
REVERSE AND GREEN LOGISTICS IMPLEMENTATION FOR SEWAGE TREATMENT PLANT INSTALLATION OF "BELLA" APARTMENT BUILDING

M. Labib Rivaldy¹, Bayu Dian Sua Pratama²

Silk Road International University of Tourism and Culture Heritage, Samarkand, Uzbekistan

rivaldylabib@gmail.com¹, bayudspratama@gmail.com²

ABSTRACT

Industrial and household operations mostly produce liquid waste that can harm the environment without further processing or processing. "Bella" Apartment is an apartment building located in one of the big cities in Indonesia, called Surabaya. The waste generated from this building comes from household activities such as toilet waste, laundry waste and kitchen waste. The purpose of this study is to minimize costs and increase the income of business owner. This study used a qualitative descriptive method with 3 informants. Based on financial analysis over the past 12 months, the management often complains about the high consumption of water so that the total cost of water paid to the water provider becomes higher and the owner's concern for the environment. water used in public facilities is taken from water sources for washing vehicles, washing clothes and other activities. In this study, the design of the Sewage Treatment Plant will be carried out, calculating the installation costs, the savings that can be obtained so that it can increase revenue, how to process secondary waste and maintenance from the sewage treatment plant, and the implementation of the Reverse Logistics concept in handling waste. Reduce the amount of operating costs from electricity and Water costs to increase revenue.

Keyword: reverse logistics, green logistics, waste treatment, wastewater treatment, liquid waste.

Corresponding Author: M. Labib Rivaldy

Email: rivaldylabib@gmail.com



INTRODUCTION

In today's business era, the level of competition is increasing. Business owners are not only required to improve the quality of products and services to meet customer needs, but are also required to reduce product costs and reuse waste to reduce total costs and destroy waste effectively, especially for the environment. This requires companies to pay more attention to Reverse Logistics and Green Logistics because it is related to controlling products that can be recycled and regained value and related to handling waste, both to minimize costs and the effects of waste on the environment. In a survey, it was shown that if the Reverse Logistics process is well implemented has the potential to regenerate product returns or waste as much as 32% of the original value of the product (Badenhorst & Van Zyl, 2015).

One way to regenerate product value is Reverse Logistics which focuses on the backflow of products coming from customers to companies with the aim of maximizing value or minimizing the total costs incurred (Sharma et al., 2016). In its utilization, reverse logistics are used to deal with problems such as remanufacturing or waste handling to be used as an effective resource (Bensalem & Kin, 2019). The reverse logistics is the process of planning, implementing, efficiently controlling product costs, and related information for the purpose of regaining value or proper disposal

(Burnard et al., 2015). Good reverse logistics management can provide cost savings on the procurement and disposal of company waste effectively (Govindan et al., 2015).

As a form of concern for the environment and the management's efforts to reduce costs, apartment building owners agreed to build an STP (Sewage Treatment Plant) to carry out waste treatment so that it could increase income from liquid waste or wastewater. Wastewater that is not treated and directly discharged into water bodies will have a negative impact on both the environment and the health of the surrounding community. The pollutant accumulated will lead to self-purification ability of water body is exceeded. Rather, it can cause scarcity of clean water sources and occurrence eutrophication. Eutrophication causes oxygen content dissolved in water is reduced so dangerous living things in it (Arsad et al., 2021). In liquid waste treatment activities, the management does not only use residual water from washing and bathing activities or referred to as Greywater, but also uses water derived from human waste such as urinals or what is called Blackwater.

Based on previous research that conducted STP designs in a village, domestic wastewater is water originating from businesses or residential activities, restaurants, offices, commerce, apartments and housing (Mubin et al., 2016). Several forms of this waste water are in the form of faeces, urine, bathroom waste, and leftover household kitchen activities. So that the type of STP that is suitable for dealing with this type of waste is STP with a “Domestic Off-Site Position” design type.

