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Quality of Liquid Waste and Hospital WWTP Management Strategy in Kendari

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ABSTRACT

Based on annual reports the Southeast Sulawesi Provincial Health Office in 2017, out of 12 hospitals in the city of Kendari, only 8 hospitals have wastewater treatment plants (WWTP). Aims: to find out the quality of liquid waste at the inlet and outlet of the hospital WWTP, in terms of decreasing the test parameters and formulating management strategies. Method: liquid waste samples were taken at the inlet and outlet at the WWTP, then were analysed in a laboratory with key parameters that have been set, such as BOD5, COD, and total coliform. Result: Laboratory test results showed that the COD and BOD test parameters that meet the quality standards was found at one hospital, and one hospital met the quality standards that have been set. While the total coliform parameters in hospital wastewater showed that there were two hospitals that exceeded the quality standard. The main problems were the lack of sanitarian, the absence of SOP and lack of budget for maintenance. Conclusion: Management of wastewater through WWTP Hospital has not been carried out properly and correctly. Management strategy, technical strategy and monitoring strategy are needed to optimize the performance and supervision of WWTP in reducing the pollutant.

Keywords: *quality of liquid waste, management strategy, WWTP, hospital*

1. INTRODUCTION

The importance of a Wastewater Treatment Plant (WWTP) for a hospital can be seen from the existing regulations, among them is regulation 32 of 2009 concerning Protection and Management Environmental article 20 which states that everyone is allowed to dispose of waste to the environment media with the requirements to meet environmental quality standards, PP No.82/2001 concerning water quality management and water pollution control, Regulation of government 44 of 2009 concerning Hospitals, namely in clause 7 and clause 11 concerning the obligation to have an WWTP.

Based on annual reports in the field of health services in the Southeast Sulawesi Provincial Health Office in 2017, of the 12 hospitals in the Kendari City area only eight hospitals have wastewater treatment plants [1].

The content of B3 waste from hospital waste is toxic pollutant, pathogenic (dangerous), and infectious, and if it enters the environment, it will eventually accumulate in the food chain, and thus will pollute the surrounding environment, both for plants, animals and including humans. This, definitely, will damage the environment, decrease the quality of the environment, and the occurrence of damage to natural resources and can endanger the environment as well as the health of the surrounding community of the hospital [2].

Before hospital waste is discharged into the river body, it must first be treated (treatment), by adjusting the analysis of the sewage outlet (wastewater after treatment), with the quality standards for hospital liquid waste contained in Kepmen LH No.05 of 2014 concerning Standard Wastewater Quality of Health Service Facilities [3].

Based on the explanation that has been stated above, it can be expected from this study that is knowing the quality of liquid waste at the outlet of the Hospital wastewater treatment unit in hospitals in Kendari and its effectiveness, in terms of the reduction efficiency of BOD, COD, and Total Coliform.

2. METHOD

The study was conducted at the Regional Public and Private Hospitals in Kendari within a period of 3 (three) months, from April to June 2018. The population was liquid waste at the inlet and output of the WWTP (outlet) of all Hospitals in Kendari, with key parameters that have been set namely BOD5, COD and total coliform. The total sample was 36, consisting of 16 liquid waste samples in the inlet section and 20 output samples in the outlet section of the hospital WWTP. The independent variable was liquid waste at the inlet and outlet of the hospital WWTP, which used the key parameters that had been set, and the dependent variable was the wastewater treatment Plant (WWTP).

The equipment used was sampling bottles, sterile bottles, etiquette paper/markers, sets of parameters for analysing hospital liquid waste quality test equipment (BOD5, COD and MPN Coli). The materials used were hospital liquid waste samples at the inlet and outlet.

The sample was liquid waste at the inlet and outlet of the Liquid Waste Water Treatment Plant in the hospital as much as 500 ml each for BOD5 and COD examination and 500 ml for MPN Coli examination, the sample was taken once using a sampling bottle. The sampling bottle was marked, then sent to a laboratory for analysis, in accordance with standardized parameters, based on Kepmen LH No.05 of 2014 concerning Wastewater Quality Standards for Health Services Facilities.

