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Analysis of Filtration Efficiency to Reduce BOD and COD Levels in Domestic Waste at the Communal WWTP of Bilebante Village, Pringgarata District, Central Lombok

Nurhidayah, Hijriati Sholehah*, Jisul Al-Qarni

Environmental Engineering Study Program, Mataram College of Environmental Engineering, Mataram, Indonesia
*E-mail: hijriati.chemist@gmail.com

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Abstract: This research aims to determine the level of reduction in BOD and COD in household wastewater after the filtration process and to determine the efficiency of the filter media in reducing BOD and COD in sewage. The research was conducted in Bilebante village, Central Lombok Regency, NTB. The method takes three wastewater samples at different locations before and after the filtration stage. The results of the research show that the COD concentration in domestic wastewater before going through the processing process using filtration media obtained a result of 63 mgl/L, then at the filtration stage using plastic bottle media, the result was 34 mgl/L with an efficiency value of 46%, and at the filtration stage using activated carbon media, a value of 12 mgl/L was obtained so that the resulting efficiency value was 64%. The results of the BOD concentration in domestic wastewater before going through the processing process using filtration media obtained an initial result of 1.6 mgl/L; then, at the filtration stage using plastic bottle media, the result was 0.6 mgl/L with an efficiency value of 62 %. At the filtration stage using active carbon media, a value of 0 mgl/L was obtained, with an efficiency value of 100%. This research concludes that wastewater is safe to use, whether for watering plants or other things because there is a decrease in levels of COD and BOD that meet quality standards.

Keywords: BOD; COD; Communal WWTP; Domestic Waste; Filter.

Introduction

Sanitation, according to the World Health Organization (WHO), is a business that monitors several factors in the physical environment that influence humans, especially things that have detrimental effects on physical development, health, and survival [1]. Sanitation can affect the condition of the environment; without good sanitation, the environment will become dirty and can reduce the quantity and quality of water. The emergence of disease and health problems starts from an unhealthy environment. According to Law of the Republic of Indonesia Number 6 of 2014, environmental health quality standards are determined in ecological media: water, air, land, food, facilities and infrastructure, and vectors and animals that carry disease. An example of the most common sanitation problem that occurs and is directly related to the community is household wastewater or domestic waste [2].

According to the Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 2014, wastewater is the remainder of a business and activity in liquid form [3], while domestic wastewater is water that comes from businesses or activities in residential areas, restaurants, offices, commerce. , apartments, and housing [4]. Activities that can produce waste include bathing, washing, and using toilets and other activities that produce liquid domestic waste. Wastewater that is not managed properly will tremendously impact water, especially water resources. Disposing wastewater directly into waters without going through a treatment process will cause serious health problems. The impact that can arise from wastewater pollution is the contamination of microorganisms in the water, which will cause disease in humans, for example, diarrhea and cholera, which result in death; apart from that, it causes dissolved oxygen and the supply of oxygen entering the water to decrease which can cause water organisms to die. Therefore, it is necessary to have a wastewater treatment plant to process wastewater so that the output or results of wastewater discharged into the environment do not pollute it.

Domestic waste can be processed biologically, chemically, and physically. In this research itself, it is physical, namely with a filtration system. Filtration is a waste processing system that separates solid substances from fluids. In domestic waste processing, filtration aims to remove suspended particles and colloids by filtering them with filter media [5]. One filter media that will be used to process domestic waste is plastic bottles and activated charcoal. It is hoped that using this filter media can reduce the concentration of BOD and COD parameters in the Bilebante Village WWTP wastewater.

Research Methods

This type of research uses qualitative descriptive research to explain and describe the state of liquid waste in

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the research object. This research provides an overview of the effectiveness of wastewater treatment plants with test parameters and BOD and COD levels before and after wastewater is treated. With testing, the samples will be taken to the Mataram Environmental Engineering College laboratory. The tools used are stationary, Winkler bottle, 100 ml measuring cup, glass funnel, 500 ml Erlenmeyer, measuring pipette, dropper pipette, glass beaker, watch glass, rubble bulf, burette, fume hood) while. The materials used are ($MnSO_4$ Solution, Alkali Iodide Azide Solution, $K_2Cr_2O_7$ Solution, concentrated H_2SO_4 Solution, 0.025 N Na-thiosulfate Solution, Amylum Indicator Solution, Ferrous ammonium sulfate solution, Domestic wastewater samples.

The samples were taken at the Communal Waste Treatment Plant with 3 collection points, namely before and after the filter, which was carried out on the 20th of May 2022 at 08.00 Central Indonesian time.

