum Refining category for further review as it ranks fourth highest among all point source categories for both toxic and non-conventional pollutants. Ha is possible to contain vanadium, mercury, and selenium, and also affects the composition of BOD and COD in river flows (Wilhm, J.L. 1975). Similarly, research on the oil company Cilacap needs to be in-depth research in assessing the impact on the water quality of the donan river. The donan river body is the final disposal of the Pertamina crude oil processing plant. (Mitra Adi Pranata, 2015). **Refinery Unit Oil and Gas, Mining Company IV Cilacap is one of Indonesia's state-owned companies that process crude oil into petroleum and petrochemical fuel. In the face of the challenges of the world's increasingly competitive oil processing industry, innovation is needed to develop new technologies to produce better products, in addition to the need to apply the cleaner industry and not negatively affect the environment. The impact of these activities is very necessary to monitor and manage well, so as not to cause environmental damage, especially in Donan river water bodies exposed to direct refinery activity.**[(2)]

The state-owned mining company Cilacap is Southeast Asia's largest crude oil refinery, with a production capacity of 348,000 barrels / day and supplying 34% of Indonesia's fuel needs. This oil refinery process crude oil (crude oil) into non-fuel products and fuel products. Crude oil as the main raw material of oil processing consists of various hydrocarbon compounds which are then treated with a sewage treatment plant and stored in a Clean Water Tank such as waste water. with better quality. Furthermore, waste water is discharged through an outlet on the Donan River.

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Location Unit of Refinery Unit (IV) Cilacap is located on Donan River with length 19,.5 km. The Donan River is a river mouth bordering the sea estuary of the Indian Ocean so that it is hydrogeologically influenced by freshwater and seawater conditions. Donan River serves as a natural drainage channel and a network of water transportation lines and various companies located in this region, therefore Donan river is very important for the surrounding community. The introduction of organic and inorganic materials due to refinery industry activities and domestic activities can cause ecological imbalances in Donan river water bodies[2, 22]. Which allows the carrying capacity of the environment to be unbalanced, resulting in increased pollution load.Around the location of Plant Wax Unit (IV) State oil company,the Donan River characteristic has been affected by the hydrocarbon condition in the water body and the water level of the river will vary according to tidal conditions. The direction of river flow is also influenced by the current pattern of Cilacap marine waters. The environmental aquatic components expected to be affected by the development of the Wax Unit Plant **in this case are aquatic components**. Aquatic ecological limits taking into account potential spreading of waste water spill during transport to vessels and mixing the discharge of liquid waste from activities with the Donan River water bodies. **In** The waters in the study area, including the type of tidal force and semi-diurnal movement pattern that is currently in the tidal period with the current flow of waters of the southern Donan river.The main river that flows in the research area is the Donan River which has a small gradient and is affected by tides. The influence of sea water can reach as far as 5 km upstream. This pattern is influenced by local rainfall and the addition of water from sea to river. even in donan rivers often show puddles. Free ground water is present in very unfragmented quarter deposits that lead to high graduation rates**The influence of this sea water can reach as far as 5 km upstream. This pattern is influenced by local rainfall and, addition of water from river to river rivers Donan is not so great, even in rivers often show marsh or puddles. Free groundwater is present in very unfragmented quarter deposits leading to high graduation rates.. [(2))](Boyd, C.E. 1990.)**

River pollution is a situation where the ecological conditions of attachment are so unbalanced that the water function changes. Based on Government Regulation no. 20/1990 on Water Pollution Control that "water pollution is the entry or the entry of living creatures, substances, energy and other components into the water by human activities and the quality of the water down to a certain extent which causes the water no longer function in accordance with the appointment and utilization.[5]. (IndonesianGovernment Regulation, 1990)**It causes changes in bio-indicators in the river, among others, changes in the condition of dissolved oxygen, the oxygen demand in the water, the demand for chemical oxygen under conditions of diversity of water and plankton-benthos.**This causes changes in bio indicators in the river, among others, changes in Dissolved Oxygen conditions, oxygen demand in water, chemical oxygen demand and plankton-benthos diversity index.Among others, benthos because it has three properties that are very helpful in indicating the level of pollution of a waters, namely: a. Has a different level of sensitivity to various types of pollutants and provide rapid reactions to changes that occur, b. Have a low mobility , so it is very easily influenced by the circumstances surrounding environment and easy to catch and identified. (Onyema, I.C 2013)