Laboratory test results for each key parameter was tabulated, then outlet data were analysed based on the Indonesia's Government regulation namely Kepmen LH No.05 of 2014 concerning Wastewater Quality Standards for Health Services Facilities. Subsequently, the decrease between inlet data and data outlet was inspected to find out its effectiveness using the following formula [4]:

$$\text{Effectivity of WWTP} = \frac{(\text{INLET parameter-OUTLETparameter})}{(\text{INLETparameter})} \times 100\%$$

The hospital is a referral health service facility for the community in Kendari with a total of 12 (twelve) hospitals across districts in the Kendari. Of the 12 hospitals studied, 2 (two) hospitals were not willing to be examined.

Research data consisted of secondary data and primary data. Secondary data were obtained from the annual report of the Health Office of Southeast Sulawesi Province and BPSof Kendari 2017. While the primary data were obtained from the examination results of the UPTD Laboratory of the Southeast Sulawesi Health Laboratory based on test parameters.

The process of wastewater treatment in the Wastewater Treatment Plant (WWTP) of hospitals in the Kendari varied, with anaerobic biofilter, anaerobic-aerobic biofilter and sedimentation processes using septic tanks. The data obtained were processed qualitatively and presented in tabular form. The variables that had been studied were BOD5, COD and total Coliform levels originating from the inlet and outlet of the hospital WWTP in Kendari.

There were 7 (seven) hospital whose COD parameters that have met the quality standard requirements. 1 (one) hospital did not meet the quality standard requirements. BOD5 parameters that have met the quality standard requirements were found at 7 (seven) hospitals. 1 (one) hospital did not meet the quality standard. Total coliform parameters that did not meet the quality standard were found at 2 (two) hospitals.

Effectiveness of Hospital WWTP based on COD parameter was Hospital "C" 95%, Hospital "D" 89%, Hospital "E", 28%, Hospital "F" 36%, Hospital "G" 82%, Hospital "H" 94%, Hospital "I" 62% and Hospital "J" 95%. Effectiveness of Hospital WWTP based on BOD parameter was Hospital "C" 98%, Hospital "D" 94%, Hospital "E" 19%, Hospital "F" 67%, Hospital "G" 92%, Hospital "H" 98%, Hospital "I" 74% and Hospital "J" 98%. Effectiveness of Hospital WWTP based on total coliform parameter was Hospital "C" 41%, Hospital "D" 67%, Hospital "E" 44%, Hospital "F" 99%, Hospital "G" 28%, Hospital "H" 74%, Hospital "I" 24% and Hospital "J" 85%.

3. RESULTS AND DISCUSSION

Table 1. The results of Environmental Chemical and Microbiological Analysis

No.	Hospital name	Test parameter	Unit	Inlet	Outlet	Standard	Spesification of Method
1	A	COD	g/l		9,1	0	Titrimetri
		BOD	g/l		8,7	0	BOD Meter
		Coliform	PN/100 ml		398	000	Multiple tubes
2	B	COD	g/l		10,6	0	Titrimetri
		BOD	g/l		3,7	0	BOD Meter
		Coliform	PN/100 ml			000	Multiple tubes
3	C	COD	g/l	07,6	8,7	0	Titrimetri
		BOD	g/l	60,3	,9	0	BOD Meter
		Coliform	PN/100 ml	7	2	000	Multiple Tubes
4	D	COD	g/l	59,7	9,6	0	Titrimetri
		BOD	g/l	10,1	8,7	0	BOD Meter
		Coliform	PN/100 ml	582	168	000	Multiple Tubes
5	E	COD	g/l	4,7	9,6	0	Titrimetri
		BOD	g/l	2,7	0,3	0	BOD Meter
		Coliform	PN/100 ml	94	66	000	Multiple Tubes
6	F	COD	g/l	20,2	7,5	0	Titrimetri
		BOD	g/l	0,2	6,8	0	BOD Meter
		Coliform	PN/100 ml	781		000	Multiple Tubes
7	G	COD	g/l	75,1	8,3	0	Titrimetri
		BOD	g/l	56,3	2,7	0	BOD Meter
		Coliform	PN/100 ml	526	389	000	Multiple Tubes
8	H	COD	g/l	60,8	4,2	0	Titrimetri
		BOD	g/l	10,6	1,6	0	BOD Meter
		Coliform	PN/100 ml	898	94	000	Multiple Tubes
9	I	COD	g/l	67,8	30,7	0	TITRIMETRI
		BOD	g/l	80,1	8,5	0	BOD METER
		COLIFORM	PN/100 ml	826	934	000	MULTIPLE TUBES
10	J	COD	g/l	80,4	8,7	0	TITRIMETRI
		BOD	g/l	90,4	0,8	0	BOD METER
		COLIFORM	PN/100 ml	639	94	000	MULTIPLE TUBES

