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Technical Evaluation of Residential Wastewater Treatment Plant in West Lombok Regency

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ABSTRACT

This study aimed to determine the technical performance of Wastewater Treatment Plant (WWTP) in residential scale in West Lombok regency. Wastewater samples were taken at the WWTP and existing piping networks, with repetitions three times each sample point. Wastewater quality testing followed Indonesian Nasional Standard, which consisted of biological oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solid (TSS). The results were compared with the domestic waste quality standard by using Minister of Environment Regulation no. 68 year 2016. From the results of research at six WWTPs showed there were four WWTPs in which the quality of wastewater was below the quality standard. However, based on the calculation for the six WWTPs, the removal efficiency for BOD was higher than COD, resulting in effluent stabilization. Factor influencing performance was the existing inflow of wastewater, which was smaller than the planned inflow.
KEYWORDS: domestic wastewater, removal efficiency, quality standard

INTRODUCTION

Wastewater from households was one of the most directly related sanitation issues to the community. According to Regulation of the Minister of Public Works No. 16 / PRT / 2008 on National Policy and Strategy of Development of Wastewater Management System of Settlements [1] in Indonesia, handling domestic household waste was important in the handling of local environmental sanitation. Wastewaters were produced in all types of economic and domestic activities, having specific characteristics dependent on technological production process, collecting system, transport, and also on-site treatment facilities.All were requiring well operating systemand/or high efficient integrated management systems[2].The effluent management system from wastewater treatment plant (WWTP) was an affordable way for people to maintain health while managing wastewater in the settlements. In order to run on a long-term basis, the management system required effective management. This management was a functioning technology, on-going financing, effective governance and sustained demand [3].

The current condition of West Lombok Regency did not yet have centralized urban wastewater treatment facilities. Topographic conditions were quite diverse causing different needs in each region, but the local government seeks to meet the provision of domestic scale communal wastewater treatment facilities or residential scale with the construction of WWTP in some villages. Others used public toilets or disposed of directly in gardens, rivers or beach. The local government of Lombok regency targeted sanitation services to reach 72% in 2019[4]. To target service with WWTP, one of West Lombok Regency's mission was to seek the service of WWTP to unreached people with existing network, so there was an increase in WWTP services from 0.84% in 2016 to 25% served by 2019. In the year 2016 has been built 6 WWTP spread across 4 districts in West Lombok regency. This number will continue to grow until later in 2019.

Based on Minister of Public Works Regulation no. 04 of 2016 [5],sanitation facilities that have been built must be evaluated periodically. To our knowledge, the current state of the WWTP has never been known or tested for the quality of the effluent coming out of the WWTP building in all locations.Viewed from environmental aspects, it was not yet certain that the effluent from WWTP was safe to be discharged into water bodies. And in terms of institutional aspects, community organization of communal wastewater treatment had not functioned optimally. The willingness of the community to play an active role in the use and maintenance was needed so that sanitation facilities could be sustainable. This research was conducted to know the performance of WWTP of residential scale in West Lombok Regency in terms of technical aspects.

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METHODS

Study Area

By the end of 2016, six WWTPs had been built in West Lombok regency. The research location was in 6 locations of WWTP spread over 4 sub-districts in West Lombok regency, namely Pelangan Dalem in Pelangan Village, Sekotong Subdistrict, Dasan Geres Tengah Kelurahan Dasan Geres Subdistrict Gerung, Batukuta Utara Narmada Subdistrict, Batukuta Paroa, Narmada Subdistrict, Sigerongan Village of Lingsar Subdistrict and Karang Bayan Barat Village Karang Bayan Village. WWTPs location spread in West Lombok Regency can be seen in the Figure 1.