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Dissolved Oxygen **(oxygen) oxygen** is needed by the organism in the process of metabolism absence of oxygen in water causes metabolic process is interrupted, so that the organic solute is not degraded completely, this causes metabolic processes become anaerobic and produce toxic compounds such as H_2S and NH_4.(Christy E, et al. 2013).The need for oxygen (BOD_5) is the amount of oxygen required by organisms in the aerobic metabolic process **Aero Bik**, while COD is **a** the chemical oxygen content. , required in degradation of organic material by chemical reaction. COD can also be defined as a parameter to estimate the amount of organic material present in water or water, which is degraded and difficult to degrade. Based on the UNESCO / WHO / UNEP**, 1992.**[6], tThe content of BOD_5 maximum allowed for drinking water and maintenance of aquatic organisms life **is** was 3.0 to 6.0 mg/L, (UNESCO/WHO/UNEP. 1992). **w**While based onministerial ministerial decree number **Kep**.51 / Ministry of Environment and Forestry / 10/1995 that the BOD_5 value for Quality Raw wastewater for industrial purposes Group I is 50 mg / L and Group II was 150 mg / L and COD values for non-contaminated waters have a value of <20 mg / L **L**.

. [7] Plankton and benthos can be used as bio-indicators of water quality, the presence of certain species may indicate **that** the conditions of pollution levels. Plankton and Benthos are organisms that can live **in ecological** and adapt to environmental conditions so that if there is a change of environmental condition, the plankton and benthic **environment** will be adapt to environmental changes. The water quality index is closely related to the water **sapometry** saprobic index as measured by the type of plankton and benthos found, since each type of plankton and benthos is a constituent of a particular saprobic group that will affect the saprobity value of water**. Oligosaprobik Oligosaprobic bio-indicatorair is a classification of waters that have not been contaminated or contaminated lightly, class chlorophage, generally bioindicators that can be well multiply wellied.**. Oligosaprobic bio-indicator water is a classification of waters that have not been contaminated or contaminated lightly, class chlorophage is generally into bioindicator waters with the category oligosaprobic .(Trishala K. Parmar, Deepak Rawtani & Y. K. Agrawal, 2016)Genera of the *chlorophyceae*such as class of the *Spirogyra* and *Desmidium* genera commonly used as water bioindicators are the *Spirogyra* and *Desmidium* genera. The α-**Waters - Mesosaprobik** mesosaprobic is waters with mild to moderate contamination levels. Bioindicators that can develop are divisions of Algae *Melosira* sp, *Spyrogira* sp, *Rhizosolonia* sp., *Nitschia* sp., *Oscillatoria* sp. *Nitzschiaactinastroides* and *Spirulina* sp. The α-mesosaprobic water is characterized by the development of algae from the Bacillariophyceae class, especially *Nitzchia* sp and *Rhizosolenia* sp and from the *Polysaprobic* waters dominated by the Chrysophyceae class, in particular *Spirulina* sp(Onyema, I.C 2013 and Edward G. Bellinger and David C 2010)[8]

This study aims to determine the condition of donan river water before and after the project footprint of State Oil Company, so it can be an effort to manage and monitor the environment in the area. especially if the area will be developed in the future.

APPLICATION METHODS IN SAMPLE

1. The sampling has been done on December, 2017. The onsite temperature were 28 ℃, with air pressure 765 mmHg, humidity 74.4 %– 78.8%. The wind speed were 0.4 – 1.3 m/s with northwest to soutwest direction.

Water sampling is carried out at two sampling points, at the point of sampling (A) near the North Holding Basin outlet and at sample point B near Unit 49 and 66 Holding Basin outlets. The exact location is shown in Figure 1. **The sampling were carried out in 2 sampling points, there are: (A) near the outlet of North Holding Basin (upstream) and (B) near**

outlet of Unit 49 and 66 Holding Basin (downstream). The exact location is shown in figure 1.