Based on the survey results, it is known that hospitals in Kendari have several sewerage channels to drain wastewater to WWTP before being discharged to urban drainage. Therefore, in this study, there had been done an examination of the quality of wastewater that was discharged from hospital activities into urban channels. The parameters measured were BOD5, COD and MPN Coli, which were carried out at the Regional Health Laboratory of Southeast Sulawesi.

3.1 Biological Oxygen Demand (BOD)

BOD or biochemical need for oxygen is the amount of oxygen needed to decompose organic substances in an aerobic state perfectly. In decomposing these organic substances, it needs the help of microorganisms and also sufficient oxygen at a certain time. The more difficult the organic substances in wastewater to be elaborated, the higher the demand for oxygen which means the oxygen in wastewater decreases, so that BOD in wastewater is high [5].

From the results of laboratory tests on the levels of Biological Oxygen Demand (BOD) using the BOD Meter method at the inlet point, the BOD content of wastewater obtained at the hospital was 296.3 mg/l at the inlet and at the outlet 26.07 mg/l. Based on the Minister of the Environment Decree No. 05 of 2014 for liquid waste hospital, activities are said to meet the requirements if the BOD5 content is not more than 50 mg/l. While the BOD5 content obtained during the study was not all that exceeded the requirements of the Minister of Environment Decree No. 05 of 2014 which is ≤50 mg/l. There was only 1 (one) hospital that did not meet the requirements, this is due to lack of control over the cleanliness of the inlet and outlet as the final container in reducing the BOD5 content to reach the normal point or meet the requirements of 50 mg/l. In addition, an improvement in the WWTP owned by the hospital also resulted in the non-optimal process of reducing the content of pollutants in wastewater.

Based on the calculation of the effectiveness of Hospital WWTP is divided into 3 (three) categories, namely low, moderate and high effectiveness. For BOD5 parameters that have low effectiveness was found at 1 (one) hospital, moderate effectiveness was found at 1 (one) hospital and high effectiveness was found at 6 (six) hospitals.

The existence of WWTP with low and moderate effectiveness indicates that WWTPs are not optimal in reducing pollutants in wastewater due to lack of maintenance on WWTP so that WWTP performance does not work optimally.

3.2 Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) is the amount of oxygen needed to break down all organic matter contained in water (Boyd, 1990). Measuring the strength of wastes with COD is another form of measurement of oxygen demand in wastewater. This method is shorter than the BOD analysis. This measurement emphasizes oxygen demand for chemicals where the compounds being measured are materials that are not biochemically broken down [6].

Based on the results of laboratory tests, the levels of Chemical Oxygen Demand (COD) using the

Titrimeter method at the inlet, it was obtained COD content of wastewater at the Hospital in Kendari, the average inlet obtained 590.79 mg / l and at the outlet obtained 92.7 mg / l.

