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FEASIBILITY STUDY OF COMMUNAL DOMESTIC WASTEWATER TREATMENT PLANT IN SEKANAK AREA, PALEMBANG CITY

Hendrik Jimmyanto, Isdaryanto Iskandar
Faculty of Engineering, Atma Jaya Catholic University of Indonesia

***Abstract*—Pollution, whether in the form of domestic wastewater or solid waste generated by daily activity, is to blame for this. In Indonesia, most domestic wastewater treatment still takes place locally, on-site, for instance, using septic tanks. The septic tank essentially only serves to precipitate the sludge content in home waste water, allowing it to contaminate soil, ground water, and eventually surface water bodies. There have been several domestic wastewater treatment facilities (WWTP) in Palembang City throughout the previous five years, both on a local and regional level, all of which are still in use. One of the city of Palembang's current WWTP facilities, Sekanak's WWTP is located not far from the river's edge. This WWTP was constructed to deal with the liquid waste generated by households in order to prevent direct pollution of the Sekanak River. This study used a quantitative descriptive method to accurately explain and represent the field circumstances based on the quantitative data that was collected. Installing an equalization tank in accordance with the input discharge to balance out the discharge of the collection tank and the discharge of the incoming wastewater will improve the old Sekanak WWTP. This method can be used to lessen and prevent water quality pollution from WWTP outputs.**

***Keywords*— Domestic Wastewater, Water Quality, Wastewater Treatment Plant, Detention Time.**

I. INTRODUCTION

WASTE is a byproduct of all human activity. Human activity-related waste has grown to be a serious environmental issue in recent years. Not just in wealthy nations, but also in developing nations, Indonesia included, is the rise in the quantity and variety of waste created. The influence of population increase on environmental quality is one of the reasons contributing to this rising impact. The environment is under increasing pressure due to the population growth. This is a result of pollution, either in the form of home wastewater or solid trash that results from daily activity. The availability of a safe collection and disposal system for home wastewater and feces is not guaranteed, even if access to appropriate sanitation in Indonesia's urban regions reached about 73% in 2010. This figure is based only on access to basic sanitation. According to data currently available, only 1% of wastewater and 4% of fecal sludge have been securely collected and processed [1].

According to the findings of the national data study, 67.89 percent of homes had access to basic sanitation, but 32.11 percent of households continued to discharge domestic waste into sewers and drainage channels. The majority of the most pressing issues are caused by domestic wastes [2].

Water pollution is characterized as an increase in chemical, biological, or physical components in a concentration or in a method that endangers people, aquatic life, or properties. Some believe that water is contaminated when it does not meet the highest standards for human needs, notably drinking, followed by all other personal and natural uses, including recreational uses [3].

In Indonesia, the majority of home wastewater treatment systems are still done locally, on-site, using septic tanks, for example. A septic tank is a subterranean construction that is insulated but not impermeable. In order to lower the amount of pollutants in the water that exits the septic tank, the septic tank functions by collecting feces and unclean water from the toilet or latrine and depositing sediment or solids in the unclean water. But the majority of effluents in modern septic tanks are not waterproof. Because the septic tank essentially just works to precipitate the sludge content in domestic wastewater so that it might contaminate soil, ground water, and ultimately lead to surface water bodies, dirty water that exits the septic tank still includes pollutants and hazardous germs [4]. The sanitation system used in metropolitan areas should ideally be integrated, communal, or centralized to enable sewerage treatment.

In Palembang City, the onsite system—specifically, the septic tank—is still being used for domestic wastewater treatment. Septic tanks collect waste and contaminated water from the toilet or latrine and add sediment to the contaminated water. Because the septic tank essentially just works to precipitate the sludge content in dirty water so that it might contaminate soil, groundwater, and ultimately lead to surface water bodies, dirty water that exits the septic tank still includes pollutants and hazardous germs.

