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# Coffee Grounds Reducing *Chemical Oxygen Demand* (Cod) Levels In *Doorsmeer* Waste In Gampong Bineh Blang Ingin Jaya District, Aceh Big District

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***ABSTRACT***

*Doorsmeer waste contains high chemical oxygen demand which results in a lack of dissolved oxygen in the water. To reduce chemical oxygen demand levels, this research uses activated charcoal from coffee grounds as an adsorbent because it can trap pollutant particles and is able to adsorb metals, dirt/dust, and detergent foam originating from doorsmeer waste. This research aims to determine the effectiveness of coffee grounds activated charcoal adsorbent in reducing chemical oxygen demand levels in doorsmeer waste. This research was experimental with 3 treatments using 10 gr, 20 gr and 30 gr coffee grounds activated charcoal with 3 repetitions. The subject in this research was a dose of 180 grams of activated charcoal from coffee grounds and the object in this research was doorsmeer waste. On an average decrease in the use of 10 grams of activated charcoal coffee grounds the results were 173.33 mg/l, on an average decrease in the use of 20 grams of activated charcoal coffee grounds the results were 229.33 mg/l, and on an average decrease in use 30 grams of activated charcoal from coffee grounds yielded 263 mg/l. The research results show that the use of activated charcoal from coffee grounds is the most effective in reducing chemical oxygen demand levels in doorsmeer waste, namely a dose of 30 grams with a reduction of 263 mg/l. It is hoped that further research during the process of making activated charcoal will first pay attention to how to make activated charcoal properly and correctly, especially when burning coffee grounds because this greatly influences the quality of the activated charcoal.*

***Keywords : Activated Charcoal, Doorsmeer Waste, COD***

## INTRODUCTION

The environment can be seen as an integration between physical elements, which includes natural resources such as soil, water, solar energy, minerals, as well as vegetation and fauna that inhabit land and waters, and institutional structures that include the results of human creation in regulating the use of these physical elements. In addition, the environment includes everything around humans that affects the development of human life. There are two main components in the environment, namely abiotic and biotic.

The development of the transportation sector has progressed rapidly along with the growth of the human population. The emergence of various types of vehicles spurred the development of various vehicle wash service businesses, including motorcycles and cars. Vehicle washing services are now an important need in urban areas and areas with high population density. While improvements in this sector can provide a boost to the community's economy and create job opportunities, on the other hand, it has the potential to add to environmental damage and pollution, especially pollution of water bodies due to the liquid waste produced. Vehicle washing business activities result in the emergence of new problems in the form of waste that is emitted every day, with the characteristics of waste that is dominated by liquid waste that is generally discharged directly into waterways. Water pollution is not only risky for aquatic life, but can also have an impact on human health.

Wastewater from vehicle wash services contains impurities such as soil and dust as well as foam from detergents (surfactants). Nowadays, more and more people are choosing vehicle wash services because they are convenient, resulting in an increase in the number of washes. This increase has an impact on the use of large amounts of clean water and the discharge of waste into the environment. In reality, wastewater from vehicle washes is often discharged directly into sewers or drainage channels without a sewage treatment plant. The development of vehicle washing services (*doorsmeer*) has increased the use of detergents and the volume of wastewater. Harsh detergent waste can pollute the aquatic environment, endanger aquatic life, and humans who consume it. In addition, this can lead to eutrophication. Therefore, *the management of doorsmeer* waste must be carried out more effectively and in accordance with

environmental quality standards.

A large amount of soap waste released by many factories or industries can result in at least two main negative effects: water eutrophication and an ongoing water crisis. Soap waste has nitrogen and phosphorus that can trigger the development of algae and phytoplankton, and increase aquatic productivity. This atmosphere can cause an explosion of algae populations that endanger other organisms in aquatic ecosystems. Not only that, experts report that chemical compounds in soap waste can disrupt the gills of fish and break down their protective mucus structure. As a result, fish run out of skills to protect themselves from parasites and germs, making them uncomfortable for humans to eat.[3]

Activated charcoal made from coffee grounds is one way to reduce pollution. Coffee grounds contain 47.8–58.9% total carbon, 1.9–2.3% total nitrogen, 6.7–13.6% protein, 0.43–1.6% ash, and 8.6% cellulose. Activated charcoal can be made from a high carbon content. Porous solids known as activated charcoal are made by heating carbon-containing substances to extremely high temperatures. Since activated charcoal is highly active against particles that come into contact with it, activated charcoal can be used as an adsorbent. It can trap pollution particles and absorb metals, dirt and detergent foam from *doorsmeer waste4*.

