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Design Planning of Wastewater Treatment Plant at Lading Hotel Banda Aceh

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Abstract. *Lading Hotel is one of the hotel industries that has a strategic location in the city center of Banda Aceh. Lading Hotel produces domestic wastewater as much as 95,000 L / day generated from kitchen activities, laundry, bathrooms, and cafes. The wastewater preliminary results showed the parameter COD 381 mg / L and TSS 371 mg / L has exceeded the quality standards set by the government. To addresses these problems, this study aims to do a design planning of the wastewater treatment plant (WWTP) in Hotel Lading. The steps of treatment technology chosen in this study consist of equalization basins, sedimentation basins with additional aeration from blowers, anaerobic biofilter basins and subsurface flow type wetlands. The planning stages include collecting data, processing data, design planning, making BoQ and drawing conclusions. The results of dimensions calculation for design drawings e.i: the equalization basin is 3.6 m × 2 m × 3 m (7.4 m^2), sedimentation basin with dimensions of 3.6 m × 1.8 m × 3 m (6.48 m^2), anaerobic biofilter basin with dimensions of 2.4 m × 1.2 m × 3 m (2.88 m^2) and Subsurface wetland dimensions of 4 m × 1 m × 1 m (4 m^2). Total land area required for WWTP design planning was 20.76 m^2.*

Keywords: *Lading Hotel, domestic wastewater, design planning, WWTP*

1. Introduction

In the hospitality industry, water use is needed to meet the needs of rooms, laundry, garden watering and to meet the needs in the kitchen. There needs to be a form of hotel management with efficient use of water resources and maintaining the environment so that it is not polluted due to waste disposal (Parhani, 2020). Water use activities will produce wastewater that can pollute water bodies if not treated first (Ayu & Sukma, 2019). One technology that has been widely applied in Indonesia is Wastewater Treatment Plant (WWTP) technology.

WWTP is a system used to treat domestic waste from office, industrial, hospital, and residential activities so that the liquid waste produced is safer when discharged into the environment and in accordance with environmental quality standards. Wastewater treatment can be done by building a WWTP by adjusting to the characteristics of wastewater and pollutant load. Processing can be done individually or in an integrated manner (Yudo and Setiyono, 2008).

The main purpose of wastewater treatment is to reduce the content of pollutants, especially organic compounds, suspended solids, pathogenic microbes, and organic compounds that cannot be decomposed by natural microorganisms. In addition, waste treatment is carried out to reduce and eliminate the adverse effects of liquid waste on human health and the environment and improve the quality of the environment through the treatment, disposal and or utilization of liquid waste for the benefit of human life and the environment (Wulandari, 2014).

Wastewater treatment is carried out with the aim of improving wastewater quality and reducing BOD, COD and TSS levels and improving environmental aesthetics. Waste

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treatment can be carried out in a natural way or with the help of equipment carried out at the Wastewater Treatment Plant (WWTP), which in general, large and easily sedimented suspended materials are set aside first before treating wastewater (Sitompul et al., 2013). The efficiency of treatment can reach environmental quality standards, management must be easy, the land required is not too large, energy consumption is as low as possible, operating costs are low, the sludge produced is as small as possible, can be used for wastewater with a large enough COD pollutant load, can remove suspended solids well, and maintenance is easy and simple.

2. Method

This research uses a mixed method of qualitative and quantitative where field observations and interviews with related parties and literacy in previous studies. This research was conducted by taking Lading Hotel wastewater as a sample which will be tested before the wastewater is treated with WWTP technology. There is also the first data collection technique, namely primary data obtained based on the results of preliminary tests of Lading Hotel wastewater outlet samples, field observations and interviews with related parties. While secondary data is obtained based on books, journals, previous research and related government regulations, such as:

a. Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 68 of 2016 concerning Domestic Wastewater Quality Standards.
b. Detailed Engineering Planning Guidelines for Centralized Domestic Wastewater Treatment Systems (SPAL-D) Ministry of Public Works and Public Housing 2018.
c. Government Regulation of the Republic of Indonesia No. 22 of 2021 on the Implementation of Environmental Protection and Management.

Hotel administration data is also listed in the research methodology where the data required is the number of hotel beds, the number of employees, the number of halls and the maximum capacity of the halls, the number of washing machines in laundry facilities and the number of kitchens.

3. Results and Discussions

Wastewater was obtained from the output of Hotel Lading Jalan Meutia No.19, Kp. Baru, Baiturahman Subdistrict, Banda Aceh City. Preliminary tests were carried out by testing the parameters of pH, COD, BOD, Oil and Fat and Ammonia have exceeded the quality standards listed in the regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 68 of 2016. Therefore, it is necessary to carry out special treatment first before the wastewater is discharged into the water receiving body with WWTP technology using wasp nest plastic media and using the anaerobic biofilter method then the water is flowed into the wetland as a plant watering utilization. The following Table 1. showed the results of the preliminary test of the waste quality of Lading Hotel.

Based on data in Table 1. the value of pH, ammonia, oil and fat parameters still meet the predetermined quality standards, while the COD and TSS parameters have exceeded the quality standards so that special treatment is needed. The COD and TSS pollutant load ratio determine the selection of the process to be used in wastewater treatment. The TSS parameter is closely related to turbidity in water caused by the content of suspended solids such as sand, clay and natural mud which are inorganic materials or

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can also be organic materials floating in the waters. Therefore, it is necessary to plan the construction of a WWTP to treat Lading Hotel wastewater so that the quality of wastewater produced is environmentally friendly and met the Government Act.

