Eduvest – Journal of Universal Studies
Volume 1 Number 11, November 2021
p- ISSN 2775-3735 e-ISSN 2775-3727

TREATMENT OF DOMESTIC LIQUID WASTE USING FILTRATION AND ADSORPTION METHODS AT VILLA CITRA MAKALE HOUSING

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ARTICLE INFO

Received:
October, 26th 2021
Revised:
November, 17th 2021
Approved:
November, 19th 2021

ABSTRACT

Domestic liquid waste comes from household activities that contain pollutants that can contaminate soil and water bodies. If the waste is simply dumped into a water body without being treated first, it can pollute the surrounding environment, so the aim of the study was to determine the volume of wastewater produced and to treat the waste using filtration and adsorption methods. The research method used is descriptive quantitative method by calculating the amount of water use to get the volume of wastewater and wastewater treatment with filtration and adsorption methods. The results showed that the volume of wastewater produced was 11.14 m3/day, and the results of wastewater treatment with filtration and adsorption methods showed that several parameters had decreased, namely the BOD value of 27.38%, Total Coliform of 93.95%, and color of 75%.

KEYWORDS

Filtration, Adsorption, Domestic Liquid Waste, Housing Villa Citra Makale.

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How to cite: Reni Oktaviani Tarru, Harni Eirene Tarru, Wiwinda Ekalisa, Febi Trisa Wahyuni. (2021). Treatment of Domestic Liquid Waste Using Filtration and Adsorption Methods at Villa Citra Makale Housing. Journal Eduvest. *1*(11): 1313-1321

E-ISSN: 2775-3727
Published by: https://greenpublisher.id/

INTRODUCTION

Domestic wastewater has become a matter of great concern along with the increase in the human population. Wastewater that is not treated effectively can cause problems, both for humans and the surrounding environment (Askari, 2015; Supriyatno, 2000). In general, the characteristics of domestic wastewater include COD (Chemical Oxygen Demand) 100 mg/l, BOD (Biochemical Oxygen Demand) 30 mg/l, Total Coliform 3000 CFU/100 ml. So far, this liquid waste is simply dumped into water bodies without being treated first, so that it can pollute the surrounding environment (Sulistyanti, Antoniker, & Nasrokhah, 2018) (Reynaldi, Mimin, Dindin, & Nany, 2020; SARI, 2016). The location of this research review is in the housing of Villa Citra Makale. The residents who live in this area do not yet have a wastewater treatment plant, especially for waste that comes from daily activities such as bathing, washing and kitchen waste (grey water). Most of the waste they produce is directly dumped into water bodies or soil which directly flows into irrigation used for irrigating rice fields and fish ponds without prior processing. If the amount of waste water discharged is excessive, it exceeds nature's ability to receive it, there will be environmental damage (PRATAMA, 2016), (Wulandari, 2014). To avoid the adverse impact of domestic wastewater disposal, it is necessary to design a domestic wastewater treatment plant that functions to reduce the concentration of pollutant substances before the wastewater is discharged into the receiving water body (Damayanti, Wuisan, & Binilang, 2018; Dimara, Supit , & Jasin, 2020).

Therefore, the manufacture of wastewater treatment plants is very much needed, but the manufacture of large-scale installations requires quite a lot of costs. One alternative for wastewater treatment that does not require too much cost is the simple filtration and adsorption method (Prastyo & Rahayoe, n.d.; Untari & Kusnadi, 2015). Wastewater is residual water from business in the form of liquid (Government Regulation No. 82 of 2001). Hazardous and toxic waste is the residue of a business or activity that contains hazardous and toxic materials which due to their nature, concentration, and/or amount, either directly or indirectly, can pollute, damage the environment, or endanger the environment for humans and living creatures. Based on its physical characteristics, waste can be categorized into solid, liquid, and gaseous wastes. Wastewater treatment technology is the key in preserving the environment.

Various wastewater treatment techniques to remove pollutant materials have been tried and developed so far. The wastewater treatment techniques that have been developed can generally be divided into three treatment methods, namely physical treatment, chemical treatment, and biological treatment.

