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DESIGN PLANNING COMMUNITY-BASED COMMUNAL WTP CIPAKU VILLAGE, SOUTH BOGOR DISTRICT, BOGOR CITY

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Abstract

One of the wastewater treatment in Bogor City is using a communal Wastewater Treatment Plant (WWTP) system. The treatment can be used for liquid waste management in densely populated, slum, and sanitation-prone settlements. The community in Cipaku Village, South Bogor District, Bogor City is one of the areas that does not have communal WWTP treatment, For some people there, wastewater disposal such as grey water and black water still uses the nearest channel and cubluk. Therefore, this technology can be applied to improve the quality of environmental sanitation. The planning of the communal WWTP system in Cipaku Village, South Bogor District, Bogor City considers aspects of the quantity and quality of household wastewater produced every day.

Keywords: Communal WWTP, WWTP Processing, Bogor City

INTRODUCTION

The development of residential wastewater infrastructure and facilities in Indonesia has not currently reached the desired conditions, especially for low-income people in densely populated, slum and sanitation-prone urban environments.

Residents' access to residential wastewater infrastructure and facilities is basically closely related to health, environment, education, socio-culture and poverty aspects. The results of various observations and studies have proven that the greater the population's access to infrastructure facilities and wastewater facilities, the less likely there is a case of the spread of diseases transmitted through water media (waterborne diseases).

WWTP functions to overcome environmental pollution caused by household activities such as feces and urine (black water) and wastewater from bathing, washing and kitchen activities (grey water).

The purpose of building the WWTP located in Cipaku Village, South Bogor District, Bogor City is due to the inadequate condition of sanitation facilities and the social conditions of the community which are classified as middle to lower which is shown by simple sanitation facilities. According to

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Law No. 32 of 2009, everyone is allowed to dispose of waste into environmental media on the condition that they meet environmental quality standards.

A WWTP building is a local or centralized wastewater treatment building where wastewater is collected and the results of its treatment are directly distributed to the receiving water body. The parts of the WWTP building consist of an inlet bath, a settler bath, a gutter, an anaerobic filter bath, a carbon filter bath, an anaerobic buffalo reactor and an outlet bath. The distribution system in the WWTP service network requires supporting buildings such as control tanks and piping networks.

Planning Area Overview

Planning for the development of this communal WWTP will be carried out for the RW community. 05 which is located in Cipaku Village, South Bogor District, Bogor City. The access road to this village consists of a one-story house with an average land area of each house of about 30 to 50 m2. The plan is that this communal WWTP building has a capacity to accommodate 100 people or 21 House Connections (SR) with the connection of a piping network with a diameter of 3'' and 4''.

METHODS

The method of planning the construction of a community-based communal WWTP based on non-governmental organizations located in Cipaku Village, South Bogor District, Bogor City is carried out by observing the location used in KKN-GTM activities.

Broadly speaking, this research is divided into five (5) stages of implementation. The first stage of research conducted was a literature study; It is an activity to collect information related to the topic or problem that is the object of research. This information can be obtained from scientific articles, theses, theses and other sources that can be accounted for. Furthermore, the second stage is carried out, namely a location survey, determining the cause why a communal WWTP must be built and primary data collection carried out at the research site to obtain accurate and up-to-date information according to needs and secondary data collection to obtain the data and information needed so that it can achieve the research objectives. Then the third stage is by analyzing data to process it into information so that the capacity that will be planned for the development of community-based communal WWTP can be known and understood. Stage four is the planning of the construction of a communal WWTP with a drawing using an autocad application and calculating the cost budget. The last one in stage five is conclusion and suggestion. At this stage, conclusions are drawn from the results of the overall data analysis with a concise and precise description.

