

BOD and DO Identification of Jeneberrang-River Water as Water Source

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Abstract: Water is a part of life on the surface of the earth. It is not a new substance which no life on earth can survive without water. This study aims to identify the quality of river water of jeneberang as municipal waterworks (PDAM) raw regarding to turbidity parameters, BOD, and DO. The used methodology is observational with descriptive approach. The sampling technique was done by grasping each sample for turbidity parameter, BOD and DO in four IPAM water inlet of Makassar City. This sampling was conducted at Laboratory of Environmental Health Engineering Center (BTKL) and Disease Control using Nephelometric Turbidity Unit, Titrimetry, and Spectrophotometric method. The results of the examination showed that the turbidity level > 5 NTU, so it is not eligible to be drunk directly. The levels for BOD and eligibles for not exceeding the specified limits are <3 mg / l and <25 mg / l and in DO for Maccini Sombala <4 mg / l region, so it is not eligible. The conclusion in this research that turbidity parameter, BOD and DO qualify as the raw water of PDAM have to be processed so that water can be drunk by society.

Keywords: Turbidity, BOD, and DO

[1] Introduction

The provision of drinking water to public has to meet with the quality requirements including physical, biological, chemical and radiological. Nowadays, surface water (rivers, springs, reservoirs and so on) is still becoming a source of raw water to meet human demands, whether processed through a government-run or managed private water supply company. Biological and radioactive is necessary to control the quality of raw water to produce drinking water to public that meets the requirements because its water is easily contaminated by chemicals [1].

National Socioeconomic Survey Data (SUSENAS) (2010) revealed that Indonesians with access to clean water only 44.19% and 55.54% who had no access to basic sanitation facilities. The total population of Indonesia in 2015 was about 248 million people based on the results of the 2010 Basic Health Research as many as 110 million people (44.5%) had not access to sanitation and 55 million people (22.1%) did not possess access to drinking water, rural population was estimated at 153 million people (61.5%) who had no encroach to sanitation and 77 million (31%) who did not have infiltrate to drinking water [2].

According to Minister of Health Regulation (Permenkes) no. 416 / MENKES / PER / IX / 1990 referred to as "clean water" is water used for daily purposes whose quality meets health



requirements and can be drunk when cooked. Clean water has to obviously own high quality physically, chemically and biologically to prevent disease [3].

Clean water supply in Indonesia especially for large scale is concentrated in urban areas, and managed by the Municipal Waterworks (PDAM) concerned. One of the Providers of Water Supply in South Sulawesi province, PDAM Kota Makassar. PDAM Makassar is one of 12 drinking water companies entering the big group in Indonesia. It has a customer above 100,000 customers. Raw water source is used by PDAM Kota Makassar to serve the provision of drinking water mostly derived from surface water (river), the Jeneberang River and Maros River [4].

Water quality can be determined by testing the water. The tests are often in chemical, and biological (smell and color) tests. It can be expressed by several parameters, for instance, physical parameters (temperature, turbidity, dissolved solids, etc.), chemical parameters (pH, dissolved oxygen, BOD, metal content, etc.) and biological parameters (presence of plankton, bacteria and so on) [5].

Regarding to data obtained from South Sulawesi BLHD in the end of 2013, Jeneberang River water quality was at severe pollutant level. The parameters referred to the TSS, BOD, NO₂, H₂S, and CI test results that were above the standard. This condition was exacerbated worsened by forest land around the Jeneberang River which is about 2,462 hectares, classified as critical [6].

Apriyantomo and Nurbowo stated that Jeneberang River as the raw water source of PDAM Makassar which was the supplier of urban water supply in Makassar must meet the criteria and requirements of the parameters. When the content of BOD and DO in water was high, it produced a high organic material so it could be a growth medium of various types of microbes causing unpleasant odors. To reduce the odor required activated carbon by utilizing halalan thayyiban materials in accordance with Islamic Shari'a. Therefore, determining the level of dissolved oxygen contained in water should be examined the levels of oxygen [7].

