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Combination of Ozone-Zeolite Filter to Reduce COD and Ammonia content in household waste

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Abstract. Domestic waste standard parameters according to PermenLH No. 68 Years. 2016 determined one of them based on the pH, COD and Ammonia values. Most household wastewater has these values, so a purification process is required before the wastewater returns to groundwater. One of the treatments carried out is in the form of ozone technology which can decompose organic and inorganic pollutants and kill microorganisms in the waste. The purpose of this study was to determine the quality of household wastewater resulting from ozone bubble treatment combined with zeolite filters. To support the research, we used the pH, COD and Ammonia measurement methods from the treated samples. The method used is in the form of ozone treatment and zeolite filters in wastewater with a variable length of treatment time. From the research results, it can be seen that the combination of ozone and zeolite filter has an effect on decreasing the concentration of COD and ammonia in wastewater.

Keywords: domestic waste, ozone technology, zeolite filter, reduction of COD and ammonia concentrations

1. Introduction

Domestic waste quality according to PerMenLHK No. 68 of 2016 can be determined chemically based on pH, COD (Chemical Oxygen Demand) and Ammonia (NH3-N) levels. The permissible pH level of domestic waste ranges from 6 to 9, while the maximum concentration of COD and Ammonia for domestic waste is 100 mg / L and 10 mg / L [1]. Most household wastewater has pH, COD and ammonia levels above the permitted value of domestic waste, this is because the types of household activities in producing waste are quite diverse, besides the source does not only come from the bathroom but also comes from the kitchen and washing activities other. The quality of domestic waste also depends on the quality of clean water used in household activities [2]. In general, domestic waste flows from homes to ditches or rivers without going through a treatment process so that within a certain time it will have an impact on the condition of river or lake waters and cause environmental and soil pollution.[3]

Research on domestic waste treatment using AOP (Advanced Oxidation Process) technology has been carried out, including: Bhatta et al [4] using ozone treatments to reduce pollutants that exist in the waste that comes from the WWTP (wastewater treatment plant), the results show that there is a reduction in COD and an increase in waste nitrate due to the oxidation process of waste molecules using ozone, but the shortcomings of this study do not explain the ammonia reduction value. Gelavizh

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Barzegar, et al [5] Using Ozone / Electrocogulant treatments for residential waste, the results showed that the combination of Ozone / Electrocogulant was effective in reducing COD and TOC concentrations, the shortcomings of this study could explain the effect of the treatment on ammonia constituents. Other studies such as that conducted by X. Luo, et al [6] describes the method of reducing ammonia in waste using two-stage ozone, this research is good but it is necessary to find alternative methods of ozone treatment, especially to reduce ammonia with low energy.

The reduction of COD and ammonia elements is important in the process of reducing domestic waste because these elements cause a significant impact on the environment, high COD concentrations indicate that the waste cannot be broken down by microorganisms, while ammonia concentrations can cause toxicity to aquatic life and abundance of algae in waters. This research is the development of ozone stream combined with a zeolite filter to reduce the concentration of COD and ammonia in domestic waste. The use of ozone technology was chosen because this technology is low in energy and has the ability to break down waste water pollutants. While the use of zeolite filters was chosen because the zeolite material has active ions that can help reduce ammonia elements, so it is hoped that with this combination there will be an increase in the reduction of ammonia concentration from waste.

2. Research Method

Sampling was carried out in the area of Anisa Asri 3 Housing in Jambi City for 4 (sample points) with two different types of waste disposal, first housing waste from bathroom and kitchen disposal which becomes one stream, the second is separate waste disposal between bathroom waste and waste kitchen. The results of measurement of waste parameters are as shown in Table 1. After measuring the waste parameters, then the waste is given an Ozone-filter treatment with a variation of the treatment time of one hour and two hours. Each of the results of these treatments is illustrated in Figure 1.

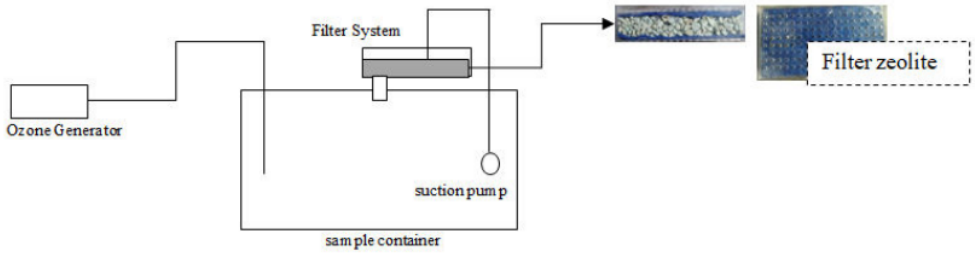

Fig. 1. Schematic of an ozone and zeolite waste treatment system.