The sampling methods for surface water quality were based on Indonesian National Standard (SNI) No. 06-6989.57:2008 of The Methods of Surface Water Sampling. **The sampling technique used in this research is purposive sampling with research location conducted in Donan River area, Cilacap regency - Central Java. Water quality measurements were carried out in 2 locations, namely A = DAS of the Donan River 39 holding output (location before project) and Location B that the Donan River is flowing 66 and 49 holding output (after project location).**

2. The analysis of heavy metal content was **using** used AAS **(**-Atomic Absorption Spectrophotometry**)**(Varian, 2015)and [11,13], while the **suspension suspended suspendeds suspension**Total Suspended Solid (TSS)analysis was used **with**gravimetric method[4]., (Indonesian National Standard. 2017, Letter J., A.M. Teeter, B.P. Donnel. 2003)

   Sampling of plankton and benthos is done at the same point.The fitoplankton and zooplankton sample were taken using plankton net with mesh size of 30-50 µm for fitoplankton and 0.2 mm for zooplankton. Then, the sampel were preserved with 4-5% formalin solution.[23] (Goswami, S.C., 2004). The identification of plankton were usedidentification key such as Bold & Wynne (1978),and APHA (1992) and **and Humm & Wicks (1980).**

   Tthe benthos sample were taken by grab sampler. The sediment that had been taken were sifted in the water by 5 mesh sieve (2.54mm). The filtered material then preserved by 10% formalin solution that had been added with coloring solution. Then, the sample were identified by identification key.

3. The plankton and benthos that had been identified then analyzed with standard Shanon-Wiener diversity index.

Research using survey method and data analysis done descriptive qualitative, that is by explaining what happened. by providing sufficient explanation based on facts obtained in the field and the results of laboratory analysis. While plankton and benthos analysis as biological indicator was done by filtering the substrate of mud or river basin by using sample of Eckman Grab (benthos) and plankton net (plankton) and then analyzed in laboratory, with standard Shannon - Wiener diversity index method. : [1, 16]

Sampling was done on December 16, 2017. at temperature 28 o Celcius, air pressure 765 mmHg, humidity 74,4 -78,7% H2O with wind direction northwest to southeast, wind speed 0,4-1,3 m / s with cloudy weather

The materials in this study include the Donan river water samples used to see the water quality concentration, while the water quality parameters measured were temperature, TSS, pH, DO, BOD, COD, chromium and phosphate. Measurements of TSS, BOD, COD, Phosphat and Chromium parameters (Indonesian National Standard No. 06-6989.3: 2004) and APHA Standard Methods for Water and Wastewater Inspection [10, 14,15]

Figure 1. below shows the sampling points of surface water, plankton and benthos, as follows:

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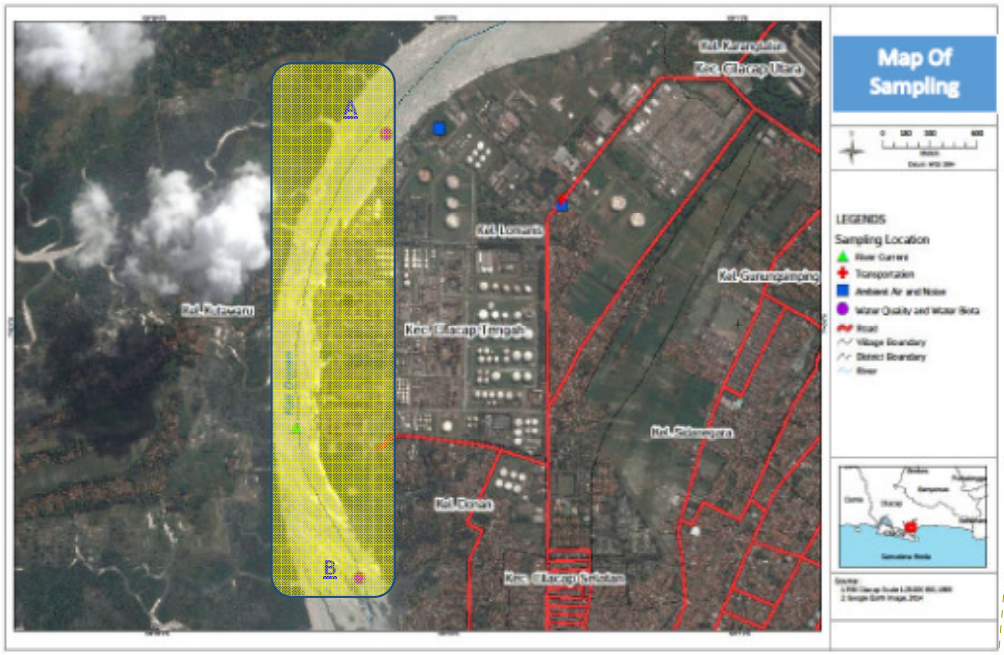