Based on the results of research which was conducted by Malokoudi River Ereniku, one of the rivers on the Continental Europe based on testing for physical and chemical parameters. There were several increases in temperature, pH, turbidity and dissolved oxygen (DO), relating to the analysis. The temperature as the most important parameter showed that there was an increase in temperature of each point of 7.9 ° at the first chemical point to 19.5 ° at the second point, turbidity also increased from 5, 9 to 25.5, while the pH value at the first point of 8.08 increased to 9.82 in the second point and DO at the first point 6.8mg / L increased to 10.8 mg / L [15].

[2] Method

Sampling Technique used for Ratulangi PDAM (IPA) is Graping Samples method. Temporary Example represents the state of water at any point from a place when a water source has characteristics that have not changed much in a short-time period. The characteristics of river water within a period or within a certain distance limit then the momentary example simply represents the time and place. Generally, a momentary example uses a 24-hour sampling period. The sample is taken from the point before entering into the inlet from the upstream of the river at the sampling frequency of three times in the morning at around 09:00 to 10:00 pm, at noon around 13:00 to 14:30 pm and in the afternoon at around 16:00-17:00 pm. Primary data was obtained from the results of the examination at the Laboratory of Environmental Health Engineering (BTKL) and the Control of Banta-Bantaeng Disease of South Sulawesi Province of Makassar City.

[3] Result

The results of examination from Laboratory of BTKL and Disease Control showed that the level of turbidity inlet IPA Makassar PDAM did not fulfill the requirement as raw drinking water based on second class because of the turbidity level of each inlets if related to PP. 82 of 2001 and Permenkes 416 of 1990 were in the range of 5 NTU and above while the maximum limit of turbidity is 5 NTU (Table 1).

The examined result of BOD inlet parameter of PDAM Makassar in Laboratory of BTKL and Disease Control showed that BOD content qualified as raw drinking water based on class II because BOD content in IPAM Inlet IPA Makassar was in the range <3 mg / l. Hence, it could be concluded

that BOD content qualified as raw drinking water in accordance with PP. 82 of 2001 and South Sulawesi Provincial Governor Regulation Number 69 of 2010 (Table 2).

The examination results of the parameters in DO inlet IPA PDAM Makassar from BTKL Laboratory and Disease Control Center indicated that the level of DO there were qualified as raw drinking water based on class II. Some results were not eligible if associated with PP. 82 Year 2001 and South Sulawesi Provincial Governor Regulation No. 69 of 2010. IPA V Inlet Somba Opu, IPAT Ratulangi inlet and IPAK Malengkeri inlet of its DO content qualify as raw drinking water for the level of DO in the three inlets IPA Makassar PDAM was located in range $> 4 \text{ mg / l}$. The level of DO did not meet the requirements of DO levels in IPA IV Inlet Maccini Sombala in the morning due the fact that its DO levels were in the range of 2.49 mg / l . Thus, it did not meet the requirements as raw materials of drinking water class of second class because $< 4 \text{ mg / l}$ (Table 3).

[4] Discussion

The turbidity parameter was measured by using a Turbiquant 3000 IR instrument. The Turbiquant 3000 IR tool will read the turbidity scale measurement results (SNI.06-6989.25-2005). The all results which were read by the tool are not qualified as raw materials of drinking water class II in accordance with PP. 82 year 2001 and Permenkes 416 year 1990 because turbidity level is above 5 NTU with average pH is in the range of 6,4-6,8 [8]. Therefore, the water turbidity level of Jeneberang River as raw water of PDAM was not feasible to be drunk directly but it must be firstly neutralized. The PDAM should perform several clarification stages, for example, the coagulation stage which was the phase of charge neutralization with the addition of certain chemicals to ensure maximum contact between the suspended solids and the added chemicals.

The result of turbidity parameter research was in line with research conducted by Makassar PDAM side, with turbidity level in each IPAM IPA inlet ranged from 21,40 NTU-120 NTU. This indicated that the turbidity level in each IPAM inlet of PDAM Makassar originating from Jeneberang River was not qualified as PDAM raw water and as raw material of clean water and drinking water as contained in Permenkes 416 of 1990 that limit the maximum level for turbidity is 5 NTU.

