Performance Comparison of Microfiltration Membranes Using Pre Treatment To Treat Hospital Wastewater

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Abstract. Microfiltration membrane is one of the physical treatments for treating hospital wastewater. However, there are drawbacks in processing using microfiltration membranes. This weakness is a problem because the treated water and the quality of the treated water are not effective. The problem is because saturation can occur on the surface of the microfiltration membrane so that it can reduce processing efficiency and wastewater quality.
The aims of this study were 1) To determine the initial quality of hospital wastewater 2) To determine the decrease in parameters of BOD, COD, TSS, Fatty Oil, Ammonia and Total Coliform. 3) find out the comparison of the amount of processed water using pre-treatment. 4) find out the comparison of the amount of processed water without using pre-treatment.
The research method carried out is a quasi-experimental, namely research that aims to explain things that will happen to the research variables through manipulation and control of the variables in order to find the effect of one or more design variables using pre-test (before treatment) and post-test. test (after treatment) for the object under study.
The results obtained from this study are, 1) The quality of the initial hospital wastewater at the fifth hour is BOD 84 mg/l, COD 282 mg/l, TSS 40 mg/l, Fatty Oil 1 mg/l, NH3 16 mg/l , and Total Coliform 3.400 Amount/100 ml sample. 2) The quality of the wastewater treated with microfiltration membranes using pre-treatment at the fifth hour obtained results, namely BOD 14 mg/l, COD 84 mg/l, TSS 18 mg/l, Fatty Oil 0.6 mg/l, NH3 3 mg/l, and Total Coliform 1200 Amount/100 ml sample. 3) The quality of wastewater treated with microfiltration membranes without using at the fifth hour showed BOD 20 mg/l, COD 92 mg/l, (TSS) 22 mg/l, Oils and Fats 0.8 mg/l, Ammonia 8 mg /l, and Total Coliform 2.900 Amount/100 ml.
The decrease in the concentration of wastewater on the microfiltration membrane shows that the results of a decrease in concentration in all parameters have met the hospital wastewater quality standards. Processing of microfiltration membranes using pretreatment is more effective in reducing the concentration of parameters than microfiltration membranes that do not use pretreatment. The quantity of water treated with microfiltration membrane 1 which uses pre-treatment is higher, namely 5,010 liters than the quantity of water treated with microfiltration membrane 2 without using pretreatment, which is 2,789 liters.

Keywords: Comparison, Microfiltration Membrane, Wastewater

PRELIMINARY

Nowadays, in general, hospitals in Indonesia treat wastewater using a biological method, namely an aerobic anaerobic biofilter system. This is based on the WWTP Technical Guidelines for Health Service Facilities which is the reference for hospital wastewater treatment. [1]

Alternative technology other than the biological method is the physical method, besides being easier to operate, it can also be made portable (can be moved) from one place to another, especially in emergency conditions such as old disasters. For water purification and wastewater treatment, a microfiltration membrane can be used, the microfiltration membrane used has a size of 0.05 m and is used for oily wastewater with a removal of up to 82.5% [2]

Novalina, et al 2016, [3] described microfiltration as an alternative to wastewater treatment which resulted in the removal of 90% BOD, 85% COD and up to 70% total Coli. Micro membrane is the

separation of micron or sub-micron-sized particles, the usual shape is like a cartridge, the point is to remove particles from water measuring 0.04 to 100 microns.

The problem of this research is how much is the decrease in the quality of wastewater using microfiltration membrane treatment using silica sand pretreatment and without silica sand pretreatment.

The material used as a preliminary treatment in the form of Silica Sand serves to purify wastewater so that it is expected that the operating time of the microfiltration membrane can last a long time in treating hospital wastewater.

The purposes of this study are 1) To determine the initial quality of hospital wastewater 2) To determine the performance comparison of decreasing the parameters of BOD, COD, TSS, Fatty Oil, Ammonia and Total Coliform using pre-treatment and without using pre-treatment. 3) Knowing the ratio of the amount of water processed by microfiltration membranes using pre-treatment and without pre-treatment.

Filtering using silica sand and activated carbon in hospital wastewater was able to reduce BOD levels of 39.97% and COD levels of 41.19% [4]. Meanwhile, coagulation was carried out using the optimum concentration of alum capable of removing turbidity up to 94.98%, TSS 93.87% and COD 57.43%.[5]

Therefore, researchers are interested in comparing the performance of microfiltration membranes using and without pretreatment.

METHOD

This study focuses on the analysis of the performance of reducing hospital wastewater parameters. This is due to the problem of fouling/saturation of the microfiltration membrane in treating hospital wastewater.

Silica sand in this study serves to purify wastewater so that the materials that cause fouling on the microfiltration membrane such as suspended solids, colloidal particles and organic matter can be removed so that the operating time of the microfiltration membrane can last a long time in treating hospital wastewater. Below is a research flow that describes the implementation of the research.

The research conducted is a quasi-experimental, namely research that aims to explain things that will happen to the research variables through manipulation and control of the variables in order to find the effect of one or more variables Design using pre test (before treatment) and post test (after treatment) for the object under study.

The time of this research was carried out in March – August 2021. The research location will be carried out at the Wastewater Treatment Plant (IPAL) of RSIA Puri Adhya Paramitha Bandar Jaya, Central Lampung.

In this study, the researchers prepared several things, namely the preparation of sampling, the manufacture of the reactor, to the implementation of the preliminary treatment of hospital wastewater treatment reactors.