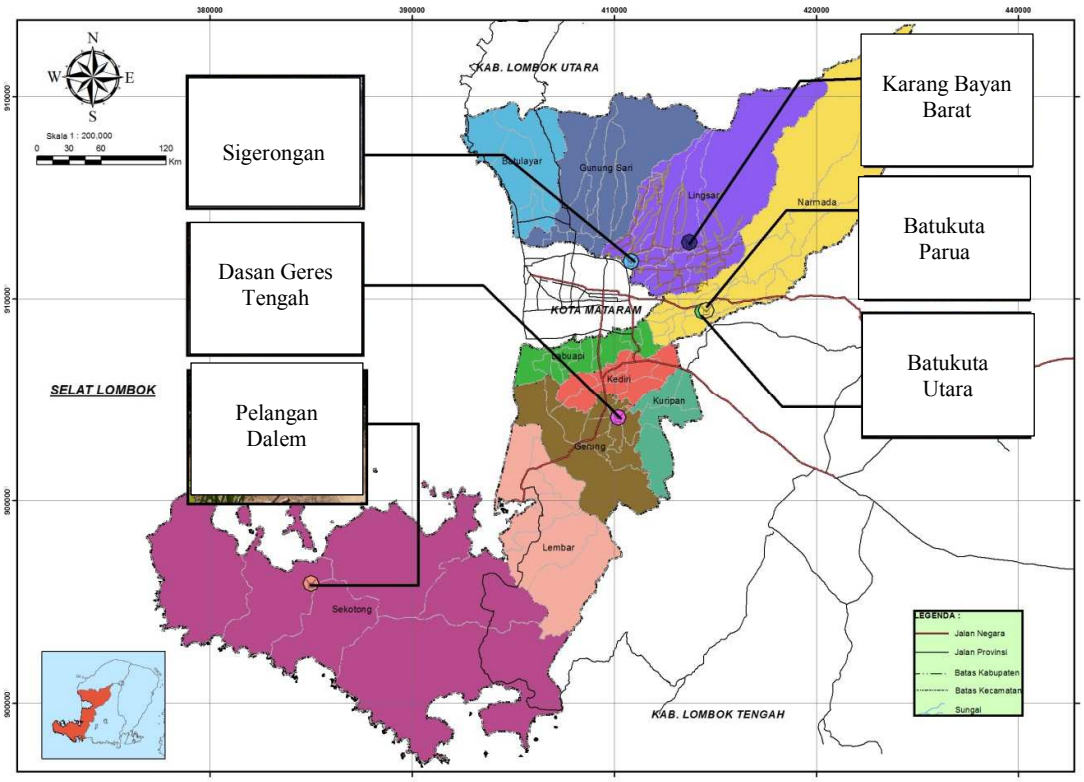

Figure 1. Six WWTPsites in West Lombok regency

Methods

Research methodscarried out by means of quantitative research method through survey and interview. Technical analysis in this study used descriptive analysis techniques to identify the conditions of building WWTP that treats waste from user through the piping network. The evaluation phase on technical aspect was done by analyzing the quality of wastewater entering and processed in WWTP and wastewater produced by WWTP with BOD, COD and TSS parameters. Samples were taken 3 times at each location of WWTP and the highest level would be compared to the quality standard as per Regulation of Minister of Environment and Forestry No. 68 Year 2016[6]. Laboratory analysis was conducted at the Laboratory of Environment Department of West Lombok Regency with testing method according to Indonesian Nasional Standard (SNI). Then it compared the existing discharge plan to calculate the efficiency removal and BOD COD ratios. Environmental aspect was done by analyzing contamination of contribution from WWTP waste to nearby river. The analysis of the effect of WWTP on the environment was done by analyzing the quality of wastewater and surface water from the measured parameters test in the laboratory. The contribution of household waste pollution load from the WWTP channel on the receiving water body was calculated using the concept of mass balance.The test results of river water from the laboratory would be compared toGovernment Regulation no. 82 Year 2001Water Quality Management andWater Pollution Control[7].

RESULTS AND DISCUSSION

The results showed that the WWTP built in 6 locations using the pipeline network was built by connecting the wastewater channel in the form of Gray Water and Black Water from every home connection. The technology

used was a combination of Anaerobic Baffled Reactor (ABR) and Anaerobic Filter (AF) systems. ABR technology was a septic tank technology that uses bulkheads so that wastewater through the bulkhead will flow up and down. AF technology was a septic tank with filters made from plastic bottles of mineral water.

Based on secondary data in the planning document called the Public Activity Plan book and based on survey results, it was known that the number of home connections in all locations were still under planning in the initial design. This condition was due to the budget available from the Local Government was still limited, and the ability of the community had not been able to install the connection at its own expense. The number of home connections that did not match the number of plan connections certainly affects the waste discharge that went into the WWTP.

In all locations of WWTP, there was a difference of plan flowrate with significant current discharge. The biggest difference was in the location of Batukuta Paroa where the discharge plan was 25.60 m3/day with the existing flowrate of 4.61 m3/day. The approaching discharge capacity was in Karang Bayan Barat with a plan flowrate of 12.80 m3/day with the existing flowrate of 9.22 m3/day.

Installation of WWTP was a unit in which biological processes occur. If this biological process went well, there would be a quality improvement on the effluent. It was characterized by relatively clear water, no particles in the flow and no excessive odor. The quality of influent and effluent could show the efficiency of WWTP until it could be known whether the WWTP works properly or not. Table 1 showed that from the results of laboratory tests it was found that the quality of wastewater in all locations was still above the quality standard so that further processing was required before discharged to the water body. As for the quality of wastewater processing results showed different results. For BOD parameters at the North Batukuta and Batukuta Paroa. For TSS parameters, the quality of wastewater that meets was in Dasan Geres Tengah, Batukuta Utara and Batukuta Paroa and Karang Bayan Barat. Unlike the COD parameters, in all WWTP locations, the quality of the wastewater meets the standard quality standards. This was because wastewater that enters pure processing from households.