RESULTS

Based on the results of the survey at the research site, the number of house buildings that will be connected to the communal WWTP system in RT 03 RW 05 Cipaku Village, South Bogor District, Bogor City is 22 buildings, consisting of 21 privately owned house buildings and 1 prayer room building. The number of people in the research location was 100 people. The WWTP was built from a large grant of land on the banks of the river and around it there are residential areas. The WWTP was built from grant land covering an area of 20 m2, with dimensions of 6 m x 5 m. WWTP construction obtained an overall main pipe length of 50 m, using a 6" diameter pipe with a pipeline channel slope ±1-2%. The wastewater distribution system in the WWTP irrigation network uses a gravity system (without pressure) adjusting the contours of the ground surface of buildings, houses, and wastewater disposal pipes. In the wastewater distribution system of residents' houses, injections are carried out into the drainage pipes of the nearest house buildings that have first installed pipes. The house drain pipe used is PVC pipe with a diameter of 11/2" to 3" with a depth of 10-20 cm. The location map and drawings of the planning results can be seen in the following Image.

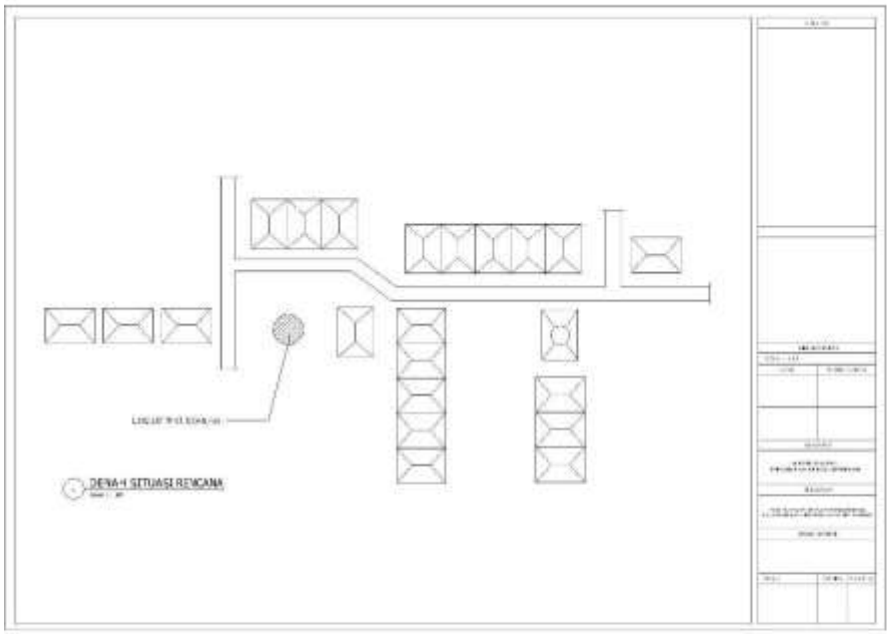

Figure 1. Map of Communal WWTP Location

Figure 2. Communal WWTP Construction Site Plan

Figure 3. The situation of the house to be connected to the communal WWTP

Calculation of Communal Wtp Design

1. The planned capacity is:
   - Processing capacity : 10 m^3 per day
   - Average wastewater BOD : 195 mg/l
   - Total processing efficiency : 90-95 %
   - BOD of treated water : 17.5 mg/l
2. Equalization Tub
   - Wastewater discharge : 10 m^3 per day
     : 0.42 m^3 per hour
     : 6.94 liters per minute
   - Planning Criteria (Retention Time) : 6 hours
   - Required tank volume : 6/24 days x 10 m^3/day'= 2.5 m^3
3. Tub Dimensions
   - Length : 1.25 m
   - Width : 1 m
   - Depth : 2 m
   - Clearance height : 0.3 m