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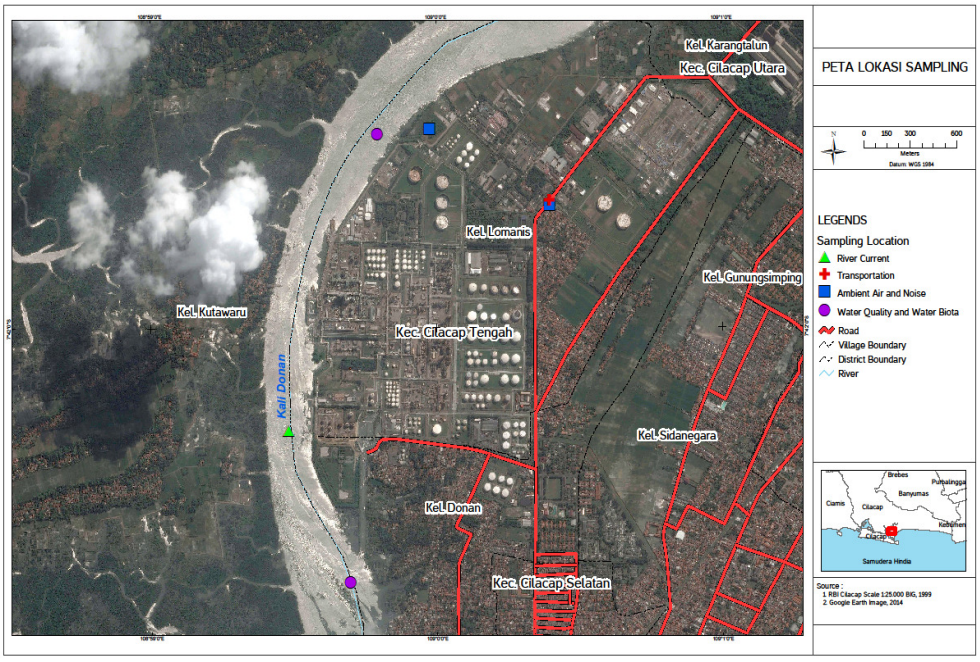

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Figure 1. Water Sampling Point, Plankton And Benthos (Sampling A = Donan River,near outlet of **Basin 39** north Holding **Output** BasinAnd Sampling B = Donan River, near outlet of holding Basin 66 And Holding Basin 49 **Holding Output**)[2]

RESULTS AND DISCUSSION

~~The state-owned mining company Cilacap is Southeast Asia's largest crude oil refinery, with a production capacity of 348,000 barrels / day and supplying 34% of Indonesia's fuel needs. This oil refinery process crude oil (crude oil) into non-fuel products and fuel products. Crude oil as the main raw material of oil processing consists of various hydrocarbon compounds which are then treated with a sewage treatment plant and stored in a Clean Water Tank such as waste water. with better quality. Furthermore, waste water is discharged through an outlet on the Donan River.~~Based on the analysis results Measurement of water quality is done in 2 locations **with the following measurements**as follows:

Table 1. Water Quality Measurement Data (Mitra Adi Pranata, 2015)[2]