Organic acids and types of chemical solutions to organic bases will react and dissolve impurities in the pores of charcoal in the form of metals and free carbon atoms. These substances are undesirable because they allow re-oxidation of activated charcoal so that the surface of the charcoal is open and protected from these unwanted processes. The adsorption power of activated charcoal increases with its surface area. Chemical activation of coffee grounds is one method to increase the adsorption capacity of activated charcoal of coffee grounds5.

Sourced from the Regulation of the Minister of Living Areas of the Republic of Indonesia No. 05 of 2014 which imposes wastewater quality standards for industrial areas, the level *of Chemical Oxygen Demand* (COD) should not exceed 180 milligrams/L. This COD value is used as a marker of the level of water pollution caused by organic substances that can be oxidized naturally through microbiological processes.[6]

Chemical Oxygen Demand (COD), or often referred to as *Chemical Oxygen Demand* (COD), is the amount of oxygen needed to oxidize organic substances contained in water. If the concentration of COD in wastewater increases, this will lead to a decrease in the level of oxygen available to aquatic organisms. Conversely, if the concentration of COD decreases, then the quality of dissolved oxygen in the water will increase. COD value measurement shares data on the amount of oxygen needed to oxidize the total compound, both biodegradable and difficult or biologically insoluble.

Variables that affect COD values include dissolved oxygen, organic compounds, and various other sources of pollution. The solubility of oxygen in water depends on the temperature, the oxygen pressure in the atmosphere, and the concentration of salts present in the organic water. The COD content in wastewater tends to shrink along with the shrinking concentration of organic compounds contained in the wastewater. COD testing aims to measure the amount of oxygen equivalent to organic matter in wastewater that can be chemically oxidized using dichromate in an acidic solution. The COD measurement principle relates the accumulation of certain potassium dichromate (K2Cr2O7) as an oxidizer to the illustration of water (with a predetermined volume) that has been given a concentrated acid and a silver sulfate catalyst, after which it is heated for a certain period of time. After that, the remaining potassium is measured by titration. Thus, the amount of potassium dichromate used to oxidize the organic matter in the illustration can be calculated and the COD value can be determined. However, there is a disadvantage, namely inorganic environmental compounds that can also be oxidized in water can also react, so that in some problems, the COD value can slightly exceed the content of organic matter.[8]

## RESEARCH METHODS

1. Types of Research

   This study applies an experimental approach using experimental methods. The type of research adopted falls under the category of *quasi-experimental studies*, which aim to evaluate the extent to which adsorbents from activated charcoal of coffee grounds can reduce COD levels in *doorsmeer waste*. The design of this study adopts the Complete Random Design (RAL) model.
2. Research Subject
   1. Subject

      This thesis focuses on the use of activated charcoal doses from coffee grounds in reducing COD levels in waste produced by one of the vehicle washing businesses located in Gampong Bineh Blang, Ingin Jaya District, Aceh Besar Regency.
   2. Object

      The object of this study is *doorsmeer waste*.

## RESULTS AND DISCUSSION

### Result

Based on a study carried out from February 9 to March 15, 2024, using a sample of 5 liters of *doorsmeer waste* and 180 grams of activated charcoal from coffee grounds as a medium to reduce COD concentrations in *doorsmeer waste*, the following results were obtained:

1. COD Examination Results

   The results of the COD examination after the use of activated charcoal of coffee grounds can be seen in table 1

