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Application of Water Recycling System on Apartments in Senopati South Jakarta

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Abstract. The population growth in Jakarta stimulates the number of residential demands around the city. In contrast with the land availability, the feasible solution would be to create the high rise such as apartments. However, this result generates another problem, which is the clean water supplies. Apartment inhabitants at least consume clean water for 200 to 250 litres per person daily. This alarming circumstance should be solved by conserve the water. The paper is discussing the alternate way for apartment to recycle the used water. The careful calculation of water usage before design will affect the apartment design decisions. Integrated building services system are required in this designing process of the water recycle system. (FDAM).

1 Introduction

Jakarta is one of the major cities in Indonesia as a center for business, politics, and culture, Jakarta is also a place where the headquarters of BUMN, private companies, and foreign companies are established. A large number of offices in Jakarta opens up many business opportunities that will spur population growth in the area itself. Table 1 shows the projected population growth in DKI Jakarta will increase from 2000 to 2025, with a total of 8,361 to 9,259 million. From this growth will spur the development of residential, health, education and so on in Jakarta.

Table 1. Population growth in Indonesia by province 2000-2025 ([1]).

Propinsi	2000	2005	2010	2015	2020	2025
(1)	(2)	(3)	(4)	(5)	(6)	(7)
11. NANGGROE ACEH DARUSSALAM	3,929.3	4,037.9	4,112.2	4,166.3	4,196.5	4,196.3
12. SUMATERA UTARA	11,642.6	12,452.8	13,217.6	13,923.6	14,549.6	15,059.3
13. SUMATERA BARAT	4,248.5	4,402.1	4,535.3	4,693.4	4,785.4	4,846.0
14. RIAU	4,948.0	6,108.4	7,469.4	8,997.7	10,692.8	12,571.3
15. JAMBI	2,407.2	2,657.3	2,911.7	3,164.8	3,409.0	3,636.8
16. SUMATERA SELATAN	6,210.8	6,755.9	7,306.3	7,840.1	8,369.6	8,875.8
17. BENGKULU	1,455.5	1,617.4	1,784.5	1,955.4	2,125.8	2,291.6
18. LAMPUNG	6,730.8	7,291.3	7,843.0	8,377.4	8,881.0	9,330.0
19. KEPULAUAN BANGKA BELITUNG	900.0	971.5	1,044.7	1,116.4	1,183.0	1,240.0
31. DKI JAKARTA	8,361.0	8,699.6	8,981.2	9,168.5	9,262.6	9,259.9
32. JAWA BARAT	35,724.0	39,066.7	42,555.3	46,073.8	49,512.1	52,740.8
33. JAWA TENGAH	31,223.0	31,887.2	32,451.6	32,882.7	33,138.9	33,152.8
34. D I YOGYAKARTA	3,121.1	3,280.2	3,439.0	3,580.3	3,694.7	3,776.5
35. JAWA TIMUR	34,766.0	35,550.4	36,269.5	36,840.4	37,183.0	37,194.5
36. BANTEN	8,098.1	9,309.0	10,661.1	12,140.0	13,717.6	15,343.5
51. B A L I	3,150.0	3,378.5	3,596.7	3,792.6	3,967.7	4,122.1
52. NUSA TENGGARA BARAT	4,008.6	4,355.5	4,701.1	5,040.8	5,367.7	5,671.6
53. NUSA TENGGARA TIMUR	3,823.1	4,127.3	4,417.6	4,694.9	4,957.6	5,194.8
61. KALIMANTAN BARAT	4,016.2	4,394.3	4,771.5	5,142.5	5,493.6	5,809.1
62. KALIMANTAN TENGAH	1,855.6	2,137.9	2,439.9	2,757.2	3,085.8	3,414.4
63. KALIMANTAN SELATAN	2,984.0	3,240.1	3,503.3	3,767.8	4,023.9	4,258.0

The apartment is one of the most popular dwellings in Jakarta today. Apartments are an option to increase the number of residences in Jakarta due to limited land and the number of enthusiasts in the apartment. Many developers have begun to build various types of apartments for various groups.

