THE EFFECTIVENESS OF WASTEWATER TREATMENT PLANT IN AL-AKBAR MOSQUE OF SURABAYA

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Abstract. Indonesia is the largest Muslim country in the world. According to The Royal Islamic Strategic Studies Center (RISCC), the number of Muslim in Indonesia is around 237.56 million people or 86.7% of the total population. The need for clean water used in ablution continues to increase and there are not many ablution water treatment systems. This research aimed to know the effectiveness of WWTP in Al-Akbar Mosque of Surabaya. The type of this research is descriptive. The variables studied were the quantity of clean water, the quality of the wastewater, and the equipment and facility used in the WWTP process. The research sample was 10 samples. Data analysis was carried out in a qualitative and quantitative descriptive manner according to the Minister of Environment and Forestry Regulation No. 68 of 2016. In the WWTP in Al-Akbar Mosque of Surabaya, there is a pre-treatment process with a collector tub and primary treatment by zeolite multiform filtration. The result of laboratory test of wastewater effluent quality with Ammonia parameter, Total Coliform and TSS exceeded the quality standard on Monday and Friday, meanwhile BOD parameter in all samples exceeded the quality standard. The conclusion of this research is the WWTP is not yet effective in reducing the parameters of Ammonia, Total Coliform, BOD, and TSS on Monday and Friday because there are no biological and disinfection stages. Suggestion for Surabaya Al-Akbar Mosque to monitor and evaluate the quality of wastewater and the performance of the WWTP so that the wastewater can be reprocessed.

Keywords: Clean Water, Domestic Waste, Wastewater Treatment plant

1 BACKGROUND

The mosque is a gathering place for Muslims to carry out their daily worship activities, resulting in a lot of liquid waste, especially domestic waste. Surabaya Al-Akbar National Mosque is the largest mosque in East Java and the second largest in Indonesia after the Istiqlal Mosque. Al Akbar Mosque is not only a place to worship, but a learning center too. Inside, there is a madrasa, library and canteen (Suryani, 2015). Al-Akbar Mosque is a center of worship in the Surabaya City and even in East Java, with so many worshipers coming every day at this mosque, the need for clean water will also continue to increase and the waste generated from activities such as ablutions, bathrooms and toilets will also increase. Al-Akbar Mosque has made efforts to process the wastewater to be reused as a reserve for watering plants and cultivating fish pond. This technology has been used in every sector of the mosque with a total of 4 sectors. In total there are 539 ablution faucets, 43 urinal units, 41 toilet units, 35 bathrooms and 41 sink units. The existence of WWTP makes the toilet waste odorless and the mosque becomes cleaner (Silva, J. A, 2023) (Joseph, T. at al., 2023).

According to HR. History of Bukhari No. 325, The Prophet recommended us to perform ablution using at least one mud of water, approximately half a liter of water. According to data from the Ministry of Religion, Indonesia has a total of 290,161 mosques as of May 2022. The majority of Indonesia's population is Muslim, around 80% or 212.5 million people (Cahyaningrum, Yunita and Rahayu, no date). With a large number of mosques, the need for water is also very high. The average use of water for ablution for people/time of prayer is 4.42 L (Mafra, 2018) if it is assumed that one day for ablution requires 25 liters of water. If the average number of people who go to the mosque is 20 people, then 500 liters of water is wasted every day (Mane, S et al.,2019).

Since the construction of the wastewater treatment plant at the Al-Akbar Mosque, not many researchers have conducted research on wastewater treatment systems, therefore this study aimed to evaluate the results of wastewater treatment. This evaluation focused on aspects of the quantity of water used for ablution, the quality of treated water from the system and the quantity of treated water processed every day. In determining the output quality of wastewater that is processed into clean water, it must be adjusted to the Regulation of the Minister of Environment and Forestry No. 68 of 2016 concerning Domestic Waste Quality Standard.

2 RESEARCH METHOD

Descriptive research by using evaluation study to compare the quality of influent and effluent of the wastewater treatment plant according to the Regulation of the Minister of Environment and Forestry No. 68 of 2016 concerning Domestic Waste Quality Standard. The method used is observational to observe and measure the research object directly. The research location is in Surabaya Al-Akbar Mosque and the object being studied is wastewater treatment plant in the mosque studied for 5 days from Monday-Friday. The variable of this study is influent and effluent quality with parameters measured are physical, chemical, and microbiology.

