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Evaluation and Addition of Waste Water Treatment Plant Units in West Lombok Regency Hotel

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Abstract: The development of hotels in Lombok is very drastic, especially in tourist areas. In carrying out their activities, hotels require large amounts of water to meet the needs of guests and employees; besides that, water use in a hotel is also seen in the supporting facilities. Using large amounts of clean water will also produce large quantities of wastewater. This research aims to evaluate wastewater treatment installations at XY Hotel. The method used in this research is a field study followed by an analysis of water quality, process, and output. Based on the evaluation results, the Wastewater Treatment Plant at Hotel Aerobic has capacities of 20 m^3/day, 15 m^3/day, and 2 m^3/day respectively.

Keywords: Evaluation; WWTP; Waste Water.

Introduction

An increase follows the increase in tourism in Mataram in the growth rate of hotels offering various comfort and facilities to attract visitors. In carrying out their activities, hotels require large amounts of water for showers, toilets, and sinks to meet the needs of guests and employees. Apart from that, the supporting facilities also show the water used in a hotel. Using large amounts of clean water will also produce large quantities of wastewater.

Hotel activities have a positive effect on the economic growth of the population, but if not managed well, they will hurt the environment. This can happen if the resulting liquid waste is disposed of into the environment without paying attention to the carrying capacity of the water body. The accumulation of garbage can, in turn, influence the scarcity of clean water resources [1]. Sources of wastewater for hospitality activities come from bathrooms (grey water), laundry, and kitchen, as well as from overflow of septic tanks (black water), water used for ablutions, etc [2].

Accumulated waste will cause the natural recovery capacity (self-purification) of water bodies to be exceeded, resulting in eutrophication events [3]. Eutrophication causes the dissolved oxygen content in water to decrease, endangering living creatures in the water body [4]. Water pollution not only hurts environmental health, but it also costs more money to get clean water. Often, local water sources are dangerous to treat because they are highly polluted [5].

Wastewater treatment can be done naturally or with the help of equipment. Natural wastewater treatment is usually carried out with the help of stabilization ponds. Meanwhile, wastewater processing with the help of equipment is generally carried out at Waste Water Treatment Plants (WWTP) [6]. WWTP is a means of treating wastewater by removing contaminants before they are released into the environment. WWTP treats domestic liquid waste from bathrooms, toilets, and washing water. The inlet tank is an essential part of the Waste Water Treatment Plant (WWTP) system, which treats wastewater [7]. In this WWTP, there is a putrefaction tank, which is the most valuable and satisfactory facility among other faecal and liquid waste disposal units that use a water flow system, which is used to capture waste from individual houses, groups of tiny homes, or offices located outside the reach of the system liquid waste channel. The other parts are the control tank, settling tank, Anaerobic Baffled Reactor (ABR) tank, and Anaerobic Filter or Biofilter tank [8]. The cleanliness of the inlet tank must be maintained because it will affect the quality of the treated wastewater. If dirt is left in, the performance of the inlet tank will decrease [9].

Hotel XY is one of the hotels located in the tourist area, precisely in the Senggigi area, West Lombok Regency, NTB; Hotel XY is one of the hotels that have domestic wastewater treatment facilities as a form of concern for the environment and as an effort to fulfil environmental permits. As one of the hotels in the tourist area has a relatively large number of rooms, it is necessary to evaluate the quality of the WWTP in the hotel. This research aims to assess the wastewater treatment plant at XY Hotel. Evaluation is considered essential so that the Quality standards are in accordance with predetermined standards.

Research Methods

This research evaluates XY's existing activities and development plans [10]. The method used in this research is analyzing primary and secondary data. The data collection method for evaluating the performance of the processing unit at the WWAP installation at XY Hotel is carried out by analyzing the waste inlet, processing process, and outlet analysis at the WWAP processing.

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WWTP Inlet Analysis

Wastewater Discharge Analysis

To analyze the inlet and outlet of the XY Hotel WWTP, data on wastewater discharge and wastewater volume is needed at each facility that produces wastewater.

Wastewater Quality Analysis

To analyze the quality of the inlet, physical and chemical quality analysis data (pH, BOD, COD, ammonia, oil and fat, and total coliform) from the wastewater inlet and outlet from the results of sampling tests analyzed in the laboratory.