**Table 1**
**COD Levels Before and After the Use of Activated Charcoal in Coffee Grounds**

| No | Repetition | Before COD Rate Use of Activated Charcoal in Coffee Grounds | COD Levels after the Use of Activated Charcoal in Coffee Grounds | | |
|---|---|---|---|---|---|
| | | Control | 10 grams (Mg/L) | 20 grams (Mg/L) | 30 grams (Mg/L) |
| 1 | First | 784 | 602 | 553 | 531 |
| 2 | Second | 784 | 621 | 544 | 520 |
| 3 | Third | 784 | 609 | 567 | 512 |
| Total | | 2352 | 1832 | 1664 | 1563 |
| Average | | 784 | 610,667 | 554,667 | 521 |

*Source: Primary Data (processed in 2024)*

Based on Table 5.1 above, it can be explained that in the average control of COD in *doorsmeer* waste was 784 Mg/L. In the use of activated charcoal adsorbents, active coffee grounds with a dose of 10 grams were obtained, an average of 610,667 Mg/L was obtained.

The percentage decrease in COD levels in *doorsmeer waste* after the use of activated charcoal of coffee grounds can be seen in table 2

**Table 2**
**Percentage Decrease in COD Levels in Doorsmeer Waste After the Use of Activated Charcoal in Coffee Grounds**

| No | Activated Charcoal Coffee Grounds | Repetition | COD Initial (mg/L) | COD End (mg/L) | Decrease (mg/L) | Average decrease (Mg/L) | Percentage Decrease (%) |
|---|---|---|---|---|---|---|---|
| 1 | 10 gram | I | 784 | 602 | 182 | 173,333 | 22,11% |
| | | II | 784 | 621 | 163 | | |
| | | III | 784 | 609 | 175 | | |
| 2 | 20 gram | I | 784 | 553 | 231 | 229,333 | 29,25% |
| | | II | 784 | 544 | 240 | | |
| | | III | 784 | 567 | 217 | | |
| 3 | 30 gram | I | 784 | 531 | 253 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | II | 784 | 520 | 264 | | |
| | | III | 784 | 512 | 272 | 263 | 33,55% |

Based on Table 2 above, it can be explained that the use of activated charcoal of coffee grounds with a dose of 10 grams at 3 repetitions obtained an average percentage reduction in COD levels in *doorsmeer* waste of 22.11%. In the use of coffee grounds activated charcoal adsorbents with a dose of 20 gr at 3 repetitions, an average percentage reduction in COD levels in *doorsmeer waste* was obtained of 29.25% and in the use of coffee grounds activated charcoal adsorbents with a dose of 30 gr at 3 repetitions, an average percentage reduction in COD levels in *doorsmeer* waste was obtainedby 33.55%. Therefore, it can be concluded that the higher the level of activated charcoal adsorbent of coffee grounds used, the greater the decrease in COD levels in *the doorsmeer* waste caused.

To evaluate the impact of the use of activated charcoal made from coffee grounds on the reduction of COD concentration in doorsmeer waste, an analysis was carried out using *the one-way* anova method, the results of which can be found in Table 3.

**Table 3**
**Anova*'s One Way Test* Results on the Use of Activated Charcoal in Coffee Grounds to Reduce COD Levels in *Doorsmeer Waste***

| Coffee Grounds | Decrease (mg/L) | Average Decline | Std. Deviation | 95% confidence interval for mean | Value p |
|---|---|---|---|---|---|
| Control | 0,00 | 0,00 | 0,00 | 0,00-0,00 | 0,00 |
| 10 gram | 182<br>163<br>175 | 173,33 | 9,609 | 149,46-197,20 | |
| 20 gram | 231<br>240<br>217 | 229,33 | 11,590 | 200,54-258,13 | |
| 30 gram | 253<br>264<br>272 | 263,00 | 9,54 | 239,30-286,70 | |
| Total | 221,88 | 166,42 | 106,05 | 99,03-233,80 | |

*Source: primary data (processed 2024)*

Based on table 5.3, it is known that there is an average difference in the decrease between the use of the dose of activated charcoal of coffee grounds as much as 10 grams, 20 grams, and 30 grams as an adsorbent to the reduction of COD levels in *doorsmeer waste*. On average, the decrease in the use of 10 grams of activated charcoal of coffee grounds obtained a result of 173.33 mg/l, on average the decrease in the use of 20 grams of activated charcoal of coffee grounds obtained a result of 229.33 mg/l, and on an average decrease in the use of 30 grams of activated charcoal of coffee grounds obtained a result of 263.00 mg/l with a value of p=0.00.