3 RESULT

3.1 Identification of Wastewater Treatment Plant in Surabaya Al-Akbar Mosque

The wastewater treatment plant at the Al-Akbar Mosque in Surabaya went through two stages, pre-treatment and primary treatment. In pre-treatment stage, it used a collector tub to collect the wastewater then being cleaned for taking floating objects and taking settled objects such as sand. The filtering model found in the Al-Akbar Mosque in Surabaya is a coarse screen using iron gratings as a filter tool (barr screen). The collection unit/tub at the Al Akbar Mosque is rectangular in shape with a size of 6x2m and there are 4 partitions used for the screening process. In the next process, wastewater will be treated with a filtration unit using multiform zeolite rock with three layers of different sizes. Based on (Suhartana and Pardoyo, 2020). Natural zeolite activated with H_2SO_4 has high effectiveness compared to activation with HCl. In the first layer with small rocks of 3 cm – 5 cm, the second layer is medium sized with a size of 7 cm – 10 cm, and the top layer uses a size of 15 cm – 25 cm.

3.2 Influent and Effluent Quality Examination

Examination of samples for five days from Monday to Friday, the concentrations of Ammonia, Total Coliform, BOD and TSS were still above the quality standards, while the concentrations of the parameters pH, Fatty Oil and COD had met the quality standards. From the liquid waste quality test of parameter Ammonia, Total Coliform, BOD and TSS obtained the following results:

Table 1. Examination of Ammonia Level in Wastewater

No.	Day	Examination Result		Quality Standard	Description
		Inlet	Outlet		
1.	Monday	216.9 mg/l	26.78 mg/l	10 mg/l	Not qualified
2.	Tuesday	209.5 mg/l	2.531 mg/l		Qualified
3.	Wednesday	212.3 mg/l	3.494 mg/l		Qualified
4.	Thursday	204.7 mg/l	2.631 mg/l		Qualified
5.	Friday	343.6 mg/l	37.95 mg/l		Not qualified
Mean		237.4 mg/l	14.6%		Not qualified

Ammonia concentration at the wastewater outlet on Monday was 26.78 mg/l and on Friday it was 37.95 mg/l so that on Monday and Friday the ammonia levels exceeded the quality standard.

Table 2. Examination of Total Coliform Level in Wastewaste

No.	Day	Examination Result		Quality Standard	Description
		Inlet	Outlet		
1.	Monday	27000 CFU/100 ml	5400 CFU/100 ml	3000 CFU/100 ml	Not qualified
2.	Tuesday	26000 CFU/100 ml	2100 CFU/100 ml		Qualified
3.	Wednesday	24000 CFU/100 ml	2400 CFU/100 ml		Not qualified
4.	Thursday	22000 CFU/100 ml	1600 CFU/100 ml		Qualified

5.	Friday	43000 CFU/100 ml	9200 CFU/100 ml		Not qualified
Mean		28400 CFU/100 ml	4140 CFU/100 ml		Not qualified

The highest levels of total coliform bacteria at the outlet occurred on Monday at 5400 CFU/100ml and Friday at 9200 CFU/100ml. From these results, Monday and Friday did not meet the quality standards.

Table 3. Examination of BOD Level in Wastewater

No.	Day	Examination Result		Quality Standard	Level Decrease
		Inlet	Outlet		
1	Monday	1770 mg/l	125.1 mg/l	30 mg/l	Not Qualified ———
2	Tuesday	1670 mg/l	38.05 mg/l		Not Qualified —
3	Wednesday	1830 mg/l	45.11 mg/l		Not Qualified —
4	Thursday	1750 mg/l	84.34 mg/l		Not Qualified —
5	Friday	2380 mg/l	72.19 mg/l		NotQualified
Mean		1880 mg/l	72.7 mg/l		Not Qualified

From the results of the inspection, all BOD parameter samples at outlets from Monday to Friday did not meet the domestic waste quality standard of 30 mg/l.

Table 4. Examination of TSS Level in Wastewater

No.	Day	Examination Result		Quality Standard	Description
		Inlet	Outlet		
1	Monday	946.0 mg/l	43.4 mg/l	30 mg/l	Not Qualified ———
2	Tuesday	735.9 mg/l	6.9 mg/l		Qualified —
3	Wednesday	4906 mg/l	9.3 mg/l		Qualified —
4	Thursday	556.6	11.7 mg/l		Qualified —

		mg/l		
5	Friday	355 3 mg/l	137.5 mg/l	Not Qualified
Mean		213 9.5 mg/l	41.76 mg/l	Not Qualified

The highest suspended solids content at the outlet occurred on Monday at 43.4 mg/l and Friday at 137.5 mg/l. In accordance with Minister of Environment and Forestry No. 68 of 2016, the quality standard for suspended solids (TSS) in domestic wastewater is 5 mg/l therefore the wastewater samples on Monday and Friday exceeded the quality standard.