Processing Unit Evaluation

Evaluation is carried out by monitoring the existing WWTP concerning conceptual benchmarks so that analysis is carried out on Technical design and processing mechanisms carried out in the installation, such as unit dimensions obtained from technical drawings and direct measurements of the processing unit, which are then compared with the design criteria and Calculation of the efficiency of setting aside processing units at the XY Hotel WWTP, characterized by the percentage of pollutant removal. The pollutant parameters in question include BOD, COD, ammonia as well as oil and fat, and total coliform, where the calculation of the percentage of pollutants is based on inlet and outlet removal quality data, which will then be compared to determine the efficiency of the processing unit.

IPAL Optimization

Based on the evaluation of the WWTP at XY Hotel Stage I, namely evaluating the performance of the wastewater treatment installation process to be able to optimize the existing IPAL unit, which is not yet optimal and Stage II, namely optimizing WWTP units that are not yet optimal through the addition of new WWTP units and direct measurements in the field [11].

Results and Discussion

Hotel XY Domestic Wastewater Quality

The quality of Hotel Samples was analyzed at the Environmental Laboratory Center of the Environment and Forestry Service of West Nusa Tenggara Province. Wastewater quality standards refer to Minister of Environment and Forestry Regulation No. 68 of 2016 concerning Domestic Wastewater Quality Standards.

The laboratory test results in Table 1 show that the parameters that do not meet quality standards based on test results in August 2023 are BOD, COD, ammonia oil fat, and total coliform. Laboratory test results include the inlet and outlet of IPAL Hotel XY.

Table 1 . Domestic Wastewater Quality

No	Parameter	Unit	Result		BML
			Inlet	Outlet	
1	BOD	mg/L	31.46	15.01	30
2	pH	-	6.93	7.27	6 - 9
3	COD	mg/L	138	62	100
4	Amoniak	mg/L	10.68	10.36	10
5	TSS	mg/L	25.5	7	30

Wastewater Quantity

Based on XY Hotel Facilities, Existing activities consist of 166 hotel room units with various types and supporting facilities in the form of restaurants, places of worship, ballrooms, clinics, spas, and laundry facilities, as well as development activities in the form of building 24 hotel rooms, one restaurant unit, one ballroom, and swimming pool. The wastewater produced from existing activities is 192.13 m3/day, and from development activities is 34.63 m3/day, so the total wastewater produced from Hotel XY activities is 226.76 m3/day.

Water Balance

Based on Hotel XY Water Usage The total need for clean water for hotel operational activities and supporting facilities in the existing area is 240.14 m3/day, and in the development area is 43.28 m3/day, so the total is 283.43 m3/day sourced from deep well water. Meanwhile, water requirements for watering will use water from recycled wastewater processing [12].

Fluctuations and Continuity of Wastewater Production

The fluctuation and continuity of wastewater production produced are directly proportional to the clean water used for operational activities, where the fluctuation and continuity are influenced by operating time [13]. Hotel activities are residential facility activities, so the operational time lasts 24 hours, and wastewater continuity also lasts 24 hours, with peak load lasting 8 hours daily. The total use of clean water is 283.43 m3/day, and the total wastewater produced is 226.76 m3/day. For existing activities, the wastewater produced is 192.13 m3/day, which will be processed in the Conventional Activated Sludge System STP with a 360 m3/day capacity. From development activities, 34.63 m3/day will be processed in 3 (three) STP/WWTP units. Biofill Anaerobic Aerobic System has capacities of 20 m3/day, 15 m3/day, and 2 m3/day. The wastewater processed by the STP/WWTP will be fully reused as watering water.

Evaluation of XY Hotel WWTP

Water Use Efficiency

With a total need for clean water of 283.43 m3/day and total wastewater of 226.76 m3/day, water use efficiency is 80%.

$$Water\ use\ efficiency = \frac{226,76}{283,43}\ x\ 100\% \ = 80\% \quad [14]$$

Existing Activities

Existing Activities at Hotel XY can be seen in the table below.

Table 2. STP Extended Aeration

No	Proses Unit	STP *Conventional Activated Sludge*
1	Grase Trap	Long : 2.5 m Wide : 3.0 m Water Height : 2.0 m Free Space Height : 0.2 m Effective Volume : 15 m^3 Residence Time : 20 menit
2	Equalizing Tank (pompa transfer (1 duty, 1 standby))	Long 1 : 7.45 m Wide 1 : 3.0 m Water Height : 2.0 m Free Space Height : 0.2 m Effective Volume : 108.30 m^3 Residence Time : 2.98 jam
3	Aeration Tank	Long : 3.0 m Wide : 6.0 m Water Height : 2.0 m Free Space Height : 0.2 m Effective Volume : 36 m^3 Residence Time : 2.4 jam F/M ratio : 0.34 MLSS : 2.500 mg/L Sludge Age : 6.04 hari Air Requirements : 1.59 m^3/menit
4	Water Filter Tank	Long : 1.90 m Wide : 3,.0 m Height : 2.0 m Media : carbon media (100 mm), Gravel (250 mm), palm fiber (300 mm)
5	Chlorine Tank	Chlorine dose required:10 mg/L Solid Chlorine: 200 grams/pcs
6	Effluent Tank	Long 1: 2.75 m Wide 1:3.0 m Water Height : 2.0 m Free Space Height `: 0.2 m Effective Volume : 16..50 m^3 Residence Time : 1.1 jam