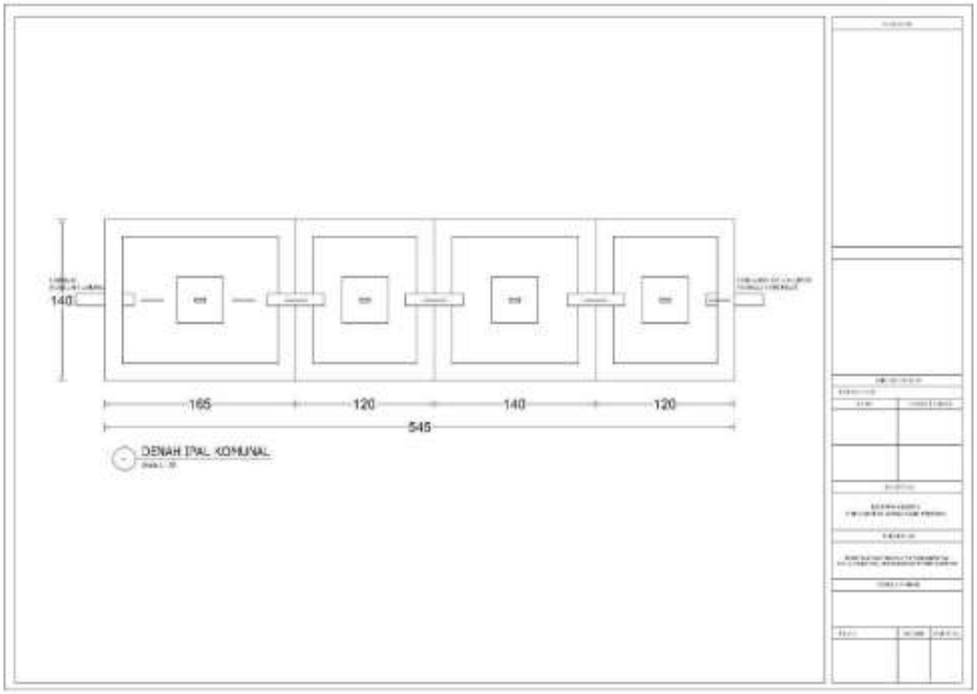

Figure 4. Communal WWTP plan

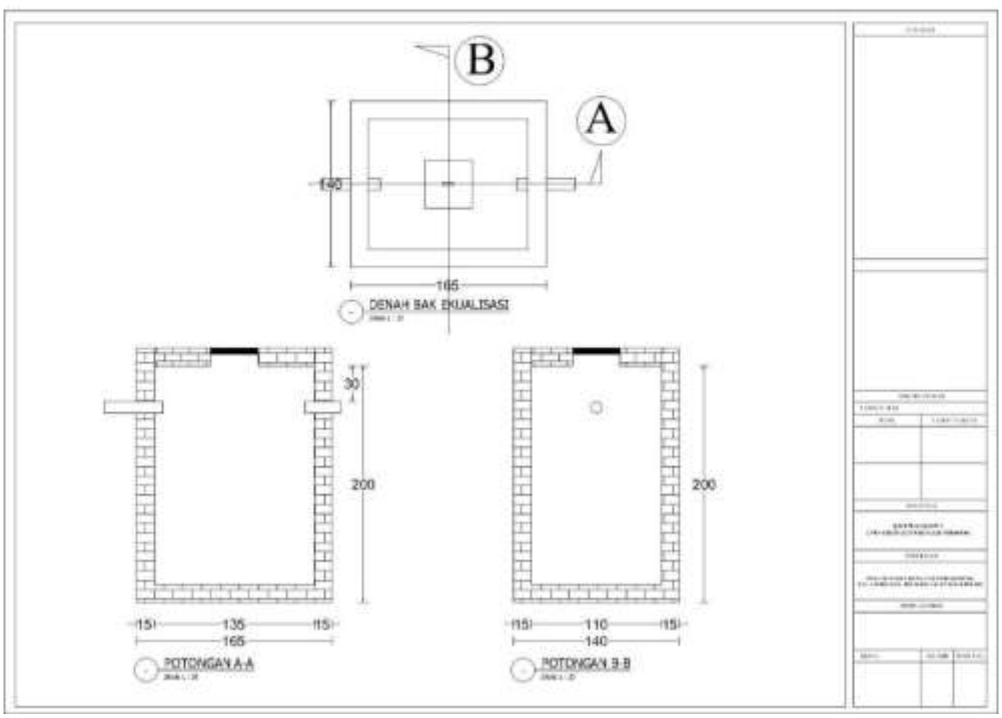

Figure 5. Equalization tub plans and pieces

4. Early Sedimentation Tub
   - Wastewater discharge : 10 m^3 per day
   - Intake BOD : 195 mg/l
   - Processing Efficiency : 40 %
   - Output BOD : 117 mg/l
   - Stay time : 3 – 5 hours
   - Required tub volume : 4/24 days x 10 m^3/day = 1.67 m^3
   - Tub dimensions:
     - Length : 0.8 m
     - Width : 1 m
     - Depth : 2 m
     - Clearance height : 0.3 m