3. Result and Analysis

Table 1. Characteristics of Greywater

Parameter	The source of the sample:				PerMenLHK No. 68 of 2016
	House 1	House 2	House 3	House 4	Maximum grade
pH	6,5±0,0	6,0±0,1	6,6±0,0	6,8±0,1	6-9
COD	293	1500	832	1085	100
DO	3,8±0,3	3,7±0,2	3,9±0,4	1,8±0,3	NA
TDS	499,3±15	260,3±2,1	105,3±2,0	420,3±2,1	NA
Ammonia	12,9±0,0	9,0±0,1	12,9±0,0	5,4±0,0	10

Table 1 shows the measurement results of the greywater wastewater sample, the data table above can be explained that the pH value of the four sample locations has a safe value against the specified maximum pH level, while the COD value of the four samples has a concentration above the specified maximum level. The highest COD levels were obtained from the sample location with waste that blends between kitchen and bathroom waste, while the low COD levels came from waste from the bathroom only. It can be explained that the combination between kitchen and bathroom waste can

cause an increase in COD levels in the waste because the chemical pollutant content is more diverse in the waste as reported by C. Noutsopoulos, et al[7]. The DO level of waste is measured because the DO value is related to the oxygen demand of the aquatic environment, the minimum DO concentration required for the aquatic environment must be more than 5 mg / L [8]. The results of wastewater DO measurement show that the value is below the recommended value threshold. It is recommended that wastewater TDS values for aquatic environments should be less than 70 mg / L [8], while the measurement results show a greater value, the largest TDS value of measurement comes from bathroom waste, this condition is caused by the presence of body waste / waste dissolved in the water. Ammonia measurements for waste samples showed values above the maximum level of the PermenLHK regulation [1], This value is far above the water ammonia threshold of 0.2 mg / L [8]. The highest ammonia value comes from bathroom waste, where generally the waste comes from urine and nitrogen content from groundwater itself [7].

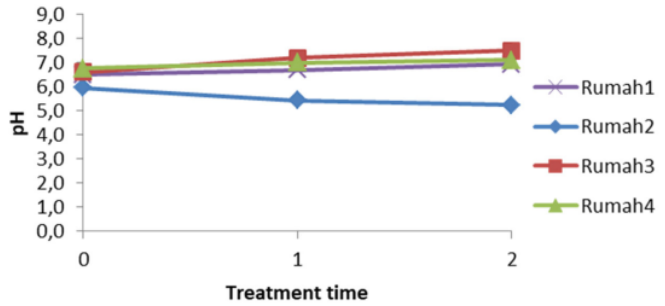

Fig. 2. Test results of waste samples using a zeolite ozone-filter treatment.

Figure 2 shows that the effect of ozone-zeolite filter to change the pH value and TDS of wastewater is not very significant, this is similar to that reported by R. Batta, et al. [4], the unchanging of the pH value indicates that the number of OH- ions formed in the waste is not much so that the pH value tends to be constant. The concentration value of waste ammonia (Figure 3) tends to fall for two samples originating from a single waste (bathroom and kitchen), namely samples of Houses 2 and Houses 4, while the waste that only comes from the bathroom tends not to change, this is due to two things: first, the waste from the bathroom has a higher level compared to single waste, so that the ozone-zeolite dose has no effect, secondly the dose of ozone generated is too small so that it is unable to decompose dissolved nitrogen. Zeolite is needed to help reduce the ammonia concentration from waste because zeolite ions can reduce ammonia to nitrite and nitrate. The use of ozone alone for ammonia treatment has a small percentage so it must be combined with zeolites. The percentage reduction in ammonia for ozone alone is only about 12.8%[6].

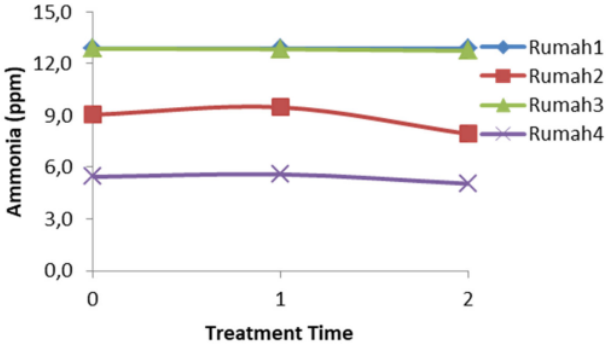

Fig. 3. Schematic of an ozone and zeolite waste treatment system.

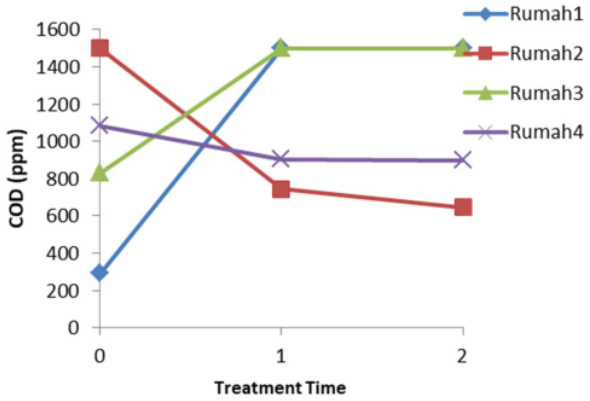

Fig. 4. Schematic of an ozone and zeolite waste treatment system

Figure 4 shows the results of reducing the COD concentration of waste using an ozone-zeolite combination, from these results it can be seen that COD elements above 1200 ppm cannot be reduced either with ozone or with the ozone-zeolite combination, this is because the ozone dose given is too small, namely 0.15 ppm, Meanwhile, according to Z. Jing and S. Chao, COD can be reduced properly using ozone doses between 2-8 ppm[9]. While the effect of zeolite itself for COD reduction is strongly influenced by zeolite mass, flow velocity and filter thickness [10]. The workings of zeolite as an absorbent medium with absorption mechanisms that may occur physically (Van der Walls force) and chemistry (electrostatic force) as well as hydrogen bonds are strongly influenced by filter thickness and flow velocity.