3.3 Waste Source and Waste Water Discharge at Surabaya Al-Akbar Mosque Waste Source.

In general, the liquid waste produced by Al-Akbar Mosque in Surabaya is categorized as domestic waste because most of the liquid waste is produced by ablution activities. Most of the mosque's waste is gray water because it comes from ablution or such activities. At this time, Al-Akbar Mosque has an ablution area that is used in each sector of the mosque with a total of 4 sectors. In total there are 539 ablution faucets, 43 urinal units, 41 toilet units, 35 bathrooms and 41 sink units. From each of these sectors, the resulting wastewater will go directly to the wastewater treatment plant.

3.4 Clean Water and Wastewater Discharge at Surabaya Al-Akbar Mosque

The clean water source used in Al-Akbar Mosque in Surabaya is from PDAM water. Measurement of clean water aimed to know its usage every day so that the resulting discharge of wastewater can be found. Measuring the use of clean water using a flowmeter.

Table 4. Clean Water Discharge at Surabaya Al-Akbar Mosque

No.	Day	Daily Use (M^3/Day)
1.	Saturday	13.68 M^3/day
2.	Sunday	14.0 M^3/day
3.	Monday	14.25 M^3/day
4.	Tuesday	14.32 M^3/day
5.	Wednesday	13.80 M^3/day
6.	Thursday	13.43 M^3/day
7.	Friday	15.82 M^3/day
8.	Mean	14.19 M^3/day

From the measurement above, of the use of clean water at the Al-Akbar Mosque in Surabaya, the discharge of wastewater generated every day can be measured. The domestic wastewater debit is measured based on data on total clean water usage by using domestic wastewater generation calculations ranging from 60 - 80% of clean water usage (Pangesti & Ariesmayana, 2022). Obtained an average of 11,347 M^3.

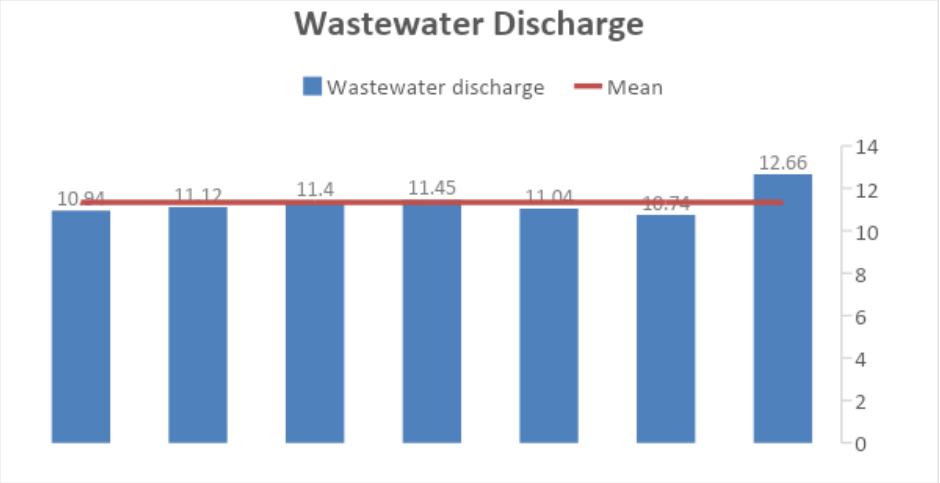

Fig. 1. Wastewater Discharge at Surabaya Al-Akbar Mosque

4 DISCUSSION

4.1 Quality of Wastewater Effluent in Surabaya Al-Akbar Mosque

The ammonia level in wastewater effluent of Surabaya Al-Akbar Mosque is still above the quality standard of domestic liquid waste due to the zeolite rock in liquid waste treatment unit is unable to process the load of ammonia level on Monday and Friday. According to study (Dan, 2023) in reducing the ammonia level by photocatalyst process. Zeolite acts as a catalyst because it can accelerate the reaction in reducing ammonia level. The more zeolite added, the lower the levels of ammonia pollution (Nurlaela and Husnah, 2019). Research Results (Setiawan *et al.*, 2023). The pH value influences the photocatalysis process. Based on the results of the photocatalysis process, the value percentage allowance highest ones obtained was 84.40% at pH 11. Apart from zeolite, ammonia can be removed maximally by secondary biological treatment processes such as aeration (Cristaldi, A et al., 2020). In the aeration stage, the addition of oxygen with optimal residence time in wastewater can activate nitrifying microorganism which can decompose ammonia into nitrite or nitrate. Advanced processing of wastewater effluent can also be used to reduce ammonia level, one of which is wetland. The use of a wetland system utilizes aquatic plants which can absorb ammonia level in the effluent. According to a study (Aurellya, 2022), the use of Vetiver (Vetiver z.) can reduce ammonia by 52.48% - 92.93%. Constructed Wetland system uses Mexican sword is proven effective in reducing the pollutant parameters of tofu industrial waste by 46% -95% (Kasman et al., 2018).