Wastewater treatment technology is the key in preserving the environment. Whatever kind of domestic or industrial wastewater treatment technology is built, it must be operated and maintained by the local community. The processing technology chosen must be in accordance with the technological capabilities of the community concerned.

In the Regulation of the Minister of Environment and Forestry concerning Domestic Wastewater Quality Standards Number P68/MNLHK-SETJEN/2016 Article 1 explains that domestic wastewater is waste water originating from human daily life activities related to water use. In simple terms, liquid waste can be defined as waste water resulting from household activities, housing, flats, apartments, offices, hospitals, malls, supermarkets, meeting halls, hotels, industries, either in the form of gray water (used water). and black water (dirty water/stool). When viewed chemically, this waste consists of chemicals, organic compounds and inorganic compounds. With a certain concentration and quantity, the presence of waste can have a negative impact on the environment, especially for human health, so it is necessary to handle waste. The level of danger of

poisoning caused by liquid waste depends on the type and characteristics of the pollutant waste (Fardiaz, 1992).

RESEARCH METHOD

The research method used is descriptive quantitative method by calculating the amount of water use to get the volume of wastewater and wastewater treatment with filtration and adsorption methods. Domestic Liquid Waste Treatment with Filtration and Adsorption Methods is carried out at the Villa Citra Makale Housing, which is located in Kalembang, Lembang Turunan, Sangalla District, Tana Toraja Regency, Indonesia.

RESULT AND DISCUSSION

Domestic Liquid Waste Characteristics

In general, the nature or characteristics of domestic wastewater is divided into three characteristics, namely physical, chemical and biological characteristics.

Adsorption Method

Based on the strength of the interaction, adsorption can be divided into 2, namely physical adsorption and chemical adsorption (Sing, 1998)

1. Physical adsorption occurs when the intermolecular forces are greater than the intermolecular attractive forces or the relatively weak attractive forces between the adsorbate and the adsorbent surface. This force is called the Van der Waals force so that the adsorbate can move from one surface to another surface of the adsorbent. The intermolecular force is the attraction between the fluid molecules and the solid surface, while the intermolecular force is the attraction between the fluid molecules themselves.

2. Chemical adsorption occurs due to the exchange or sharing of electrons between the adsorbate molecule and the surface of the adsorbent so that a chemical reaction occurs. The bond formed between the adsorbate and the adsorbent is a chemical bond and the bond is stronger than physical adsorption.

Filtration Method

Filtration is a process used to separate solids from liquids or gases using a filter medium that allows the liquid to pass (Wakeman, 2007), but not the solids. The term “filtration” applies whether the filter is mechanical, biological, or physical. The liquid that passes through the filter is called the filtrate. The filter medium can be a surface filter, which is a solid that traps solid particles, or a deep filter, which is a base material that traps solids.

1). Filtration With Natural Zeolite

Filtration is a process used in clean water treatment to separate impurities (particulates) contained in water. In the process, water seeps and passes through the filter media so that it will accumulate on the filter surface and collect along the depth of the media it passes through.

The filter also has the ability to separate particulates of all sizes including algae, viruses and soil colloids.

Gravel For Filtration

In the filtration process, gravel acts as a filter material and helps oxygen aeration.

Gravel can also function as a filter for large impurities found in water or liquid waste

Sand For Filtration

Sand can serve to remove the content of silt, soil, small particles and sediment in the water. Usually functioned as a pre-filter for processing with the next filter.

Coconut Fiber For Filtration

Coconut fiber functions as a filter for impurities contained in liquid waste.

Wastewater

The calculation of the volume of waste water or waste water is based on the amount of water used. The volume of wastewater is 80% of the volume of drinking water. To calculate the waste water used the formula:

a = Qtotal x 80%

Qtotal = need for clean water

80% = assumption of clean water that will be waste water

Wastewater Preliminary Sampling

The initial sample of the waste is first taken for testing. This test is conducted to determine the chemical, physical, and biological levels before processing.