2. LSD Test Results

To evaluate the difference in the effect of using activated charcoal of coffee grounds with doses of 10 grams, 20 grams, and 30 grams as an adsorbent in reducing COD concentrations in waste from car washes, the authors applied the LSD (*Least Significant Difference*) test method.
The results of the LSD test calculation can be seen in table 4

**Table 4**
**LSD Test Results of the Use of Activated Charcoal in Coffee Grounds as an Adsorbent on Reducing COD Levels in *Doorsmeer Waste***

| Dosage of | Dosage of | | | | 95% Confidence Interval |
|---|---|---|---|---|---|

| Activated Charcoal Coffee Grounds | Activated Charcoal in Coffee Grounds | Rata - Rata | Std. Error | Value p | Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Control | Serving 10 gr | -173.333* | 7.276 | 0,00 | -190.11 | -156.55 |
| | Dosage 20 gr | -229.333* | 7.276 | 0,00 | -246.11 | -212.55 |
| | Serving 30 gr | -263.000* | 7.276 | 0,00 | -279.78 | -246.22 |
| 10 gr | Control | 173.333* | 7.276 | 0,00 | 156.55 | 190.11 |
| | Dosage 20 gr | -56.000* | 7.276 | 0,00 | -72.78 | -39.22 |
| | Serving 30 gr | -89.667* | 7.276 | 0,00 | -106.45 | -72.89 |
| 20 gr | Control | 229.333* | 7.276 | 0,00 | 212.55 | 246.11 |
| | Serving 10 gr | 56.000* | 7.276 | 0,00 | 39.22 | 72.78 |
| | Serving 30 gr | -33.667* | 7.276 | 0,02 | -50.45 | -16.89 |
| 30 gr | Control | 263.000* | 7.276 | 0,00 | 246.22 | 279.78 |
| | Serving 10 gr | 89.667* | 7.276 | 0,00 | 72.89 | 106.45 |
| | Dosage 20 gr | 33.667* | 7.276 | 0,02 | 16.89 | 50.45 |

Information:
( * ) = There is a difference

Based on Table 5.4, it is known that the difference that can be read for the LSD test is the control with a dose of 10 gr of activated charcoal of coffee grounds with an average value of 173,333 and a value of p = 0.00 which means that there is a difference in the use of activated charcoal with a dose of 10 gr with control for reducing COD levels. The difference between the control dose and the dose of 20 grams of activated charcoal of coffee grounds was obtained with an average value of 229,333 and a value of p = 0.00 which means that there is a difference in the use of activated charcoal of coffee grounds and a dose of 20 grams with control for reducing COD levels. The difference between the control dose and the dose of 30 grams of activated charcoal of coffee grounds was obtained with an average value of 263,000 and a value of p = 0.00 which means that there is a difference in the use of activated charcoal of coffee grounds with a dose of 30 grams with control for reducing COD levels.

**Discussion**

Based on the research that has been carried out, the results obtained that activated charcoal coffee grounds are able to reduce COD levels in *doorsmeer* waste because activated charcoal is able to absorb polluting particles and is able to absorb metals, dirt/dust and detergent residue foam from *doorsmeer* waste with 3 repetitions with various treatments.

The use of 10 grams, 20 grams, and 30 grams of activated charcoal had a difference in the average reduction in COD levels in *doorsmeer waste* with a p value of < 0.05. From the data (Table 5.2), it shows that the COD level from *doorsmeer waste* decreases with each additional dose of activated charcoal of coffee grounds. On average, the decrease in the use of 10 grams of activated charcoal of coffee grounds obtained a result of 173.33 mg/l, on an average decrease in the use of 20 grams of activated charcoal, coffee grounds obtained a result of 229.33 mg/l, and on an average decrease in the use of 30 grams of activated charcoal, coffee grounds obtained a result of 263.00 mg/l.