Since the past five years, Palembang City has had a number of domestic wastewater treatment plants (WWTP), both on a settlement and regional scale, all of which are still in operation. However, other initiatives are required in order for the WWTP's network and circumstances to operate at their best. The issue that frequently arises is the flow line from the house connection to the WWTP tub, which frequently leaks or is clogged, making it impossible for the dirty water discharge to be processed entirely in the WWTP tub.

The three major types of wastewater treatment—primary, secondary, and tertiary—include mechanical, biological, and chemical processes that can be used to treat wastewater. The selection of the treatment system design heavily depends on the characterization of the wastewater, including daily volumes, rates of flow, and associated pollutant load. An accurate evaluation of the wastewater to be treated is necessary for determining the performance requirements for the treatment system, choosing appropriate treatment methods, designing the system, and running it [5,13].

A study on the effectiveness of a public wastewater treatment facility in the city of Bogor was undertaken by Dhama Susanthi [6]. An anaerobic filter (AF) and anaerobic baffled reactor (ABR) system is employed by the municipal WWTP. The technique utilized to assess the effectiveness of the WWTP includes field observations, interviews, and wastewater samples. The effluent's properties, how wastewater is discharged into the WWTP system, and management all have an impact on how well the communal WWTP with the ABR system performs.

Domestic wastewater can come from restaurants, offices, retail establishments, apartment complexes, residential settlements, and wastewater treatment facilities. The majority of them are made up of organic material that is disposed of in restrooms, kitchens, and laundry facilities. Water bodies are affected by pollution when there is less oxygen in the water, which puts aquatic life in danger and makes it easier for bacteria to grow. Sonia Prilly Ismi Arum [7] examined the effect of domestic wastewater from the Dinoyo Urban Village population on the BOD and COD levels of water bodies. It was determined that domestic wastewater from population surpassed class II water quality regulations in Indonesia and could not be used for its intended purpose due to the increase in BOD and COD contents at each test station, which had an impact on stream flow quality.

Gede Adi Wiguna Sudiartha [8] did research on Analysis of Faecal Sludge Treatment of WWTP Suwung Denpasar City. An off-site treatment facility at WWTP Suwung treats the majority of the domestic wastewater produced in Denpasar City. Higher BOD loads cannot be treated by the current treatment, which uses the aerated lagoon technique, and can only handle organic pollutant loads up to about 225 mg/l. The findings of evaluating several factors, including economic, land use, technological, and environmental factors, were used to choose the alternative approach. Based on the findings, an anaerobic baffled reactor was chosen as a secondary treatment and a solid separation chamber as the primary treatment. The sludge was reshaped into a recyclable cake using a Belt Filter-Press. It will cost roughly 16 billion rupiahs to complete the project.

Sekanak's WWTP is one of the city of Palembang's current WWTP infrastructure and is situated close to the river's boundary. In order to prevent direct pollution of the Sekanak River, this WWTP was built to handle the liquid waste produced by residents. According to observations made at the WWTP, wastewater treatment outputs are not sufficient when the water is still black and turbid when it exits the outlet pipe. In order for the Sekanak WWTP to manage domestic wastewaters properly and optimally, a research study from the Sekanak WWTP's feasibility study is required.

The main principle is that wastewater that has been released into the environment poses no threat to the health of the environment. If wastewater is not managed effectively, it can cause a variety of problems, including the contamination of pet food and drinking water and the disruption of river ecosystems [9].

II. RESEARCH METHODOLOGY

Based on collecting the quantitative data, this study employed a quantitative descriptive method to objectively explain and depict the field conditions. Sekanak, Palembang City, was the site of the study. Surveys and in-person observations are used to gather data, including the measurement of flow rate and the obtaining of water samples from the WWTP outlet. A table that comprises water quality metrics and maximum permissible water content values is created for the analysis of finding the maximum allowable value for each water quality parameter [10].