Waste Treatment Building

Simple building for wastewater treatment with filtration and adsorption methods. The building for storage before filtration is made of tarpaulin with a size of 1x3m . The building is made with a width of 1m and a length that is adjusted to the trench due to the location that is not possible. Then the filtration and adsorption building is made of a plastic container measuring 35x28 cm and a framework is made of wooden blocks shaped like a ladder that is adjusted to the contours of the soil in the trench. Plastic containers are arranged on a frame and then the materials are arranged into containers with a thickness of 5cm.s each. The composition of the materials is as follows:

a) Layer 1 coconut fiber
b) Layer 2 sand
c) Layer 3 coconut fiber
d) Layer 4 sand
e) Layer 5 coconut shell charcoal
f) Layer 6 natural zeolite
g) Layer 7 gravel

Each layer is covered with gauze to separate each ingredient so as not to mix as shown in the following picture.

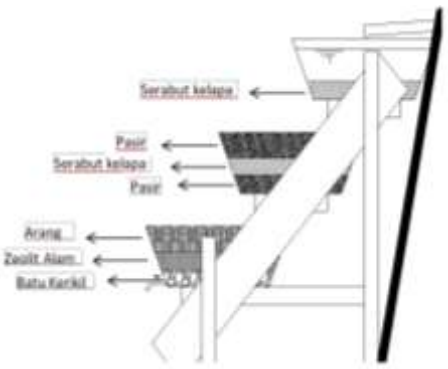


Figure 1. Processing Building Sketch

Wastewater Sampling After Treatment

Before taking the wastewater, it was first deposited for 3 days. After going

through the deposition process, sampling was carried out by sampling using a 150 ml bottle and a 2 liter jerry can.

Sample Analysis in the Laboratory

After taking the sample, the sample will be tested at the Makassar Plantation Product Industry Center. Testing is done by measuring the chemical, physical, and biological levels.

Calculation of Wastewater Volume or waste water

a = Qtotal x 80%

= 13.92 m3/day x 80%

= 11.14 m3/day

So, the amount of waste water for residential residents is 11.14 m3/day

Results of Domestic Liquid Waste Parameter Analysis with Filtration and Absobs Methods.

1. Chemical Parameters

Table 1. Results of Chemical Parameter Analysis of Household Liquid Waste for Villa Citra Makale Housing Before Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results Before Processing
1.	pH	-	6-9	6,90
2.	Kesadahan (caco3)	Mg/L	500	2475
3.	BOD	Mg/L	30	43,3775
4.	COD	Mg/L	100	145,451
5.	DO	Mg/L	Minimum 4	4,7318
6.	Nitrat(NO3)	Mg/L	10	0,2399
7.	Besi (Fe)	Mg/L	0,3	<0,03
8.	Mangan (Mn)	Mg/L	0,4	<0,008
9.	Nitrit (NO2)	Mg/L	0,06	0,0068
10.	Sianida (CN)	Mg/L	0,07	<0,002
11.	Flourida (F)	Mg/L	1,5	0,2031
12.	Detergen sebagai MBAS	Mg/L	100	4658,40

Table 2 Results of Chemical Parameter Analysis of Household Liquid Waste for Villa Citra Makale Housing After Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results After Processing
1.	pH	-	6-9	3,94
2.	Kesadahan (caco3)	Mg/L	500	990,00
3.	BOD	Mg/L	30	31,4986
4.	COD	Mg/L	100	170,649
5.	DO	Mg/L	Minimum 4	3,9435
6.	Nitrat(NO3)	Mg/L	10	7,3047
7.	Besi (Fe)	Mg/L	0,3	0,03
8.	Mangan (Mn)	Mg/L	0,4	0,008
9.	Nitrit (NO2)	Mg/L	0,06	0,0146

10.	Sianida (SN)	Mg/L	0,07	0,0478
11.	Flourida (F)	Mg/L	1,5	0,1214
12.	Detergent as MBAS	Mg/L	100	3111,80

The results of the analysis can be illustrated in a graph of the comparison of chemical parameters of domestic wastewater before and after treatment as follows:

