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Decreasing pH, COD and TSS of Domestic Liquid Waste Using Photocatalysis TiO_2 (Titanium Dioxide)

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Abstract: Domestic waste comes from households that must be treated. Based on the Minister of Environment and Forestry Regulation Number P.68/Minister Environment and Forestry Secretary General/2016 concerning Domestic Wastewater Quality Standards, the government has set a maximum limit for waste water that can be disposed of to the environment or receiving water bodies. includes pH, TSS and COD parameters. This is useful for overcoming the problem of environmental pollution caused by wastewater. Waste water that is not managed properly will have an impact on human health. environmental pollution is harmful to humans. Domestic sewage treatment using a titanium dioxide photocatalyst shows the results of testing the pH value on domestic waste as shown below, showing that overall the concentration of parameters has increased the pH decrease 22,8% from acidic to normal best pH value with a value of 6.57 at a contact time of 210 minutes of mass catalyst 2.5 grams. Parameter concentration decreased TSS value from initial value of 157 mg/L to normal with the best TSS value of 94 mg/L at contact time of 210 minutes with catalyst mass of 2.5 grams. COD contact time of 210 minutes with a mass of 2.5 grams of catalyst with a value of 2861 mg/L. COD value affects the time and mass of the catalyst a decrease of 40.1% where the TSS value meets the quality standard, and the COD value has decreased by 31%. Addition of further processing to get a better COD.

Keywords: Domestic Waste, Photocatalyst, Titanium Dioxide

1. Introduction

Domestic waste is one of the wastes originating from households that must be treated [1] Based on Minister of Environment and Forestry Regulation Number P.68/Minister of environment and forestry-Seketary general/2016[2] concerning Domestic Wastewater Quality Standards, the government has determined the maximum level of wastewater that can be discharged into the environment or receiving water bodies. Among them include the parameters pH, COD, BOD, TSS, Oil & Fat, Total Coliform, and Discharge. This is useful for overcoming the problem of environmental pollution caused by wastewater. Waste water that is not managed properly will have an impact on human health[3].

environmental pollution is harmful to humans [4].

Parameter pH or degree of acidity is a parameter used to express the level of acidity or alkalinity of a solution. A good pH size ranges from 6-9. [5].Chemical Oxygen Demand describes the total amount of oxygen needed to chemically oxidize organic matter [6].TSS parameter is the residue of total solids retained by the filter with a maximum particle size of 2 μm. TSS in wastewater is caused by the presence of silt, clay, metal oxides, sulfides, algae, bacteria and fungi present in wastewater [7].

Degradation of pH, COD and TSS levels in wastewater can also be through a photocatalytic process with the help of ultraviolet (UV) light [8] and adding a catalyst to accelerate the reduction of pH, COD and TSS [9]. Material used for the photocatalytic process is TiO_2 (Titanium Dioxide). TiO2 (Titanium Dioxide) has a fairly high photocatalyst activity so that it can reduce organic matter levels and remove odors in processed water. In addition, TiO_2 (Titanium Dioxide) is an environmentally material and can be easily found on the market because the price is relatively affordable[10].

Photocatalytic process can reduce the levels of organic and non-organic pollutants in processed water into CO_2 and H_2O compounds if supported by optimum catalyst content, pH, oxidant concentration, and light intensity. This waste treatment is classified as effective for solving wastewater problems in the environment [11]. The purpose of this research is to treat domestic wastewater using titanium dioxide by comparing the processing time.

2 MATERIAL AND METHOD

2.1 Material

Type of research uses quantitative research. This study was to determine the pH, COD and TSS content of before and after treatment with TiO2 (Titanium Dioxide) photocatalysis.

2.2 Method

Photodegradation Experiments

a. Photocatalysis experimental procedure

1) The photocatalytic unit is designed using a glass material that has a thickness of 5 mm with the dimensions used are 45 cm x 35 cm x 40 cm (length x width x height)

2) Prepare a 1000 ml hot plate and beaker for the photocatalytic process

3) A total of 800 ml of domestic waste water sample is poured into a beaker glass

4) 2.5 grams of TiO_2 catalyst is added to the beaker glass

5) The sample is stirred using a magnetic stirrer at a speed of 1000 rpm at a temperature of 200ºC.

6) Close the reactor during the photocatalytic process

7) The sample is irradiated using 4 UV lamps for 1.5 hours.

8) The process of cooling and settling was carried out after the experiment for 2 hours.