Table 1. Wastewater quality testing results

No.	Parameters	Units	Preliminary Test Results	Maximum Level	Description
1	pH	-	6,3	6 – 9	As per quality standards
2	COD	mg/L	381	100	Exceeds quality standard
3	BOD	mg/L	-	30	-
4	TSS	mg/L	371	30	Exceeds quality standard
5	Oils and Fats	mg/L	0,210	5	As per quality standards
6	Ammonia	mg/L	7,58	10	As per quality standards

Source: Laboratorium analysis at FST UIN, 2023

In predicted the residence time of each treatment unit in the WWTP, it is necessary to calculate the pollutant load parameters generated per day. The equation used were described below:

Preliminary Data:
TSS level = 371 mg/L
$Q_{Effluent\ water}$ = 95,000 L/day
TSS/day = TSS × $Q_{Effluent\ water}$
= 371 mg/L × 95,000 L/day
= 35,245 mg/day
= 35.245 kg/day

Preliminary Data:
COD level = 381 mg/L
$Q_{Effluent\ water}$ = 95,000 L/day
COD/day = COD × $Q_{water\ effluent}$
= 381 mg/L × 95,000 L/day
= 36,195 mg/day
= 36.195 kg/day

The parameters pH, BOD, ammonia, oil and grease are not taken into account in this planning because these parameters are still below the established wastewater quality standards. The parameters tested in the domestic wastewater produced by Lading Hotel are some that exceed the quality standards so that handling needs to be done to prevent pollution around the hotel water body. Wastewater flowing from hospitality activities is flowed into an equalization basin where there is a fat catcher at the beginning of the basin to separate oil and fat that floats on the surface of the wastewater so as to avoid clots that clog the pipes. In the equalization basin to prevent shock loading or wastewater discharge that increases suddenly.

Wastewater from the equalization basin is flowed into the next unit, namely the sedimentation basin, in this sedimentation basin is equipped with a blower to help the aeration process so that it helps reduce TSS and COD. After passing the sedimentation process, the wastewater is flowed into the Anaerobic Biofilter unit with wasp nest media measuring 160cm long × 120cm wide × 150cm high which is designed according to the

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needs of the wastewater pollutant load. Finally, the water will flow into the wetland, in the wetland the flow will be designed at a low speed so that particle deposition occurs in wastewater. This speed is also to extend the contact time of the wetland surface and wastewater, so that vegetation and organisms use organic compounds as nutrients and can reduce pathogens in wastewater.

In each treatment unit there is an efficiency that is expected to reduce the organic content in the Lading Hotel wastewater. The estimated effluent quality using wastewater Mass Balance can be seen in table 2. The final effluent of each parameter (pH, COD and TSS) has met the Government Regulation for Domestic wastewater.

Table 2. Estimated effluent quality

No	Unit WWTP	Parameter and Percentage of removal	
		COD (mg/l)	TSS (mg/l)
	Influent	381	371
		0%	**50%**
1.	Equalization Unit	381	185,5
		60,75%	**80%**
2.	Sedimentation Unit	213,5	148,4
		95%	**94%**
3.	Biofilter Anaerob	7,4	2,2
		80%	**0%**
4.	Wetland	1,48	2,2
	Effluent	**1,48**	**2,2**

The Design Planning that was calculated then put into drawing, as descripted at the Figure 1 below.

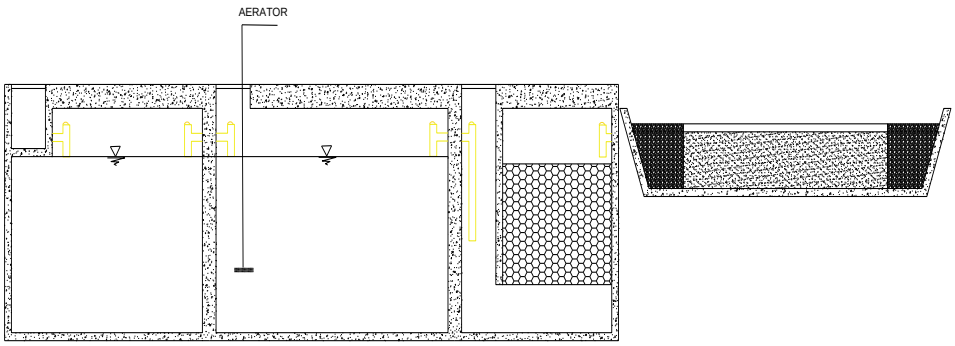

Figure 1. Design Planning of WWTP in Lading Hotel

The technologies chosen in this study are equalization basins, sedimentation basins with additional aeration from blowers, anaerobic biofilter basins and subsurface flow type wetlands. The designed step for each of basin based on Massa Balance of wastewater parameter chosen from the domestic water characteristics in Lading Hotel. The results of the calculation in the form of design drawings of the treatment unit for the dimensions of the eculization basin are 3.6 m × 2 m × 3 m with the required land area of 7.4 m2, sedimentation basin with dimensions of 3.6 m × 1.8 m × 3 m with the required land area of 6.48 m2, anaerobic biofilter basin with dimensions of 2.4 m × 1.2 m × 3 m with the required land area of 2.88 m2 and SSFCW dimensions of 4 m × 1 m × 1 m with the required land area of 4 m2. With a total of all land for the planning of 20.76 m2. We hope that the design planned will met the need of

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Hotel management and help reduce the water pollution discharge into the drainage and to the River.

4. Conclusions

Wastewater treatment technology that can be applied at Lading Hotel is to use an anaerobic biofilter and wetland system consisting of 4 compartments, namely the Equalization basin, Sedimentation with aeration basin, Biofilter Anaerobic basin and subsurface wetland with a total planning area of 20.76 m2.

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