This study not only focuses on Blackwater such as waste resulting from the use of toilets, but also Greywater, which is waste water that comes from other than toilets. The types of liquid waste are divided into two, namely Blackwater and Greywater (Wilson et al., 2015). The definition of this type of liquid waste is as follows. Blackwater is liquid waste that starts from the toilet, including toilet flush water, urine, and excreta (Zaied, 2018). Meanwhile, Greywater is a liquid waste that does not contain human or animal waste (Chen & Fagan, 2015). Examples are wastewater from the kitchen, laundry water, and rinse water. The purpose of this research is to reduce cost and improve the profit, also to meet government regulations.

METHODS

The approach in this study is an analytical qualitative approach. This approach is a method to describe and give an overview of the object under study through data or samples that have been collected as they are and make conclusions that can be used for the public (Sugiyono & Lestari, 2021). Data collection was carried out by conducting location observations and interviews with apartment managers, contractors and STP designers. Then, adjust with previous research to determine the type of STP that is suitable for the location and in accordance with government regulations. The results of the interview with the building owner on the building specifications are as follows:

Table 1. Building specification

Land Area	500m ²
Building Area	390m ²
Reservoir capacity	3000 liters
Building Level	3 floors
Number of Rooms	30 rooms

The amount of electricity cost expenditure in the last 1 year (2022) for public facilities is as follows:

Table 2. Electricity use for public facilities

Month	Fees (Indonesian Rupiah)
January	IDR 1,054,000 (739Kwh)
February	IDR 986,000 (730Kwh)
March	IDR 1,480,000 (740Kwh)
April	IDR 1,004,000 (743Kwh)
May	IDR 986,000 (730Kwh)
June	IDR 1,054,000 (739Kwh)
July	IDR 959,920 (710Kwh)
August	IDR 993,720 (735Kwh)
September	IDR 985,608 (729Kwh)
October	Rp. 988,312(731Kwh)
November	IDR 1,054,000 (739Kwh)
December	IDR 1,054,000 (739Kwh)

The amount of electricity costs depends on the busyness of apartment residents, the majority of whom are students and employees who use public facilities such as lounges, laundry rooms, kitchens, and Entertainment rooms. It can be concluded that the average expenditure of electricity operating costs for public facilities per month is Rp. 1,049,964 (777Kwh). For the electricity costs of each room is borne by each occupant at a rate of Rp. 2000 / Kwh. While the tariff from the electricity provider "PT. PLN" is Rp. 1,700 / Kwh. At this stage the owner has benefited from the residents. The amount of electricity costs depends on the busyness of apartment residents, the majority of whom are students and employees who use public facilities such as lounges, laundry rooms, kitchens, and Entertainment rooms. It can be concluded that the average expenditure of electricity operating costs for public facilities per month is Rp. 1,049,964 (777Kwh). For the electricity costs of each room is borne by each occupant at a rate of Rp. 2000/Kwh. While the tariff from the electricity provider "PLN" is Rp. 1,700 / Kwh. At this stage the owner has benefited from the residents.

As for the cost of using water. This building has a water reservoir with a capacity of 3m³ which is filled from the water supply channel, namely "PDAM Surabaya" with the help of a water pump to raise water to the top floor where the reservoir is stored. The use of water in this building serves to supply water needs. Here are the water costs in 2022:

Table 3. Water Use

Month	Fees (Indonesian Rupiah)
January	IDR 2,200,000 (250m ³)
February	IDR 2,100,000 (239m ³)
March	IDR 2,180,000 (248m ³)
April	IDR 2,040,130 (232m ³)
May	IDR 2,173,043 (247m ³)
June	IDR 2,054,010 (233m ³)
July	IDR 2,099,930 (239m ³)
August	IDR 2,100,230 (239m ³)
September	IDR 2,008,000 (228m ³)
October	IDR 2,132,000(242m ³)

Month	Fees (Indonesian Rupiah)
November	IDR 2,200,000 (250m ³)
December	IDR 2,143,000 (244m ³)

The average cost of water use in a month is 2,119,195 (241m³) with water costs Rp. 8,800/m³. And sold to residents for Rp. 9,000/m³ for use in each unit. The problem of this water consumption is the high consumption of water by the residents. Meanwhile, the management feels that excessive water consumption is not good for the environment. However, this cannot be avoided considering that residents also pay for it.