Based on the Minister of the Environment Decree No. 05 of 2014 for liquid waste hospital, activities are said to meet the requirements if the COD content is not more than 80 mg / l. The COD content obtained during the study did not normally exceed the requirements of the Minister of Environment Decree No. 05 in 2014. Only 1 (one) hospital that exceeded the quality standard requirements that was 330.7 mg / l. This condition is due to lack of control over the cleanliness of the inlet and outlet as the final container to reduce the COD content to the normal level or meet the requirements of 80 mg / l. The presence of other organic material in inlets and outlets that are difficult to decompose by microorganisms caused higher COD content.

Beril Salman Akin (2016), states laboratory waste in hospitals and pollution loads (pathogens, heavy metals, and organic materials), where concentrations that exceed the threshold will pose health risks [7].

Based on the calculation of the effectiveness of hospital WWTP, Low effectiveness was found at 2 (two) hospitals, moderate effectiveness was found at 1 (one) hospital and high effectiveness was found at 5 (five) hospitals. The hospital WWTP with low and moderate effectiveness indicates that WWTP performance does not work with optimally.

Delila Grez Waang, et al. (2017), states the importance of efficient water treatment plants at the hospital so that the quality of wastewater samples from the inlet and outlet pipes is maintained [8].

3.3 Total Coliform

Total Coliform is an indicator of fecal contamination in water and can cause diarrhoea if the amount of Coliform in water exceeds the threshold determined by KepmenLH no.05 2014 which is 5000 per 100 ml. The method used in the measurement was the double tube method. Based on the calculation of effectiveness, the results obtained for hospital WWTP with low effectiveness was fond at 2 (two) hospitals, medium effectiveness was found at 3 (three) hospitals and high effectiveness was found at 3 (three) hospitals.

This affects the effectiveness of chlorination mainly depending on the concentration of C (mg / l) and the contact time T (minutes). If concentration is determined, the time available between chlorine and creatures in water must be extended to guarantee annihilation, and vice versa. The pH of wastewater can also affect the action of chlorine disinfection, if the pH of the wastewater is high then the

dose of chlorine must be increased to maintain effective levels. Turbidity in wastewater caused by small impurities and other impurities will prevent contact and protect microorganisms from disinfection. Therefore, for chlorination to be effective, turbidity must be removed.

Wiafe, S (2016), stated that the clinical management of waste management used by hospitals will determine the efficiency and effectiveness of the hospital's wastewater treatment plant in treating clinical waste [9].

4. CONCLUSION

Based on the results of laboratory examinations of Hospital Waste water samples in Kendari, it can be concluded that the average effectiveness of the Hospital WWTP performance on BOD content is 91% very effective, COD is 84% very effective and the total Coli content is 41% less effective. The BOD5 content in theHospital WWTP inlet in Kendari averaged 296.3 mg/l and thus does not meet the requirements and at the outlet was 26.07 mg/l, meets the requirements of Minister of Environment Decree No. 05 of 2014 which is ≤ 50 mg/l. The COD content in the WWTP inlet of the Hospital in the Kendari averaged 590.79 mg/l and thus does not meet the requirements and the average outlet meet the requirements except Bhayangkara Hospital which was 330.7 mg/l which does not meet the Minister of Environment Decree No. 05 of 2014 which is ≤ 80 mg/l. The total coli content in Hospital WWTP inlets in Kendari averaged 1464.8 per 100 ml which meets the requirements, while the hospital WWTP outlets averaged 857.4 per 100 ml fulfilling the Minister of Environment Decree No. 05 of 2014 which is 5000 per 100 ml. There are still hospitals that meet the threshold value of the quality standards that have been set, for this, it is necessary to continuously monitor and periodically checks on the parameters of liquid waste from each source of waste water production so that the quality of liquid waste produced meets the specified requirements. The hospital will optimize the performance and supervision of WWTP in reducing the pollutant produced. And there is a need for further research on parameters that have not been studied by researchers, namely toxic substances contained in wastewater.

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Conflict of Interest

Authors declares that there is no any conflict of interest within this research.

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