   Average Retentation Time (T) T = $0.8 \text{ m} \times 1 \text{ m} \times 2 \text{ m} \times \dfrac{24 \text{ hours/day}}{10 \text{ m3/day}}$ = 3.84 hours

   Surface Loading = $\dfrac{10 \text{ m3/day}}{0.8 \text{ m} \times 1 \text{ m}}$ = 12.5 m^3/m^2.day

   - Dwell time at peak load = 7.68 hours (assuming the sum of 2x the average amount)
   - Average surface load = 12.5 m^3/m^2.day
   - Surface load at peak time = 25 m^3/m^2.day
   - Standard Stay Time : 3 – 5 hours
   - Surface load : 20 – 50 m^3/m^2.day (JWWA)

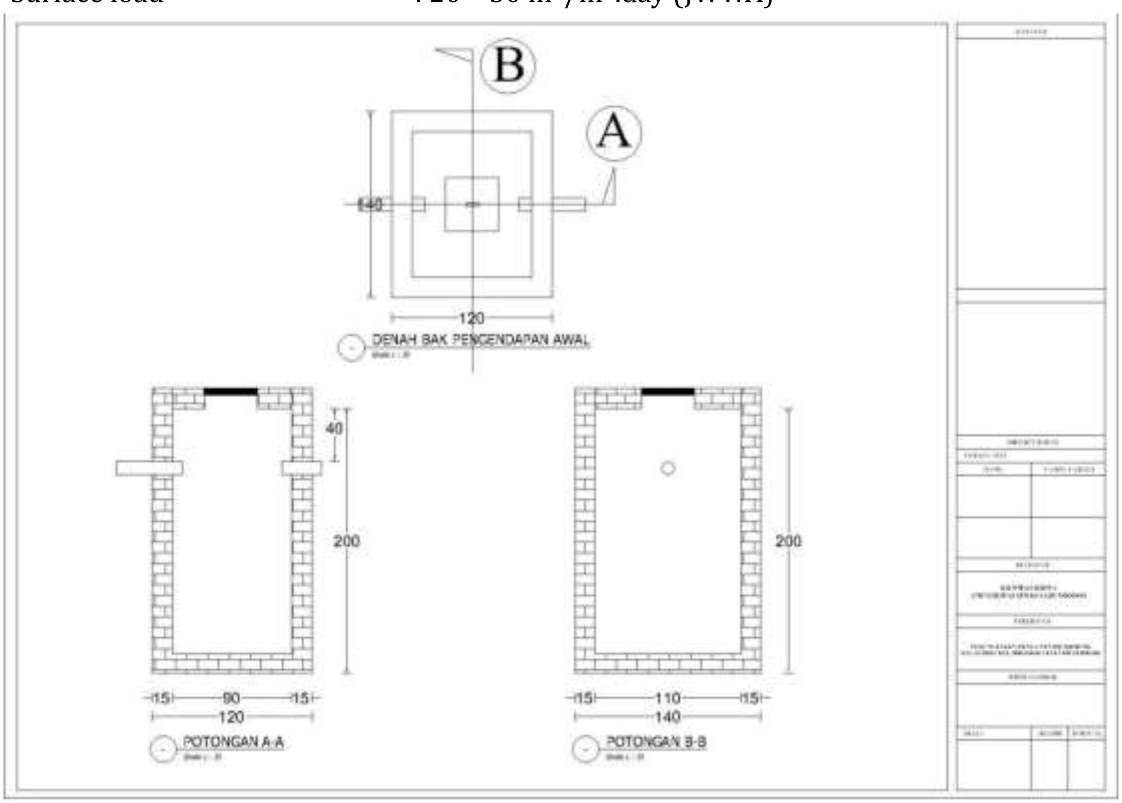

Figure 5. Initial sedimentation tub plans and cuts

5. Bak Kontaktor Anaerobic
   - Wastewater discharge : 10 m^3 per day
   - Intake BOD : 117 mg/l
   - Processing Efficiency : 85 %
   - Output BOD : 17.5 mg/l

For water treatment with a standard biofilter process, BOD load per volume medium is 0.4 – 4.7 kg BOD /m^3.day. The BOD load used is set to be 1.0 kg BOD /m^3.day.