9) After the photocatalysis process is carried out, the sample is put into a sample bottle and labeled according to the time variation for laboratory testing

10) Repeat procedures 1 to 9 with a contact time of 2.5 hours and 3.5 hours

11) Repeat procedures 1 to 9 for domestiv waste resulting from multilevel filtering

12) The parameters of pH, COD and TSS were tested on three sample bottles of domestic waste resulting from the TiO2 (Titanium Dioxide) photocatalytic method and three sample bottles of domestic waste resulting from a combined multilevel filter method and TiO2 (Titanium Dioxide) photocatalysis

b. Self safety procedures

1) The photocatalytic reactor is covered with aluminum foil to cover the entire surface

2) The photocatalytic reactor is stored and turned on in a closed room and avoided exposure to many people

3) Do not open the reactor during the photocatalytic process

2.2 Data Analysis

Data in this study was carried out in four stages which included:

1. Initial Sample

Tests were carried out on the parameters of pH, COD and TSS on one initial sample bottle of Domestic waste to determine the levels of the parameters prior to treatment.

2. Processing ofTests were carried out on the parameters of pH, COD and TSS on one bottle of domestic waste sample to analyze the effect of treatment using multilevel filters in degrading the parameters of pH, COD and TSS.

3. Domestic Waste Treatment with TiO_2 Photocatalytic Method

Tests were carried out on the parameters of pH, COD and TSS on three bottles of domestic waste samples at various times to analyze the effect of treatment using TiO_2 (Titanium Dioxide) photocatalysis in degrading the parameters of pH, COD and TSS.

3. RESULT AND DISCUSSION

3.1 Analysis

Figure 1 is pH testing value of domestic waste as shown below show that overall the concentration of parameters experienced an increase in pH value from acidic to normal with a pH value of 5.73, 6.52 and 6.57 at a contact time of 120 minutes, 180 minutes and 210 minutes time variations affect the pH value [12]. as shown in the graph shows that overall the concentration of the pH parameter has a standard value. At this value it meets the quality standards in the environment

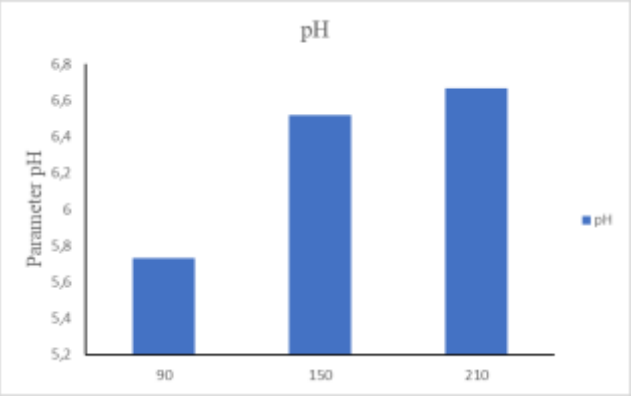

Figure 1 Graph pH

Testing the TSS is Figure 2 value using the domestic waste Titanium dioxide photocatalyst as shown below shows that overall the concentration of the parameters experienced a decrease in the TSS value from an initial value of 157 mg/L to normal with a TSS value of 136 mg/L, 127 mg/L and 94 respectively. mg/L at contact times of 120 minutes, 180 minutes and 210 minutes. as shown in the graph shows that overall the TSS parameter concentration has a standard value with a value of 94 at 2.5 grams of catalyst mass and 210 minutes of catalyst mass affecting the reduction of waste [13]. At this value it meets the quality standards in the environment.

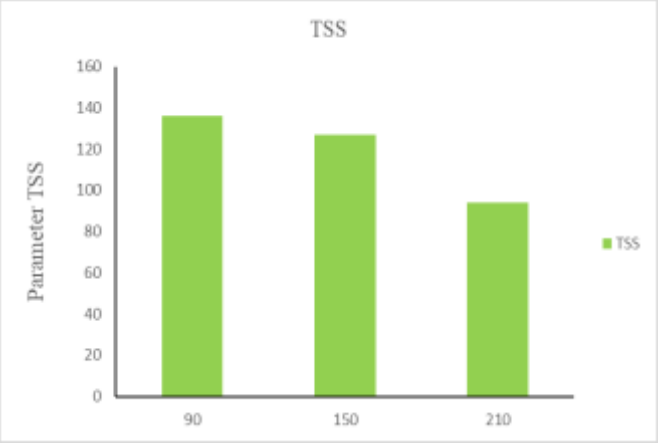

Figure 2 Graph TSS

COD Parameter is Figure 3 in domestic waste as shown in the figure shows that overall the parameter concentration has decreased the value of COD with successive values at contact time of 120 minutes with a value of 3493 mg/L, 180 minutes with a value of 3126 mg/L and 210 minutes with a value of 2861 mg/L. the need for additional time and molar ratio of the catalyst [14]