No	Parameter	Unit	Sampling Location		Water Quality Criteria Based on Maximum Class Level (PP No. 82/2001))[12]			
			A (sampling before project)	B (sampling after project)	Class I	Class II	Class III	Class IV
	I. PHYSICS							
1	Temperature	℃	31,,7^0	31,,9^0	Deviation+/- 3	Deviation +/- 3	Deviation+/- 3	Deviation+/- 3
2	Dissolved Residue	mg/L	15,,752	11,,916	1,,000	1,,000	1,,000	1,,000
3	Suspended Residue	mg/L	22	32	50	50	400	400
	II. CHEMICAL							
1	pH	-	7,,9	7,,8	6 - 9	6 – 9	6 – 9	6 – 9
2	BOD	mg/L	5,,530	7,,2188	2	3	6	12
3	COD	mg/L	33,,764	33,,73	10	25	50	100
4	DO	mg/L	6,,01	5,,90	6	4	3	0
5	Total Phosphate as P	mg/L	< 0,,001	< 0,,001	0,,2	0,,2	1	5
6	NO3 as N	mg/L	0,,018	0,,161	10	10	20	20
7	Arsenic (As)	mg/L	< 0,,003	< 0,,003	0,,05	1	1	1
8	Cadmium (Cd)	mg/L	< 0,,010	< 0,,010	0,,01	0,,01	0,,01	0,,01
9	Chromium (Cr +6)	mg/L	0,,004	0,,005	0,,05	0,,05	0,,05	1
10	Copper (Cu)	mg/L	< 0,,010	< 0,,010	0,,2	0,,2	0,,2	0,,2
11	Lead (Pb)	mg/L	< 0,,030	< 0,,030	0,,3	0,,3	0,,3	1
12	Mercury (Hg)	mg/L	< 0,,001	< 0,,001	0,,001	0,,002	0,,002	0,,005

13	Zinc (Zn)	mg/L	< 0,.001	< 0,.001	0,.05	0,.05	0,.05	2
14	Cyanide (CN)	mg/L	< 0,.002	< 0,.002	0,.02	0,.02	0,.02	-
15	Fluoride (F)	mg/L	0,.8878	1,.0107	0,.5	1,.5	1,.5	-
16	Nitrit as N (NO_2)	mg/L	< 0,.001	< 0,.001	0,.06	0,.06	0,.06	-
17	Free chlorine	mg/L	0,.02	0,.02	0,.03	0,.03	0,.03	-
18	Sulfur as H2S	mg/L	< 0,.002	0,.002	0,.002	0,.002	0,.002	-
	III. ORGANIC CHEMICALS							
1	Oil and fat	µg/L	250	500	1,.000	1,.000	1,.000	-
2	Detergent as MBAS	µg/L	12	21	200	200	200	-
3	Phenol compounds as Phenol	µg/L	< 1	< 1	1	1	1	-
	IV. MICROBIOLOGY							
1	Faecal Coliform	Jml/100 mL	330	270	100	1,.,000	2,.,000	2,.,000
2	Total Coliform	Jml/100 mL	330	270	1,.,000	3,.,000	1.0,.000	10,.,000

Description: A = Donan River basin holding output 39 Source: Primary Data Analysis Result, 2014
B = Donan River basin holding output 66 and 49

a) First class, water which can be used for drinking water, and / or other designations that require the same water quality as that purpose;
b) Secondary classes, water which may be used for recreational water facilities, cultivation of freshwater fish, farms, water to irrigate crops, and or other designations that require the same water quality as those uses;
c) Class three, water whose designation may be used for the cultivation of freshwater fish, farms, water to irrigate crops, and or other designations that require the same water quality as those uses;
d) Class four, the water of which the designation may be used to irrigate crops and / or other designations which require the same water quality as those uses

Based on the analysis of the water sample then some parameters have exceeded the specified limit is are as follows :