- BOD load in wastewater = 10 m^3/hi x 117 g/m^3
  = 1170 g/day
  = 1.17 kg/ day
- Required media volume = $\frac{1.17 \text{ kg/day}}{1.0 \text{ kg/m}^3\text{.day}}$
  = 1.17 m^3
- Volume media = 60% of the total volume
- Time stay in the reactor = $\frac{1.95 \text{ m}^3}{10 \text{ m}^3\text{/day x 24 hours/day}}$
  = 4.68 hours
- Dimensions of anaerobic contactors:
  a. Length : 1 m
  b. Width : 1 m
  c. Depth : 2 m
  d. High clearance : 0.4 m
  e. Number of rooms : divided into 2 rooms
- Media biofilter
  a. Media : Sarang Tawon (Honeycomb Tube)
  b. Material : PVC sheet
  c. Media area : 150 cm x 150 cm x 230 cm
  d. Hole diameter : 2 cm x 2 cm
  e. Color : Transparent
  f. Specific weight : 30 – 35 kg/m^3

Figure 6. Sarang Tawon (Honeycomb Tube)

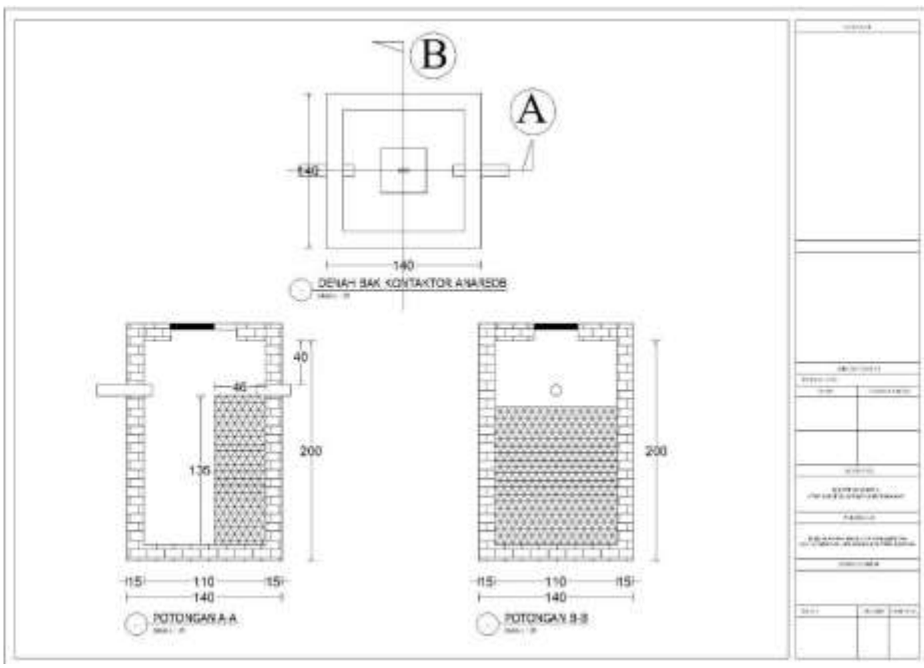

Figure 7. Plans and pieces of anaerobic contactor tubs

Final Settling Tub

- Wastewater discharge : 10 m^3 per day
- Stay time : 3 – 5 hours
- Required tub volume $\frac{4}{24}$ day x 10 m^3/day = 1.67 m^3
- Tub dimensions:
  a. Length : 0.8 m
  b. Width : 1 m
  c. Depth : 2 m

d. High clearance : 0.4 m

Chek:

Average Retentation Time (T)

$$T = \frac{0.8\ m \times 1\ m \times 2\ m}{10\ m3/day} \times 24\ hours/day = 3.84\ hours$$

$$\text{Surface Loading} = \frac{10\ m3/day}{0.8\ m \times 1\ m} = 12.5\ m^3/m^2.day$$

a) Dwell time at peak load = 7.68 hours (assuming the sum of 2x the average amount)
b) Average surface load = 12.5 m^3/m^2.day
c) Surface load at peak time = 25 m^3/m^2.day
d) Standard Stay Time : 3 – 5 hours
e) Surface load : 20 – 50 m^3/m^2.day (JWWA)

