

laundry wastewater

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Ultrafiltration of Laundry Wastewater Using Natural Zeolite-PVA Hybrid Membrane

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Abstract. The laundry wastewater produced by laundry service becomes a pollutant of the water. The main characteristics of laundry wastewater are a high value of BOD dan COD. This research is aimed to study the utilization of ceramic hybrid membranes for laundry wastewater treatment. The ceramic hybrid membrane was produced from natural zeolite that coated with polyvinyl alcohol (PVA). The results show that the average percentage of the decreasing value of BOD reaches 83.37% and the average percentage of the decreasing value of COD is 89.86%. Based on turbidity, the higher rejection is obtained at the pressure of 5 bars with the value of rejection of 96.85%.

1. Introduction

Dukuh Waluh is an area where the University of Muhammadiyah Purwokerto is founded, which of course almost all houses become a boarding house for students. One of the business activities carried out by the Dukuh Waluh community is laundry services. Most of the material that requires a laundry process such as blankets, towels, sheets, clothes, and so forth. This shows that the laundry process plays an important role in the campus environment. The laundry process generally consumes a lot of water. The amount of water consumed and discharged is very dominant. A large amount of laundry wastewater discharged is closely related to the stages of the process in the laundry process that requires a lot of water.

The source of pollutants comes from the use of detergents as washing agents. Detergent is used because it has good washing power and is not affected by water hardness. However, it has a high phosphate content because phosphate is the main building material in detergents. The characteristics of laundry wastewater obtained from Slovenia have chemical oxygen demand (COD) values from 600 to 2500 mg O₂/l [1] and biochemical oxygen demand (BOD) values from 48 – 1200 mg O₂/l [2].

There are several methods to treat the laundry wastewater before it is discharged to the river or municipal irrigation. The conventional methods are using flocculation methods and adsorption methods [1]. The alternative methods for laundry wastewater are using membrane processes. Seo et al. [3] were using the ultrafiltration process that combined with ozone for domestic laundry wastewater reclamation and reuse. Turk et al. [1] were used two membranes process separation namely ultrafiltration and reverse osmosis. Polak et al. [4] were treated the laundry wastewater using the ceramic membrane that modified by carbon.



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This research is aimed to study the utilization of ceramic hybrid membranes for laundry wastewater treatment. The ceramic hybrid membrane was produced from natural zeolite that coated with polyvinyl alcohol (PVA).

2. Materials and Methods

2.1. Materials

The Ceramic hybrid membrane was obtained from Polymer and Membrane Research Center (PMRC) of Chemical Engineering Department of Universitas Muhammadiyah Purwokerto, Indonesia. The Ceramic hybrid membrane was produced from natural zeolite with polyvinyl alcohol (PVA). Laundry wastewater was obtained from laundry service near Universitas Muhammadiyah Purwokerto, Indonesia. The characteristics of laundry wastewater are presented in Table 1.

2.2. Ultrafiltration Set-up

The ultrafiltration process was done by cross-flow proses (Figure 1). Laundry wastewater was filled in the feed tank. Then pumped to the flat sheet membrane at the constant pressure. The permeate was collected and weighed periodically. The retentate was recycled to the feed tank.

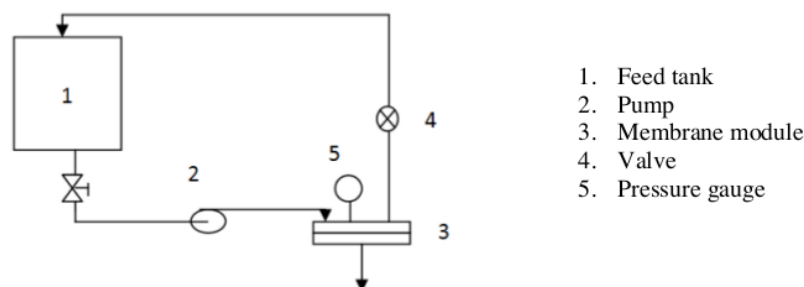


Figure 1. Experimental set-up

Table 1. The characteristics of laundry wastewater

Parameters	values
TDS, ppt	2.09
PH	10
Conductivity, mS	4.17
Turbidity, NTU	255
COD, mg/l	7480
BOD, mg/l	889.18