Based on the information that has been obtained that in the Senopati area which is precisely on Jl. Senopati Dalam II No.9 Senayan Kby. New South Jakarta City will be built an apartment by PT Asiana. PT Asiana is a company engaged in the field of Developer. The strategic location of the apartment with a complete range of facilities such as being in an office, business, industrial, school, shopping center, entertainment center and so on is the main attraction of the apartment as well as being comfortable, modern and practical.

But for its needs, the apartment is included in one of the buildings that use quite a lot of water for daily use. According to table 2 for apartment buildings the water use requirements for the building are 100-200 gals/occupant/day or around 378.54-757.08 L/occupant/day. It can be imagined for the use of water in an apartment in one tower with the number of units up to hundreds, of course, it will use water very much.

Moreover, in the location of the site where the surrounding area has a density of high buildings such as offices, shopping centers, and other apartments that have a high occupancy in the use of water.

Table 2. The need for clean water in buildings [2].

		Flow, gal/unit/day	
User	**Unit**	**Range**	**Typical**
Airport	Passenger	4-5	3
Apartment house	Person	100-200	100
Automobile service station	Employee	8-15	13
	Vehicle served	8-15	10
Boarding house	Person	25-50	40
Department store	Toilet room	400-600	550
	Employee	8-13	10
Hotel	Guest	40-60	50
	Employee	8-13	10
Lodging house and tourist home	Guest	30-50	40
Motel	Guest	25-40	35
Note **: gal x 3.7854 = L**			

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And in Jakarta itself is still experiencing a clean water crisis. Of the total needs of 26,100 liters per second, the supply of basic necessities of life has only been fulfilled as much as 17,000 liters per second. In a research journal [3] concerning the calculation of the use of clean water in three apartments in Jakarta, it has been proven that the use of clean water in the three apartments has exceeded the maximum daily factor value in urban areas (1.1 - 1.3).

Sustainable energy use can be increased by optimizing energy efficiency, in ways such as pricing policies, fuel replacement, alternative energy, public transportation, and public awareness. Human settlement and energy policy must be actively coordinated [4]. At present the Jakarta government is launching a green building program where the application of the concept is expected to reduce energy use in buildings in Jakarta.

One of the elements in green building is water conservation which is implemented using a water recycling system. The water recycling system is expected to be able to conserve the use of water in the apartment so that used water is not wasted and can be reused for other needs so as to reduce the use of clean water in operating the apartment.

Wastewater recycling is the reuse of wastewater that comes from wastewater baths, washing dishes, washing clothes (grey water) that can be used for agricultural irrigation, landscape irrigation (parks, school/office yards, golf courses, highways, green belt, tombs, housing, etc.), industrial processes, toilet flushing, etc. By using the wastewater cycle, it can save the cost of using clean water (PDAM / freshwater). Waste water that cannot be recycled is black water from the toilet. Untreated wastewater usually contains various pathogens, or causes of diseases, microorganisms that live in the human intestinal tract or which may be present in certain industrial wastes.

1.1 Grey water composition

Grey water from the bathroom is water used in washing hands and bathing produces about 50-60% of total grey water and is considered the least contaminated. Chemical contaminants contained in it include soap, shampoo, hair dye, toothpaste and cleaning products. It also has some faecal contamination (and associated bacteria and viruses) through body washing

Grey water from steel washing is water used to wash clothes, producing about 25-30% of the total grey water. Wastewater and washing clothes vary in quality from washing water to rinse water to the second rinse water. Grey water is produced because washing clothes can have faecal contamination with associated pathogens and parasites such as bacteria

Grey water from the kitchen accounts for around 10% of the total volume of grey water. It is contaminated with food particles, oil, fat, and other waste. It easily promotes and supports the growth of micro-organisms. Grey water kitchens also contain chemical pollutants such as detergents and cleaning agents that are alkaline in nature and contain a variety of chemicals. Therefore the wastewater kitchen cannot also be suitable for reuse in all types of grey water systems.