The level of physical brightness of wastewater can be observed in Figure 5.Where the results of the ozone-zeolite treatment for two hours have a better color brightness level than before being given the treatment, this brightness level indicates a reduction in solids (TSS). Zeolite material itself has a better ability to reduce the TSS element of waste when compared to ozone technology itself [11][12]. In addition, the flocation process of the zeolite ozone-filter treatment runs well.

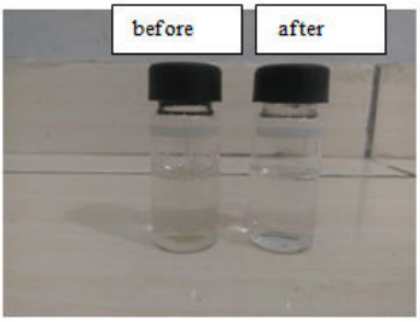

Fig. 5. Test results of waste samples using a zeolite ozone-filter treatment

4. Conclusion

Based on the results of testing the zeolite ozone-filter treatment on domestic waste it can be concluded that:

a. The zeolite ozone-filter treatment can reduce the ammonia content of domestic waste with mixed types of kitchen and bathroom waste, the reduction of ammonia for bathroom waste is insignificant because the ammonia concentration is quite large> 12 ppm.
b. The zeolite ozone-filter treatment can reduce COD content both for waste originating from bathrooms only and bathroom and kitchen waste, there is no significant reduction in COD waste because the ozone dose is too small (0.15 ppm) and the thickness of the zeolite filter (filter mass) is unable to reduce COD alone.
c. The combination of ozone-zeolite filters can reduce TSS levels of waste based on the brightness of the observed waste samples, this is because the zeolite filter itself is more effective at reducing TSS than using ozone alone.

References

[1] 2016 *PERATURAN MENTERI LINGKUNGAN HIDUP DAN KEHUTANANREPUBLIK INDONESIANOMOR P.68/Menlhk-Setjen/2016*
[2] Firdayati M, Indiyani A, Prihandrijanti M, Otterpohl R and Protection W 2015 Greywater in Indonesia : Characteristic and Treatment Systems *J. Tek. Lingkung.* **21** 98–114
[3] Mohamed R M, Aznin S S, Hasila A H, Wurochekke A A and Kassim A H 2017 Removal of nutrients and organic pollutants from household greywater by phycoremediation for safe disposal *Int. J. Energy Environ. Eng.* **8** 259–72
[4] Bhatta R, Kayastha R, Subedi D P and Joshi R 2015 Treatment of Wastewater by Ozone Produced in Dielectric Barrier Discharge *J. Chem.* **2015** 1–6
[5] Barzegar G, Wu J and Ghanbari F 2019 Enhanced treatment of greywater using electrocoagulation / ozonation : Investigation of process parameters *Process Saf. Environ. Prot.* **121** 125–32
[6] Luo X, Yan Q, Wang C, Luo C and Zhou N 2015 Treatment of Ammonia Nitrogen Wastewater in Low Concentration by Two-Stage Ozonization *Int. J. Environ. Res. Public Health* **12** 11975–87
[7] Noutsopoulos C, Andreadakis A, Kouris N, Charchousi D, Mendrinou P and Galani A 2017 Greywater characterization and loadings – Physicochemical treatment to promote onsite reuse *J. Environ. Manage.* **216** 337–46
[8] Padmavathy P 2017 Review on water quality parameters in freshwater cage fish culture *Int. J. Appl. Res.* **3** 114–20
[9] Jing Z and Cao S 2012 Combined Application of UV Photolysis and Ozonation with Biological Aerating Filter in Tertiary Wastewater Treatment *Int. J. Photoenergy* **2012** 1–6
[10] Komariah S, Waspodo R S B and Chadirin Y 2016 Keefektifan Zeolit dan Arang sebagai Bahan Penyusunan Akuifer Buatan (Artificial Aquifer) untuk Menurunkan BOD dan COD Air

Sungai *J. Keteknikan Pertan.* **4** 9–14
[11] Yulianti I and Munawaroh R 2016 PENGARUH VARIASI MASSA ZEOLIT PADA PENGOLAHAN AIR LIMBAH PABRIK PAKAN TERNAK MELALUI MEDIA FILTRASI *Seminar Nasional Fisika* vol V pp 43–6
[12] Li F, Wichmann K and Otterpohl R 2009 Review of the technological approaches for grey water treatment and reuses Science of the Total Environment Review of the technological approaches for grey water treatment and reuses *Sci. Total Environ.* **407** 3439–49

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