Based on the results of the one way anova statistical test, a value of p = 0.05 was obtained, therefore, H0 was rejected so that it was known that there was an effect of the use of activated charcoal of coffee grounds in reducing the COD content in *doorsmeer waste*. The results of the statistical test were obtained if there was a comparison between early COD in *doorsmeer waste* and after the use of activated charcoal of coffee grounds with doses of 10 grams, 20 grams, and 30 grams with a value of p = 0.00.

The use of activated charcoal in coffee grounds with a dose of 30 grams is very efficient in lowering the COD content in *doorsmeer waste* with a shrinkage percentage of 33.55% compared to the use of activated charcoal in coffee grounds with a dose of 10 grams and 20 grams. It continues to be a large dose of activated charcoal of coffee grounds that are used until it continues to be good in lowering the COD

content in *doorsmeer waste*. This can be seen from the difference in early COD compared to the final COD after the use of activated charcoal in coffee grounds with a shrinkage percentage that has almost reached 35%.

In accordance with the quality standards for the regulation of the Minister of Living Areas regarding wastewater quality standards for industrial zones must not have a COD value exceeding 180 milligrams/l, but in this research the value of COD content depreciation is still greater than the official quality standard of 263 milligrams/l. Due to previous research on the process of making activated charcoal for coffee grounds facing large temperature heating, coffee grounds are dried to eliminate the remaining water from soaking coffee grounds by using an oven at a temperature of 1500 C for 2 hours and after that the coffee grounds are made in the furnace at a temperature of 5000 C for 60 minutes, on the other hand, in this research the production of activated charcoal coffee grounds is only in gongseng with different temperature heating for 60 minutes.

It is hoped that further research at the time of the process of making activated charcoal will be considered in advance on how to work with activated charcoal properly and correctly, especially at the time of burning coffee grounds because it is very influential.

## CONCLUSIONS AND SUGGESTIONS

### Conclusion

1. The effectiveness of using activated charcoal from coffee grounds at a dose of 10 grams per 500 ml *of doorsmeer* waste showed an average concentration reduction of 173.333 mg/L.
2. At a dose of 20 grams per 500 ml of *doorsmeer waste*, the use of activated charcoal from coffee grounds resulted in an average concentration reduction of 229,333 mg/L.
3. With a dose of 30 grams per 500 ml of *doorsmeer waste*, activated charcoal of coffee grounds was able to reduce the average concentration by 263 mg/L.
4. A dose of 30 grams of activated charcoal from coffee grounds was the most effective in reducing COD levels in *doorsmeer* waste, with an average reduction of 263 mg/L.

## REFERENCES

1. Siregar ES, Nasution MW. The Impact of Economic Activities on Environmental Pollution (Case Study in Pejuan City, Kotanopan). *J Educ Dev*. 2020;8:589-593.
2. Muhammad Iqbal, Sorasuh Wadiana, Afsari, Isna Apriani. Treatment of vehicle washing liquid waste using a combination of adsorption and filtration methods. 2023: 493 – 499.
3. Wardalia, R. (2016) 'Waste Treatment of Vehicle Washing Services by Coagulation-Flocculation Method', Proceedings of the National Seminar on Chemical Engineering 'Struggle' for the Development of Chemical Engineering for the Processing of Indonesian Natural Resources, (1), pp. 1–5. Available at: Wastewater of washing service business of motor vehicles, Jar Test, Coagulation Flocculation.
4. Sulianto, A. A., Aji, A. D. S., and Alkahi, M. F. (2020). Design and Build Groundwater Filtration Unit to Reduce Turbidity and Manganese Content with Upflow Flow. Journal of Natural Resources and Environment, 7(2), 72–80.
5. Isti'anah, Sayyidatun Najah, and Selvy Hani Putri Pratiwi (2017). Effect of detergent waste pollution on aquatic biota, 2597-9612.
6. Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 2014. Published 2014.
7. Fransiska Vony Wicheisa, Yusniar Hanani, Nikie Astorina (2018). Reduction of COD Levels in Liquid Waste of Orange Laundry Tembalang with Various Variations in Activated Carbon Doses of Coconut Shells, 2356-3346.
8. Waste-A TDPMKPT and P. Soil Absorption and Waste Management-A. Diploma IV Department of Environmental Health; 2018.
9. Rafa Diah Kirani, Munawar Ali (2023). Coffee Grounds as Activated Carbon to Reduce COD and TSS Levels in Tempeh Industrial Liquid Waste, 7173-7179.
10. Rizki AP, Sanjaya AS. Kinetics Study of Fe Content Decrease In Well Water With Activated Carbon Adsorption Of Coffee Waste. In: Prosiding Seminar Nasional Teknik Kimia “Kejuangan.” ; 2015:1-5.
11. Fernianti D. Activated Carbon Adsorption Ability from Brewed Coffee Grounds Powder. Berk Tek. 2013;3:563-572.
12. Lismiatun, Fadillah, Matta EHYD, Ellesia N. Utilization of Household Waste as a Learning Media at Pamulang Permai State Elementary School. J ABDIMAS. 2021;2:9-14.
13. Baryatic P. Utilization of Activated Charcoal from Coffee Grounds as an Adsorbent of Chromium Metal