Figure 1 is the expected volume of water from each wastewater source that has been used. From the picture, it can be seen that the highest contribution of grey water is found in wastewater used for washing hands and bathing.

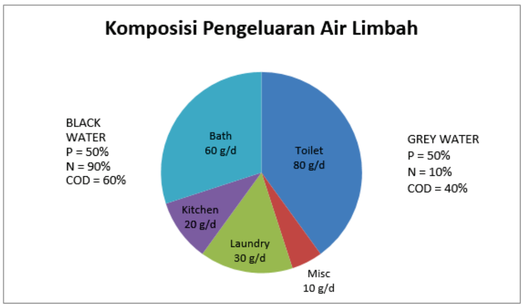

Fig. 1. Composition of wastewater discharge [5].

2 Research method

The research method by the author uses quantitative methods by calculating the water needs needed in an apartment for each occupant on each day. And calculate the amount of water that can be recycled as treated water which can later be used for flushing and flush plants. Then collect data about the condition of the site around it.

3 Result and discussion

In this apartment, two types of unit types will be built, namely, type 2 bedroom for residents who are married and type 3 bedrooms for residents who are married and have children. Based on the location of the site adjacent to the CBD / office area where the target occupants of the apartment are married but do not have children and are also newly married, and have children. The number of units between 2 bedrooms and 3 bedrooms is made equal. Then the ratio of the number of units made with the number of 2 bedrooms by 50% and 3 bedrooms 50%. These figures will be a reference for how many units will be built for 2 bedroom and 3 bedroom units.

In meeting the needs of its residents it turns out that the apartment requires quite a lot of water for each day. The following is a calculation formula for determining the water needs of an apartment [6].

$$Q = \frac{\text{The need for water in the apartment x the number of occupants}}{\text{Day}}$$

Table 3 is the average of the need for clean water usage for each user every day in various buildings, that is, the water demand for apartments is 100-200 gal/unit/day with an average use of 100 gals/unit/day. From the plan for the number of units to be built in the apartment, with 2 types of units, the total number of inhabitants is 120 people with a typical 13 floors.

So that the need for clean water for all residents of the apartment is:

Q = 120 x 378,54 L/day = 45.424,8 L/day.

Table 3. A typical average of the use of clean water for commercial facilities [2].

		Flow, gal/unit/day	
User	**Unit**	**Range**	**Typical**
Airport	Passenger	4-5	3
Apartment house	Person	100-200	100
Automobile service station	Employee	8-15	13
	Vehicle served	8-15	10
Boarding house	Person	25-50	40
Department store	Toilet room	400-600	550
	Employee	8-13	10
Hotel	Guest	40-60	50
	Employee	8-13	10
Lodging house and tourist home	Guest	30-50	40
Motel	Guest	25-40	35
Motel with kitchen	Guest	25-60	40
Laundry (self service)	Machine	400-650	550
	Wash	45-55	50
Office	Employee	8-20	15
Public lavatory	User	3-6	5
Restaurant (including toilet)			
Conventional	Customer	8-10	9
Short – order	Customer	3-8	6
Bar and cocktail lounge	Customer	2-4	3
	Seat	15-25	20
Shopping center	Parking space	1-3	2
	Employee	8-13	10
Theater			
Indoor	Seat	2-4	3
Outdoor	Car	3-5	4
Note : gal x 3.7854 = L			

In table 4 it can be seen that the highest percentage of water use itself is for toilet needs which are 33.9% with a total of 15,400 L/day. With the use of large water, the writer will focus on the use of this wastewater for toilet flushing needs.

Table 4. Percentage of water use [2].