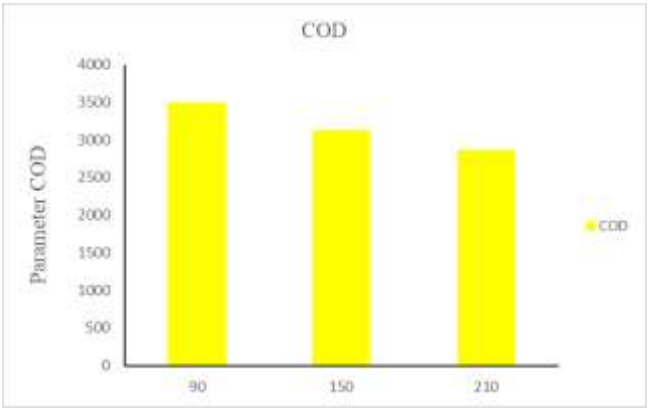

Figure 3 Graph COD

Result show Figure 4 Photocatlyst TiO_2 Testing pH value of domestic waste as shown below show that overall the concentration of parameters experienced an increase in pH value from acidic to normal with the best pH value with a value of 6.57 at a contact time of 210 minutes. as shown in the graph shows that overall the concentration of the pH parameter has a standard standard value with an average of 6.27. At this value it meets the quality standards in the environment [15]

TSS value using the domestic waste Titanium dioxide photocatalyst as shown below shows that overall the parameter concentration has decreased the TSS value from the initial value of 157 mg/L to normal with the best TSS value of 94 mg/L at a contact time of 210 minutes with a catalyst mass of 2, 5 grams. as shown in the graph shows that overall the concentration of TSS parameters has fulfilled [16].environmental quality standard values and suitable for disposal into water bodies [17]

COD value in domestic waste as shown shows that overall the parameter concentration has decreased the COD value, the best time is 210 minutes with a value of 2861 mg/L. the COD value affects the time and mass of the catalyst [18], the longer the time and the more ideal the catalyst mass affects the COD yield [19] as shown in the graph

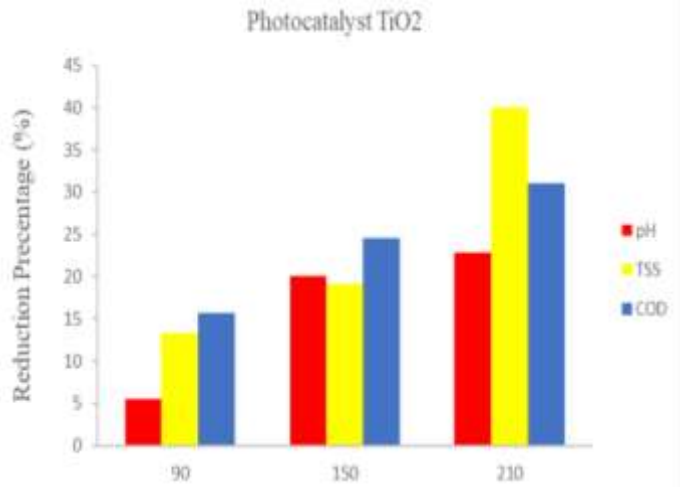

Figure 4 Photocatlyst TiO_2

The test results shows that overall the pH concentration has increased by 90% from acid to base the value has meet the quality standard, the TSS value has decreased by 40.1% where the TSS value has met the quality standard, and the COD value has decreased by 31%. Addition of further processing to get a better COD value [20].

4. Conclusion

This research is easy to implement and applied to domestic waste treatment, pH Concentration increased by 90% from acid to base the value has meet the quality standard, the TSS value has decreased by 40.1% where the TSS value has met the quality standard, and the COD value has decreased by 31%. Addition of further processing to get a better COD value. variations in time will affect the waste treatment process the longer the better the results obtained.

