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Effectiveness of Reducing Household Waste BOD, COD and TSS with the Ecotech Garden Method

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Abstract: The main source of household waste water (grey water) is domestic liquid waste, originating from non-latrine activities, namely bathrooms, kitchens, yards, and waste other than feces (black water). This waste poses a burden to water bodies, rivers that pass through densely populated settlements are in very poor condition, are black, murky and smelly, contain soap, fatty oils, detergents and microorganisms. These conditions can disrupt aquatic ecosystems so that the photosynthesis process cannot run smoothly, this causes water productivity to decrease. Waste treatment with the Ecotech Garden (EGA) system or sanitary garden is very appropriate to reduce the level of pollution considering the characteristics of gray water wastewater with relatively low organic load, high nitrogen and phosphate elements. Research objective: to determine the effectiveness of reducing BOD, COD and TSS levels in household waste using the Ecotech Garden method with Echinodorus palaefolius and Typha Angustifolia plants. This research is quasi-experimental, using 6 waste treatment miniatures, made of acrylic with a size of 50x50x50 cm. In Box 1, Box 2: filled with waste and given Typha Angustifolia plants; Box 3, Box 4: filled with waste and given Echinodorus palaefolius and Bak 5, Bak 6 filled with waste as a control. Household liquid waste levels were measured for pH, temperature, TSS, BOD and COD before being treated. The 6 BAK were kept in contact for 6 days (5 days of residence), every day the levels of TSS, BOD and COD were measured. The reduction in TSS, BOD and COD pollutant levels was calculated. Conclusion: Echinodorus palaefolius is more effective than Typha Angustifolia in reducing pollutant levels.

Keywords – *Reduction, domestic waste, ecotech garden*

I. INTRODUCTION

Rapid population growth and accompanied by an increasing number of settlements, which will affect the amount of liquid waste as a result of discharge from household activities (Amha Rosihan, 2019). The main source of gray water is domestic liquid waste, originating from non-latrine activities in bathrooms, kitchens, courtyards, and waste other than feces (black water). The general composition of domestic wastewater is fat (33%), protein (25%), cellulose (8%), starch (8%), lignin (6%), ash (20%) and BOD values range from 275 – 3000 ppm [Kasman, M., Kalsum, S.U., Aditia, A.S., (2012). Reduction of pH, BOD and COD in Gray Water by Electrocoagulation-Sedimentation Process Scientific Journal, University of Batanghari Jambi 12(3), 2–5] The high quantity and pollutant content of gray water has the potential to contaminate receiving water bodies, especially rivers, where 60% - 70% are pollutant river water comes from domestic waste (Wibisono, G2013). Domestic Waste Management Using Water Plant Garden Technology (Constructed Wetlands). Indonesian Green Technology Journal 2 (2), 70–77]. By disposing of household liquid waste without going through management it causes the water quality to decrease, conditions like this will be very detrimental for raw water

users. Management is an effort to maintain water so that the desired water quality can be achieved and according to its designation so that the water quality remains in good condition.

Based on the morphology of the Typha Angustifolia plant, it is very suitable for processing with the Ecotech Garden system. The Typha Angustifolia plant has a rich root system that can absorb organic matter in the water table. Meanwhile, Typha Angustifolia plants are widely sold around Jakarta. Based on the above, a study was conducted on the ability of the water plant Cattail (Typha Angustifolia) in the Constructed Wetland System which is expected to reduce BOD, COD and TSS in domestic wastewater. The water jasmine plant (Echinodorus palaefolius) is a plant whose roots are located at the bottom of the waters and its reproduction is flexible, can reduce nutrient levels (eutrophication) in the waters. This water jasmine plant is easy to grow and does not require special care.

In the Sungkowo study using tofu waste, 2 types of plants were used, Typha latifolia (cat's tail plant) and water hyacinth to determine the efficiency of removing COD pollutant parameters by planting mixed plants. showed it could reduce the concentration from 2640 mg/L to 200 with an efficiency of 92.42%. In the Yovo study using domestic waste using Thalia geniculata and Crassipes Eichhornia (water hyacinth) plants, Thalia geniculata and water hyacinth plants provided total efficiency, nitrate [97.64%], total nitrogen [82.38%] and phosphate (22.92%).

Hamizah's research used Typha Angustifolia and Lepironia Articulata (purun Danau) plants to set aside the BOD COD parameter. For the BOD parameter, it was able to reduce contaminants in wastewater from 482.48 mg/L to 28.08 mg/L. Meanwhile, the COD allowance can reach 88.35%. This shows the potential of using mixed vegetation in water bodies that are polluted with various contaminants. The use of hyperaccumulator plants can be combined with fish with other plant species to remove other contaminants found in water bodies. The selection of plant species determines the contaminants present in the water, but sometimes they are not effective enough and sufficient to remove the contaminants effectively. Other factors such as waste characteristics and nutrient availability have a major influence on the growth of bacteria and plants (Yuridna Afifah and Sarwoko Mangkoedihardjo 2018).

