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Analysis of Water Resources Quality at Semarang State University

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Abstract— Water has important roles for the life of all creatures. Semarang State University (UNNES) campuses use water sources to daily needs and housekeeping which enable water to get into the body accidentally and possible to contaminate, which can trigger health and aesthetic problems. The water sources used are drilled and dug wells. This research was conducted in order to know the quality of water source around UNNES, to make sure safety water consumed for academic community. This research purpose is to know the water quality based on physical, chemical and biological parameter. This method research is observational study with survey, field observation, and laboratory analysis on process collecting data. The result shows that the water physical quality meets the quality principal standards determined. The result of the chemical parameter, the high amount of Fe and Mn at some of sample locations is affected by the ground structure conditions. The result of the biological parameter shows that the MPN and fecal coliform in most of the clean water sources exceeds the quality principal standards determined. Based on function, the water sources in UNNES campuses are used for hygienic sanitation, water processing or water treatment have to be done first before use.

Keywords: water quality parameters, water source

I. INTRODUCTION

The role of water which is very important for human's life and other creatures' makes the existence of water source become essential, not only its water quantity but also its water quality. Semarang State University is one of state colleges in the province of Central Java with more than 20,000 college people, who have activities on campus everyday, who need water for the needs of college practice and hygienic sanitation. As a vital need for the college people, the quality of the water sources at Semarang State University needs to be monitored and controlled to guarantee a sufficiency of the water in general and health of the water in particular. The clean water sources at Semarang State University campuses are from ground water obtained from drilled wells and dug wells.

Ground water is defined as the water which is in the ground layers or in rock layers underground. Ground water is one of water resources, beside river water and rain water. Ground water has a very important role, mainly in maintaining the balance of and the availability of water for household (domestic) needs and for industrial needs. Although, physically, clean water sources seem clear, having no smell, and tasteless, monitoring and testing are required to know and to make sure that water sources quality has meet the requirements as clean water. Periodic inspection and monitoring are conducted to anticipate the decrease of clean water quality indicated by measurement results that exceed the quality principal standards determined. If the decrease of clean water sources quality happens to such an extent, so actions of betterment have to be done immediately to handle such a problem.

The planning of meeting clean water needs should pay attention to quality, quantity and continuity. Quality is related to water quality, both raw water and the water that has been processed and ready for use. Quantity concerns the amount of or the availability of water source. It needs to be put under consideration whether raw water sources can meet the needs of raw water during the planning periods. Continuity is about continuous needs of water meaning whether raw water sources can supply water needs continuously, mainly when dry seasons occur [4].

Clean water quality worthy of use must be appropriate to Permenkes RI Nomor 32 tahun 2017 about the quality principal standards of environmental health and water health requirements for the needs of hygienic sanitation, swimming pools, solus per aqua, and public baths. Based on this regulation, to guarantee the college people's health and to avoid contaminants on clean water sources at Semarang State University campuses, analyses of water quality are highly required concerning some parameters which are physical parameter, chemical parameter, and biological parameter, considering any water sources quality measurement at UNNES has not been done yet. Then, the measurement result of each parameter on each sample is analyzed and compared with quality principal standards determined. Based on the explanation above, this research purposes are to know the water quality based on physical parameter, chemical parameter, and biological parameter from each of the water sources at Semarang State University and to compare the water quality test result with the quality principal standards appropriate to the Regulation of Permenkes Nomor 32 tahun 2017, about the quality principal standards of environmental health and water health requirements for the needs of hygienic sanitation, swimming pools, solus per aqua, and public baths [9].

II. METHODS

The methode research is observasional research with design study descriptive-quantitative, which is describe comparison data results of water quality from laboratory test results with the quality principal standards determined and describe the

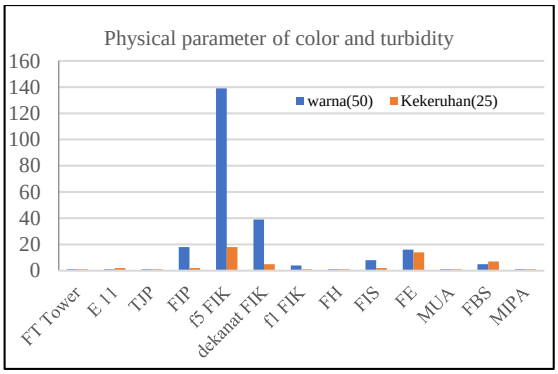
research results based on document study. The research sample is the 13 wells at 8 faculties of Semarang State University. Collecting data methods in this research are survey, field observation, and laboratory analysis (physical, chemical and biological parameters) for each wells. The research instruments are form survey, water quality and form identification environment condition. Water quality parameters which had been tested and the analysis methods which had been used are as follows. Analysis data had done with comparing laboratory result and limited value which permitted on regulation Permenkes Nomor 32 tahun 2017.