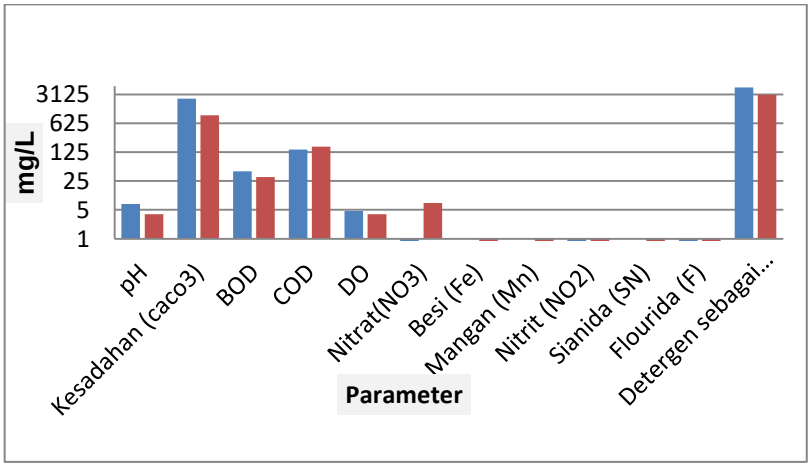


Figure 1 Comparison of Domestic Liquid Waste Chemical Parameters

2. Physical parameters

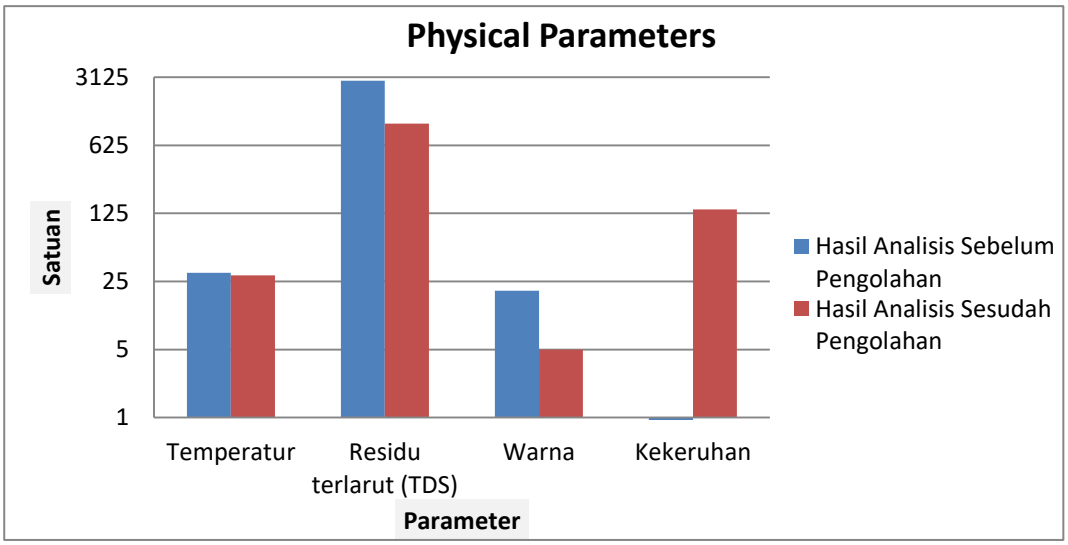
Table 3 Results of Physical Parameter Analysis of Household Liquid Waste for Villa Citra Makale Housing Before Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results Before Processing
1.	Temperatur	^{o}C	15-354	30,6
2.	Residu terlarut (TDS)	Mg/L	800	2869
3.	Warna	TCU	15	20
4.	Kekeruhan	Skala NTU	5	0,21

Table 4. Results of Physical Parameter Analysis of Household Liquid Waste for Villa Citra Makale After Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results After Processing
1.	Temperatur	^{o}C		28,8
2.	Residu terlarut (TDS)	Mg/L	800	1042
3.	Warna	TCU	15	5
4.	Kekeruhan	Skala NTU	5	137,00