Research by Monik Kasman, 2018 on reducing BOD and TSS pollutants in gray water by water jasmine plants. The gray water detention time in the constructed wetlands reactor includes 3 days, 4 days, 5 days, 6 days and 7 days. Constructed wetlands reactor conditions include control reactor without water jasmine (CW 1); reactor with flowering water jasmine (CW 2); reactor with water jasmine with less than (<)20 leaves (CW 3) and reactor with water jasmine with more than (>)20 leaves (CW 4). The results of the research show that detention time and reactor conditions greatly affect the reduction of BOD and TSS. Effluent concentrations of BOD and TSS decreased with increasing detention time. Meanwhile, based on the conditions of the constructed wetlands reactor, it was concluded that the more the number of leaves, the lower the BOD and TSS effluent. Concentrations of BOD and TSS range from (1.6 – 3.22) mg/L) and (0.003 – 0.147) mg/L (Kasman et al. 2018).

II. METHODOLOGY

This type of research is quasi-experimental in nature, which is a research method that uses a quantitative approach, carrying out three control activities, manipulating activities, and observation. The research was conducted at the Work Workshop of the Department of Environmental Health, Health Polytechnic Jakarta II. The population in this study is household waste which is discharged directly into a water body, namely in the Jelawe River. According to Kasman, domestic waste water is waste water originating from residential areas. In general, this waste water occurs from excreta (feces and urine). Water used for washing kitchens and bathrooms (consisting of organic materials) originating from other sources such as rainwater mixed with sewage water and so on. The sample in this study was 60 liters of liquid waste water at the mouth of the Jelawe River household waste.

Sampling technique are taken by grab sampling or momentary sampling. Tools and materials used include: acrylic and acrylic glue, toolkit, scales, Echinodorus palaefolius plant with 20 leaves, Typha Angustifolia plant with 20 leaves, gravel, and pipes. How the Ecotech Garden method of wastewater treatment works:

1. Create 6 waste treatment miniatures using acrylic with a size of 50x50x50 cm (as shown in picture 3.1)

2. Plants that have been purchased are maintained for 6 days to adjust the plants to the environment.
3. In box 1 and box 2: filled with waste and given Typha Angustifolia plants then given gravel that has been washed on top of the planting medium
4. In box 3 and box 4: filled with waste and given the Echinodorus palaefolius plant then given gravel which has been washed on top of the planting medium
5. In box 5 and box 6: column 1 column 1 is filled with waste as a control
6. Household liquid waste levels are measured for pH, temperature, TSS, BOD and COD before being treated
7. The 6 box were left in contact for 6 days (5 days of residence time), every day the levels of TSS, BOD and COD were measured
8. Calculated the reduction in the levels of TSS, BOD and COD pollutants

Data collection was carried out by measuring temperature, pH, odor and turbidity. Wastewater samples were taken as much as 1 liter every day for laboratory tests for TSS, BOD and COD. The results of the inspection made a table. To find out the difference in the reduction of pollutants by plants, an Anova test was carried out. The effectiveness test was carried out by calculating the decrease in levels and comparing it with the standard. Effective if the plant is able to reduce levels of indicators below the quality standard. Ineffective if the plant is not able to reduce the levels of indicators below the quality standard. Presentation of data using tables and graphs.

III. RESULT AND DISCUSSION

Differences in the reduction of TSS, BOD and COD levels from household waste after treatment using Echinodorus palaefolius and Typha Angustifolia plants

The best decrease in TSS levels occurred in processing using Echinodorus palaefolius because it met the requirements on day 3 of 58% and mapir. And the control up to day 5 of the stay still does not meet the requirements.

In the statistical test there was no significant difference in the average TSS level in the average TSS level in the control, Echinodorus palaefolius, and Typha Angustifolia (Pvalue = 0.631)

Table 1: Distribution of the average TSS levels in the treatment with Echinodorus palaefolius and Typha Angustifolia

Variable	Mean	SD	95% CI	P value
Control	103,8	43,77	49,45 – 158,15	0,631
Echinodorus palaefolius	74,7	52,17	9,93– 139,47	
Typha Angustifolia	83,80	48,13	24,04 – 143,46	

Statistically (Table 2) with a Pvalue of 0.004 meaning that there was a significant difference in the average BOD levels between groups and a significant difference was between Echinodorus palaefolius and controls.