A grease trap or fat trap is a tool used to filter fat, oil, and other solid substances before they enter the wastewater disposal system [14]. Grease traps exploit the difference in density between oil and water so that the oil can be separated from the water [15]. At the XY Hotel, the Grease Trap used is by the specified standards, where the material used to make the grease trap consists of durable materials. The Grease Trap consists of several partitions/compartments, namely: Separation One, there is a filter for filtering dirt/garbage, and Separation Two, a place for separating oil and fat from wastewater. Oil and fat will float on the surface, which needs to be carried out routinely manually from Seal Three, the part of the wastewater that is clean from dirt, oil, and fat. [16].

In addition to the Grease trap, the XY hotel's equalizing tank or equalization tank also meets the standards. The equalizing tank accommodates and equalizes water quality and acts as a balancing tank that regulates the inflow and outflow of water from the pre-sedimentation tank. The WWTP Equalizing Tank or equalization tank is part of the Waste Water Treatment Installation (IPAL), which functions to equalize the flow and quality of wastewater: Mixing wastewater from various rooms so that it becomes homogeneous**,** Regulating the flow rate of sewage so that it enters the WWTP constantly, Connecting all other waste storage tanks and Prevent the occurrence of high pressure in other factory tanks. In the Equalizing tank, wastewater is stirred with air from an "air blower" using a diffuser to achieve homogenization [17].

The next important stage in wastewater treatment is the aeration process, which is carried out using an aeration tank to aerate or mix air into the wastewater. Aeration is done by adding oxygen to the wastewater through a blower or mixer. In this aeration tank, the wastewater is blown with air so that the "aerobic" microorganisms present will decompose organic matter in the wastewater. Microorganisms will use the energy obtained from the decomposition for their growth; thus, biomass will grow and develop in large quantities, which will decompose pollutant compounds in the water [18].

Biofill system STP Development activity

STP biofill system development activities at Hotel XY can be seen in the following table.