The results of the analysis can be illustrated in a comparison chart of the physical parameters of domestic wastewater before and after processing as follows:



Graph 2 Comparison of Physical Parameters of Domestic Liquid Waste

3. Biological Parameters

Table 5. Results of Analysis of Biological Parameters of Household Liquid Waste for Villa Citra Makale Housing Before Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results Before Processing
1.	Fecal Coliform	Total/100 ml	100	94
2.	Total Coliform	Total/100 ml	3000	430

Table 6 Results of Analysis of Household Liquid Waste Biological Parameters for Villa Citra Makale After Processing

No.	Parameter	Unit	Maximum Quality Requirements	Analysis Results After Processing
1.	Fecal Coliform	Total/100 ml	100	10
2.	Total Coliform	Total/100 ml	3000	26

The results of the analysis can be illustrated in a comparison chart of the biological parameters of domestic wastewater before and after treatment as follows:

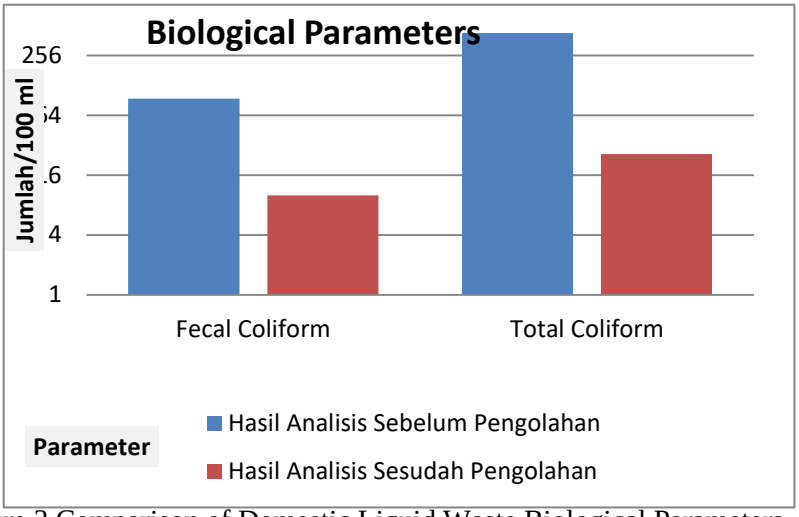


Figure 3 Comparison of Domestic Liquid Waste Biological Parameters

Based on the results of research and analysis of domestic wastewater treatment at Villa Citra Makale Housing using filtration and adsorption methods when viewed from the value of Chemical, Physical, Biological parameters, the quality of liquid waste has changed although it is still not optimal. COD increased because the deposition time in this study was not optimal so that the adsorption process did not occur optimally. This is because the contact between the particles and the adsorbent medium lasts for a short time. The longer the contact time, the more particles are bound. This increase is also influenced by the size of the adsorbent media used, the smaller the size of the media, the larger the surface area and the more particles that stick to the surface. BOD value decreased by 27.38%, color decreased by 75%, Fecal Coliform value decreased by 89.36% and Total Coliform value decreased by 93.95%.

CONCLUSION

Based on the results of research and analysis of domestic wastewater parameters in the Villa Citra Makale Housing, it can be concluded that: The volume of waste water or wastewater generated from the housing is about 80% of the total daily water usage, which is 11.14 m3/day. The application of the filtration and adsorption method using sand, coconut fiber, gravel, activated charcoal and natural zeolite media gave good results in reducing the value of domestic wastewater parameters, especially BOD, color and total coliform, the decrease was due to the use of activated charcoal and Zeolite has pores that can bind impurities in wastewater. The results of the analysis of the quality of domestic wastewater based on the filtration and adsorption methods are: the BOD value decreased by 27.38%, the color decreased by 75%, the Fecal Coliform value decreased by 89.36% and the Total Coliform value decreased by 93.95 %.

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