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References

[1] Adriansyah, E., Agustina, T. E., & Arita, S. (2019). Leachate Treatment of TPA Talang Gulo, Jambi City by Fenton method and adsorption. *Indonesian Journal of Fundamental and Applied Chemistry*, *4*(1), 20–24. https://doi.org/10.24845/ijfac.v4.i1.20

[2] Minister of Environment and Forestry Regulation Number P.68/Minister of environment and forestry-Seketary general/2016

[3] Adriansyah, E., Kasman, M., Prabasari, I.G., dan Permana, E (2019). "Korelasi Parameter Pencemar Fisika dan Mikrobiologi Dalam Leachate Dengan Response Surface Methodology. *Jurnal Teknik Kimia*, 25(3). 86-89. https://doi.org/10.36706/jtk.v25i3.132

[4] Fadli, M., Herawati, P., Hadrah, Adriansyah, E., Sufra, R., & Syaiful, M. (2022). Analysis of Carbon Monoxide (CO) Quality Due to the Construction of the Miftahun Najah Islamic Boarding School. *International Journal of Research in Vocational Studies (IJRVOCAS)*, *2*(2), 36–40. https://doi.org/10.53893/ijrvocas.v2i2.101

[5] Amuda, O.S. (2006). Removal of COD and Color from Sanitary Landfill Leachate by Using Coagulation – Fenton's Process. *Journal Application Science Environmental Management*. Vol. 10 (2) 49 – 53.

[6] Parsons, S. (2004). *Advanced Oxidation Processes For Water and Wastewater treatment, IWA Publishing, London, UK*

[7] Ozturk, I., Altinbas, M., Koyuncu, I., Arikan, O., Gomec-Yangin, C. (2003). Advanced Physico-Chemical Treatment Experiences on Young Municipal Landfill Leachates. *Journal Waste Managemen*t. 23 : 441–446.

[8] Kang, Y.W. and Hwang, K.Y. (2000). Effects of Reaction Conditions on The Oxidation Efficiency In The Fenton Process. *Water Res. Kidlington*. 34: pp. 2786-2790.

[9] Agustina, T.E. (2011). Pengolahan Air Limbah Pewarna Sintetis dengan Metode Adsorpsi Menggunakan Karbon Aktif, *Jurnal Rekayasa Sriwijaya*, 20(1), pp. 36-42.

[10] Agustina, T.E. dan Muhammad Amir, (2012). Pengaruh Temperatur dan Waktu Pada Pengolahan Pewarna Sintetis Procion Menggunakan Reagen Fenton, *Jurnal Rekayasa Sriwijaya*, 20(1), pp. 36-42.

[11] Gowda, S.T. and Yashaswini, (2018). Optimization of Fenton Process. *International Journal of Advances In science Engineering and Technology, Bengaluru*. 6, pp. 46-48.

[12] Talebi, A., Norli, I. Tjoon, T.T., Abbas, F.M. and Alkarkhi. (2013). "Optimization of COD, Apparent Color, And Turbidity Reductions Of Landfill Leachate By Fenton Reagent". *Desalinations and Water Journal*. 52: pp. 1524–1530.

[13] Kocak, S. (2013). Treatment of Landfill Leachate by Advanced Oxidation Processes. *Journal Environmental.* 25(2): pp. 51-64.

[14] Agustina, T.E. (2016). Teknologi Pengolahan Limbah Cair Dengan Metode Oksidasi Lanjutan*, Unsri Press*, Palembang.

[15] Yonar, T. (2011). Decolorization Of Textile Effluent Using Homogeneous Photochemical Oxidation Processes. *Journal Coloration Technology*. 121(5): pp. 258-264.

[16] Gottschalk, C., Libra, J.A., and Saupe, A., (2010). Ozonation Of Water and Waste Water, 2nd Ed, Wiley-VCH, Verlag GmbH & Co, Weinheim.

[17] E. Damanhuri, W. Handoko and T. Padmi. (2014). Municipal Solid Waste Management in Asia and The Pacific Islands, Springer, Singapore.

[18] Sufra, R., Adriansyah, E., & Wati, L. A. (2023). *Karbon aktif dari limbah kulit kayu sebagai penyerap logam Mangan (Mn) pada Leachate*. *2*(1), 13–16.

[19] Sufra, R., Latifah, L., Susilo, N. A., Adriansyah, E., Wati, L. A., Yulia, A., Syaiful, M., Viareco, H., Marhadi, M., Ghony, M. A., & Herawati, P. (2023). Pemanfaatan Sisa Kulit Kayu sebagai Karbon Aktif dalam Pengolahan Air Lindi Industri Pulp and Paper. *Jurnal Civronlit Unbari*, *8*(1), 17. https://doi.org/10.33087/civronlit.v8i1.106

[20] Viareco, H., Adriansyah, E., & Sufra, R. (2023). Potential Sequencing Batch Reactor in Leachate Treatment for Organic and Nitrogen Removal Efficiency. *JURNAL KESEHATAN LINGKUNGAN*, *15*(2), 143–151. https://doi.org/10.20473/jkl.v15i2.2023.143-151