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THE EFFECT OF THE CONSTRUCTED WETLAND SUBSURFACE MODEL USING TWO SPECIES OF Epipremnum aureum AND Canna indica IN REDUCE COD IN LAUNDRY WASTE

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Abstract

Pollution of aquatic ecosystems is mostly caused by human activities such as the laundry industry in urban areas, where often the disposal of laundry waste that is discharged directly without proper management triggers environmental pollution. There are two compounds in laundry waste that are difficult to decompose naturally in water, which can trigger environmental pollution in river ecosystems, namely sodium dodecyl benzene sulfonate (NaDBS) and sodium tripolyphosphate (STTP). Therefore, it is necessary to carry out integrated treatment measures, one of which is the Subsurface Flow Constructed Wetland model. This research aims to see the level of effectiveness of the subsurface Flow constructed wetlands model using two types of plants, namely Epipremnum aureum and Canna indica in reducing the laundry waste parameters such as Chemical Oxygen Demand (COD), Total Suspended Solid (TSS) and Detergent. This research was carried out experimentally by comparing the output of the reactor processing between the inlet and outlet. Based on this research, it can be concluded that the level of effectiveness of laundry waste treatment in the subsurface flow constructed wetland system model uses two types of plants, namely Epipremnum aureum and Canna indica can reduce the concentration of test parameters, namely COD by 76.4%, TSS by 66.2%, and Detergent by 80.9%.

***Keywords**: Laundry Waste; Subsurface Flow; Constructed Wetlands; COD*

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INTRODUCTION

Indonesia is a country that has many cases of environmental pollution problems, especially in river waters. It can occur due to human activities which often dispose of waste directly into river bodies without prior waste treatment. Hence it has triggered serious environmental pollution problems over time such as a decrease in the quality of river water. As for most of the rivers in Indonesia, the level of pollution comes from domestic waste ranging from 60% -70% (Trifando et al., 2022). According to the Decree of the Minister of Environment (Kepmen LH) number 112 of 2013 concerning quality standards for domestic wastewater, most of them come from office activities, residential areas, laundry businesses and other public places.

The laundry waste itself contains detergents which are used to wash dirty clothes and are often found in the laundry industry. Meanwhile, the content of the detergent itself consists of three basic components, namely the first surfactant of 20-30% which functions as a dirt binder, the second is an additive consisting of bleach and deodorizer of 2-8%, and the third is a phosphate compound builder of 70-80% (Saparuddin, 2019). Apart from that, there are also two compounds in laundry waste that are difficult to decompose naturally in water, which can trigger environmental pollution in river ecosystems, the two compounds are sodium dodecyl benzene sulfonate (NaDBS), which is usually a foam-producing compound, and sodium tripolyphosphate (STTP) which functions as a builder. These two compounds are capable of deactivating the hardness minerals in water so that the detergent works optimally in cleaning dirty clothes (Afrianti & Irni, 2020).

There are several factors that cause laundry waste to be disposed of without prior treatment, including because there are no special waste treatment facilities, then the availability of land in urban areas is very minimal, the economic level is low, and people's behavior is still not concerned about protecting the surrounding environment. (Darmayanti et al., 2013).

The danger that can arise from domestic waste, especially such as laundry waste disposal, is the decrease in the quality of the existing water, which can then cause various health problems such as skin diseases and diarrhea. This can be caused because domestic waste itself has several criteria such as containing concentrations of Biochemical Oxygen

Demand (BOD), Chemical Oxygen Demand (COD), oil and grease, nitrogen, phosphates and detergents which can contaminate water bodies (Astuti et al, 2016).

Therefore, an integrated waste management system is needed, one of which is the Subsurface Constructed Wetland system. This system is also a method of treating wastewater that is easy, cheap and has good capabilities (Siswoyo et al., 2020). In addition, this processing system is relatively easy to use and does not require special skills to carry out its operations (Rangel-Peraza et al, 2019).