The research reactor consists of:

1. The initial collection tank serves as a place to collect waste water before it is processed.
2. Pipe filter serves to filter waste (dirt) in wastewater before flowing to the centrifugal pump.
3. Centryfugal pump discharge 18 liters per minute functions to suck and drain water from the initial collection tank to the filter tube.
4. The filter tube containing silica sand serves as a preliminary treatment (filtering suspended materials) before flowing into the microfiltration membrane.
5. The microfiltration membrane serves as the main treatment for the removal of BOD, COD, TSS, Fatty Oil, Ammonia and Total Coliform parameters.
6. Water meter serves to measure the amount of water produced from the processing.
7. Valve serves to close and open the flow of waste water.
8. The initial settling basin serves to accommodate the processed water produced.

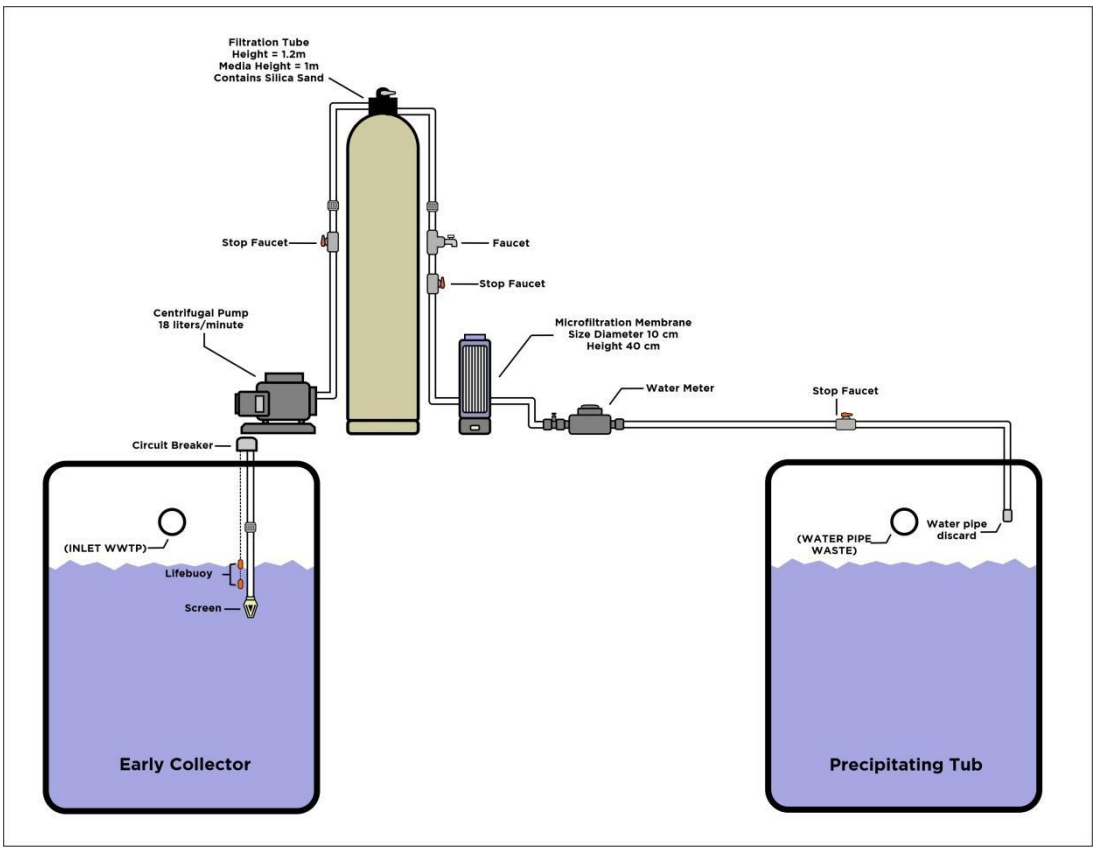


Figure 1. The flow of wastewater in the microfiltration membrane process using silica sand.

RESULTS

A. Hospital Preliminary Wastewater Quality

The quality of the hospital's initial wastewater is presented in the table below:

Table 1. Initial Hospital Wastewater Quality

No	Parameters	Time					Quality StandardsPermenlhk No. P.68/2016	Unit
		1	2	3	4	5		
1	BOD	82	82	83	83	84	30	mg/l
2	COD	271	271	282	282	282	100	mg/l
3	Total Solid Suspendid/TSS	38	40	44	40	40	30	mg/l
4	Fat Oil	1	1	1	1	1	5	mg/l
5	NH3 /Amonnia	16	14	16	18	16	10	mg/l
6	Total Coliform	3400	3400	3400	3400	3400	3000	MPN/100 ml sample

Source: Research Results, 2022

Based on the table above, the quality of the initial hospital wastewater at the fifth hour is BOD 84 mg/l, COD 282 mg/l, TSS 40 mg/l, Fatty Oil 1 mg/l, NH3 16 mg/l, and Total Coliform 3.400 Total/ 100 ml sample.

B. Microfiltration Membrane Wastewater Quality 1 With Treatment Introduction.

The quality of wastewater processed by 1 hospital microfiltration membrane is presented in the table below:

Table 2. Wastewater Quality of Microfiltration Membrane Tubes 1
(Microfiltration Membrane With Preliminary Treatment)

No	Parameters	Time					Quality Standards Permenlhk No. P.68/2016	Unit
		1	2	3	4	5		
1	BOD	10	10	12	12	14	30	mg/l
2	COD	64	64	84	84	84	100	mg/l
3	Total Solid Suspendid/TSS	12	14	16	16	18	30	mg/l
4	Fat Oil	0,5	0,5	0,5	0,6	0,6	5	mg/l
5	NH3 /Amonnia	1	1	2	2	3	10	mg/l
6	Total Coliform	800	1000	1000	1200	1200	3000	MPN/100 ml sampel

Source: Research Results, 2022

Based on the table above, the quality of wastewater obtained at the fifth hour is BOD 14 mg/l, COD 84 mg/l, TSS 18 mg/l, Fatty Oil 0.6 mg/l, NH3 3 mg/l, and Total Coliform 1200 Total /100 ml sample.