Use	% of total
Baths	8.9
Dishwashers	3.1
Faucets	11.7
Showers	21.2
Toilets	28.4
Toilet Leakage	5.5
Total	100
Note **: gal x 3.7854 = L**	

3.1 Analysis of waste generated

Waste from this apartment which will later be treated so that it can be reused for toilet flushing purposes but can also be used to flush plants and also wash cars. The waste comes from bathing water, washing clothes, washing dishes and washing hands where the wastewater is called grey water waste, while the waste originating from the toilet is called blackwater waste.

Table 5. Typical wastewater generated from dwellings [2].

		Flow, gal/unit/day	
Source	**Unit**	**Range**	**Typical**
Apartment :			
High – rise	Person	35-75	50
Low – rise	Person	50-80	65
Hotel	Guest	30-55	45
Individual residence :			
Typical home	Person	45-90	70
Better home	Person	60-100	80
Luxury home	Person	75-150	95
Older home	Person	30-60	45
Summer cottage	Person	25-50	40
Motel :			
Motel with kitchen	Unit	90-180	100
Without kitchen	Unit	75-150	95
Trailer park	Person	30-50	40
Note : gal x 3.7854 = L			

From table 5 it can be seen that the waste generated from the apartment is 22,712.4 L/day with the percentage of greywater waste from table 4 is 66.1%, with a value of 15,013 L/day and the percentage of blackwater waste is 33.9% with a value of 7,700 L/day.

3.2 Analysis of space requirement for a water recycle system

At this stage, it must be known beforehand how much water needs to be used from one apartment building. The calculation can be obtained from how many bathrooms are contained in the apartment and how many occupants in each unit. Besides that, it is added with supporting facilities such as swimming pool and bathroom for the management office and other sanitary facilities in the apartment.

3.3 Planning criteria on the water recycle system

In the wastewater recycling system, there are several plans so that the water can be reused. Among the planning, criteria are the Preliminary Treatment consisting of the fat separator, filtering and storage tanks, Primary Treatment consisting of primary deposition with a square-shaped tub, Secondary Treatment (Secondary Treatment) consisting of a biological activated sludge processing unit. However, for the apartment itself, the drying stage mud is not built because sludge has already been deposited immediately so there is no need to make a basin for drying beds. From this process, the rooms needed in the process of water recycling include:

3.4 Greywater processing unit

At this stage of analysis, it is used to determine the rooms needed in the treatment process and determine what size is needed to process the greywater with a conventional system. The rooms consist of fat separator tanks, storage tanks, initial settling tanks, aeration ponds, final clarifiers, disinfection tanks/contact rooms, installation control rooms.

3.4.1 Like a fat separator

A fat separator tub is used to separate fat from water to be recycled (greywater). This bath is the initial stage for filtering wastewater. For the planning criteria, this unit refers to the design of a simple fat separator tub in DKI Jakarta Provincial Governor Regulation No. 122, 2005 which has specifications, namely 30-60 minutes residence time, for WWTP capacity of 6 m or equal to 25 people or more must be equipped with a fat separator tub, consisting of at least 2 rooms, installed before WWTP.

Dimension calculation:

$$\text{Qdesain} = \text{Q max } (m^3/s) / (m^3/day)$$

$$\text{Volume tub design} = p \times l \times t$$

Amount of space required:

$$= \frac{\text{Qdesign x residence time/usage}}{\text{Volume}} \text{ x 1 room}$$

3.4.1.1 Analysis the needs of a fat separator in an apartment

Water requirements in buildings of 45,424.8 L / day were then converted to cubic meters per second to 5.26 × 10-7 m^3 / sec.

Determined the water depth of 1 m, with a length coupled with the width of the tub that is equal to 1 m. Then the guard height of 0.3 m. So the amount of space is needed:

0,000000526 m^3/s x 1800 s : 1 x 1 room = 0,0009468 ~ 2 room

From the above provisions, it is necessary to provide at least 2 pieces of space, although from the count already in it cannot reach 2 amounts of space.