Table 3. STP Biofill system development at XY Hotel

No	Proses Unit	STP 20 m^3	STP 15 m^3	STP 2 m^3
1	Grase Trap	Portable integrated with sink Removal oil and grase = 95%	Portable integrated with sink Removal oil and grase = 95%	Portable integrated with sink Removal oil and grase = 95%
2	Equalizing Tank	Long : 0.95 m R1 : 1.0 m R2 : 0.3 m Water Height : 1.7 m Free space height`: 0.3 m L1 : 0.94 m^2 Wide 2 : 1.9 m^2 Effective volume : 4.83 m^3 Residdene time : 7.03 jam Diffuser Type : coarse bubble diffuser Number of Diffuser : 1 unit	Long : 0.95 m R1 : 1.0 m R2 : 0.3 m Water Height : 1.7 m Free space height`: 0.3 m L1 : 0,.94 m^2 Wide 2 : 1.9 m^2 Effective volume : 4.83 m^3 Residdene time : 7.03 jam Diffuser Type : coarse bubble diffuser Number of Diffuser : 1 unit	-
3	Anoxic Tank	Long : 1.25 m Wide : 2.0 m Water Height: 1.7 m Free space height `: 0.3 m Effective volume : 4.25 m^3 Residdene time : 6.18 jam Biomediotype : honeycomb Volume media : 2.44 m^3	Long : 1.25 m Lebar : 2.0 m Water Height: 1.7 m Free space height `: 0.3 m Effective volume : 4.25 m^3 Residdene time : 6.18 jam Biomedotype : honeycomb Volume media : 2.44 m^3	Long : 0.4 m Diameter 1 : 1.2 m Diameter 2 : 0.6 m Water Height: 1.0 m Free space height `: 0.53 m Effective volume : 1.35 m^3 Residdene time : 11.41 jam Biomedotype : honeycomb Volume media : 0.33 m^3
4	Aeration Tank	Long : 2.3 m Wider : 2.0 m Water Height: 1.7 m Free space height `: 0.3 m Effective volume : 7.28 m^3 Residdene time : 11.37 jam Biomediotype : honeycomb Area : 225 m^2/m^3 Media Volume : 1.32 m^3 Diffuser Type : fine bubble diffuser Diffuser Efficiency: 20% Number of Diffuser : 2 unit	Long : 2.3 m Wider : 2.0 m Water Height: 1.7 m Free space height `: 0.3 m Effective volume : 7.28 m^3 Residdene time : 11.37 jam Biomediotype : honeycomb Area : 225 m^2/m^3 Media Volume : 1.32 m^3 Diffuser Type : fine bubble diffuser Diffuser Efficiency: 20% Number of Diffuser : 2 unit	Long : 1.0 m Wide : 1.2 m Ater Height : 1.0 m Free space height`: 0.35 m Number of stages: 1 stage Effective Volume: 1.2 m^3 Residene time : 13.09 jam Biomediotype: honeycomb Area : 225 m^2/m^3 Media Volume : 0.18 m^3 Diffuser Type : fine bubble diffuser Diffuser Efficiency: 20% Nuberof Diffuser : 1 unit
5	Sedimentation Tank	Long : 1.0 m Wider : 2.0 m Wide : 2 m^2 Square water height: 1.2 m Height water level: 0.5 m Free space height: 0.3 m Effective Volume : 2.73 m^2 Residdene time: 3.98 jam Form : rectangular Tube settler: 2 unit	Long : 1.0 m Lebar : 2.0 m Wide : 2 m^2 Square water height : 1.2 m Height water level : 0.5 m Free space height: 0.3 m Effective Volume : 2.73 m^2 Residdene time: 3.98 jam Form : rectangular Tube settler : 2 unit	Long : 0.9 m Wide : 1.2 m Free space height: 0.35 m Effektif Volume : 0.58 m^2 Residdene time: 6.28 jam Form : rectangular Tube settler : 2 unit
6	Chlorine Tank	Required dose of chlorine : 3 mg/L Solid Chlorine Spesification : 200 g/pcs % Purity : 80% Chlorine Requirement: 2.86 kg/month Daily use : 9 tablets berat 200 gr/pcs for 1 month	Required dose of chlorine : 3 mg/L Solid Chlorine Spesification : 200 g/pcs % Purity : 80% Chlorine Requirement : 2.86 kg/month Daily use : 9 tablets berat 200 gr/pcs for 1 month	Required dose of chlorine:3 mg/L Spesifikasi kaporit padat : 200 g/pcs % Purity : 80% Chlorine Requirement: 0.25 kg/month Daily Use : 9 tablets berat 200 gr/pcs for 1 month

7	Effluent Tank	Long : 0.7 m R1 : 1 m R2 : 0.3 m Wide 1 : 0.94 m^2 Wide 2 : 1.4 m^2 Water Height : 1.7 m Free space height `: 0.3 m Effective Volume: 3.98 m^3 Residdene time: 5.79 jam	Long : 0.7 m R1 : 1 m R2 : 0.3 m Wide 1 : 0.94 m^2 Wide 2 : 1.4 m^2 Water Height : 1.7 m Free space height `: 0.3 m Effective Volume: 3.98 m^3 Residdene time: 5.79 jam	Long : 0,5 m R1 : 1.2 m R2 : 0.6 m Water Height : 1.0 m Free space height `: 0.3 m Effective Volume: 1.17 m^3 Residdene time: 12,.71 jam

Wastewater flow, Pollutant parameters, Availability of land and space, and Availability of costs [19]. With the development activities at Hotel XY, the existing WWTP has been confirmed that it cannot accommodate the wastewater load during development activities, namely the addition of 3 (three) units of STP/WWTP Biofill Anaerobic Aerobic Systems with a capacity of 20 m^3/day each, 15 m^3/day and 2 m^3/day. Existing conditions are the basis for planning and are essential for proper development. Analyzing existing conditions involves reviewing data sources to obtain accurate and relevant data [20].

Conclusion

Based on the evaluation results of the development activities at the XY Hotel, the existing WWTP is not sure it can accommodate the wastewater load. The hotel is expected to pay attention to the problem of insufficient WWTP because it can affect environmental quality.

Author's Contributions

Tina Melinda: Contributed to compiling the background, determining research methods or data analysis techniques, and preparing abstracts and conclusions. Nurhidayah: Contributed to interpreting ata and research analysis results and enriching the discussion with related previous research (Previous Journals).

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