No.	Parameters	Methods of Analysis	Maximum value
1	Physical		
	a. Temperature	Visual method	suhu udara ±3
	b. Color	Visual method	50
	c. Turbidity	Visual method	25
	d. Taste	Visual method	no taste
	e. Smell	Visual method	no smell
2	Chemical		
	a. Hardness	EDTA titration	500
	b. Fe	Spectrophotometry	1
	c. Mn	Spectrophotometry	0,5
	d. pH	Visual method	6,5-8,5
3	Biological		
	a. MPN coliform	Tube method/MPN	50
	b. MPN e.coli	Tube method/MPN	0

III. Result and Discussion

A. Physical Parameter

Based on the physical parameter measurement result, generally the clean water sources at Semarang University campuses meet the requirements of clean water quality because their unit value below the quality principal standards determined namely having a temperature unit range, between 27^0C – 29^0C, a color unit range between 1-39 TCU, a turbidity unit range between 1-18 NTU, water having no smell and taste, except for some of the locations whose units exceed the quality principal standards on color and turbidity. The physical parameter measurement result is as follows.



The True Color Unit (TCU) shows a higher result than NAB at F5 FIK building. In all likelihood, the water source from that building is a deep well newly made and is located at ricefield areas that have not been touched yet by any construction activities. Meanwhile, at FIP, FE and Dekanat FIK buildings, there is an increase but the units do not exceed the quality principal standards determined. What is interesting is FE, where its water color measurement result unit is not high but it is high on turbidity. The reason that can be given is that there are two possibilities, namely rare containers clean-up or it happened while the sample was being collected.

The presence of color on water can be caused to occur by the presence of organisms, colored suspended materials, and the extracts of organic compounds and plants. Meanwhile, water turbidity can be caused by inorganic and organic materials contained in water such as mud and materials from industrial waste. Color unit and turbidity unit that exceed the quality principal standards need to be paid a wary attention to because in rainy seasons, there is a possibility for color unit and turbidity unit to increase on water sources.

Efforts to reduce color and turbidity of clean water can be realized by using coagulation-flocculation method[6][10], plus coagulant substances that are usually used such as alum (Al2(SO4)3), ferrous sulfate (FeSO4), ferric sulfate (Fe2(SO4)3), poly aluminum chloride (PAC), ferrous chloride (FeCl2), dan ferric chloride (FeCl3). Nowadays, in markets, we can see many coagulant aids such as super floc, magni floc, and aqua floc that function to accelerate the process of sedimentation so that the coagulant dosage can decrease.

B. Chemical Parameter

Generally, the chemical test parameter units which include turbidity, pH, Fe and Mn are still below the quality principal standards and fulfill clean water quality requirements for hygienic sanitation. Only at some of the locations, the water sources have Fe and Mn which are above the quality principal standards. The table of the measurement result of the chemical parameter of the clean water sources is as follows.

No.	Locations	Chemical parameter			
		Turbidity (mg/l)	pH	Fe (mg/l)	Mn (mg/l)
1.	FT	188,169	7,45	0.12	0.74
2.	E 11	168,151	6,82	0.26	0.67
3.	TJP	160,144	6,7	0.16	0.63
4.	FIP	152,136	6,95	0.63	0.57
5.	F5	148,133	7,36	1.16	0.37
6.	FIK	140,266	7,6	1.18*	0.41
7.	F1	144,417	6,82	0.91	0.32
8.	FH	152,136	7,12	0.11	0.26
9.	FIS	160,144	7,64	0.20	0.58
10.	FE	196,176*	7,22	0.01	0.79*
11.	MUA	168,151	7,46	0.25	0.38
12.	FBS	132,118	7,34	0.11	0.41
13.	MIPA	120,108	6,71	0.13	0.29