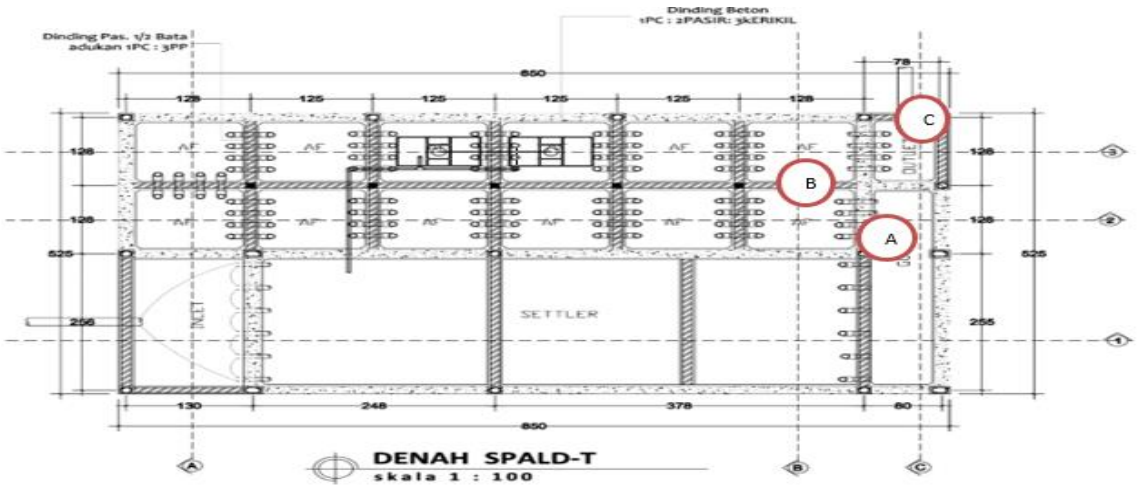

Figure 1. Location of Sampling Points

Work Scheme:
DO0 and DO5 working procedures

BOD Work Procedures: Put the river water sample into a Winkler bottle, incubate for 3-5 days in the dark, and determine the DO5 value by determining dissolved oxygen. Subtracting the DO0 and DO5 values [6].

COD Work Procedures: Take a water sample using an Erlemeyer. Take 10ml of water sample and put it in another Erlemeyer. Add 5ml $K_2Cr_2O_7$ 0.025N. Then, pipette 10ml of concentrated H2SO4 and cover it using a watch glass. Leave it for 30 minutes; after 30 minutes, add 7.5 ml of distilled water, add 3 drops of ferroin indicator, then homogenize. Titrate with 0.1N ferrous ammonium sulfate solution (from green to orange solution) pay attention to the titration volume. Observe the solution[7].
The formula used is as follows:

$$COD = \frac{(B-S)x\ 0{,}025(N)\ x\ 8}{ml\ \ of\ sample} x\ 1000$$

Information :
B = millilitres of blank titration
S = millilitres of a sample titration

Efficiency calculations :

$$Removal\ Efficiency = \frac{SO\ -\ S}{SO} x\ 100\%$$

Information :
SO = is wastewater influent (mg/L)
S = is water effluent waste (mg/L) [8].

Results and Discussion

The results of testing BOD and COD concentrations in domestic wastewater are as follows:

Table 1. BOD and COD concentration test results on samples A, B, and C

Parameter	Sample code	Results (%)	Efficiency (%)	Regulation of the Minister of Environment and Forestry No.68 THN.2016	Method
COD (mg/L)	A	64		100	SNI 6989.72:2009
	B	3	46		
	C	12	64		
BOD (mg/L)	A	1.6		30	SNI 6.6989.2:2009
	B	0.6	62		
	C	0	100		

Information:
A: Guter
B: Plastic Bottle Filter
C: Activated Carbon [9].

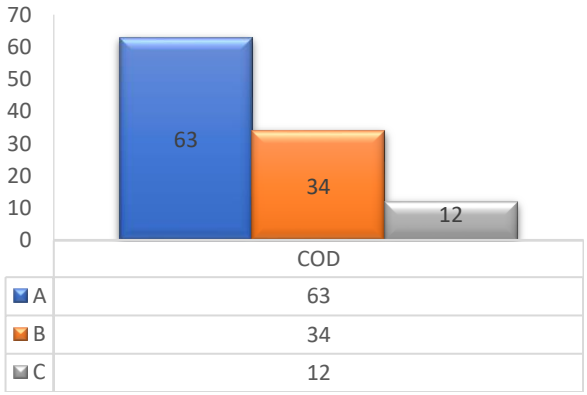

Figure 1. COD concentration test results for samples A, B, and C

Table 1 shows the data obtained from the COD test results. COD or chemical oxygen demand is needed to oxidize organic compounds in wastewater through chemical reactions. Organic waste will be oxidized by potassium bichromate ($K_2Cr_2O_7$) as an oxygen source to become CO_2 and H_2O gas, as well as several chromium ions. The COD value is a measure of the level of pollution by organic materials [10]. COD is needed to decompose all organic materials in water because the existing organic materials are deliberately decomposed chemically using the strong oxidizer potassium bichromate in acidic and hot conditions with a silver catalyst. Sulfate, so that all kinds of organic materials, both easily decomposed and complex and difficult to decompose, will be oxidized. Thus, the difference in value between COD and BOD gives an idea of the amount of organic material that is difficult to decompose in the waters. The BOD value may be the same as COD, but BOD cannot be greater than COD. So, COD describes the total amount of organic material present [11].