C. Microfiltration 2 Membrane Wastewater Quality Without Treatment Introduction.

The quality of wastewater processed by microfiltration membranes from 2 hospitals is presented in the table below:

Table 3. Wastewater Quality of Microfiltration Membrane Tubes 2
(Microfiltration Membrane Without Pretreatment)

No	Parameters	Time					Quality Standards Permenlhk No. P.68/2016	Unit
		1	2	3	4	5		
1	BOD	16	18	18	20	20	30	mg/l
2	COD	72	72	92	92	92	100	mg/l
3	Total Solid Suspendid/TSS	18	18	20	20	22	30	mg/l
4	Fat Oil	0,6	0,6	0,6	0,8	0,8	5	mg/l
5	NH3 /Amonnia	4	7	8	8	8	10	mg/l
6	Total Coliform	2700	2700	2800	2800	2900	3000	MPN/100 ml sampel

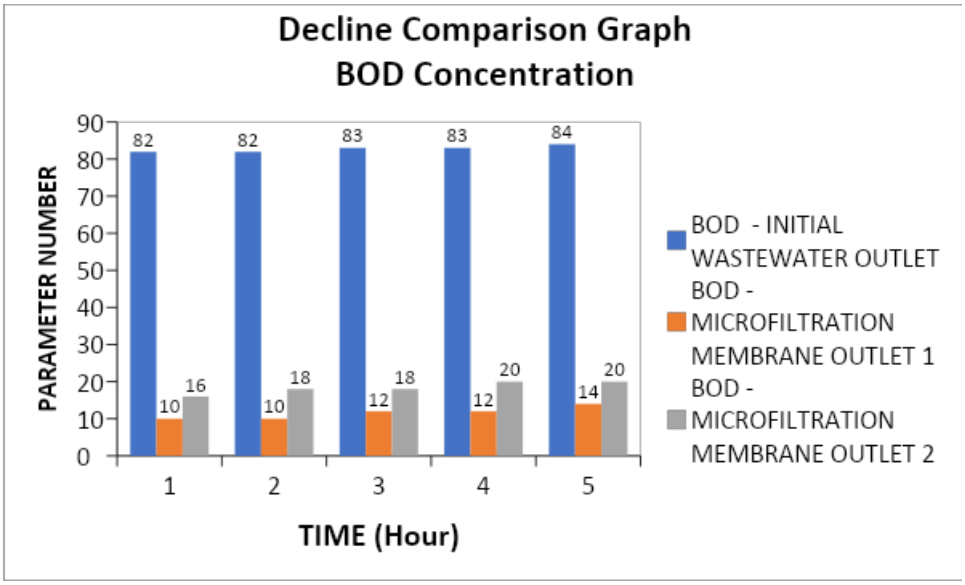
Source: Research Results, 2022

Based on the table above, the quality of wastewater obtained at the fifth hour is BOD 20 mg/l, COD 92 mg/l, (TSS) 22 mg/l, Oil and Fat 0.8 mg/l, Ammonia 8 mg/l, and Total Coliform 2.900 Quantity/100 ml.

D. **Comparison of Wastewater Quality Degradation in Microfiltration Treatment 1 and 2**

Based on the results of laboratory examinations of wastewater processed by microfiltration membranes 1 and 2, the following data were obtained:

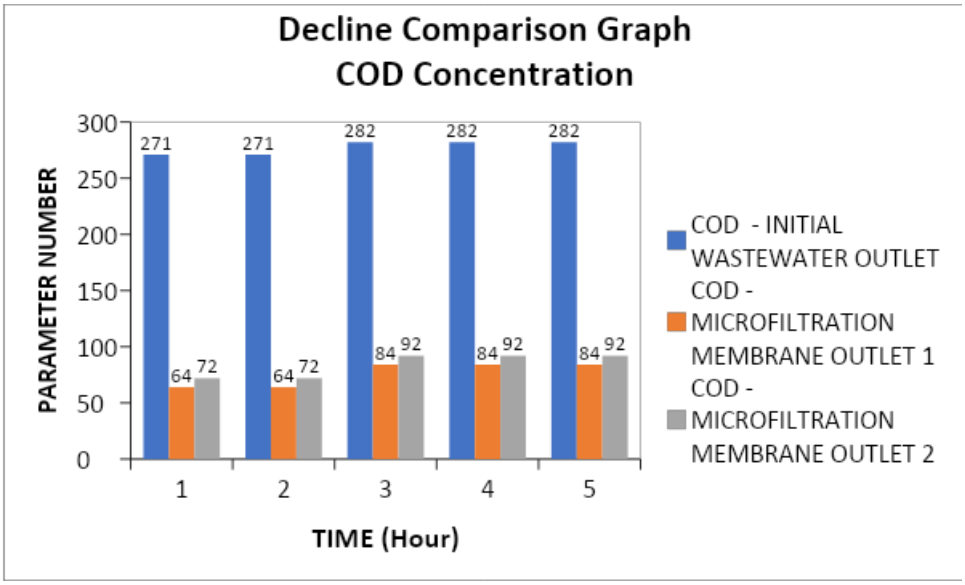
1. **BOD**



Graph 1. Results of Comparison of Performance of Microfiltration Membranes 1 and 2 BOD Parameter

Based on the graphic data above, the BOD parameter quality for the first hour of the initial wastewater outlet is 82, the outlet for the microfiltration membrane 1 is 10, the outlet for the microfiltration membrane 2 is 16.