BOD parameters are measured by titrimetric method. BOD is one of pollutant indicator parameters in water caused by organic waste. Its presence in the environment is largely determined by organic waste, whether from domestic waste or from industrial waste [9].

Based on the laboratory test result data, BOD inlet level of IPA PDAM Makassar if related to PP. 82 of 2001, and South Sulawesi Provincial Governor Regulation No. 69 of 2010 qualifies as raw drinking water regarding to class II because BOD content in IPAM inlet of Makassar PDAM is in the range $< 3 \text{ mg / l}$ therefore it can be argued that the lower the BOD, the higher DO [10]. BOD in the Makassar PDAM inlet can be decomposed aerobically to the maximum because the organic matter contained in the waste water is low. Thus, the oxygen supply increases and goes on continuously [11].

Other research results were regarding to this research conducted by Fadhillah Jamal, which showed the measurement of raw water quality of PDAM on IPA transmission channel Panaikang. For BOD parameters, there were eligible whilst others were not qualified [12]. For example, point 1,3,4,5,6, and 7 qualified each ranged between 2.96 mg / l , 2.32 mg / l , 2.28 mg / l , 2.64 mg / l , 2.96 mg / l and 2.32 mg / l and all of these were $< 3 \text{ mg / l}$ according to PP. 82 for 2001 and South Sulawesi Provincial Governor Regulation No. 69 of 2010. As for point 2 and point 8 BOD levels ranged between 3.28 mg / l and 3.92 mg / l and both were $> 3 \text{ mg / l}$, hence, that they did not meet the requirements as the water of PDAM in accordance with PP. 82 of 2001 and South Sulawesi Provincial Governor Regulation No. 69 of 2010. This was because at point 2 that in the village of Kabung District Tanralili Maros regency there were activities of citizens who used water for bathing and washing, land use consisted of settlements, rice fields, gardens, poultry, cattle and buffalo. Point 8 that was in the IPA Panaikang Jl. Abd. Daeng Sirua was a dense end-use density intake, close to markets and shops, there were several garbage containers at the edge of the canal, lots of piles of scattered waste.

Similar to BOD research, DO research was also measured by titrimetric method using a winkler bottle. According to Government Regulation on Water Quality Management and Water Pollution Control and South Sulawesi Provincial Governor Regulation No. 69 of 2010 that the minimum dissolved Oxygen (DO) limit for class II water quality is 4 mg / l, based on the calculation of DOs obtained dissolved oxygen for three IPA IPAM inlets were IPA V Somba Opu inlet, IPAL Malengkeri inlet and IPA Ratulangi inlet are in the range of 5.3 - 8.5 mg / l, the dissolved oxygen in Jeneberang river water was below the minimum limit so that it qualified as raw drinking water.

The highly oxygen content dissolved in water at the IPA V inlet Somba Opu, IPAT inlet Ratulangi and Inlet IPA Malengkeri showed that the degree of water contamination in the inlet was small realtif. This was caused by the absence of settlements around the inlet, so that the contamination by the waste and domestic waste did not exist then caused the process of decomposition in the water was relatively low. It also witnessed that the Jeneberang River was still safe for the life of aquatic biota such as fish and others.

However, it could not be denied that the current levels of DO would decline someday due to human activity and the existence of the industry along the Jeneberang River such as tofu factories in Pangkabinanga and the Sungguminasa mains market. The difference of dissolved oxygen content in water at each sampling point was influenced by the difference of sampling location so that the effect on the temperature that affects the dissolved oxygen content in the water. As well as other factors such as biological activity, photosynthesis activities, and waste or the influence of terrestrial activity.

Uncomplicated DO levels whereas DO levels in IPA IV Inlet Maccini Sombala in the morning due to its DO levels were in the range of 2.49 mg / l so as not to qualify as raw materials for second class drinking water because <4 mg / l . The low content of dissolved oxygen at the sample point was due to the habit of disposing of waste by residents around the river into the river where most of the waste is organic waste. In addition, the researchers observed that the low dissolved oxygen content in the Maccini Sombala area in the morning was due to the fact that at night trucks picking up sand and sand dredging could increase the turbidity of raw water so that dissolved oxygen content was low. This was also because of the Mayor Regulation no. 94 of 2013 concerning the ban on 10-wheeler trucks operating during the day[13].

