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The effectiveness of drum of wastewater treatment (DOWT) in reducing TSS of domestic wastewater☆

Muh. Fajaruddin Natsir[a,*], **Makmur Selomo**[a], **Ainkhaer**[b]

[a] *Department of Environmental Health, Faculty of Public Health, Hasanuddin University, Indonesia*
[b] *Department of Environmental Health, Health Polytechnic of Makassar, Indonesia*

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KEYWORDS
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Abstract
Objective: This study aims to determine the effectiveness of the Drum of Wastewater treatment (DOWT) in reducing levels of Total Suspended Solid (TSS) in domestic wastewater.
Method: This study was an experiment to determine the effectiveness of Drum of Wastewater Treatment (DOWT) in reducing TSS levels of domestic wastewater. It was conducted from September to October with Pretest–Postest Design. Pretest data obtained from examination of wastewater parameters before processing, while posttest data was after processing.
Result: The pH level of wastewater during the measurement process is in the range between 6.12 and 6.85 where in this circumstance the bacterial microorganisms are very dominant from others. The temperature ranged from 24 to 32. The measurement results of TSS obtained an average 34 mg/L before processing and 2.85 mg/L after processing with an efficiency of 91.6%.
Conclusion: DOWT wastewater treatment has been able to reduce TSS levels according to the specified quality standards.

Introduction

Many issues of water pollutions still occur both in the rivers and in the seas. For example, in the Ngringo Karanganyar River, the biggest pollution load was TSS pollution by 388.41 mg/L.[1] In the Jakarta river mouth, the results of evaluation during the period of 1999–2004 showed that the concentration of TSS parameters tended to show an increase, especially at a low tide.[2]

The causes of water pollution are wastewater from domestic and industries thrown away into the river or the sea without processing first. The research conducted in Jakarta by the JICA Team (1990) in Said (2011) explained that for the region of Jakarta, the largest contribution of waste in terms of quantity to pollution were 75% obtained from domestic, 15% come from offices and commercial areas, the remaining 10% originated from industry. However, when it is viewed from the organic pollutant load, the largest source was 70%

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* Corresponding author.
E-mail address: ahmadfajarislam@gmail.com (Muh.F. Natsir).

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domestic, 16% industry, and 14% offices. Thus, domestic wastewater is significantly responsible for water pollution in the region of DKI Jakarta.[3]

One of the devices processing wastewaters is the Drum of Wastewater Treatment (DOWT). DOWT is wastewater treatment equipment using a dipped biofilter system with bioball as a biofilm growth medium. Biofilter is a method of treating wastewater by utilizing microorganisms that naturally reside in wastewater to reduce the content of compounds, physical, chemical and bacteriological in the wastewater. The use of Biofilter as wastewater treatment, for example, it is applied to laundry industry wastewater treatment; the efficiency of TSS levels decrease reaches 62.26%.[4] Research conducted by Zahra (2015) stated that the aerobic biofilter process with downflow and using intermittent systems with biofilter like as gravel and stones get an elimination for TSS parameters gained 95% as well.[5] The use of biobal on biofilter media has been widely applied. The results employing biobal as a biofilter medium for processing jean washing wastewater got a TSS elimination of 80–93%.[6]

Method

This study was an experiment to determine the effectiveness of Drum of Wastewater Treatment (DOWT) in reducing TSS levels of domestic wastewater. It was conducted from September to October with Pretest-Postest Design. Pretest data obtained from examination of wastewater parameters before processing, while posttest data was after processing. To find out the value of the efficiency of the load elimination, it is calculated using the following formula:

$$\text{Reduction Percentage } X = \frac{X \text{ Before Processing} - X \text{ After Processing}}{X \text{ Before Processing}} \times 100\%$$

To find out the effectiveness of this processing model, the measurement results obtained will be compared with the Minister of Environment Decree No. 51 of 2014.

Results

Research on wastewater treatment using the Drum of Wastewater Treatment (DOWT) compares TSS levels before and after processing. This study also measured environmental conditions in the form of pH and temperature during sampling. Sampling is carried out at each point three times.

From the measurement, it results in the pH levels ranged from 6.12 to 6.85 while the temperature ranged from 24 to 32. The pH and temperature scale were still at the allowed quality standards (Table 1).