Table 2: Distribution of average BOD levels in treatment with Echinodorus palaefolius and Typha Angustifolia

Variabel	Mean	SD	95% CI	P value
Controls	52,28	10,57	39,15 – 65,41	0,004
Echinodorus palaefolius	18,78	7,22	9, 81 – 27,75	
Typha Angustifolia	34,884	17,31	13,39 – 56,37	

Household waste contains organic matter and suspended solids so that the BOD (Biological Oxygen Demand) is usually high. Organic components will decompose biologically so that the oxygen content becomes less. Floating materials in the form of organic and inorganic materials on the surface of the water or are in suspension. This condition inhibits the rate of photosynthesis and affects the self-purification process (Eddy Sontan M Karden, 2007) With Ecotech garden can prevent the formation of suspension of organic and inorganic

materials and increase the value of oxygen. However, statistically there was no significant difference in the average COD level of each treatment (Pvalue = 0.115).

Table 3: Distribution of the average COD levels in the treatment with Echinodorus palaefolius and Typha Angustifoli

Variabel	Mean	SD	95% CI	P value
Controls	137,98	63,14	59,58 – 216,38	0,120
Echinodorus palaefolius	56,78	17,27	35,32 – 78,23	
Typha Angustifolia	106,98	74,81	14,08 – 199,88	

With a certain concentration and quantity, the presence of waste can have a negative impact on the environment, especially for human health, so it is necessary to handle the waste. The level of poisoning hazard caused by waste depends on the type and characteristics of the waste (Sarudji Didik, 2010).

COD is a parameter of liquid waste quality, and is a measure of the requirements for sample oxygen requirements under certain conditions, which are determined using chemical oxidants, there is a relationship between COD and BOD but varies from one city to another (Suparmin, 2002).

The effectiveness of reducing BOD, COD and TSS levels from household waste using the ecotech garden method

Table 4: Decreased TSS Levels in Controls, Treated with Echinodorus palaefolius and Typha Angustifolia

Contact Time	Controls	Echinodorus palaefolius	Typha Angustifolia
1 day	157,5	148,0	149,5
Effectiveness	Ineffective	Ineffective	Ineffective
2 days	137,0	108,5	111,0
Effectiveness	Ineffective	Ineffective	Ineffective
3 days	100,0	56,0	76,0
Effectiveness	Ineffective	Ineffective	Ineffective
4 days	72,5	38,0	57,5
Effectiveness	Ineffective	Effective	Ineffective
5 days	52,0	23,0	25,0
Effectiveness	Ineffective	Effective	Effective
Communal Quality Standards	50	50	50

Effectiveness results based on DKI Jakarta Governor Regulation 122 of 2005, it can be seen that the control up to day 5 is not effective but the treatment with EGA with Echinodorus palaefolius plants can reduce TSS levels to be effective on day 4 and on Typha Angustifolia bari plants it is effective on day 5 (Table 4).

The ability of plants to reduce BOD can be seen in table 5. Treatment with EGA can reduce BOD numbers and is effective on day 2, for Typha Angustifolia plants it can be seen that on day 3 it is not effective probably due to rotting of the plants on the outermost petals, so the BOD results on day 3 is not effective.

Table 5: Reducing BOD Levels in Controls, Treated with Echinodorus palaefolius and Typha Angustifolia

Contact Time	Controls	Echinodorus palaefolius	Typha Angustifolia

1 day	68,2	24,2	60,2
Effectiveness	Ineffective	Ineffective	Ineffective
2 days	48,0	10,9	20,5
Effectiveness	Effective	Effective	Effective
3 days	44,2	26,7	45,2
Effectiveness	Effective	Effective	Effective
4 days	57,7	20,5	27,2
Effectiveness	Ineffective	Effective	Effective
5 days	43,3	11,6	21,3
Effectiveness	Effective	Effective	Effective
Communal Quality Standards	50	50	50

For COD levels (Table 6), treatment using EGA will be effective in reducing COD levels, but it is better for Echinodorus palaefolius compared to Typha Angustifolia.

Table 6: Decreased COD Levels in Controls, Treated with Echinodorus palaefolius and Typha Angustifolia

CONTACT TIME	CONTROLS	Echinodorus palaefolius	Typha Angustifolia
1 day	240,9	76,9	239,2
Effectiveness	Ineffective	Effective	Ineffective
2 days	74,3	40,8	55,3
Effectiveness	Effective	Effective	Effective
3 days	143,4	68,7	83,2
Effectiveness	Ineffective	Effective	Ineffective
4 days	127,3	60,2	84,1
Effectiveness	Ineffective	Effective	Ineffective
5 days	104,0	37,3	73,1
Effectiveness	Ineffective	Effective	Effective
Communal Quality Standards	80	80	80

The Echinodorus palaefolius plant can be used especially in cities as a garden which is made in ditches around the house, the garden does not take up space but can reduce the numbers of BOD, COD and TSS pollutants before being discharged into water bodies so that household waste will not damage the water ecosystem. Echinodorus palaefolius plants often flower out of season and don't need special handling because they are easy to live so they don't require special handling in managing the garden.