3.4.2 Bar rack

The rack bar is used to prevent objects/solids that can clog the processing unit's performance. The filter used is stainless steel with a diameter of 1 cm.

The design criteria are the speed of flow entering the filter (v = 0.3 - 0.6 m / sec), opening distance between the rods, B = 25-75mm used 25 mm, stainless steel grating, grating diameter, D = 10 mm, the angle of inclination to horizontal a = (45 - 60)º, channel width (b) = 0.58 m, depth of water in channel (d) = 0.29 m. Calculation of the amount of water needed is made in cubic meters per second to 5.26 × 10-7 m^3 / sec

The number of gaps or openings between the stems:

nc = 0,48 : (0,025 + 0,010) m = 13,71 ~ 14

3.4.3 Reservoir

The reservoir is used as a reservoir and uniform flow of water in greywater waste

The body dimension calculation formula is as follows:

Qmaxday x 1 hour = m^3 / hour

The time is taken to fill the body (td) = ¼ hours

Maximum body volume = Q x td (m^2)

Then to determine the volume of each tub:

$$= \frac{\text{Volume tube max}}{2} \text{: number of reservoirs}$$

then the depth of the tub:

$$= \frac{\text{Volume tube max}}{\text{Cross-section}}$$

3.4.3.1 Analysis of the calculation of needs like a container

With a maximum amount of water discharged per day of 5.26 × 10-7 m^2 /sec then converted in to per hour of 1.89 × 10-3 m^3 / hour. Obtained a maximum body volume to 0,0004725 m^3. So that the number of reservoirs made 2 pieces, then the volume of each tub:

= 0,00023625 : 2 = 0,000118125 m^3

Then it is assumed that the length and width of the tub are equal to 1 m. So that the depth of the tub becomes 1 m. So the size obtained is 1 m long and 1 m wide and it takes 2 tubs so that the total land area needed 2 m^2.

3.4.4 The initial settling tub

At this stage, the tank is included in the primary treatment where the functions as follows precipitate organic matter, let the mud settle without assistance with gravity, reduce TSS levels up to 50-65%, the sludge settles, take it at a certain time, making this tub must also have criteria in the design namely Overflow rate (Vo) = 30-50 m^2/hour used an average of 40 m^3 / m^2 / hour. To build a rectangular tub, the ratio of length to width is 1.0 - 7.5. Comparison of length with a depth of 4.2-25. A number of planned sedimentation tanks 2 units. Then the bottom slope is made like 1-2% sedimentation.

How to calculate the dimensions of the sedimentation basin itself with a ratio of length and width of 3 to 1. And the ratio of length to the depth of 7 to 1.

Calculating surface area:

$$A = \frac{Q}{Vo}$$

Then calculating the length and width of the tub with the length requirement equal to 3 times the width. And the depth of the tub is 1/7 of its length. So that the volume becomes like.

P x L x (body depth + guard height)

3.4.4.1 Analysis of the size of the sedimentation needs of the apartment

From the formula, the surface area can be 0.00062 m^2. With the size obtained is 0.3 m long and 0.1 m wide and it takes 2 tubs so that the total land area needed is 0.06 m^2. And with a guard height of 0.3 m, the volume of tanks that can be accommodated is as big as 0,01026 m^3.

3.4.5 Aeration pool

In the aeration pond, it is entered into the secondary processing stage. The activated sludge building unit that is built is a conventional type which consists of 2 aeration ponds and 2 secondary clarifier buildings.

3.4.5.1 Analysis of the size of aeration ponds for apartments

With a length of 2 m and 1.8 m with a height of 1.8 m, a land area of 7.2 m^2 is needed. And can accommodate water that will be treated in aeration ponds with water volume 6,48 m^3.

3.4.6 Final clarifier

This settling tub is designed with 2 tub units.