III. EXPERIMENT AND RESULT

A WWTP building and a pipe network system make up a communal wastewater treatment plant (WWTP) with a piping system. The purpose of the WWTP facility is to house the wastewater that is piped in to be treated into effluent that is safe for the environment. WWTP in Sekanak are classified into the old WWTPs that built in 2015 (Fig.2.) and the new WWTPs that built in 2017 (Fig.3.) based on the findings of surveys and observations of the current conditions, and they will be detailed as follows in Table-1:

Table -1 WWTP existing condition

Description of WWTP	Information	
	Old WWTP	**New WWTP**
Year built	2015	2017
Plan capacity	90 m^3/days	135 m^3/days
Capacity built	21,6 m^3/days	10,8 m^3/days
Construction type	Fiber	Concrete construction
Stream system	Gravity	Gravity
Processing system used	Anaerobic Upflow Filtration (AUF) and Anaerobic Baffle Reactor (ABR)	Anaerobic Upflow Filtration (AUF) and Anaerobic Baffle Reactor (ABR)
Number of treatment tanks	7 tubs of WWTP	7 tubs of WWTP
Supporting facilities	1) Road infrastructure in the form of access roads, operational roads, and inspection roads 2) Maintenance Tools 3) Exhaust pipe 4) Maintance Room 5) Pump house	

Aerobic Upflow Filter (AUF) and Aerobic Buffle Reactor (ABR) systems are used in the Sekanak WWTP treatment system. The wastewater treatment method known as anaerobic upflow filtering (AUF) involves draining wastewater into the first digester and then flowing it into the second decomposer tank. The first and second tanks serve as sediment and decomposers as well as wastewater treatment facilities. It enters the UAF (Anerobic Upflow Filter) media with a flow from the bottom to the top after leaving the second decomposer.

The bottom-up flow system will improve treatment effectiveness by lowering the velocity of the particles in the wastewater stream. The Anaerobic Buffle Reactor (ABR), on the other hand, is made up of a settling compartment followed by a number of buffle reactors that are utilized to control the water's upflow via a number of series of sludge blanket reactors. This ABR system enables for the naturally occurring separation of microorganisms involved in hydrolysis, acidogenesis, and methanogenesis and has an outstanding anaerobic reactor structure that makes it suited for usage in impoverished nations [11]. ABR is categorized as a biological treatment method. The values of BOD and COD for both locations continue to be governed by the water quality control rule for effluent discharge onto water streams. Using a pump, the aerobic zone's waste is recycled into the anaerobic zone. It removed roughly 90% of the BOD and COD, respectively [12]. By interacting with an excess of anaerobic microbes in the filter medium, this anaerobic system processes non-deposited materials and dissolved solids with the purpose of decomposing dissolved organic matter and scattered organic matter in wastewater in an oxygen-free environment. The summary of Sekanak WWTP process can be seen in Fig.1.

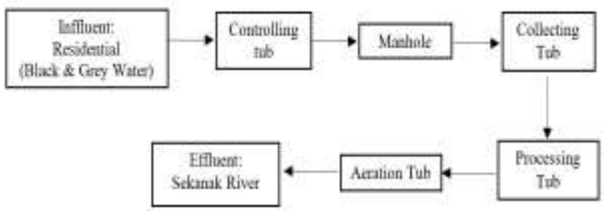

Fig. 1. Flowchart of the Sekanak WWTP processing process

The household connection pipes, Service Pipes (Tertiary Pipes), Branch Pipes (Secondary Pipes), and Main Pipes (Main Pipes) make up the piping network system at Sekanak WWTP. These pipes are used to collect wastewater from its origins and flow it to the WWTP building. in accordance with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number: P.68 /Menlhk/Setjen/ Kum.1/8/2016 regarding Domestic Wastewater Quality Standards that are safe for the environment, to be processed to create effluent wastewater.

Fig. 2. Old WWTP Sekanak

Fig. 3. New WWTP Sekanak

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This plumbing system also needs a control tub and a manhole that are at least 50 meters apart, with the control tub serving as a trap tub that collects wastewater from bathroom drains and directs it to the main pipe channel so that, in the event of sediment buildup, the pipe can become clogged from either the drain or the control tub. We have control over and access to both the manhole channel and bathroom exhaust. While the manhole helps with maintenance in the event that the pipeline between the control tank and the collection tank in the WWTP processing unit becomes blocked.