BOD (mg/L) value range 5,.530- 7,.2 ppm188, COD (mg/L) value range 33,.64- 33,.73, DO (mg/L)value range 6,.01- 5,.90 ppm, Fluoride **(F)** (mg/L) value range 0,..878 -1,..007 ppm , while the other parameters are still below the specified threshold base on Government of the Republic of Indonesia, 2001. Indonesia Government Regulation No. 82 of 2001 on Water Quality Management and Water Pollution Control . (Indonesia Government Regulation, 2001)[12]

a. Dissolved Oxygen

The need for dissolved oxygen in the waters of the Donan river will increase as the oxygen demand of water organisms increases to metabolize organic matter. Therefore, an increase in organic matter will increase the oxygen demand in donan river waters. The quality of donan river waters on Dissolved Oxygen parameters are classified as mild contamination streams, based on measurement results show that DO (mg / L) has a value between 6.01 - 5.90ppm (mg / L)**The increase in DO due to The need of dissolved oxygen in the waters of the Donan**

river will increase due will increase due to the increase of oxygen demand of ofaquatic organisms become high to metabolize organic material metabolism. Therefore, twith the increase of ingredient ingredients, especially organic ingredients will be increasinge the need for oxygen in the waters of the river donan. The quality of donan river waters at Dissolved Oxygen parmeter is classified as mild contaminated. The measurement results indicate that DO (mg / L) has a value between 6.01 - 5.90. and belongs This DO level were in the first class category to the category First class, water which can be used for drinking water, and / or other designs that require the same water quality as that purpose [12] (Indonesia Government Regulation, 2001)

b. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Biological Oxygen Deman (BOD) condition is very related to the content of Dissolved Oxygen (DO) in a waters, this is linear. ,If BOD needs increase then DO will also rise. Biological Oxygen Demand (BOD) is the Oxygen Needs required by all biological activities in water. Biological imbalances in the waters cause water to become polluted (APHA, 1992**10**). The higher the BOD requirement, the worse the water conservation. also according to lee *at al* (1978) BOD value 5,.530 ppm - 7,.1988 ppm included in the range of 5 ppm -15 ppm Waters with fairly polluted criteria. The COD number is a measure for water pollution by organic substances that can be oxidized naturally through microbiological processes, and result in reduced oxygen in water (Poole, R.W., 1974) **18).**. The COD value is always higher than the BOD value. The differences between the two values (BOD and COD) are caused by many factors such as chemicals that are resistant to biochemical oxidation but are not resistant to chemical oxidation, such as lignin, (Environmental Protection Agency, 2001)[19].

Based on the analysis with BOD parameter, the donan river is included in the category of medium polluted river (Government Regulation No. 82/2001)[12] , While based on the analysis with COD parameters then the Donan river with COD value = 33.64 ppm -– 33.,73 ppm (Table 1) , included in the category of mild contaminated streams that are class 3 categories based on government regulations on the quality of river water (standard 50 ppm - 100 ppm).**including in the category of mild contaminated river, class 3 (standard 50 ppm - 100 ppm). Based on the BOD-COD analysis on the status of the Donan river waters is a river with mildly polluted criteria, and the retention of the State Oil Company Retentive activity has no significant effect.**

c. Flouride

Based on Indonesia Government Regulation no. 82 of 2001 on the Management and Control of Water Quality for First Class Water Pollution that is water that can be used for drinking water requires maximum permissible fluoride level of 0.5 ppm (mg/L) Effect of fluoride may be detrimental to health if at high exposure, Fluoride compound mechanism in the body it is possible to inhibit nerve impulses and inhibit resistance chains so as to cause necrosis, if fluorescent fluids range from 3 ppm to 10 ppm (mg / L) (WHO, 2004)

Based on the measurement results that the content of fluoride from the Donan flow is in the range of 0.88 mg - 1.01 ppm (mg /L) included in the category of mild contamination so that the waters of the donan river belonging to Class 1 category is mild contamination so that water category can be used as raw drinking water source after cooking (Chinoy, NJ , et al, 1994and Government of the Republic of Indonesia, 2001)