Layout Design

The site design and placement of the STP will be built in an area of vacant land from the building whose land is still owned by the owner covering an area of 10m X 5m.

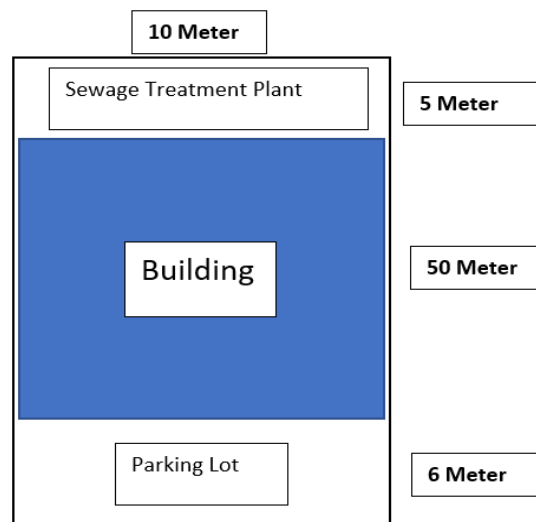


Figure 1. Location sketch

The wastewater processing process will use 2 processes, namely biological systems, and chemical systems. Here is the design layout of the process:

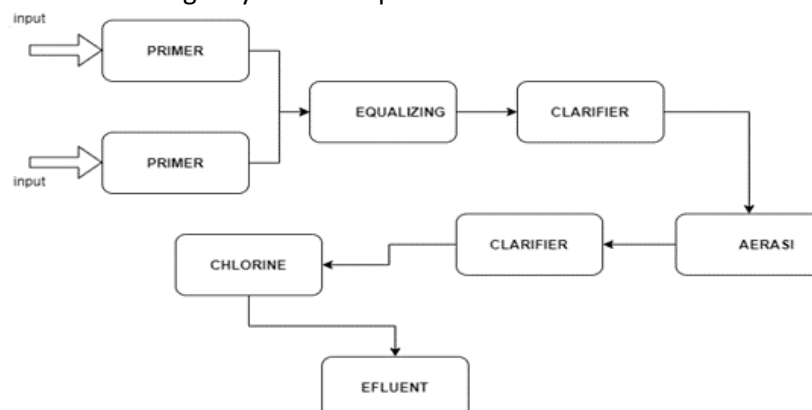


Figure 2. Biological System

1. Primer Tank

STP (*Sewage Treatment Plant*) gets waste supply from sewerage from both toilets to water catchment areas. The waste is accommodated in different primary tanks according to the

characteristics of the waste. The function of this primary tank is to separate the character of the existing waste, both from the toilet and from other sources.

For the waste process coming from the kitchen, the process of separating the character of oil and water uses the *overflow* method with the Grease Trap method. *Grease Trap* is a control tank that functions to separate oil and fat in wastewater so that it can be filtered easily. Meanwhile, the process of toilet waste is carried out by separating large particles or solid dirt by applying a baffle or filter on a special primary tank for toilets.

2. Equalizing Tank

After the process of separating oil and water and filtering dirt on the primary tank, the waste will proceed to the next stage, which is to enter the equalizing tank. This *equalizing* tank is a building waste discharge storage tank whose purpose is to separate the types of substance characters in the water content so that the tankteri decomposition process becomes lighter. In this *equalizing* tank, there is an air blower as a tool to decompose and separate the character of waste and water.