The indicator bacteria used are E.coli and coliform, because the presence of these bacteria in the water. E. coli bacteria able to survive in water for 4 – 12 weeks, depending on environmental conditions (Khan and Gupta, 2020). Waterborne

Escherichia coli are a major reservoir of antimicrobial resistance (AMR) (Haberecht *et al.*, 2019). At a dose of Calcium Hypochlorite Ca (OCl) 2.5 mg in 1 liter of raw water was able to reduce the number of E. Coli by 99.40% (Munawar, Donoriyanto and Rahmawati, 2021). Escherichia Coli poses a danger to human health. E. Coli can also cause acute diarrhea which is grouped into 3 categories, namely enteropathogenic which causes acute gastroenteritis in newborns to 2 years of age, enteroinactive and enterotoxigenic which causes diarhea in children and adults. (Melliawati, no date) (Pillay, L., & Olaniran, A. O, 2016)..

From the observation result, a high total coliform level is due to the increasing number of worshipers on Monday and Friday. On Mondays, Al-Akbar Mosque routinely holds routine study activity, while on Fridays there are Friday Prayer services so that the wastewater discharge generated increases. In wastewater treatment units that do not have a disinfection stage. The type of disinfectant and the length of contact time greatly affect the ability to disinfect. At present, there are many studies using ozone and chlorine oxide types of disinfectant because chlorine dioxide is stronger than other types of chlorine (Said, 2017).

In the Surabaya Al-Akbar Mosque wastewater treatment unit, the high BOD load is due to the inability to process it optimally. The concentrations of BOD and DO at the study site show numbers that have exceeded the quality standards of the local regulations, causing the quality of the ecosystem to decline (Lusiana, Widiatmono and Luthfiyana, 2020). There is no biological treatment process which is also a factor that causes high level of BOD. Biological treatment is important to apply because it can eliminate contamination in wastewater (Bekkari & Zeddouri, 2019). Biological treatment that can be used to reduce BOD level is aerobic (with the addition of oxygen) or anaerobic (without oxygen). Advanced treatment systems with a combination of constructed wetlands using water Mexican sword is able to reduce the BOD level of domestic wastewater with an average reduction of 14.89 mg/l and a percentage of 96.97% (Sumarta & Ronny, 2023). A constructed wetland concept garden is effective in reducing COD and BOD5 parameters. the highest removal of COD parameters was 86% and BOD5 parameters was 84% (Kasman, Hadrah and Firmanda, 2022).

The high concentration of TSS due to the increase in the number of worshipers on Fridays causes the level of suspended solids in the resulting wastewater to be higher than on other days so that the wastewater treatment plant is unable to reduce the concentration of the TSS parameter above 0.0434 m^3. During Friday prayer service is the peak of the increase in the number of worshipers compared to other days. The ability of natural zeolite as an adsorbent for turbidity in water has high effectiveness, but the turbidity load factor in wastewater and the treatment of the zeolite filter is a factor in the level of zeolite filter ability. Study (Raja, 2016) stated that the addition of zeolite in cellulose acetate membrane has strong adsorption power in reducing water turbidity. The filtration process uses a combination of zeolites media, activated charcoal, and activated sand, can eliminate TSS by 99% (Bontinge *et al.*, 2017).