3. Results and Discussion

3.1. The Characteristics of Ceramics Hybrid Membrane (CHM)

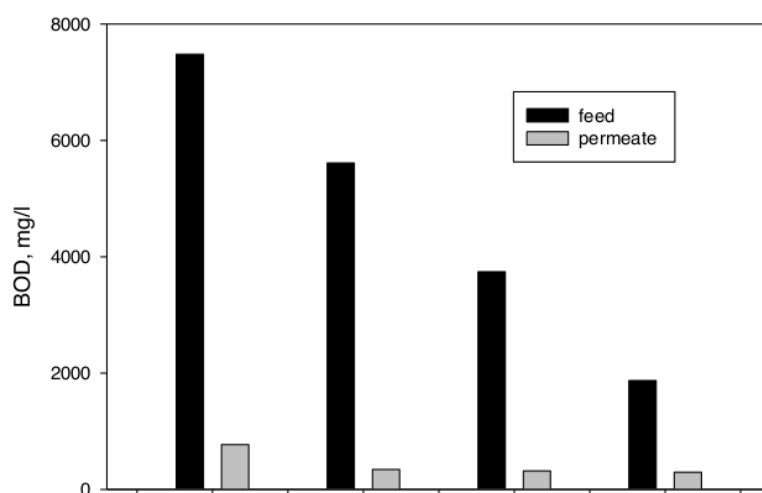
The CHM that used was produced from natural zeolite that coated with PVA 7%. The characteristics of CHM are shown in Table 2. The Permeability test of CHM shows that the CHM is categorized as ultrafiltration.

Table 2. The characteristics of CHM

Parameters	Value
Density, g/cm ³	1.8
Porosity, %	32.2
Water absorption, %	17.91
Permeability, l/m ² h	40.42 – 58.36

3.2. Effect of concentration of feed

Figure 2 shows the BOD of laundry wastewater feed and permeate. Based on BOD values, the decrease of BOD values of feed, the BOD values of permeate will be decreased. The average percentage of the decreasing value of BOD is 83.37%. Figure 3 shows the COD of laundry wastewater feed and permeate. Based on COD values, the decrease of COD values of feed, the COD values of permeate will be decreased. The average percentage of the decreasing value of COD is 89.86%. Ashfaq and Qiblawey [5] have reported at the process of ultrafiltration of laundry wastewater using polyethersulfone (PES) UF Membrane with MWCO of 5 kDa was achieved the percentage rejection of COD was 88.79% to 90.86 %. The percentage of rejection was decreased when pressure was increased. Islam et al. [6] used an aerobic membrane bioreactor (MBR) system for laundry wastewater. The result showed that the COD decreased varied from 87% at the first cycle to 95% at the fifth cycle.

**Figure 2.** Characteristics of BOD of feed and permeate of laundry wastewater

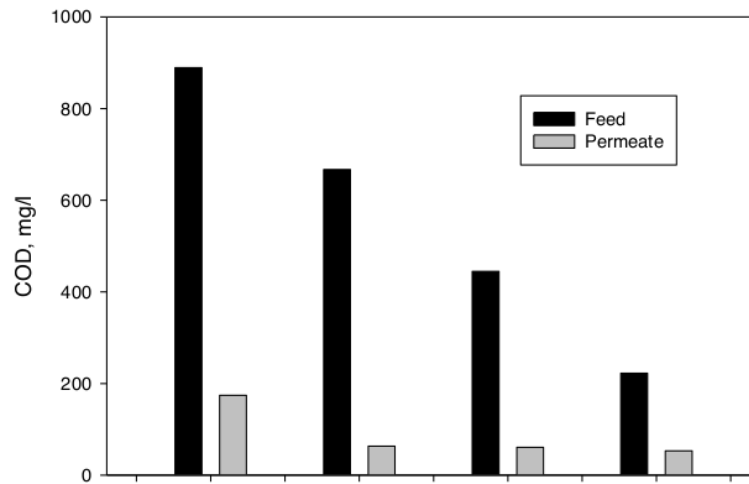


Figure 3. Characteristics of COD of feed and permeate of laundry wastewater

3.3. Effect of pressure

Figure 4 shows the flux of laundry wastewater at various pressure. The flux of the CHM increases with the pressure increasing. Figure 5 shows the rejection of CHM based on the turbidity of the laundry wastewater of feed and permeate. The higher rejection is obtained at the pressure of 5 bars with the value of rejection of 96.85%. Figure 6 shows the laundry wastewater before and after ultrafiltration process.