Other advantages are also according to (Prabowo & Mangkoedihardjo, 2013 in Fildzah et al., 2016) domestic waste treatment using the Subsurface Flow Constructed Wetland system can produce an optimum BOD and COD reduction of 75% and 87%. Therefore this research used two types of plants, namely *Epipremnum aureum and Canna indica* which are proven to have resistance to domestic waste, one of which is laundry waste (Yadav et al., 2021). And this research will also discuss the level of effectiveness of the two plants *Epipremnum aureum* and *Canna indica* in reducing COD, TSS, and detergent loads in laundry waste using the Subsurface Constructed Wetland system method.

RESEARCH METHODS

The research was carried out from May to July 2022. The location of the research was carried out in the Biotechnology faculty laboratory and the Chemical Environmental Risk Factors laboratory (Yogyakarta Center for Environmental Health Engineering and Disease Control).

For sampling, laundry waste was obtained from one of the laundry businesses in the Lempuyang area, Yogyakarta. Laundry waste processing and parameter testing such as Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), pH, temperature were carried out at the Environmental Laboratory of the Faculty of Biotechnology, Duta Wacana Christian University. While testing the parameters of Total Suspended Solid (TSS) and Detergent were carried out at the Environmental Risk Factor Laboratory Installation, Center for Environmental Health Engineering and Disease Control (BBTKLPP), Yogyakarta.

This research was conducted on a laboratory scale using the Sub Surface Flow Construted Wetland model using two types of plants, namely *Epipremnum aureum* and *Canna indica*. The

components of the reactor consist of *Epipremnum aureum* and *Canna indica* plants, paddy soil, gravel, medium stones and large stones. With the ratio of the depth of arrangement of each component based on research (Loshinta et al, 2020) 7.7 cm paddy soil, 23 cm gravel, 23 cm medium stones, and 17 cm large stones. The other supporting components for the reactor were the inlet tub from a 120 liter capacity drum and the outlet tub from a 26 liter bucket, then the infusion hose connector which functions as a regulator of water discharged at the desired HRT duration.

The data analysis process used the One-Way ANOVA (analysis of variance) method. Where this method can detect differences in average values between wastes after or before processing so that it made easier to carry out data analysis processing such as TSS parameter data, temperature, pH, DO, COD, Detergent, leaf width, leaf length, and plant stem height. In addition, the results obtained were compared with the quality standards for laundry waste based on DIY Regional Regulation number 7 of 2016 concerning Quality Standards for Laundry Wastewater and analyzed descriptively.

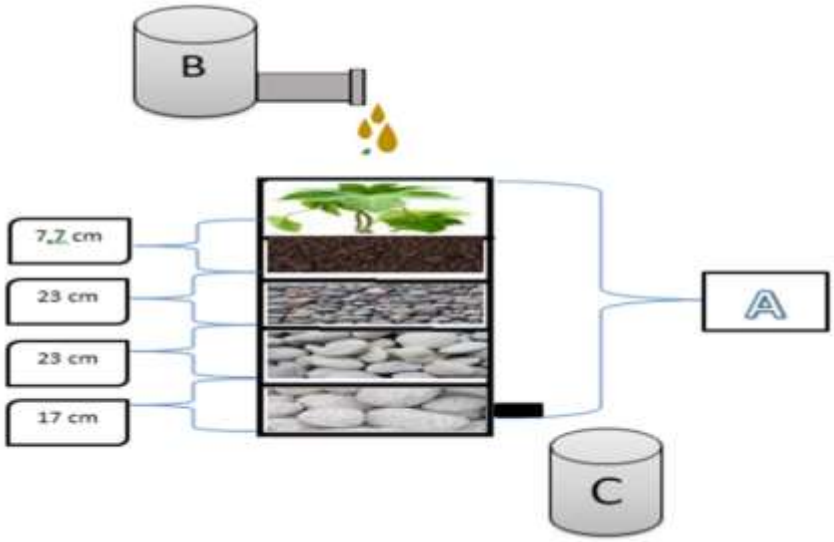

Figure 1. (A) Design of the Sub Surface Flow Construted Wetland reactor with two types of Epipremnum aureum and Canna indica plants, (B) inlet tub, (c) outlet tub used as a storage place for waste output from the reactor. (Source: Personal document)

RESULTS AND DISCUSSION

Parameter testing was carried out every 3 days for 24 days both from the inlet and outlet tubs with 2 parameter test repeaters. The COD test method used Colorimetry, DO used the Winkler method, pH meter, Temperature used a Thermometer, Detergent used the

IK/BBTKLPP/3-K/PjC-31 method, and TSS used the In House Methode.