(Cr) in Batik Liquid Waste. Faculty of Public Health, University of Jember; 2016.
14. Ichtiakhir TH, Sudarmaji. B3 Waste Management and Worker Health Complaints at PT. INKA (PERSERO) Madiun City. J Environmental Health. 2015;8:118-127.
15. Muhammad Iqbal, Sorasuh Wadiana, Afsari, Isna Apriani (2023). Treatment of Vehicle Washing Liquid Waste Using the Combined Method of Adsorption and Filtration, 493-499.
16. Thousands of them. Study of the Rate of Reduction in BOD and pH Content in Laundry Service Waste Using Moringa Seed Powder (Moringan Oliefera). Health Polytechnic of the Ministry of Health of Kupang; 2019.
17. Sunarsih, E. (2014). The concept of household waste treatment in an effort to prevent environmental pollution. Public Health Sciences, 5(10), 162–167.
18. Rusdi, and Wardalia. (2016). Waste Treatment of Vehicle Washing Services by Coagulation-Flocculation Method. Proceedings of the National Seminar on Chemical Engineering "Struggle" on the Development of Chemical Technology for Indonesian Natural Resources Processing, 1(1), 1–5.
19. Wati, D. M., Asmadi, and Hajimi. (2016). Design of Wastewater Treatment for Motorcycle and Car Washing "TM" with Anaerobic-Aerobic Biofilter Method Using Split Stone Media. Sanitarian, 8(1), 85–94.
20. Nasihah, M., Saraswati, A. A., and Najah, S. (2018). Domestic Liquid Waste Treatment Test Through Coagulation-Flocculation and Phytoremediation Method with Apu Wood Plants (Pistia stratiotes L.). Journal of Enviscience, 2(2), 76–79.
21. Susanthi, D., J. Purwanto, M. Y., and Suprihatin, S. (2018). Evaluation of Domestic Wastewater Treatment with Communal WWTP in Bogor City. Journal of Environmental Technology, 19(2), 229–238.
22. Wirosoedarmo, R., Haji, A. T. S., and Hidayati, E. A. (2016). Effect of Concentration and Contact Time on Domestic Waste Treatment Using Corn Cob Activated Carbon to Reduce BOD and COD. Journal of Natural Resources and Environment, 3(2), 31–38.
23. Prihatiningsih, B., Kusuma, Z., Suharyanto, A., dan Leksono, A. S. (2019). Prediction Spatial Model of Domestic Liquid Waste Distribution in Sawojajar Village, Malang City of Indonesia. International Journal of Multicultural and Multireligious Understanding, 6(5), 186–194.
24. Imron, I., Sriyani, N., Dermiyati, D., Suroso, E., and Yuwono, S. B. (2019). Improving Domestic Wastewater Quality with Phytoremediation Using a Combination of Several Water Weeds: A Case Study of the Palembang City Safe Gutter Retention Pond. Journal of Environmental Science, 17(1), 51–60.
25. Muliyadi, M., and Sowohy, I. S. (2020). Comparison of the Effectiveness of Electrocoagulation and Distillation Methods on Reducing the Burden of Physical Pollutants on Domestic Wastewater. Indonesian Journal of Environmental Health, 19(1), 45–50.