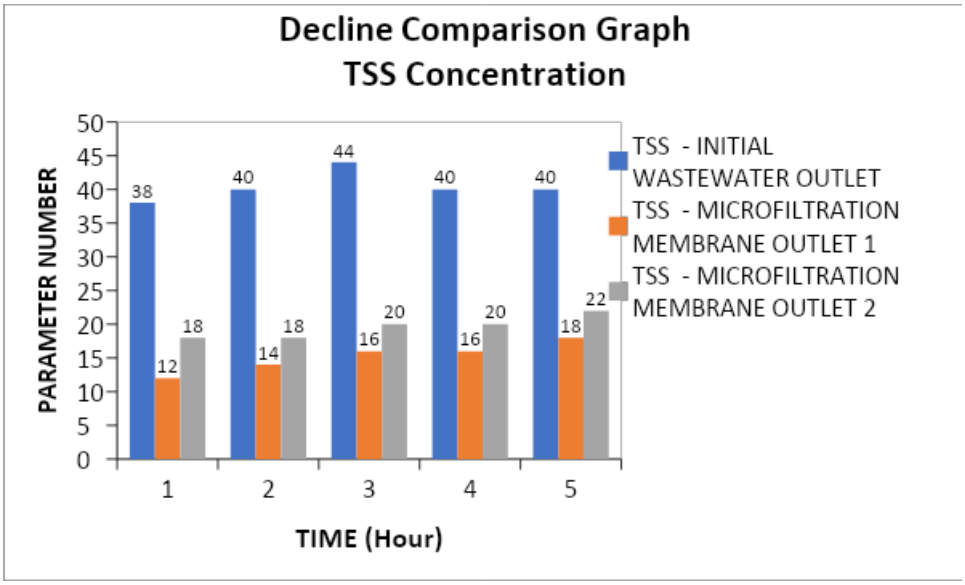
2. **COD**



Graph 2. Comparative Results of Microfiltration Membrane Performance 1 and 2 COD Parameters

Based on the graphic data above, the quality of the COD parameters in the first hour of the initial wastewater outlet was 271 microfiltration membrane outlets 1 which was 64, microfiltration membrane outlets 2 were 72.

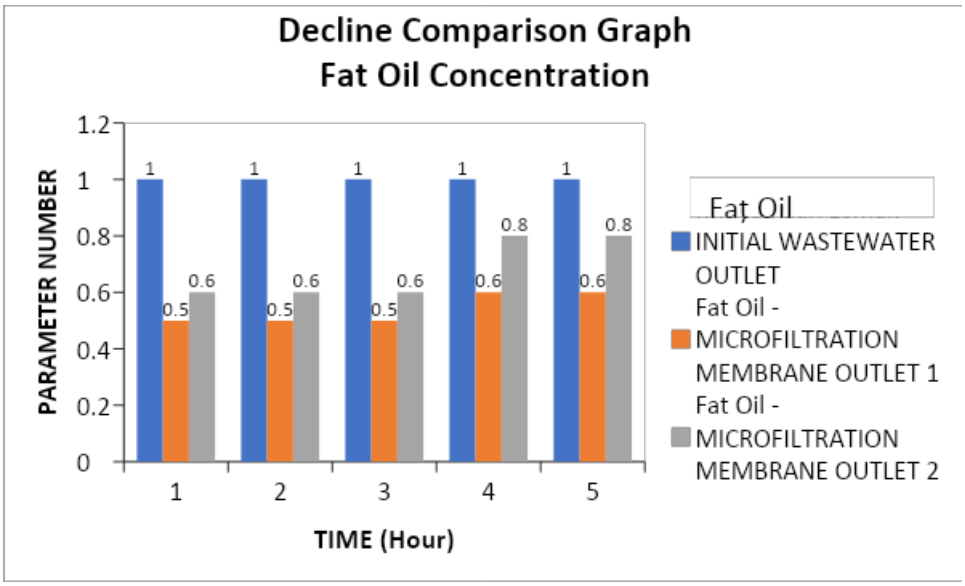
3. **TSS**



Graph 3. Comparative Results of Microfiltration Membrane Performance 1 and 2 TSS Parameters

Based on the graphic data above, the quality of the TSS parameters in the first hour of the initial wastewater outlet is 38, the outlet for the microfiltration membrane 1 is 12, the outlet for the microfiltration membrane 2 is 18.

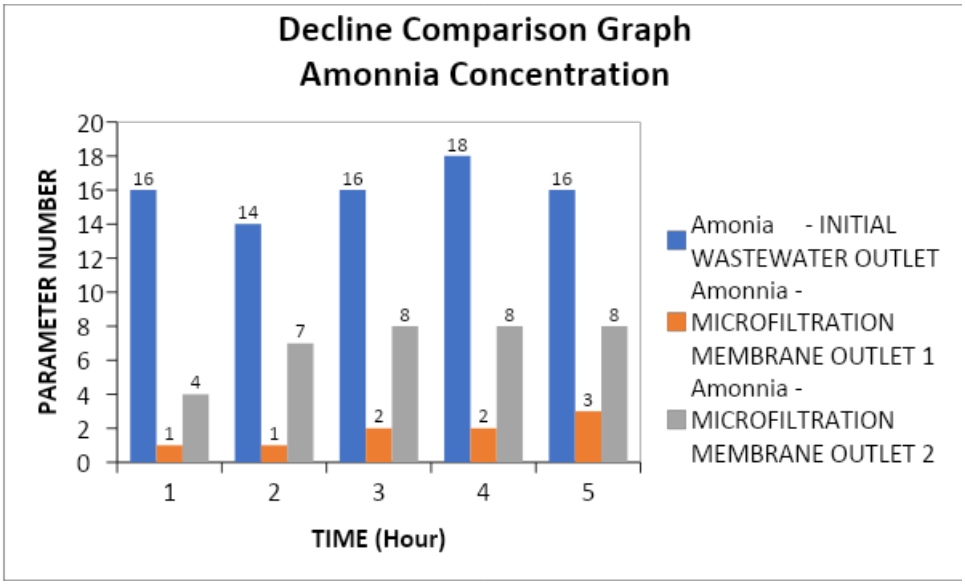
4. **Fat Oil**



Graph 4. Comparison Results of Microfiltration Membrane Performance 1 and 2 Fat Oil Parameters

Based on the graphic data above, the quality of the fatty oil parameters in the first hour of the initial wastewater outlet is 1, the outlet for the microfiltration membrane 1 is 0.5, and the outlet for the microfiltration membrane 2 is 0.6.