The capacity of each old WWTP was 200 units (1000 people), while the capacity of the new WWTPs was 300 units (1500 people). The Sekanak WWTP service coverage is 48 units (240 people) for the old WWTPs and 24 units (120 people) for the new WWTPs. translates to 152 units for the old WWTP and 276 units for the new WWTP having idle capacity. Due to inefficient utilization of the existing infrastructure or operational challenges, there is underutilized water capacity in this situation (idle capacity). The lack of installation of distribution pipes or house connection pipes is the root cause of this idle capacity.

Disposal systems from wastewater treatment processes into water bodies must not exceed environmental quality requirements, namely the maximum size, level, or permissible quantity of polluting elements in wastewater that will be released into water sources as a result of an activity. Table-2 show the result of WWTP outlet water quality which the parameter have not exceed the maximum level based on the South Sumatra Governor Regulation No. 8 of 2012, serves as the basis for the environmental quality standard for home wastewater. To reduce suspended residue parameter levels in the WWTP treatment process, it can be done by draining the sludge in treatment tanks.

Table -2 WWTP outlet water quality test results

No.	**Parameter**	**Unit**	**Maximum**	**Test Result**
1	pH	-	6 – 9	6,3
2	BOD	mg/l	100	4.04
3	Suspended Residue	mg/l	100	97.6
4	Oil and Fat	mg/l	10	2.3

Fecal sludge is periodically suctioned from the treatment tank using a suction hose and pump, and then the sludge is drained every three months. With a maximum suction capacity of no more than 2/3 of the tub's volume, the suction hose is placed at a height of 20 cm from the tub floor to vacuum.

The discharge from the house connection (SR), intake discharge, and output discharge make up the processing discharge under examination. The amount of waste produced by household activities is used to compute the house connection discharge (SR). The total volume of wastewater entering from the collection tank to the WWTP treatment basin is used to compute the inlet discharge, while the total volume of wastewater exiting the outlet over a specific period of time is used to calculate the outlet discharge. The quantity of home connection discharge (Q SR) for old WWTPs is calculated as follows: Q water use x number of dwellings x number of occupants where Q water use is 90 liters/person/day so the amount of house connection discharge Q SR for old WWTP = 21.6 m^3/day or 3.17 m^3/hour and Q SR for new WWTP = 10.8 m^3/day or 0.45 m^3/hour

By dividing the amount of water in the collection tank by the pumping duration, one can calculate the inlet discharge (Q inlet). The time needed to transfer wastewater from the collection tank to the WWTP treatment tank is known as the pumping time. The dimensions of the collection tank for the old WWTP are 1.2 m in length, 1.85 m in width, and 3.5 m in height, whereas the collection tank for the new WWTP is 3 m long, 2.4 m wide, and 3 m high. As a result, the collection tank's volume is 7.77 m^3 for old WWTPs and 21.6 m^3 for new WWTPs.

The pumping time of wastewater at Sekanak WWTP is at 06.00 – 08.30 so that the maximum pumping time is 2.5 hours. The amount of inlet discharge (Q inlet) based on the explanation above is 3.11 m^3/hour for the old WWTP and 8.64 m^3/hour for the new WWTP.

Table -3 Comparison of discharge

WWTP	**Q SR (m^3/hour)**	**Q Inlet (m^3/hour)**	**Deviation (%)**
Old WWTP	3.17	3.11	1,9%
New WWTP	0.45	8.64	860%

The discharge in Table-3, that is accommodated in the collection tank does not only come from household wastewater, but also from rainwater, seepage of ground water, and water nearby the WWTP location, according to the results of the analysis of house connection discharge (Q SR) and inlet discharge (Q inlet), which show that the Q inlet is greater than the Q SR in the new WWTP with 860%. The analysis of house connection discharge (Q SR) and inlet discharge (Q inlet) for the old WWTP revealed that the discharge entering the collection tank in the old WWTP only came from the waste water produced by residents and that there was no other increase in discharge. The house connection discharge was almost the same as the inlet discharge with a difference in d of 1.9 %.