Based on Minister of Health Republic Indonesia regulation 492 / Menkes / Per / IV / 2010[9] about drinking water quality requirements, fluoride including parameters that are directly related to health. The maximum allowable fluoride content is 1.5 mg / l, whereas based on Government Regulation No. 82 of 2001 on Water Quality Management and Control of First Class Water Pollution ie water which can be used for drinking water water requires maximum permissible fluoride flouride levels Is 0.5 mg / l. The influence of floride can be detrimental to health if at high exposure, The fluoride mechanism in the body is possible to inhibit nerve impulses and inhibit the resurgence chain so that it can cause necrosis, if flouride exposure ranges from 3 to 10 mg[20]

The fluoride content of the Donan stream is in the range of 0.878 mg - 1.007 mg, included in the category of mild contaminated contamination so the donan stream belongs to the category of class 1 (First class, water which can be used for drinking water, and / or other designations that require the same water quality as that purpose) [3, 12]

d. Plankton and Benthos

The quality of donan river can be known based on the plankton diversity index and benthos. The plankton diversity index is the ratio value of the number of an individual of each type to the total number of indi- viduals of all species found. The plankton diversity index is the ratio value of the number of an individual of each type to the total number of indi- viduals of all species found. The diversity index (H) represents the species diversity of plankton and benthos inhabiting a community, where the value of diversity is closely related to the small number of species present in the community denoted by H.

Plankton and benthos are organisms that can be used as bioindicators of water pollution, therefore plankton and benthos sampling are important parameters.[8](Onyema, I.C 2013). Sampling of plankton and benthos was conducted at the same location as water quality sampling. Sampling is done at two points, namely the Donan River output from North Basin Holding, and Donan River output from Holding Basin Units 66 and Unit 49. Table 2 shows Plankton and Benthos sampling results in waters around the study area as follows:

Tabel 2. Plankton Analysis in Donan River Waters(Mitra Adi Pranata, 2015 and Kathleen A. Nolan and Jill E. 2005) [1, 2]

No	Species (Type)	Sampling after Project (ind/L)	Sampling before Project (ind/L)
1	*Asterionella sp*	1	-
2	*Biddulphia sp*	-	1
3	*Chaetoceros sp*	2	9
4	*Codonellopsis sp*	3	-
5	*Coscinodiscus sp*	3	79
6	*Cyclops sp*	64	6
7	*Nauplius sp*	76	80
8	*Nitzchia sp*	1	-
9	*Peridinium sp*	2	39
10	*Thalasiothrix sp*	-	2
	Number of types	8	7
	Number of individuals	152	216
	Index of diversity (H)	1,.0545	1,.3545
	Index dominance	0,.4982	0,.3106
	Uniformity index	0,.2108	0,.250

Source: Primary data analysis results, 2014

Water quality based on plankton and benthos diversity is calculated by using the shannon winner diversity index as follows (Kathleen A. Nolan and Jill E. 2005)[1]:

$H = - \Sigma \, pi \ln pi$

Information:
pi = comparison of the number of individuals of a type with the whole type
The pollution index is divided into four categories:
> 2.0 = Unaffected
2.0 - 1.6 = Pure Light
1.5 - 1.0 = Medium Medium
<1.0 = Seriously Weight

Most of the identified plankton are diatoms. Some types of diatoms can be used as environmental bioindicators. Type *Coscinodiscus* is a type of plankton that can survive in waters that contain lots of calcium while the type of *Nitzchia* can survive at high H_2S levels[8]. From the result of measurement of water quality of H_2S parameter shows the value of 0,.002 ppm (mg / l) and has been on the threshold of water quality standard for class I, II and III. The value of the diversity index shows that the quality of the waters is contaminated lightly so that the plankton community in the waters is quite good. The stability of the plankton community is supported by a dominant index value ranging from 0.114 to 0.156base on shannon winner diversity index indicating that no species dominates other species so that the plankton community structure becomes stable.[8](Onyema, I.C 2013)