Table 1.Value of domestic wastewater parameters before and after processing

Location	Influent			Effluent		
	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	TSS (mg/L)
Pelangan Dalem	140.7	197.6	153.2	55.7	87,2	66.2
Dasan Geres Tengah	158.1	222.8	89.9	41.6	80.5	29.0
Batu Kuta Utara	109.4	204.3	35.6	28.8	70.4	15.4
Batu Kuta Paroa	92.4	148.3	41.5	26.4	50.7	14.7
Sigerongan	180.5	220.8	85.3	58.2	76.1	37.1
Karang Bayan Barat	159.6	190.4	51.3	50.2	65.3	22.3
Pelangan Dalem	140.7	197.6	153.2	55.7	87.2	66.2
Quality standard	30	100	30	30	100	30

Analysis of the removal of the treatment efficiency was carried out to find out how much the ability of the reactor in reducing the content of pollutants entering the reactor. The efficiency of decomposition of organic materials would increase in accordance with the number of compartments passed. This occured because the longer the contact time between the substrate with the biomass contained in the reactor, it would give bacteria a chance to degrade more organic matter in wastewater. The total processing efficiency was calculated based on the quality of the first influent and the effluent quality of the final processing as shown in Table 2.

Table2. WWTP Efficiency

Location	Eficiency		
	BOD (%)	COD (%)	TSS (%)
Pelangan Dalem	60.4	55.9	56.8
Dasan Geres Tengah	73.7	63.9	67.7
Batu Kuta Utara	73.7	65.5	56.7
Batu Kuta Paroa	71.4	65.8	64.6
Sigerongan	67.8	65.5	56.5
Karang Bayan Barat	68.6	65.7	56.5
Pelangan Dalem	60.4	55.9	56.8

From Table 2, it can be seen that the BOD efficiency removal that meets the Sasse design criteria [8] was at the location of Dasan Geres, Batu Kuta Paroa. In the parameters of COD removal efficiency that meets the design criteriawas at the location of North Batukuta WWTP, Batukuta Paroa, Sigerongan and Karang Bayan Barat. The high value of BOD efficiency indicates that ABR technology can still run well. For COD Efficiency, which was still under the design criteria was on Pelangan Dalem and Dasan Geres. ForWWTP Batukuta Utara, Batukuta Paroa, Sigerongan and Coral Bayan West already met the criteria. For the efficiency of TSS had decreased. This shows the ability of flocculation and precipitation of anaerobic sludge quite well [8, 9].

The efficiency values of laboratory test results on BOD parameters ranged from 60-70%, on COD parameters ranged between 55-65% and on TSS parameters ranged from 56-67%.Based on design criteriaBOD efficiency removal: 70-95% and COD efficiency removal: 65 - 90% [10,11]. Long stay in the WWTP compartment would give longer time to microorganisms to decompose organic substances.

The calculation of BOD and COD ratios was intended to determine the level of biodegradable waste. The results of the ratio of BOD/COD ratio in each location ranges from 0.4 to 0.7. This condition was biodegradable, that wastewater could still be treated biologically [12, 13].

CONCLUSIONS

Technically it was concluded that all communal wastewater treatment plantrequired treatment improvement. Biodegradable properties of the wastewater suggested the biological treatment would be appropriate to meet Indonesian standard for effluent.

REFERENCES

1. Regulation of the Minister of Public Works No. 16 / PRT / 2008 on National Policy and Strategy for Development of Wastewater Management System of Settlements.
2. Zaharia C. 2017. Decentralized wastewater treatment systems: Efficiency and its estimated impact against onsite natural water pollution status. A Romanian case study, In Process Safety and Environmental Protection 108: 74–88.
3. Ministry of Public Works and People's Housing. 2016. In Domestic Wastewater Treatment Systems - Centralized Settlement Scale (Book 3)
4. BAPPEDA of West Lombok Regency. 2016. City Sanitation Strategy (SSK) year 2017-2021. West Lombok Regency
5. Ministry of Public Works and People's Housing. 2017. Regulation of the Minister of Public Works and People's Housing No. 04 / PRT / M / 2017 on the Implementation of Domestic Wastewater Management System). Jakarta.
6. Ministry of Environment and Forests, Regulation of the Minister of Life and Forestry No. 68 of 2016 on the Standards of Domestic Waste
7. Government Regulation of the Republic of Indonesia No. 82/2001 on the management of water quality and water pollution control.
8. Nizami, A.-S. 2012. Anaerobic digestion: Processes, Products, and Applications. *Anaerobic Digesrion*. https://doi.org/10.13140/2.1.4550.7529.
9. Bratby, J. 2006. Coagulation and Flocculation in Water and Wastewater Treatment - Second Edition. Coagulation and Flocculation in Water and Wastewater Treatment (pp. 1–400). https://doi.org/10.2166/9781780402321.
10. Sasse, L. 1998. Decentralised Wastewater Treatment in Developing Countries, DEWATS. Bremen: Borda.
11. Peavy, H.S., Rowe, D.R. & Tchobanoglous, G. 1985. Environmental Engineering. Singapore: McGraw-Hill Book Co.
12. Bhat, M. R., Roopali, Hiremath, S., & Kulkarni, V. R. 2004. Correlation between BOD, COD and TOC. Journal of Industrial Pollution Control, 20(1), 187–191.
13. Katie Allan. 2014. *COD & BOD. Igarss 2014* (pp. 1–5). https://doi.org/10.1007/s13398-014-0173-7.2.