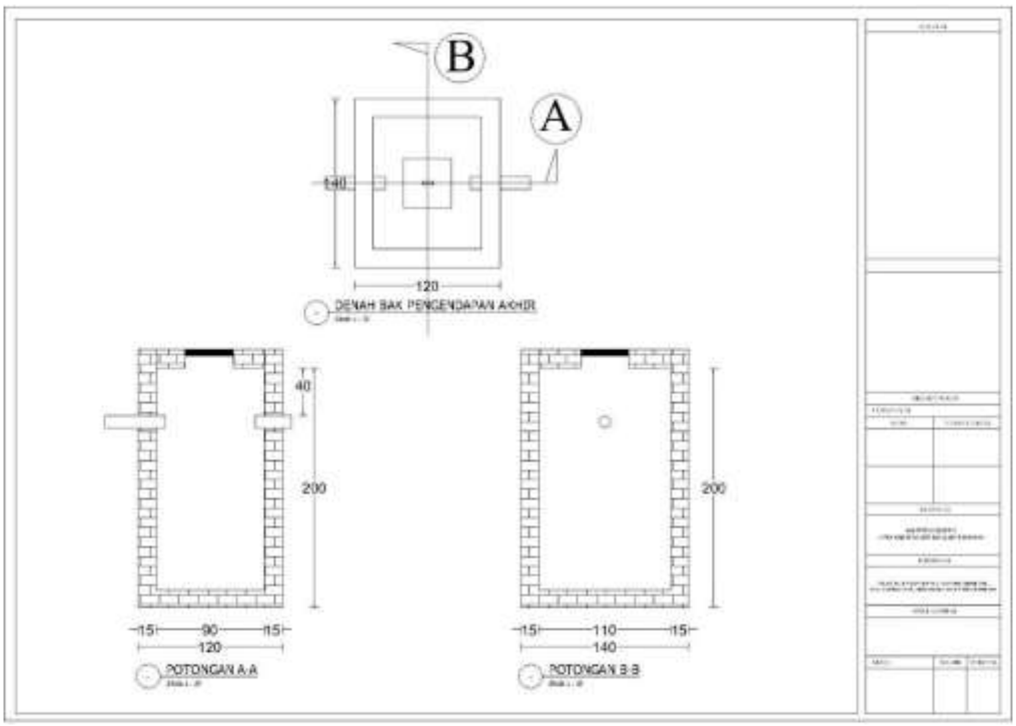

Figure 8. Final sedimentation tub plan and cut

Calculation of Cost Needs for Communal WWTP Manufacturing Materials

Table 3. Cost Requirements for WWTP Manufacturing Materials

NO	MATERIAL NAME	SATUAN	VOLUME	PRICE (Rp)	AMOUNT (Rp)
1	2	3	4	5	6
	WWTP WORK				
1	3" D-type PVC pipe	btg	21	118.800	2.494.800
2	4" D type PVC pipe	btg	9	158.960	1.430.640
3	Elbow 3"	bh	8	9.950	79.600
4	Elbow 4"	bh	2	20.250	40.500
6	Sock 4"	bh	5	10.355	51.775
7	Tea 3"	bh	12	14.995	179.940
8	Tea 4"	bh	7	21.670	151.690
9	Bricks uk. 10x10x20 cm	bh	3010	1.100	3.311.000
10	White sand/pairs	m^3	4,21	294.800	1.241.108
11	Semen abu abu	Bag	16,33	69.550	1.135.751
12	Media sarang tawon	bh	120	65.500	7.860.000
		TOTAL			17.976.804

CONCLUSIONS

1. In the planning of the communal WWTP in Cipaku Village, South Bogor District, Bogor City, it is inhabited by as many as 100 people. With the number of residents, it produces a wastewater discharge of 10 m^3 every day.
2. The plan for the dimensions of the communal WWTP basin is based on the amount of wastewater discharge produced, namely: length 4.85 m; 1.4 m wide and 2.3 m deep.
3. The cost needed to make a communal WWTP in Cipaku Village, South Bogor District, Bogor City is Rp. 17,976,804.

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