5. **Ammonia**



Graph 5. Comparison Results of Microfiltration Membrane Performance 1 and 2 Ammonia Parameters

Based on the graphic data above, the quality of the NH3 parameters in the first hour of the initial wastewater outlet is 16, the outlet for the microfiltration membrane 1 is 1, the outlet for the microfiltration membrane 2 is 4.

6. **Total Coliform**

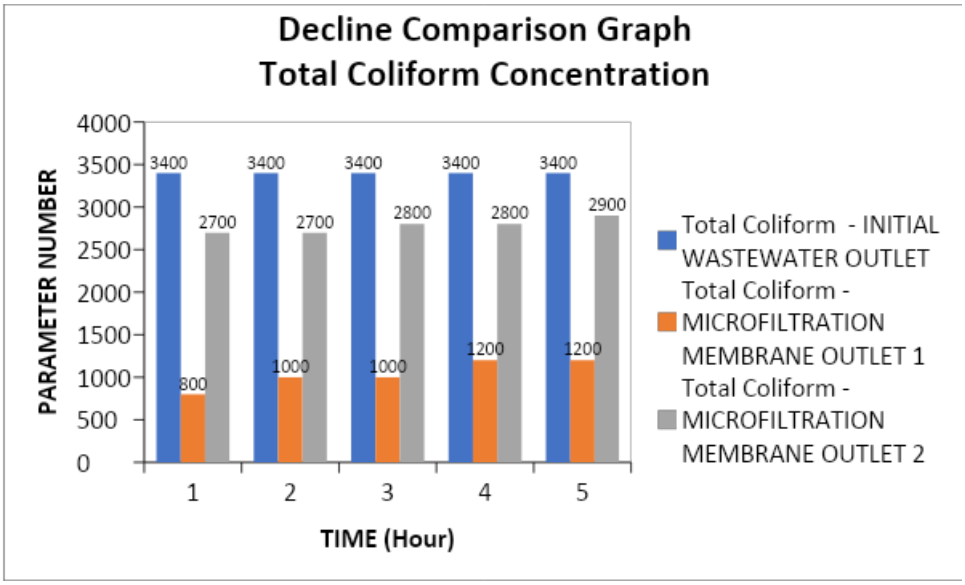


Figure 6. Comparison Results of Microfiltration Membrane Performance 1 and 2 Total Coliform Parameters

Based on the graphic data above, the quality of the Total Coliform parameter in the first hour of the initial wastewater is 3400, the outlet of the microfiltration membrane 1 is 800, the outlet of the microfiltration membrane 2 is 2700.

E. **Comparison of the Amount of Processed Water from Microfiltration Membranes 1 and 2**

A table of the results of the quantity of wastewater with pretreatment of silica sand is presented.

Table 4. Wastewater Quantity Results With Preliminary Treatment of Silica Sand

No	Reactor	Waste Water Deposit (L/Hour)					
		1	2	3	4	5	6
1	Microfiltration Membrane 2 With Pretreatment	1880	1424	1153	519	24	10

Source: 2022 Research Results

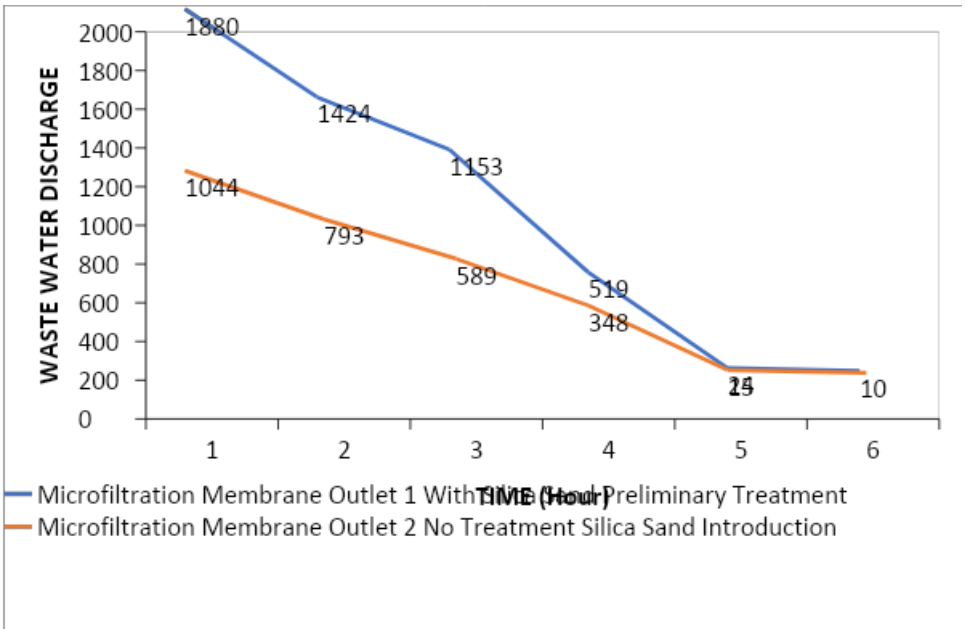
Based on the table above, the first hour wastewater discharge is 1880 l/hour and the 6th hour discharge is 10.