Benthos are organisms that live in the bottom of the water (substrate) either sleazy, creep or dig a hole. Bentos live in sand, mud, rocks, broken corals or dead corals. The aquatic substrates and depths affect the pattern of dispersal and functional morphology as well as the behavior of benthic animals. This is related to the characteristics and types of food benthos. Bentos is an organism that lives on the seabed or river either attached to sand or mud. Some examples of bentos include shellfish, sea urchins, starfish, sea whips, coral reefs and others. Animals bentos live relatively settled, so good used as a guide of environmental quality, because it is always in contact with waste into its habitat(Ernest Hodgson, 2004)[8.17]. The result of bentos analysis in the study area is presented in table 3 below:

Table 3. Bentos Analysis Of Sampling at DonanRiver(Mitra Adi Pranata, 2015)**(1,2)**

No	Species (Type)	Sampling after Project (ind/L)	Sampling before Project (ind/L)
1	*Macoma sp*	4	6
2	*Macula sp*	4	2
3	*Prothothaca sp*	2	4
4	*Tagelus sp*	4	4
	Number of types	4	4
	Number of individuals	14	16
	Index of diversity Diversity index	1,.352	1,.321
	Index dominance Dominance index	0,.1984	0,.141
	Uniformity index	0,.512	0,.4876

Source: Primary data analysis results, 2014

According to Lee, et.al, 1978, water quality criteria associated with the Sannon winner Diversity Index are: (<1.0) highly polluted; (1.0 - 1.5) is sufficiently polluted; (1.5 - 2.0) is lightly contaminated, and; (> 2) has not been polluted. Based on benthos analysis, sample diversity index A = 1.35 and sample B = 1.32 indicating that benthos diversity index in donan river is mild-moderate contaminated category (**Lee, C.D et al. 1978)**

The condition of waters in the mild-moderate category of contamination is usually dominated by shrubs (bivalves) that live in mud substrate and sandy mud, because their shells (bivalves) are able to utilize the remaining organic material as a source of energy. . Therefore, bivalves may be used as an indicator of bio-water contaminated with organic matter under moderate-to-moderate category (Kaushik Guptaet al, 2015)

According to Lee, et.al, 1978, water quality criteria related to the Diversity Index are: (<1.0) heavily polluted; (1.0 - 1.5) is moderately polluted; (1.5 - 2.0) is lightly contaminated, and; (> 2) has not been polluted. Based on the result of benthos analysis, the result of diversity indexdiversity index on of sampling sampleA = 1.352 and sampling sampleB = 1,.321, it shows that benthos diversity index in donan river is included in moderately polluted category; (index diversity = 1.5 - 2.0). [(18)]

In The condition of waters in the category of polluted medium polluted category is usually dominated by shellfish species (bivalves) that live in the substrate of mud and sandy mud, this is because the shell (bivalvia) is able to utilize the

remaining organic material as a source of energy.Therefore,bivalves can be used as bio-indicators waters are contaminated with organic materials of moderate-to-moderate category[21]

CONCLUSION

Conclusion Of Research I Shows That The Operational Activity Of Pertamina Iv Cilacap Refinery Does Not Have A Significant Impact On Water Quality Of Donan River Between Chemical Equipment, Physics And Biology So River Donan Still In Light Category Light

Based on the Result of Donan River Water Quality Analysis result of Donan River, where the donan river is the waste disposal site of Operation Refinery Indonesian state oil mining company Unit IV Cilacap Pertamina Unit IV Cilacap-Central Java, is as follows:

1. The DO- BOD and COD parameters indicate that the quality of the Donan streams riverincluding is in the polluted category is in based on accordance with Government Regulation no. 82/2001
2. Flouride Parameters, indicate the quality of Donan river included is in the category of first class 1, based on Minister of Health Republic Indonesia regulation 492 / Menkes / Per / IV / 2010 ie water which can be used for drinking water, and / or other designs that require the same water quality as that purpose
3. Plankton and benthos parameters, the quality of Donan streams riverwere includedis in the mild-moderate polluted category based on the diversity index with values of 1.352 (sampling A) and 1.321 (sampling B) (index diversity standard = 1.5 - 2.0, based on lee et al, 1978)

This conclusion shows that the operational activity of PERTAMINA Refinery Unit IV Cilacap Indonesian state oil mining company Unit IV of Cilacap-Central Java does not show give significant impact to the water quality of the river Donan river.

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