3.4.6.1 Final clarifier tub size analysis for apartments

Dimensions of water settling buildings:

The incoming discharge of water settling building = design discharge + discharge of mud return - MLSS of building

To calculate the surface area of the clarifier tub, it is necessary to find the Qinffluent first. Qinffluent calculation can be obtained from the calculation of TSS and debit of incoming sludge, discharge of incoming water every day. So that the influential discharge can be equal to 0.03729 m^3/day.

Then calculate the slurry discharge return so that it gets 0.0223 m^3/hour. From these calculations, the clarifier inflow including the return of sludge was 4.88 × 10-7 m^3/sec.

The formula determines the area of the clarifier:

$$A = \frac{QX}{SF}$$

Information:
A = Clarifier area
Q = Clarifier inflows include sludge return (m^3 / hour)
X = MLSS (kg/m^3)
SF = price of solid limits (book. syed R.Qasim)

Then from the formula, then can be obtained diameter of the clarifier:

$$(D) = \sqrt{4A/\pi}$$

The dimensions of the final settling building water flow in the design are converted to cubic meters per hour which is 1.76 × 10-3m^3 / hour. So that the area of clarifier can be 0.0033 m^2. And the diameter of the final clarifier is 1 m and the required area is 6.28 with the number of 2 units.

3.4.7 Disinfection box / contact room

This disinfection box serves to kill germs that still follow so that the resulting water is odorless and free of bacteria. The design criteria are optimum pH 6-7, even flow, disinfection dose, contact time 15-45 minutes, chlorite content, chlorine density (p) of 0.8 - 0.88 kg / lt., The dimensions of each contact tub are determined at when the water discharge reaches the peak hour, choose the arrangement of spaces and dimensions, provided 2 typical contact rooms each room has 3 rounds around the arrangement of baffles with dimensions and settings as follows:

$$Vbak = Q \times t$$

Q = Discharge from clarifier
t = Contact time

3.4.7.1 Analysis of the size of the disinfection box for an apartment

Q = design discharge - MLSS building

Obtained a tube volume of 0,00042 m^2. Then it is assumed that the length of rotation around the contact room is 8m, 0.5m wide, 0.5m depth, and 0.3m guard height. So that the total volume of the contact space is 2 m^3. Assuming the length of the tub is equal to L.

So that it can be 3 m long and 2 m wide so that the total area needed is around 6 m^2 with the number of 1 unit.

3.4.8 Installation control room

The control room is used to control whether the system is running well and monitor if there are problems. The size of the room adjusted to their needs.

3.5 Anaerobic or aerobic biofilter

For the processing of STP in this apartment, the author will use products that are already sold in the market with biotech products. Inside the device, it can combine 4 processing system tanks at the same time as storage tanks, initial settling tanks, aeration ponds, final clarifier. The following is the calculation of the space needed in one such tool with the following conditions:

Q = 45.424,8 L/day = 45,42 m^3/day

It takes 1 biotech tank with a tank capacity 50 m^3/day
Tank capacity = 50 m^3/day = 2,09 m^3/hour = 34,8 lt/minute.

3.5.1 Anaerobic tank 1

From the specified residence time of 6 hours, the required volume is 12.5 m^3. From the required volume assuming the radius calculation is 1.05 m and the tub length is 4.08 m the effective volume produced is 14,13 m^3.

3.5.2 Anaerobic tank 2

From the specified residence time of 2 hours, the required volume is 4.17 m^3. Of the required volume assuming the calculation of the radius of 1.05 m and the length of the tub of 1.85 m the effective volume produced is 6,41 m^3.

3.5.3 Biofiltration tank

From the specified residence time of 3 hours, the required volume is 6.25 m^3. From the required volume assuming the radius calculation is 1.05 m and the tub length is 3.14 m the effective volume produced is 10,9 m^3.

3.5.4 Backwash tank

From the specified residence time of 2 hours, the required volume is 3.34 m^3. From the required volume assuming the radius calculation is 1.05 m and the tub length is 2.69 m the effective volume produced is 9,32 m^3.