From the research results obtained in the processing of laundry waste using *the Sub Surface Flow Construted Wetland* model using two types of plants namely *Epipremnum aureum* and *Canna indica* succeeded in reducing pollutant concentrations in laundry waste such as COD, TSS and Detergent with different levels of efficiency.

Table 1. Parameter Test Results for Laundry Waste on Sub Surface Flow Constructed Wetland.

No	Parameter	Unit	inlet	Outlets	Treatment Efficiency (%)	Quality standards*
1.	COD	mg/L	29,8b	7.03a	76.4%	150
2.	DO	mg/L	0.6b	3,5a	-	-
3.	TSS	mg/L	507b	171 a	66.2%	100
4.	Detergent	mg/L	75.2 b	14.3 a	80.9%	5
5.	Temperature	°C	28a	28 a	-	±3°C air temperature
6.	pH	-	8,1a	8 a	-	6-9

(*): Regional Regulation of DIY nr. 7of 2016 concerning Wastewater Quality Standards.

In table 1. The results of the parameter test for Inlet and Outlet laundry waste which have been processed in a reactor with an estimated HRT of 3 days have succeeded in reducing test parameters such as COD, TSS, and detergent with an efficiency above 50%. From the results of table 1, it is known that the Sub Surface Flow Construted Wetland model treatment system used two types of plants, namely *Epipremnum aureum* and *Canna indica*. It succeeded in reducing the levels of detergent and COD in laundry waste, namely 80.9% and 76.4% which were obtained from the comparison between the inlet and outlet output.

Based on (Al Kholif et al, 2020) the reduction factor for detergent and COD is in the Sub Surface Flow Construted Wetland system since the microorganisms present in the waste can break down the pollutants in the waste besides that the soil media functions as a place for microorganisms to attach as well as a support for plants. and can help the process of filtration and accommodate sediment. Meanwhile (Gupta et al., 2016) states that COD and detergent can also decrease due to the presence of reactor constituent components such as large rocks with porous surfaces.

It is due to the porous rock structure can become a place for contaminants to attach and can increase the growth of microorganisms on the rock surface so that the effectiveness of the Constructed Wetland system will also increase even better. It can be proven in Figure 2, which shows medium and large stones experiencing a blackish discoloration.

Total Suspended Solids(TSS) itself is a small solid-like material consisting of particles of organic and non-organic matter suspended in waters (Jiyah et al., 2017). The danger of high TSS content in aquatic ecosystems is that it can cause a decrease in photosynthetic activity in aquatic plants so that it can reduce dissolved oxygen levels in water and the worst impact can cause death to aquatic biota.