Residential and non-residential buildings that have been built and do not yet have a domestic wastewater management installation that meets the requirements for wastewater quality standards, are required to repair and/or build a domestic wastewater treatment installation (Pemprov DKI. Regulation of the Governor of the Province of the Special Capital Region of Jakarta Number 122 of 2005). The domestic wastewater treatment plant to be built can be adapted to local conditions. The selected wastewater treatment technology must be able to improve the quality of the effluent water chemically, physically and bacterially [Euis Nurul Hidayah, Wahyu Aditya, Potential and Influence of Plants on Domestic Wastewater Treatment with the Constructed Wetland System at the National Development University "Veteran" East Java. Surabaya]. It is expected that the quality of wastewater from the processing of the Ecotech garden method can be used on a par with the quality of the fourth class. Class four, water that can be used for irrigation, planting and/or other uses

that require the same quality of water as that use (Government Regulation of the Republic of Indonesia Number 82, 2001). Ecotech Garden (EGA) is an alternative technology for ditch water treatment using ornamental water plants. Pollutants BOD, COD, Detergent, Pathogenic bacteria, and remove odors and purify water. Several types of plants that can be planted include Canna Aquatic, Typa sp, Thalia Dealbata, Cyperus Altemifolius, Pontederia Condata Arrouhead Sagita Japonica, Waterdop-Echinodorus Paleafolius, water hyacinth (Ministry of Environment Regulation No. 112 of 2003).

IV. CONCLUSION

In this study the Echinodorus palaefolius plant was more effective than the Typha Angustifolia plant in reducing pollutant levels. Suggestions in this study are that acclimatization time should be paid more attention, especially if the plants used are plants from areas with different climatic conditions, before household waste is disposed of into water bodies it is better to make an EHA garden in the spal, and use the Echinodorus palaefolius plant in making EGA because lowers pollutants faster and does not need special treatment.

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REFERENCES

[1.] Amha Rosihan, Pengertian Limbah Cair. dipetik tanggal 12 Februari 2019, dari: https://www.astalog.com/8682/pengertian-limbah-cair.htm
[2.] Kasman, M., Kalsum, S.U., Aditia, A.S., (2012). Reduksi pH, BOD dan COD dalam Grey Water dengan Proses Elektrokuagulasi-Sedimentasi Jurnal Ilmiah Universitas Batanghari Jambi 12(3), 2–5
[3.] Suswati, A.C.S.P., Wibisono, G. (2013). Pengolahan Limbah Domestik Dengan Teknologi Taman Tanaman Air (Constructed Wetlands). Indonesian Green Technology Journal 2 (2), 70–77
[4.] Juli Soemirat Slamet, Kesehatan Lingkungan . Penerbit Penerbit Gadjah Mada University Press. Yogyakarta : 1996
[5.] Yuridna Afifah dan Sarwoko Mangkoedihardjo Studi Literatur Pengolahan Air Limbah Menggunakan Mixed Aquatic Plants Fakultas Teknik Sipil, Lingkungan, dan Kebumian, Institut Teknologi Sepuluh Nopember (ITS). Surabaya: 2018
[6.] Monik Kasman dkk Pemanfaatan Tumbuhan Melati Air (Echinodorus Palaefolius) dengan Sistem Constructed Wetlands untuk Pengolahan Grey Water Fakultas Teknik, Universitas Batanghari. Jambi : 2018.
[7.] Sutanto. Statistik Kesehatan. UI Press. Jakarta:2010
[8.] Eddy Sontan M Karden. Pengelolaan Lingkungan Hidup. Djambatan : 2007
[9.] Sarudji Didik. Kesehatan Lingkungan, Karya Putra Darwati. Bandung : 2010
[10.] Soeparman, Suparmin. Pembuangan Tinja dan Limbah Cair Suatu Pengantar,. Buku Kedokteran EGC : 2002
[11.] Pemprov DKI. Peraturan Gubernur Provinsi Daerah Khusus Ibukota Jakarta Nomor 122 Tahun 2005, tentang Pengelolaan Air Limbah Domestik Di Provinsi Daerah Khusus Ibukota Jakarta. Jakarta : 2005
[12.] Euis Nurul Hidayah, Wahyu Aditya, Potensi Dan Pengaruh Tanaman Pada Pengolahan Air Limbah Domestik Dengan Sistem Constructed Wetland Universitas Pembangunan Nasional "Veteran" Jawa Timur. Surabaya
[13.] Peraturan Pemerintah Republik Indonesia Nomor 82, tahun 2001 tentang Tentang Pengelolaan Kualitas Air Danpengendalian Pencemaran Air. Jakarta: 2001
[14.] Peraturan Menteri KLH No. 112 Tahun 2003 tentang standar kualitas air limbah rumah tangga. Jakarta: 2003