Evaluation of Wastewater Treatment Plant in Surabaya Al-Akbar Mosque

Measurement of the effectiveness of wastewater removal from the wastewater treatment unit at the Al-Akbar Mosque in Surabaya, the results are as follows:

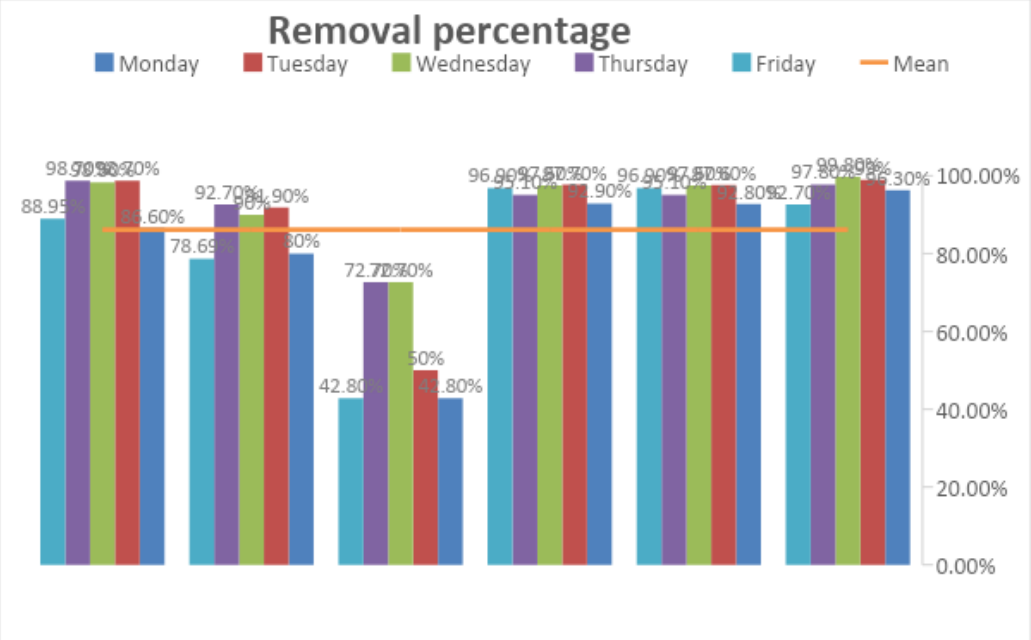

Fig. 2. Removal Effectiveness Percentage

From the calculation of the percentage of the effectiveness of the wastewater treatment plant in reducing the pollutant parameters of domestic wastewater, oil and grease has a low percentage and TSS has a high percentage. The low percentage of oil and grease is caused by the generation of waste containing oil and grease.

The average percentage reduction of all pollutant parameters is 86.12%. Even though it has a high percentage of capacity, the wastewater treatment unit has not been able to reduce the parameters of ammonia, total coliform, and TSS below the domestic liquid waste quality standard because the capacity of the wastewater treatment plant is unable to process the load of pollutant parameters at peak conditions for the number of worshipers at Surabaya Al-Akbar Mosque.

As much as 70% of Surabaya Al-Akbar Mosque's wastewater effluent is discharged into water, while the other 30% is used for garden watering reserves. If the 70% of the water discharged into water bodies is not considered for its quality, it will result in transmission of waterborne diseases such as cholera, diarrhea, typhoid, and hepatitis (Bhave et al., 2020). With current studies and research literature, wastewater treatment is important in order to protect the environment in a sustainable manner, so one solution is to treat wastewater so that it can be reused (Muthuraman et al., 2023) (Tadsuwan, K., & Babel, S, 2021). We should utilize ablution water to be used from time to time so as to save large amounts of water (Fajaruddin Natsir *et al.*, no date). Indonesian Ulema Council through Fatwa No. 02 of 2010 stated that treated wastewater can be reused by engineering various technologies.

The wastewater treatment at the Al-Akbar Mosque in Surabaya can also reduce costs for clean water. Based on (Mudofir *et al.*, 2022) The results showed that the ablution wastewater that was treated using electrocoagulation meets water quality standards for sanitary hygiene purposes based on the parameters pH, TDS, conductivity, and ammonia. This water is safe when reused for ablution activities in mosques.This study has a weakness that it only examined for 5 days from Monday to Friday, whereas from observations on Saturday and Sunday activities at the Al-Akbar Mosque in

Surabaya have the potential to produce waste types of oil and grease, therefore it is necessary to carry out further research for 7 days to determine other potential pollutant parameters.

5 CONLUSION AND RECOMMENDATION

Examination of the quality test for domestic wastewater at the Al-Akbar Mosque in Surabaya was obtained on Monday and Friday for the parameters Ammonia, Total Coliform and TSS were still above the quality standard and the concentration of the BOD parameter for all samples exceeded the quality standard. The concentration of pH, COD, Oil and Fat is in accordance with quality standards. It is recommended for further researchers to make observations for 7 days, because Saturday and Sunday have the potential to produce oil and grease waste from activities at the Al-Akbar Mosque in Surabaya.

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