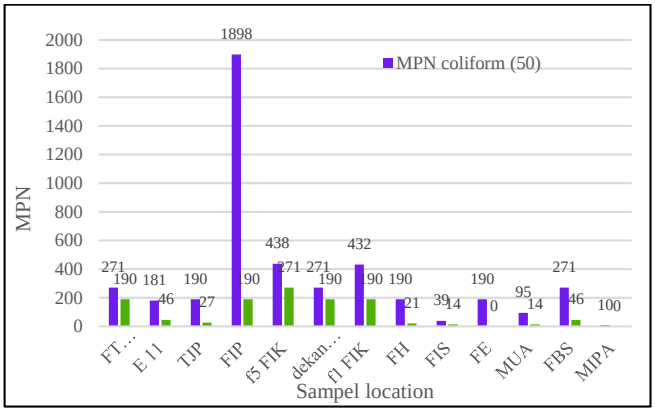
*Note : *high value*

The result of highest Fe amount measurement in clean water is at F5 which is 1,156 mg/l, while the highest Mn amount is at FE which is 0.797 mg/l. Iron (Fe) is one of the elements which can be found almost everywhere on earth, in all geological layers and in all bodies of water. Generally, the iron in water can dissolve as Fe2+ or Fe3+. This high amount of Fe (Fe2+,Fe3+) is in connection with ground structure conditions. A ground structure which consists of peat soil, peat clay and the inner parts which are the mix of peat clay and a little amount of sand will have an effect on Fe in the ground. The amount of iron (Fe) that dissolves in water which crosses the limit will cause some problems, namely technical perturbation, because Fe sediment (OH) is corrosive for pipes, so it will become sediment in pipe channels and cause blockage and bad effects such as dirtying water containers, dirtying basins and water closets. The physical perturbations caused by the iron dissolved in water are the presence of color, smell and taste. Water tastes bad if the dissolved iron concentration is more than 1.0 mg/l.It also causes health disorders because the high amount of Fe in human body cannot get out. So, for those who often receive blood transfusion, their skin colors change to become black because of the Fe accumulated. The drinking water which contains iron tends to cause nausea if it is consumed. Besides, consuming such water in high dosage can corrode the intestine walls. Deathsare often caused by the damage of these intestine walls. The amount of Fe more than 1 mg/l can cause irritation to the eyes and to the skin. If the solubility of iron in water is more than 10 mg/l, it will make the water smell like spoiled egg. One of the efforts that can be done to reduce the amount of iron (Fe2+,Fe3+) in water is aeration. This technology also can be combined with sedimentation and filtration.

Manganese (Mn) is a cation metal that has similar chemical characteristics to iron. Manganese is in Manganous form (Mn2+) and Manganic form (Mn4+). In the ground, Mn4+ is in manganese dioxide compound form. The concentration of manganese in natural waters is about 0.2 mg/l. The higher concentration can happen to underground ground water and deep lakes. Some spots have concentrations of Fe and Mn above the quality principal standards determined. Likely, it is caused by different ground composition conditions. At some of the sample locations, there is an inverse relationship between Fe amount and Mn amount. If the Fe is high, the Mn tends to be low and vice versa. This pattern could be regarded a coincidence but also can be regarded because of a difference of chemical concentrations of the soils at each of the sample locations. Manganese can cause chronic poisoning to humans. It can cause legs to be weak, dull face, and the following effects for those who have manganese poisoning are slow speech and hyper-reflection [10].Therefore, further researches are needed related to the conditions of ground at the research locations. Removing manganese (Mn) can be done by oxidation, which consists of three ways: oxidation by air (aeration), oxidation by chlorine (chlorination) and oxidation by potassium permanganate. Beside oxidation, another way of removing manganese compound in water which is common in use especially for household scale is done by passing the water-manganese solution through a filter with a manganese zeolite medium.

C. Biological Parameter

The result of the biological parameter measurement generally shows a result higher than the quality principal standards determined, except at the sample locations at FMIPA and FIS. The result of the biological parameter measurement can be described in this following bar chart.



The highest unit of coliform MPN at FIP is 1,898 per 100 ml of water, and the highest amount of Escherichia coli at F5 is 271 per 100 ml of water. This shows that there is an indication of contamination on human excrement, because coliform bacteria are normal flora in human intestines. If carefully examined, based on the measurement result of coli MPN obtained, it shows that the highest unit is found at the locations on the northern side of roads through UNNES.

This happens possibly because of several things. Some of those are maintenance of the water-containing structures which

have no good schedule, the water locations that are near human activities, the water containers near septic tanks, water-containing building conditions that do not meet the requirements so that human excrement can contaminate when clean water sources are being made. Based on those possibilities, further researches are needed related to factors that affect the high amount of coliform MPN and coli MPN in the clean water sources at the research locations. E. coli bacteria in water can be destroyed by disinfection. Chlorine with a chemical formula Ca(OCl)2 is a disinfectant which is often used in disinfection because it is effective enough and affordable perceived from the economic aspect, stable, and can be stored longer. Nowadays, some researches have been conducted in order to decrease microbiological pollution which is by using ceramic filters, combined with silver into a filter so that this silver functions as a bactericide [8].

IV. CONCLUSION

This study concluded that the water quality of the clean water sources at UNNES, based on the physical parameter, is still good enough. But, based on the biological parameter and the chemical parameter, it shows an inclination to exceed the water quality principal standards established in the Regulation of Permenkes Nomor 32 tahun 2017 about the quality principal standards of environmental health and water health requirements for the needs of hygienic sanitation, swimming pools, *solus per aqua*, and public baths. Based on the water-providing buildings at UNNES are not well maintained yet, and there is no water quality monitoring yet which is running the physical, chemical and biological parameters, which is able to affect the water quality.

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