Table 5. Results of Wastewater Quantity Without Pre-treatment

No	Reactor	Waste Water Deposit (L/Hour)					
		1	2	3	4	5	6
1	Microfiltration Membrane 2 No Processing Introduction	1044	793	589	348	15	0

Source: 2022 Research Results

Based on the table above, the first hour wastewater discharge is 1044 l/hour and the 6th hour discharge is 0.



Graph 7. Comparison Graph of Wastewater Quantity Results With Preliminary Treatment And Without Pretreatment Silica Sand

Based on the graphic data above, the outlet discharge of microfiltration membrane 1 with pretreatment of silica sand is 1880 l/hour, while the outlet discharge of microfiltration membrane 2 without pretreatment of silica sand is 1044 l/hour.

DISCUSSION

A. Hospital Preliminary Waste Quality

Based on the results of the initial hospital wastewater sample research that has been tested in the laboratory by testing 6 parameters, namely BOD, COD, Total Solid Suspended (TSS), Free Ammonia, Fatty Oil, and MPN-Coli, it was found that hospital wastewater samples the first hour, the results have been compared with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 68 of 2016 concerning Domestic Wastewater Quality Standards, there are several parameters that do not meet the requirements, namely, BOD, COD, and Total Solid Suspended (TSS), Ammonia and Total Coliform. [6]

The conclusion from the exposure of the hospital's initial wastewater quality from the first hour to the fifth hour is, the quality of wastewater used for field-scale research has decreased but did not experience significant changes during the process of carrying out the experiment.

B. Microfiltration Membrane Wastewater Quality 1 With Treatment Introduction

Based on table 2, the quality of wastewater obtained at the fifth hour is BOD 14 mg/l, COD 84 mg/l, TSS 18 mg/l, Fatty Oil 0.6 mg/l, NH3 3 mg/l, and Total Coliform 1200 Quantity/100 ml sample.

In hospital wastewater samples processed from microfiltration membrane tubes, the results were compared with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No.P, 68/Menlhk/Setjen/Kum,1/8/2016 concerning Domestic Wastewater Quality Standards, all parameters that meet the requirements are below the specified quality standards.[6]

The fulfillment of this quality standard is due to the combination of processing between silica sand and microfiltration membranes. In the treatment process, the quality of treated water that meets the requirements is caused by the size of the microfiltration membrane which is micron in size so that the water quality can meet the specified requirements.

Microfiltration membranes function to filter macromolecules of more than 500,000 g/mol or particles that have a size of 0.1 – 10 m with dissolved solids content of not more than 100 ppm. Many industrial applications are carried out in the water sterilization process with the aim of separating microorganisms (bacteria, fungi) and filtration of oil and water emulsions with operating pressures of 0.5 – 2 atm. [7]

C. Microfiltration Membrane Wastewater Quality 1 Without Treatment Introduction

Based on table 3, the quality of wastewater obtained at the fifth hour is BOD 20 mg/l, COD 92 mg/l, (TSS) 22 mg/l, Oil and Fat 0.8 mg/l, Ammonia 8 mg/l, and Total Coliform 2.900 Quantity/100 ml.

In hospital wastewater samples processed from microfiltration membrane tubes, the results were compared with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. P, 68/Menlhk/Setjen/Kum,1/8/2016 concerning Domestic Wastewater Quality Standards, all parameters that meet the requirements are below the specified quality standards [6]

The fulfillment of this quality standard is due to the filtration of the microfiltration membrane. In the treatment process, the quality of treated water that meets the requirements is caused by the size of the microfiltration membrane which is micron in size so that the water quality can meet the specified requirements.

Microfiltration membranes function to filter macromolecules of more than 500,000 g/mol or particles that have a size of 0.1 – 10 m with dissolved solids content of not more than 100 ppm. Industrial applications are mostly carried out in the water sterilization process with the aim of

separating microorganisms (bacteria, fungi) and filtration of oil and water emulsions with operating pressures of 0.5 – 2 atm. [7]

D. Comparison of the Quality of Treated Wastewater on Each Parameter of Microfiltration Membranes 1 and 2.

1. BOD

BOD indicates the presence of liquid waste organic matter. Biological Oxygen Demand (BOD) is the amount of oxygen needed by bacteria to decompose all organic materials in water within 5 days and at a temperature of 200C, [8]

Based on table 1 data, the quality of the BOD parameters at the fifth hour of the initial wastewater outlet is 82, the outlet of the microfiltration membrane 1 is 14, the outlet of the microfiltration membrane 2 is 20.

In this study, graph 1 shows the results of the comparison of processing for BOD parameters and the most effective for reducing BOD levels is processing using a microfiltration membrane tube 1 with preliminary processing using silica sand.

This is because silica sand is the result of weathering rocks containing major minerals such as quartz and feldspar. The use of silica sand is to remove the physical properties of water, such as turbidity / muddy water and remove odors in water. In general, silica sand is used in the early stages as a filter in processing dirty water into clean water (Artiyani and Firmansyah 2016). [9]

Water treatment with membrane technology has produced treated water with the required drinking water quality (for 7 important parameters, namely pH, temperature, color, turbidity, TSS, TDS, and the content of E. coli bacteria), not just producing clean water, so that Membrane technology treated water can be safely consumed by humans. [10]

2. COD

COD indicates the amount of oxygen required by oxidant materials such as: Potassium bicromate to decompose organic matter into CO2 and H2O gases. Chemical oxygen demand (COD) is the amount of oxygen needed for the oxidation of organic and inorganic substances in water, [8].

Based on table 1 data, the COD parameter quality at the fifth hour of the initial wastewater outlet is 271, the outlet for the microfiltration membrane 1 is 84, the outlet for the microfiltration membrane 2 is 92.

In this study 2, shows the results of the comparison of processing for COD parameters and the most effective for reducing COD levels is processing using a microfiltration membrane tube 1 with preliminary processing using silica sand.