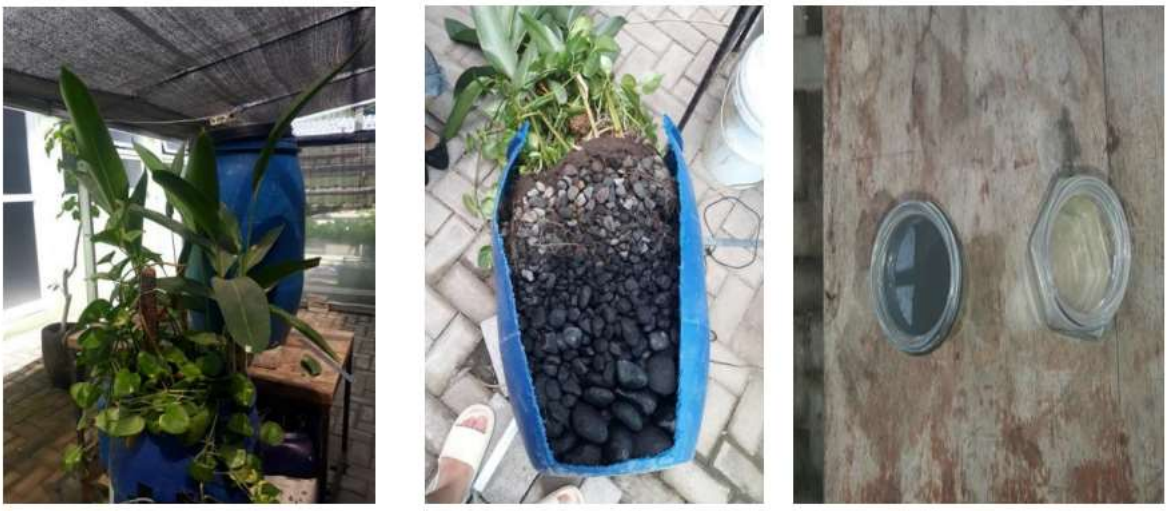

Figure 2. Documentation of the reactor, (a) condition of the reactor, (b) condition of the reactor after being dismantled on the 24th day, (c) photos of waste before and after processing. (Source: Personal Documents)

In Table 1. TSS can decrease in the SSF-CW system due to physical processes such as filtration, adsorption, and sedimentation. It is also in accordance with what was stated by Sitoresmi (2015) that TSS can experience a decrease in concentration due to physical processes in the Constructed Wetland system, for example such as filtration caused by gravel or rock components, then sedimentation processes, and adsorption caused by the existing soil media. The highest percentage reduction in TSS concentration in the Constructed Wetland system occurred in the components in the sand and gravel media with a TSS reduction percentage rate of 85% -90% (Minakshi et al., 2022)

The Dissolved Oxygen (DO) parameter or also known as dissolved oxygen is very important for the Constructed Wetlands system. It is since the higher the DO value in water, the performance of microorganism activities

in reducing pollutants in waste, such as BOD and COD (Hidayah et al., 2018).

The results are shown in table 1. DO concentration increased at the outlet of the laundry waste treatment system, where initially the DO concentration at the inlet was only around 0.6 mg/L. However, after the waste was processed in the Sub Surface Flow Constructed Wetland using two types of plants, namely *Epipremnum aureum and Canna indica,* there was an increase in the DO concentration at the Outlet by 3.5 ppm, which was 7 times greater than the DO at the Inlet.

Based on (Hidayah et al, 2018) it can occur due to the activity of the *Epipremnum aureu*m and *Canna indica* plants in absorbing the nutrients present in laundry waste thereby triggering photosynthetic activity in plants and when this process occurs the plant undergoes diffusion which can increase the levels of dissolved oxygen in the Constructed Wetlands system. Another factor is the flow of wastewater that flows from top to bottom (vertically). It can also affect the addition of the concentration of DO due to the aeration of wastewater from a vertical flow.

The temperature and pH in the results of table 1. are one of the important supporting parameters in the Constructed Wetland system. It is supported by research (Parde et al., 2021) where the pH value in the Constructed Wetland must be kept close to a neutral pH, because pH can affect the course of photosynthetic activity in plants and microorganisms in the Constructed Wetland reactor. While the good temperature for the Constructed Wetland reactor system is the mesophilic condition (20-45°C) which is the optimum temperature condition for reducing organic and non-organic matter in waste (Al Kholif et al, 2020). The temperature of the wastewater also greatly influences the Constructed Wetland system because the activity of plants and microorganisms is highly dependent on temperature in the decomposition process of pollutants such as BOD, COD, and TSS (Astuti et al, 2016).

CONCLUSION

From the research that has been done, it is known that the level of effectiveness of laundry waste processing in the subsurface flow constructed wetland system model used two types of plants, namely *Epipremnum aureum and Canna indica* in the test parameters, namely COD of 76.4%, TSS of 66.2%, and Detergent of 80.9%.

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