The measurement results obtained the average TSS level before processing is 34 mg/L and after processing 2.85 mg/L. Average TSS reduction efficiency is 91.61% (Table 2).

Table 1 Results of measurements of temperature and pH in wastewater before and after processing.

Measurement	pH level		Temperature (°C)	
	Before	After	Before	After
1	6.12	6.71	28	26
2	6.3	6.85	26	24
3	6.2	6.70	32	30

Source: Primary Data, 2018.

Table 2 Results of measurements of Total Suspended Solid (TSS) of wastewater before and after processing.

Measurement	TSS (mg/L)		Efficiency (%)	Allowed maximum standard
	Before	After		
1	20	2.78	86.1	
2	23	2.78	87.91	30 mg/L
3	59	3	94.91	
Average	34	2.85	91.61	

Source: Primary Data, 2018.

Discussion

Drum of Wastewater Treatment (DOWT) is a process of treating wastewater with a biofilter system using bioball as a biofilm growing medium. It consists of two tanks, each of the tanks has a 4-inch pipe and inside the pipe measuring 2 in. The processing growth of Biofilm is set aerobically by supplying oxygen through an air blower on both tanks. It is carried out for one-month growth. The Drum of Wastewater Treatment (DOWT) gives an advantage due to the contact time of the wastewater with the media which is quite long. The pH level of wastewater during the measurement process is in the range between 6.12 and 6.85 where in this circumstance the bacterial microorganisms are very dominant from others. The optimum pH of the media environment significantly influences the biological waste treatment process; in general, microorganisms require the pH level of 6.5–9.[7] A very high pH (>9) will inhibit the activity of microorganisms, while a pH below 6.5 will result in a fungal growth and competition with bacteria in the metabolism of organic substance.

The temperature of wastewater during the treatment process is in the range of 24–32 °C. Mesophilic microorganisms have a temperature range of 20–40 °C. High temperatures will damage the process by preventing enzyme activity in cells. An increase in temperature can cause a decrease in processing efficiency.

The results of measuring TSS levels of wastewater after using the Drum of Wastewater Treatment (DOWT) experienced a decrease. The quality standard of wastewater TSS parameters is $\leq$30 mg/L based on RI Minister of Environment and Forestry Regulation Number P.68/Menlh Setjen/Kum1/8/2016 about Domestic Waste Water Quality Standards. Wastewater before processing in the first and second measurements of 20 mg/L and 23 mg/L was still below the allowed quality standard. Meanwhile, in the third measurement, TSS levels of wastewater before processing were 59 mg/L, exceeding the allowed quality standards. The average TSS level of wastewater before processing was 34 mg/L, upper allowed quality standard. The results of the measurement of wastewater after processing the first, second and third measurements resulted in 67 mg/L, 2.67 mg/L, and 3 mg/L, with an average TSS level was

2.85 mg/L after processing, all of them meet the allowed quality standards. The average efficiency of TSS reduction was 91.61 with the largest decrease of efficiency in the third measurement by 94.91 mg/L.

The Drum of Wastewater Treatment (DOWT) applies a biofilter system to reduce wastewater. In fact, the use of biofilter in domestic wastewater treatment has been carried out and in line with this research. For example, a research conducted resulting a decrease from 38.8 mg/L to 7.2 mg/L with a reduction of 81.44 mg/L (efficiency 81.44%).[8] Another study using biofilter in processing wastewater, with the percentage of removal for TSS parameters amounting 83.082%.[9]

Using biofilter in processing wastewater also implement in managing hospital wastewater. This research is in accordance with study conducted by Said, using biofilter dipped in honeycomb media in processing hospital wastewater with a high TSS efficiency of 80.0–97.8%.[10] Research experienced applied same media to obtain efficiency of reducing TSS reached 62.51% with a bacterial growth time of 21 days.[11]

Furthermore, employing biofilter in processing common wastewater is also added by other ingredients, for example the addition of alum to reduce TSS obtained an average efficiency of 82%,[12] the addition of aerobic-anaerobic biofilter starter amounting 77%[13]; moreover, the addition of EM 4 on wasp nest biofilter underwent efficiency in decreasing TSS by 90.05%.[14]