The waste will be decomposed in water by microorganisms so that the decomposition of compounds by microorganisms utilized oxygen so that the dissolved oxygen (DO) decreased. The higher the dissolved oxygen in the water, the easier the life of the water biota to live, the lower the oxygen was dissolved in the water, the more difficult life of the water biota to live[14].

Table 1
Results of Turbidity Parameter Examination on Jeneberang River Water
in Every Inlet Municipal Waterworks (PDAM) Makassar City

| Times | Results of Parameter Turbidity (NTU) | | | |
|-----------|--------------------------------------|---------------------|---------------------------|----------------------|
| | Inlet IPA Somba Opu | Inlet IPA Ratulangi | Inlet IPA Maccini Sombala | Inlet IPA Malengkeri |
| Morning | 78,59 | 38,85 | 11,45 | 101,39 |
| Noon | 102,20 | 24,39 | 10,61 | 88,76 |
| Afternoon | 79,16 | 21,34 | 8,01 | 1972,8 |

Table 2
Results of BOD (Bissolved Oxygen Demand) Parameter on Jeneberang River
Water in Every Inlet Municipal Waterworks (PDAM) Makassar City

| Times | Results of Parameter BOD (Bissolved Oxygen Demand) (mg/l) |
|-------|---|
|-------|---|

| | Inlet IPA Somba Opu | Inlet IPA Ratulangi | Inlet IPA Maccini Sombala | Inlet IPA Malengkeri |
|-----------|---------------------------|------------------------|---------------------------------|-------------------------|
| Morning | 0,92 | 0,62 | 1,28 | 0,92 |
| Noon | 1,24 | 0,51 | 1,60 | 1,08 |
| Afternoon | 1,72 | 0,58 | 1,40 | 0,63 |

Table 3
Results of DO (Dissolved Oxygen) Parameter on Jeneberang River
Water in Every Inlet Municipal Waterworks (PDAM) Makassar City

| Results of DO (Dissolved Oxygen) (mg/l) | | | | |
|---|------------------------|------------------------|---------------------------------|-------------------------|
| Times | Inlet IPA Somba Opu | Inlet IPA Ratulangi | Inlet IPA Maccini Sombala | Inlet IPA Malengkeri |
| Morning | 8,62 | 7,59 | 2,49 | 7,55 |
| Noon | 6,93 | 7,51 | 4,98 | 7,02 |
| Afternoon | 7,45 | 7,18 | 5,35 | 7,47 |

Table 4
Result of Measurement and Observation of Environmental Condition on
Jeneberang River Water around Makassar IPAL Inlet Science

| Times | Environment Condition | | | |
|--|-----------------------|---------------------|------------------------------|---------|
| | pH | Temperature (°C) | Current Velocity (m/s) | Weather |
| Inlet IPA V Somba Opu | | | | |
| Morning | 6,9 | 28 | 0,1 | Sunny |
| Noon | 6,9 | 31 | 0,15 | Sunny |
| Afternoon | 6,8 | 29 | 0,1 | Sunny |
| Inlet Sungguminasa IPA Ratulangi | | | | |
| Morning | 7,1 | 27,5 | 0,20 | Sunny |
| Noon | 7,1 | 29 | 0,20 | Sunny |
| Afternoon | 7,1 | 28 | 0,26 | Cloudy |
| Inlet Malengkeri IPA IV Maccini Sombala | | | | |
| Morning | 7,0 | 27 | 0,12 | Sunny |
| Noon | 6,8 | 28 | 0,12 | Sunny |
| Afternoon | 6,8 | 27 | 0,00 | Sunny |
| Inlet IPA IV Maccini Sombala | | | | |
| Morning | 6,5 | 29,5 | 0,00 | Sunny |
| Noon | 6,4 | 32 | 0,00 | Sunny |

Afternoon 6,5 30 0,00 Sunny

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