Initial COD testing of domestic wastewater before passing through the filtration stage with used plastic bottle media obtained a level of 63 mg/L. After passing through the filtration stage with used plastic bottle media, the concentration decreased to 34 mg/L. so the removal value was 29 mg/L with an efficiency of 46%. This happens because plastic bottle filters are a medium for separating solids from liquids and removing colloids, suspended materials, and other substances in the wastewater. On the surface of plastic bottles is the growth of microorganisms that form films, so the filtration process can reduce or remove organic substances in the wastewater. Filtration is an appropriate technology that is simple, effective, efficient, and cheap [12].

Previous research used plastic bottles for probiotic drinks can reduce COD by 73.24%-80.53% [13]. The advantages of the biofilter process are that the efficiency of removing COD, BOD, and suspended solids is quite high, management is easy, operational costs are low, and it produces relatively little sludge compared to the active sludge process [14]. Biofiltration is a processing activity in which contaminants' absorption, oxidation, and filtration occur due to certain microorganisms' activity in the biofilm. The research showed a decrease in COD levels from microorganism biofilm from prior processing, namely the aerobic process [15].

In the next stage, after the wastewater passes through the filtration stage of used plastic bottles, there is a COD concentration value in domestic wastewater of 34 mg/L. After passing through activated carbon, there is a COD concentration value in domestic wastewater of 12 mg/L, so the COD allowance is 22 mg/L with an efficiency of 64%. Activated carbon is one type of adsorbent most often used in wastewater treatment processes [16]. This is because activated carbon has better adsorption capacity and surface area than other adsorbents. Adsorption occurs because the molecules on the surface of a solid or liquid have an unbalanced attractive force, so they tend to be pulled inward (the adsorbent's cohesive force is greater than its adhesion force). This imbalance in attractive forces causes the activated carbon used as an adsorbent to tend to attract other substances or organic materials that come into contact with its surface [17] so that the efficiency in this research reaches 64 %. This study obtained the same results as previous research, namely a decrease in COD values after using filters of 41.19% in hospital liquid waste [18]. Based on Table 1, the data obtained from the BOD test results are as follows figure 2.

Biochemical Oxygen Demand (BOD) is the amount of oxygen water microorganisms use to carry out metabolic activities [19]. Based on Figure 2, the initial BOD level was 1.6 mg/L, then decreased to 0.6 mg/L after passing through the plastic bottle filter. This decrease was because microorganisms used organic material that grew on the surface of the filter as an energy source. Microorganisms form biofilm on the surface of plastic bottles. Apart from that, the plastic bottles used have been designed to have a density that allows them to filter organic material that passes through them. Next, the waste passes through an active carbon filter, and the BOD level test results are 0 mg/L, so the filter's efficiency in reducing BOD levels in this study is 100%.

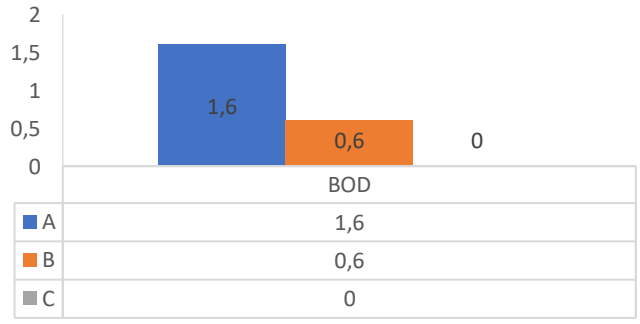

Figure 2. BOD concentration test results for samples A, B, and C

Activated carbon has the ability as an adsorbent can adsorb certain chemical compounds in liquid waste,

especially organic compounds, so that the BOD load is reduced, and can also remove unpleasant odors, tastes, colors, and toxic organic compounds originating from liquid waste [20]. Reducing BOD levels using a filter can reduce BOD levels. This is in line with research conducted by Ulfa in 2019, which also experienced a decrease in efficiency of 52% [21]; other research that used filters also obtained efficiency results of 60%, so it can be concluded that the use of filters can be useful in water treatment up to clean meets quality standards [22].

Conclusion

The conclusions obtained from the research results are as follows: The COD level of domestic wastewater before passing through the filtration stage with used plastic bottle media was found to be 63 mg/L, then after passing through the filtration stage with plastic bottle media, it decreased to 34 mg/L. so the removal value was 29 mg/L with an efficiency of 46%. Meanwhile, the initial BOD level was 1.6 mg/L, then decreased to 0.6 mg/L after passing through a plastic bottle filter. Next, the waste passes through an active carbon filter, and the BOD level test results are 0 mg/L, so the filter's efficiency in reducing BOD levels in this study is 100%. COD and BOD levels in communal IPAL wastewater are safe because they meet the 2016 domestic waste quality standards.

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