The decrease in BOD levels using silica sand and activated carbon filter media was able to reduce BOD levels. This is in line with the research of Djoko, et al, which also decreased with an average percentage of 39.97% using silica sand and activated carbon as filter media. This decrease is influenced by the media where the silica sand filter media and activated carbon have dual capabilities such as carrying out the filtration, adsorption and ion exchange processes simultaneously so that they are able to decompose and degrade organic matter in liquid waste. [4]

This reduction is also due to the combination of treatment with microfiltration membranes. The microfiltration membrane functions to filter macromolecules of more than 500,000 g/mol or particles that have a size of 0.1 – 10 m with a dissolved solids content of not more than 100 ppm. Many industrial applications are carried out in the water sterilization process with the aim of separating microorganisms (bacteria, fungi) and filtration of oil and water emulsions with operating pressures of 0.5 – 2 atm, [7]

3. Total Solid Suspended (TSS)

TSS (total suspended solid) indicates the presence of suspended carbohydrates larger than 1 um. According to Efendi, TSS are suspended materials with a diameter of > 1 m that are retained on a millipore sieve with a pore diameter of 0.45 m, [8].

Based on table 1 data, the quality of the TSS parameters at the fifth hour of the initial wastewater outlet is 38, the outlet of the microfiltration membrane 1 is 18, the outlet of the microfiltration membrane 2 is 12.

In this study, Graph 3 shows the results of the comparison of processing for TSS parameters and the most effective for reducing TSS levels is processing using a microfiltration membrane tube 1 with preliminary processing using silica sand.

This is because the microfiltration membrane functions to filter macromolecules of more than 500,000 g/mol or particles that have a size of 0.1 – 10 m with a dissolved solids content of not more than 100 ppm. Industrial applications are mostly carried out in the water sterilization process with the aim of separating microorganisms (bacteria, fungi) and filtration of oil and water emulsions with operating pressures of 0.5 – 2 atm. [7]

4. Fat Oil

Oil and detergent are domestic waste materials that affect the penetration of organic and inorganic materials, [8].

Based on the data from table 1, the quality of the fat oil parameters at the fifth hour of the initial wastewater outlet was 1, the microfiltration membrane outlet 1 was 0.6, the microfiltration membrane outlet 2 was 0.8.

In this study, graph 4 shows the results of the comparison of processing for fatty oil parameters and the most effective for reducing fatty oil levels is processing using a microfiltration membrane tube 1 with preliminary processing using silica sand.

This is because the microfiltration membrane can filter the fatty oils in the wastewater. Applications of microfiltration and ultrafiltration membranes to treat wastewater are widely accepted as they consistently produce better wastewater quality and return valuable components for recycling or sale. Microfiltration and ultrafiltration membrane technologies have good prospects to be used as an oily wastewater treatment unit, especially in ultrafiltration membrane operations because the ability to reject COD and surfactants is quite high (94.89 – 98.83% for COD rejection at UF, 48.55 – 64.41% for rejection of COD on MF and 69 – 86% for rejection of surfactants) [11]

5. Ammonia free

Free ammonia indicates the presence of protein content in the waste obtained around 1.11 mg/l. Ammonium in waters comes from the decomposition of organic nitrogen such as protein. Nitrogen found in soil and water, which comes from the decomposition of organic matter such as dead plants and aquatic biota. Free ammonia and free chlorine will react with each other and form an antagonistic relationship, [8]

Based on the data in table 1, the quality of the NH3 parameters in the five initial wastewater outlets is 16, the microfiltration membrane outlet 1 is 3, the microfiltration membrane outlet 2 is 8.

In this study, graph 5 shows the results of the comparison of processing for free ammonia (NH3) parameters and the most effective for reducing free ammonia (NH3) levels is processing using a microfiltration membrane tube 1 with preliminary treatment using silica sand.

This is because silica sand is the result of weathering rocks containing major minerals such as quartz and feldspar. The use of silica sand is to remove physical properties of water, such as turbidity/muddy water and to remove odors in water. In general, silica sand is used in the early stages as filter in processing dirty water into clean water. [9]

Water treatment with membrane technology has produced treated water with the required drinking water quality (for 7 important parameters, namely pH, temperature, color, turbidity, TSS, TDS, and E. coli bacteria content), not just producing clean water, so that Membrane technology treated water can be safely consumed by humans. [10]

6. Total Coliform

Total coliform bacteria is the calculated value of the number of colonies of Escherichia, Citobacter, and Enterobacter bacteria found on the filter membrane after being cultured for 18-24 hours. Coliform bacteria are types of coli bacteria that are divided into two groups, namely fecal coliforms, namely bacteria that live normally in the intestines of humans and animals, for example Escherichia coli, and non-fecal coliforms are bacteria that live in dead animals and plants, for example Enterobacter Aerogenes.[8]

Based on table 1 data, the quality of the Total Coliform parameter at the fifth hour of the initial wastewater outlet is 3400, the outlet for the microfiltration membrane 1 is 1,200, the outlet for the microfiltration membrane 2 is 2,900.

In this study, graph 6, shows the results of the comparison of processing for total coliform parameters and the most effective for reducing total coliform levels is processing using a microfiltration membrane tube 1 with preliminary processing using silica sand.

This is because the microfiltration membrane functions to filter macromolecules or particles that have a size of 0.1 – 10 m. Microfiltration membrane technology can be used to reduce E. coli bacteria and raw water turbidity. [12]

Water treatment with membrane technology has produced treated water with the required drinking water quality (for 7 important parameters, namely pH, temperature, color, turbidity, TSS, TDS, and E. coli bacteria content), not just producing clean water, so that Membrane technology treated water can be safely consumed by humans. [10]

E. Comparison of the Amount of Processed Water from Microfiltration Membranes 1 and 2

Based on the data in table 4, the results of the first hour wastewater discharge are 1880 l/hour and the 6th hour discharge is 10 and based on table 5 data, the results of the first hour wastewater discharge are 1044 l/hour and the 6th hour discharge is 0.