Table -4 Measurement of discharge at the Sekanak WWTP outlet

Measurements	**Volume (liter)**	**Time (second)**	**Discharge outlet (liter/sec)**
1	1.1	14	0.079
2	0.6	10	0.06
3	1	14	0.071
		Average	**0.07**
			0.252 m^3/hour

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Using a measuring cup and a timer, the volume that exits every second is measured to determine the WWTP outlet discharge. One WWTP outlet, formed by the combination of the old and new WWTPs (Fig.4.), is the maximum number of WWTP outlets. The average discharge from a WWTP outlet (see Table-4) when the pump engine is not running is 0.252 m^3/hour, or 0.07 liter/second, according to the findings of three measurements of the discharge at the WWTP outlet.

Fig.5. shows the flow diagram for the discharge from the reservoir to the WWTP outlet discharge. There is a decrease in discharge at each level of the old Sekanak WWTP processing when the wastewater discharge from residents' homes (SR) is more than the intake discharge in the WWTP tub and also at the WWTP outlet. The discharge from house connection discharge to inlet discharge increased at the new WWTPs during this time. These findings demonstrate that while the pump engine is not running, the inlet discharge (Q inlet) is greater than the discharge at the WWTP outlet. This suggests that less wastewater is being discharged once it has gone through the WWTP treatment tanks.

Fig. 4. Sekanak WWTP outlet

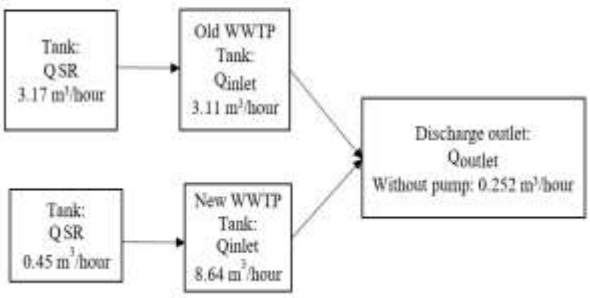

Fig. 5. Sekanak WWTP debit scheme

In order to lower BOD and sludge levels in wastewater before it is discharged into water bodies, a sedimentation process that occurs in the WWTP treatment basin for a set period of time is likely to be responsible for the drop in discharge. The residence time is the length of time needed for the process of mud or sedimentation in the WWTP treatment basin (detention time).

.Table -5 Measurement of discharge at the Sekanak WWTP outlet when pump engine is running

Measurements	**Volume (liter)**	**Time (second)**	**Discharge outlet (liter/sec)**
1	1,0	1.5	0.67
2	0,8	1.0	0.8
3	1,0	2.0	0.5
		Average	**0.66**
			2.38 m^3/hour

The discharge at the WWTP outlet is significantly larger when the pump engine is running (Table-5). As a result, the water quality is cloudier and the BOD value is higher. This is because the treatment in the WWTP tank is not optimal and there is no detention time in the tank. When the pump engine is running, causing a very fast discharge flow and a lot of unsettled sedimentation

It is different when the pump engine is not running because it results in a slow flow to the WWTP treatment basin and a longer residence period or detention time, which results in a clearer water quality (lower BOD levels) as a result of the presence or absence of silt. Detention time, also known as residence time, is the amount of time that must pass in the wastewater treatment unit during the interaction period between wastewater and microorganisms. The calculation of the residence time or the existing detention time can be calculated by:

$$\text{Existing detention time} = \frac{volume\ tank}{Q\ inlet}$$

The old WWTP treatment basin is divided into 7 treatment tanks where the volume of the WWTP can be calculated by multiplying the dimensions of length 13.60 m, width 3.5 m and depth of 4.5 m, so that 214.2 m^3 is obtained so that the existing residence time obtained is 9.84 hours. for 1 tub. The new WWTP treatment basin is divided into 7 treatment tanks where the volume of the WWTP can be calculated by multiplying the dimensions of the length 31.3 m, width 5.4 m and depth of 4.5 m to obtain 760.59 m^3 so that the existing residence time obtained is 12.56 hours. for 1 tub.