3. Tank Clarifier

At this stage, waste will be deposited against soft particles that are still in the water such as sludge to reduce the workload of the next tank, namely the aeration tank with the aim that the tankteri can decompose. The nature of this storage tank is to create calm water so that particles that have mass can sink at the bottom of the tank and the water will separate with the particles.

4. Aeration

In aeration tanks, liquid waste will be decomposed tankteri or microbes with a blower tool to dissolve oxygen into water to increase dissolved oxygen levels in water and release the content of gases dissolved in water, as well as help stirring water.

5. Clarifier Tank

After passing through the aeration tank, another deposition will be carried out with the aim of separating particles from water so that particles in the waste can settle to the bottom and separate from water. The purpose of another settling after going through the previous settling is to get clearer water so that it is carried out twice as precipitation.

6. Chlorine Tank

This tahap focuses on killing tankteri by *inject* chemical water, namely *chemical chlorine* using the help of a dosing pump.

7. Effluent Tank

At this stage, clean water will be accommodated in this *effluent* tank for further use as a non-consumable irrigation system.

In determining the feasibility of this biological system, water quality must meet the following parameters.

1. BOD (Bio Oxygen Demand) level should be below 5 PPM (Part Per Million)
2. COD (Chemical Oxygen Demand) level should be below 10 PPM (Part Per Million)
3. The pH level (Power of Hydrogen) should be between 6–9 PPM (Parts Per Million)

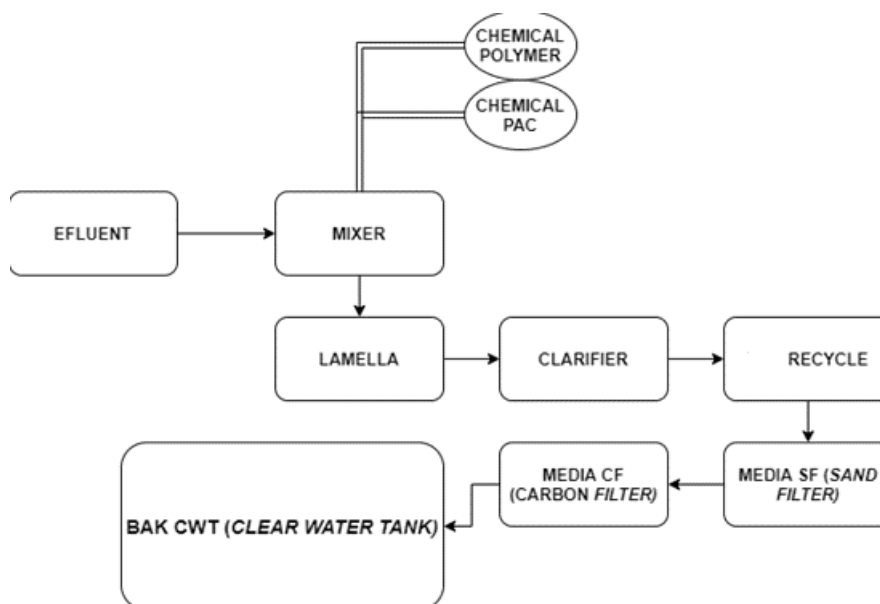


Figure 3. Biological System

1. Mixer

At this stage after the water in the Effluent Tank is declared to have passed the test, it will proceed to the Mixing stage using a Mixer. At this stage the water will be mixed with chemicals, namely Chemical PAC and Chemical Polymer. Chemical PAC serves to precipitate waste particles and Chemical Polymer serves to bind waste particles.

2. Lamella

Lamella tanks function to hold or regulate the flow of sludge levels through the grille using cup settler media with dimensions of 80 cm high and 120 cm wide.

3. Tank Clarifier

After going through the Lamella Tank, the water will continue to flow into the Tank Clarifier to be deposited like the previous Tank Clarifier.