Based on data from graph 7 on the comparison of the quantity of wastewater discharge, the microfiltration membrane reactor 1 with silica sand pretreatment at 1880 l/hour was the highest producer of wastewater discharge after the microfiltration membrane reactor 2 without pretreatment silica sand, which was 1044 l/hour.

This is because the flow rate that passes through the microfiltration membrane, the greater the flow rate, the greater the resulting discharge. Discharge is the volume multiplied by the cross-sectional area of the surface so that the faster the flow rate, the larger the volume of wastewater that passes through the microfiltration membrane per unit time. This causes the flow rate to be directly proportional to the resulting discharge value. As stated by other researchers, the flow rate is one of the factors that affect the flux value. The higher the flow rate, the greater the value of the given flux, because the more particles on the membrane surface that can be moved by the feed stream. [13]

If the difference between microfiltration membrane 1 and microfiltration 2 is calculated, it can be seen that the amount of water produced is more microfiltration membrane 1 than microfiltration membrane 2.

The following illustrates the amount of water produced every hour from microfiltration membrane 1 and microfiltration membrane 2:

Table 6. Comparison of the Quantity of Treated Water

No	Reactor	Time						
		Hours 1*	**Hours2 ***	**Hours3 ***	**Hours4 ***	**Hours5 ***	**Hours6 ***	**Total Volume**
1	Microfiltration Membrane 1 With Pretreatment	1.880 liter	1.424 liter	1.153 liter	519 liter	24 liter	10 liter	5.010 liter

2	Microfiltration Membrane 2 No Processing Introduction	1.044 liter	793 liter	589 liter	348 liter	15 liter	0 liter	2.789 liter

Source: 2022 Calculation Results

*Note : Discharge x operating time = 1,880 l/hour x 1 hour = 1,880 liter

Based on table 6 above, the total volume of hospital waste treated water for microfiltration membrane 1 is 5,010 liters, while for microfiltration membrane 2 is 2,789 liters.

The application of this research certainly cannot be used for hospital wastewater treatment with a processing discharge of more than 5 m3 per day. If you want to get the amount of treated water that is greater than 5 m3 per day, the diameter and height of the microfiltration membrane used must be 2 times or more than the size of the microfiltration membrane used in this study, which is 40 cm high and 10 cm in diameter. An illustration of the addition of diameter and height can be seen in the table below:

Table 7. Effect of Membrane Size on the Quantity of Treated Water

No	Reactor	Membrane Size		
		Diameter 10 Cm Height 40 Cm	**Diameter 20 Cm Height 80 Cm**	**Diameter 30 Cm Height 120 Cm**
1	Microfiltration Membrane 1 With Pretreatment	5.010 liter	10.02 liter	15.030 liter
2	Microfiltration Membrane 2 No Processing Introduction	2.789 liter	5.578 liter	16.734 liter

Source: 2022 Calculation Results

Based on table 7 above, it can be seen that the higher the size of the microfiltration membrane, the more the amount of treated water produced.

This is in accordance with the research of Meidinariasty, et al in 2019 [13], namely the flow rate is directly proportional to the flow flux that passes through the microfiltration filter, the greater the flow rate, the greater the flux produced. This means that the quantity of treated water is influenced by the surface area of the microfiltration membrane, this can be proven by the formula discharge (Q) = Flow Rate x Surface Area.

Therefore, the application of microfiltration membranes to treat hospital wastewater based on the research carried out can be used to produce 15m3 treated water with a processing time of 5-6 hours. After that the microfiltration membrane must be replaced with a new one.

CONCLUSION

From a series of studies on microfiltration membranes that have been carried out, it can be concluded that:

1. The quality of the initial hospital wastewater in the first hour to the fifth hour and the measurement results at the fifth hour are BOD 84 mg/l, COD 282 mg/l, TSS 40 mg/l, Fatty Oil 1 mg/l, NH3 16 mg/l, and Total Coliform 3.400 Amount/100 ml sample.
2. The quality of hospital wastewater in microfiltration membrane processing 1 using preliminary treatment obtained results, namely BOD 14 mg/l, COD 84 mg/l, TSS 18 mg/l, Fatty Oil 0.6 mg/l, NH3 3 mg/l , and Total Coliform 1200 Amount/100 ml sample.

3. The quality of hospital wastewater in the processing of microfiltration membrane 1 using preliminary treatment obtained results, namely BOD 20 mg/l, COD 92 mg/l, (TSS) 22 mg/l, Oil and Fat 0.8 mg/l, Ammonia 8 mg/l, and Total Coliform 2.900 Amount/100 ml
4. Comparison between microfiltration membrane 1 using pre-treatment has the quality of treated wastewater for each parameter BOD, COD, TSS, Fatty Oil, Ammonia and Total Colifom more effective in reducing parameter levels than microfiltration membrane 2 without pretreatment.
5. The quantity of water treated with microfiltration membrane 1 using pre-treatment is 5,010 liters. While the quantity of water treated with microfiltration membrane 2 without using pre-treatment is 2,789 liters

SUGGESTION

From a series of studies on microfiltration membranes that have been carried out, the following suggestions can be given:

1. The application of the results of this study when used to treat hospital wastewater, the processing discharge is not more than 5 m3 per day. If you want to get the amount of treated water that is greater than 5 m3 per day, the diameter and height of the microfiltration membrane used must be 2 times or more than the size of the microfiltration membrane used in this study, which is 40 cm high and 10 cm in diameter.

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