SNI 8455:2017 states that there is a relationship that depicts the effectiveness of BOD removal as a function of the amount of time anaerobic bacteria have to interact with wastewater. According to SNI 8455:2017, the appropriate residence duration for Sekanak WWTP processing should be between 7 and 20 hours based on the correlation graph between residence time and the percentage of BOD allowance. The recommended percentage of BOD allowance is between 70 and 95 percent (Fig.6.).

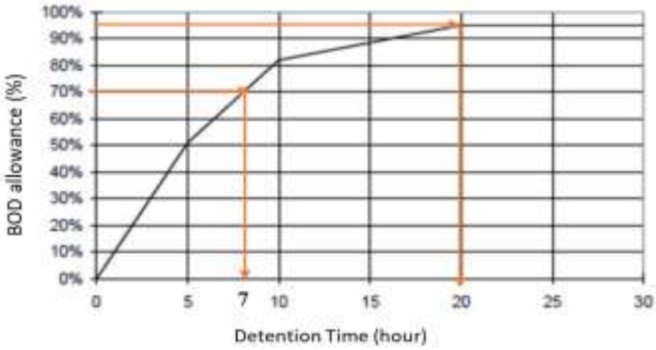

Fig. 6. Correlation of detention time and percentage of BOD allowance

Table -6 Result of WWTP problem study

WWTP problems	**Aspects of feasibility study**			**Total Score**
	Processing discharge	**Detention time**	**Water quality of outlet**	
The collection tank's output exceeds the inflowing wastewater's discharge.	**1**	**1**	**1**	**3**
The WWTP treatment tank's detention time falls short of the recommended range of 7 to 20 hours.	**1**	**1**	**1**	**3**
Found the presence of oil - oil or grease on the edge of the control tub and the surface of the end of the pipe	**1**	**1**	**1**	**3**
In the collection and processing tanks, waste is still found	**1**	**1**	**1**	**3**
The treated water that	**1**	**1**	**1**	**3**

comes out is still cloudy and smells bad				
While in operation, a flood surrounds the WWTP.	**1**	**0**	**0**	**1**
The two WWTP exits are used as a single sewer, not separately.	**0**	**1**	**1**	**2**

Use a scoring table containing several parts of a feasibility assessment (Table-6), such as processing discharge, residence time, water quality at the WWTP outlet, and idle capacity, to identify the Sekanak WWTP's most significant issues. It receives a score of 1 if there is a relationship between these elements; otherwise, it receives a value of 0. The score for each of these factors will be summed up, and the scores for each problem will then be ordered by highest to lowest. Priority is given to solving the issues with the highest scores. The following issues have the highest scores when compared to the feasibility study component, according to the table above:

1) The collection tank's discharge exceeds the inflowing wastewater's discharge.
2) The WWTP treatment tank's detention time falls short of the recommended range of 7 to 20 hours.
3) The collecting tank still contains waste.
4) The cleaned water still has a hazy appearance and an unpleasant smell.

IV.CONCLUSION

Several implications may be drawn from the study's findings regarding Sekanak WWTP in Palembang City. The capacity of each old WWTP was 200 houses (1000 people), while the capacity of new WWTPs was 300 houses (1500 people). Sekanak WWTP service coverage is 48 houses (240 people) for old WWTPs and 24 houses (120 people) for new WWTPs. translates to 152 homes for aging WWTPs and 276 homes for the idle capacity. This demonstrates that the Sekanak WWTP's idle capacity is quite high and that more homes must be connected The old Sekanak WWTP can be improved by installing an equalization tank in accordance with the input discharge to balance out the discharge of the collection tank and the discharge of the incoming wastewater. By taking this approach, water quality pollution from WWTP outputs can be reduced and prevented.

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