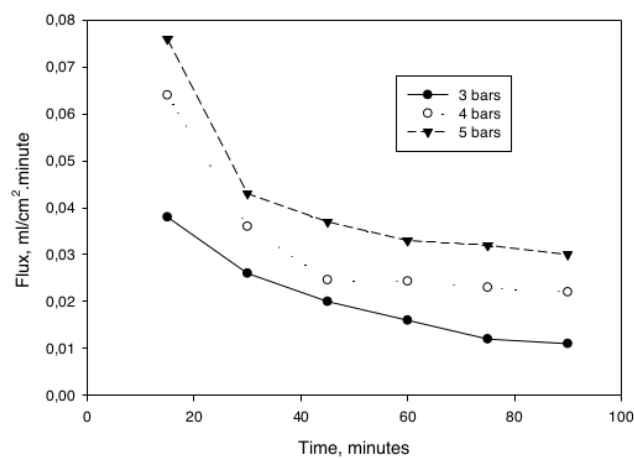


Figure 4. The flux of laundry wastewater at various pressure

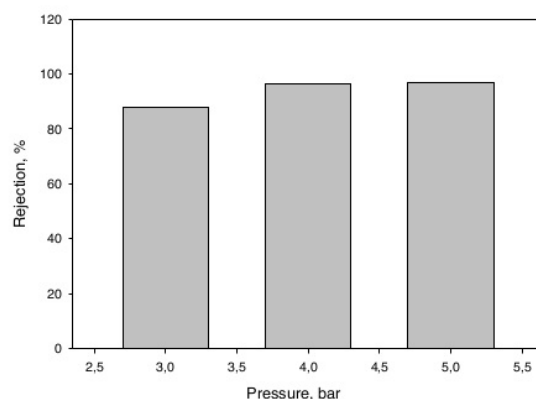


Figure 5. Rejection of laundry wastewater at various pressure

Table 1 shows the characteristics of permeate during the ultrafiltration of laundry wastewater. Overall, the parameters of laundry wastewater such as total dissolve solute (TDS), pH, conductivity and turbidity will decrease significantly.

Table 3. Characteristics of permeate during ultrafiltration of laundry wastewater

Parameters	Feed	Pressure, bar		
		3	4	5
TDS, ppt	2.09	1.49	1.34	0.685
pH	10	9	8.5	7.5
Conductivity, mS	4.17	3.10	2.75	1.370
Turbidity, NTU	255	30.9	8.57	8.02

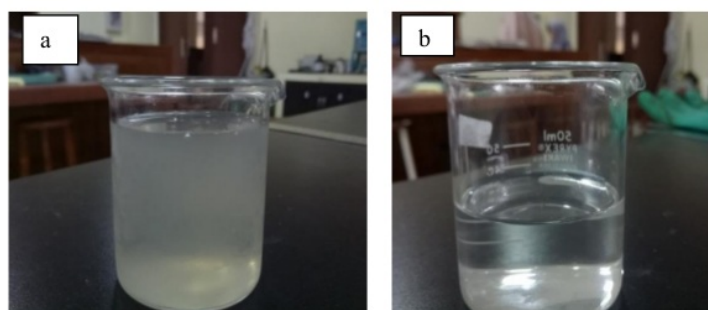


Figure 6. Laundry wastewater: (a) before ultrafiltration; (b) after ultrafiltration

4. Conclusion

The CHM can be used for the ultrafiltration of laundry wastewater. The average percentage of the decreasing value of BOD reaches 83.37% and the average percentage of the decreasing value of COD is 89.86%. Based on turbidity, the higher rejection is obtained at the pressure of 5 bars with the value of rejection of 96.85%.

Acknowledgments

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