3.6 Percentage analysis of the benefits of using a water recycling system

Based on the calculation of the total water use in this apartment is 45,424.8 L/day with a total number of residents of 120 people. And it is known that the waste generated from the apartment is 22,712.4 L/day with the percentage of greywater waste from table 4.19 of 66.1% i.e., with a value 15.013 L/day.

With this large amount of water, the use of recycled water will focus on toilet flushing needs. The effluent from the processing is assumed to be the same as the influent or greywater generation so that the wastewater that can be utilized is 15,013 L/day. Flushing requirements for the plumbing equipment are calculated based on the amount of usage and water requirements in the plumbing equipment.

Table 6. The use of water in each plumbing device [2].

	Flow, gal/capita/d
Use	**Without conservation devices**
Baths	7
Dishwashers	2
Faucets	9
Showers	16
Toilets	22
Toilet leakage	4
Washing machines	16
Total	76
***Note* : gal x 3.7854 = L**	

Based on research journals [7] about the calculation of the percentage of profits generated by using recycled water, it can be seen from table 6 that water needs for toilets for all residents are 11,810 L/day. It can be seen that the amount of greywater produced is more than greywater reuse for flushing needs. The resulting excess greywater is 15,013-11,810 L/day = 3,203 L/day. This excess water will be used to flush the park with a total garden area of 424.72 m² with a water requirement of 2,123.6 L/m². So that the excess of greywater becomes 3,203 L/day -2,123.6 L/day = 1,079.4 L/day this will be channeled to infiltration wells with effluent blackwater. The application of the use of greywater as much as 13,933.6 L/day can reduce the use of main source water (groundwater or PDAM) which was originally by 45,424.8 L/day to 31,491.2 L/day. So the percentage of savings from implementing this water recycling system is 30%.

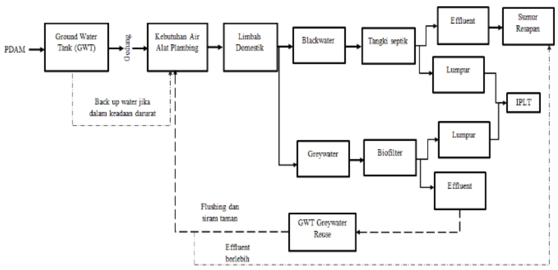

Fig. 2. Water treatment system diagram.

Figure 2 is the running of a wastewater treatment system to be recycled. Waste that will be recycled is only waste originating from greywater and for blackwater, waste is not treated. The water piping system in the building was separated between blackwater and greywater.

4 Conclusion and suggestion

By using the water recycling system in the apartment can reduce the use of clean water in the apartment for purposes such as flushing toilets and to maximize the use of recycled water, it is also used to water plants.

By implementing this water recycling system the use of clean water savings reaches 30% using clean water and can save operational costs for the apartment.

From the analysis carried out for the purposes of a water recycling system, there are 2 options in determining the rooms needed for the processing system in the apartment. From the first analytical calculation with a conventional type can be determined the minimum size in the fat separator tub P x L = 1m x 1m per room with the amount of space needed is 2 rooms. Container with size P x L = 1m x 1m and total 2 tanks. The initial settling basin with a size of P x L = 0.3 m x 0.1 m and the number of 2 tanks. Aeration pond with size P x L = 2m x 1.8m and total 2 units. Final clarifier with 1m diameter and 2 units. Disinfection tank / contact room with size P x L = 3m x 2m and total 1 unit. Installation control room with a minimum size P x L = 3m x3m can be adjusted to the needs and in the field.

From the second analysis calculation using a biotech system product, the calculation obtained is a fat separator P x L = 1m x 1m per room with the amount of space needed is 1 room. STP with a size P x L = 12.1m x 2.7m with a total of 2 processing units. Disinfection tank / contact room with size P x L = 3m x 2m and total 1 unit.

Suggestions for this research is that further information is needed on the characteristics of grey water waste in Indonesia.

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