4. Recycle

At this stage the precipitated water will enter the next process, namely further filtration using Sand Filter media consisting of gravel measuring 3 mm to 6 mm to filter further dirt particles. Then, water enters the Carbon Filter media consisting of charcoal or cartridge components to remove odors and kill tankteri.

5. CWT (Clear Water Tank)

CWT tanks can use a capacity of 300 m³ to accommodate the intake of clean water ready for consumption. With a note that it is mandatory to have a pH criterion of 6–9 PPM and a TDS of 50–150 PPM.

Construction and Maintenance Cost

Based on discussions with the contractor, the cost of purchasing mixer machines and other machines as well as various tanks according to the layout was set, a cost of Rp. 10,665,000 was set. As for the maintenance costs every month as follows:

Table 4. Operation Cost

Activity	Fee Indonesian Currency (Rp)/month
STP Treatment	200,000
Water quality testing	105,000
Chemicals	185,000
Cost of electricity	550,000
Sludge disposal costs	150,000
Total	1,190,000

RESULTS AND DISCUSSION

The quality of the water tested must be appropriate, based on the Regulation of the Minister of Health of the Republic of Indonesia No. 82/2001 concerning Water Quality for Household Needs is as follows.

Table 5. Useable Water Quality Regulation

Parameters	Unit	Maximum Content
Ph		6–9
BOD	Ppm	6
COD	Ppm	12
TDS	Ppm	1.500

For water quality testing, you can use third parties who do have the ability to test water quality, namely "KAN and "Sucoffindo" which are in the city of Surabaya.

Green logistics implementation

1. Ecological Criteria

In the wastewater processing process, secondary waste will appear, namely Sludge. In the city of Surabaya, there are third parties who serve sludge disposal and can even process sludge into substitution raw materials so that it does not pollute the environment. *Sludge* waste can be used as a substitution material in making concrete bricks (Sri & Fajar, 2021).

2. Economic Analysis

With this system, it will save water expenditure costs up to 100% even though it increases electricity costs every month. However, owners can still benefit from monthly payments to electricity and water by residents. As a calculation, the average per month of electricity is Rp. 1,049,964 + Rp. 1,190,000 (STP additional electricity cost) = Rp.2,239,964. Meanwhile, building owners can sell water to residents for Rp.9,000 /m³. If the average water use by residents is 230 m³ then, 9000 X 230 = 2,070,000. Then the owner will get a profit of Rp. 2,070,000 only from water payments not including from electricity payments by residents. Unfortunately, the owners do not keep data on what the average income from electricity use has been over the past year. Waste from *Wastewater Treatment*, namely *Sludge*, can be used as a substitution material in making concrete bricks (Mulyati & Sihite, 2021). By having Sewage Treatment Plant, can involve water consumption for entire life cycle of the building (Usman et al., 2018).

3. Technological Capabilities

In this design, specifications for pumps and filtration tanks have been set according to needs, to provide effective and efficient results. Electricity consumption is not excessive but still effective in carrying out the process. Waste originating from the toilet is channeled into a holding tank

which must be watertight to prevent odor leaks and then overflow from the liquid waste holding tank is pumped into the domestic STP system (Yudo, 2018).

4. Social Acceptance

The STP location will be placed in the back area of the building which was originally just vacant land. The location is also isolated by the parapet of apartment areas and residential areas. The determination of the STP location is also in an open area and the storage tank will be stored in the ground by the soil excavation method.

CONCLUSION

Based on the data that has been obtained, the existence of a Sewage Treatment Plant in this apartment building can minimize the cost of water use and reduce dependence on third-party water providers. And can increase income from business owners. The design is determined based on existing regulations in the local area as well as the concept of green logistics to produce outputs that are in accordance with the existing conception. If the management wants to do more business, they can cooperate with "PT. PRIA" is a specialist company that processes sludge in Surabaya to be used as substitute raw materials such as concrete bricks, for example.

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