The bioball usage as a biofilm growth medium in this study is effective in reducing TSS levels of wastewater. It is in line with several studies that considered TSS removal efficiency using biofilter with biobal, for instance research conducted that it managed domestic waste in DKI Jakarta with an efficiency of 82.06%,[15] In addition, in Said's study stated that it processed waste from jean washing with an efficiency of 80–93%.[6]

Conclusion

Domestic wastewater treatment using the Drum of Wastewater Treatment (DOWT) is proven to reduce TSS levels in wastewater with an average efficiency reduction of 91.4%. TSS parameters after processing met the quality standards allowed based on Indonesia Minister of Environment and Forestry Regulation Number P.68/Menlh. Setjen/kum. 1/8/2016 Concerning Domestic Waste Water Quality Standards which is $\leq$30 mg/L. Liquid waste originating from domestic needs to be processed first before being discharged into the environment so as not to pollute clean water sources.

Conflict of interest

The authors declare no conflict of interest.

References

1. Yuliastuti E [Thesis] Kajian Kualitas Air Sungai Ngringo Karanganyar dalam Upaya Pengendalian Pencemaran Air. Diponegoro University; 2011.
2. Sachoemar SI, Wahjono HD. Kondisi pencemaran lingkungan perairan di Teluk Jakarta. J Air Indones. 2018;3:1–14.
3. Said NI, Wahjono HD. Teknologi Pengolahan Air Limbah Rumah Sakit dengan Sistem Biofilter Anaerob-Aerob. Jakarta: BBPT; 1999.
4. Nugroho SY, Sumiyati S, Hadiwidodo M. Penurunan Kadar COD dan TSS pada Limbah Industri Pencucian Pakaian (Laundry) dengan Teknologi Biofilm Menggunakan Media Filter Serat Plastik dan Tembikar dengan Susunan Random. J Tek Lingkung. 2014;3:1–6.
5. Zahra LZ, Purwanti IF. Pengolahan Limbah Rumah Makan dengan Proses Biofilter Aerobik. J Tek ITS. 2015;4:D35–9.
6. Said NI. Aplikasi Bio-Ball Untuk Media Biofilter Studi Kasus Pengolahan Air Limbah Pencucian Jean. J Air Indones. 2005;1.
7. Flathman PE, Jerger DE, Exner JH. Bioremediation field experience. CRC Press; 1993.
8. Bahar E, Tawali AB, Muin M. Spesifikasi dan Efektivitas Peralatan Pengolahan Limbah Cair Domestik Studi Kasus Rusunawa Blok D Universitas hasanuddin. J Sains dan Teknol. 2013;13:156–63.
9. Natsir MF, Ibrahim E, Arsunan AA, Mallongi A, Selomo M. The addition of effective microrganism 4 and charcoal husk to biofilter in domestic wastewater treatment in Makassar. J Phys Conf Ser. 2019;1155.
10. Said NI. Teknologi Pengolahan Air Limbah Rumah Sakit dengan Sistem Biofilter Anaerob-Aerob Studi Kasus: Rumah Sakit Elizabeth Situbondo. Jakarta: Direktorat Teknologi Lingkungan; 2014.
11. Khaer A [Thesis] Analisis Efektivitas Biofilter Anaerob-Aerob Media Model Sarang Tawondalam Mereduksi Parameter Air Limbah Rumah Sakit Unhas. Universitas Hasanuddin; 2014.
12. Ningsih R. Pengaruh Pembubuhan Tawas Dalam Menurunkan TSS Pada Air Limbah Rumah Sakit. Jurnal Kesehatan Masyarakat. 2011;6.
13. Mustafa M, Alwathan A, Thahir R. Pemanfaatan Sludge Hasil Pengolahan Limbah Cair Rumah Sakit Sebagai Bahan Baku Pembuatan Biogas: Penelitian Awal. J Sains dan Terap Kim. 2016;6:130–8.
14. Pitriani, Natsir MF, Daud A. The effectiveness of EM4 addition into anaerob-aerob biofilter in the processing of wastewater at Hasanuddin University Hospital. Int J Sci Basic Appl Res. 2015;22:178–87.
15. Utomo K. Penyisihan COD, BOD, TSS Ammonia Menggunakan Proses Biofilter Tercelup dengan Media Bioball secara Aerob (Studi Kasus Air Limbah Domestik Waduk Setiabudi Jakarta Selatan). [Monograph]. Diponegoro University; 2002.