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GREYWATER TREATMENT DEVELOPMENT MODEL USING CONSTRUCTED WETLAND THROUGH MUTUALISM SYMBIOSIS HYDROPHYTA AND MYCORRIZHA

Roslinda Ibrahim
Environment Engineering Department, Hasanuddin University, 90245,
Makassar City, Indonesia

Mary Selintung
Environment Engineering Department, Hasanuddin University, 90245,
Makassar City, Indonesia

Baharuddin
Agrotechnology Engineering Department, Hasanuddin University, 90245,
Makassar City, Indonesia

Rita Tahir Lopa
Civil Engineering Department, Hasanuddin University, 90245,
Makassar City, Indonesia

ABSTRACT

The problem of greywater management must be handled appropriately because it can cause environmental pollution. This phenomenon is as the basic to conduct study to overcome environmental problems by processing greywater. The objective of this study was to analyze the effect of symbiotic mutualism of Hydrophyta and mycorrhiza on the efficiency of greywater contaminant removal. The result can be a reference model of greywater processing at the household level or small scale. The experimental research was designed to flowing greywater into the reactor by several treatment variations, followed by BOD and COD parameters. The data were analyzed by two-way anova statistics. The symbiosis of mutualism Hydrophyta and mycorrhizal fungi increasinged the efficiency of the greywater contaminant in the constructed wetland system. The variation can influence the treatments to word plant with the mycorrhizal concentration of 15 g / plant showed that the highest removal efficiency of BOD and COD was 86,96% and 81,08.

Key words: Mutualism Symbiosis, Greywater, Mycorrizha.

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1. INTRODUCTION

The problem of environmental sanitation, especially the management of greywater should be handled seriously, because it can affect the quality of the environment. Almost all of the greywater is dumped into the rivers through drainage. River is defined as natural water where the flow of rain and wastewater into the sea and its abode of biotic and abiotic elements [11]. Greywater without treatment before enter the aquatic can increase COD and BOD, which causes a decrease in dissolved oxygen (DO). the small amount DO in the water will affect the life of fish and other aquatic biota. In addition, the flow of domestic wastewater into the river can also cause bad smell and eutrophication [3]. Proper greywater treatment, can reduce environmental pollution and increase the availability of clean water. Greywater has great potential as an alternative water source for as irrigation, flushing toilets, car washing and watering the yard as well as refill aquifers [8]. About 60-85% of the total volume of clean water needs will be a domestic wastewater [6]. The portion of greywater is about 75% of the total volume of domestic wastewater [4]. The dissemination of the use of greywater has not been widely known and interested by the public due to the difficulty of selecting a suitable greywater treatment system for household level and the lack of knowledge and experience in this issue, especially in developing countries [7]. Proper greywater treatment for household level is easy and economical as most people have financial and knowledge about environmental sanitation. The phytoremediation method in constructed wetland is the right choice that meets these criteria, but the application of phytoremediation method must be accompanied by adequate plant maintenance for the sustainability of its use. Plants used in phytoremediation methods may experience growth disorders caused by contaminants in wastewater. Plants usually miscarried on some parts of the leaves. Therefore, fertilization is important to maintain the growth of plants so it can be used for a long time [5].

Mycorrhizal fertilizer is one type of fertilizer that can be used to support plant growth. In spite of biofertiliser, mycorrhiza also serves as a bioprotector against pathogenic microorganisms and bioremediators for contaminated soil. Several previous studies have showed that mycorrhizal fungi can remove soil contaminants, including pesticide residues and heavy metals. The use of hyperakumulator plants and mycorrhizal may increase the potential for bioremediation process (fitoextraction) of heavy metal contaminated land [1]. Consentration of Cu, Zn, Pb and Cd on the leaves and the uptake of the metal on the roots and leaves of corn plant increased by the presence of mycorrhizal inoculation [16]. Mycorrhizal fungi may be symbiotic with most plant families. The mutualism symbiosis occur in the form of the availability of nutrients for plants by mycorrhiza while the plants provide photosynthesis to support survived of mycorrhizal survival. This relationship can be used in the wastewater treatment process because they support each other. In spite of, plants and mycorrhiza can also function as a biofilter that serves to treat water so that the processing runs quickly and produces effluent with better quality.

Refer to this matter, it is necessary to conduct to know study the effect of symbiotic mutualism of plants with mycorrhizal in removing contaminants in greywater. The presence of symbiotic mutualism, it is expected that the quality of the greywater products will be better and can increase the plant the resistence so that the problems of environmental pollution and water limitations in the dry season because it can be overcome and the use of land and the

fund for building constucted wetland can be decreased. It can also improve the aesthetic and green open space.

2. MATERIAL AND METHODS

This research uses quantitative approach with laboratory-scale experimental research by creating a model of greywater treatment with constructed wetland system. The study was conducted based on Randomized Block Design, consisting of two variables and two replications. The independent variables consisted of Hydraulic Retention Time (HRT) and mycorrhizal concentration while the dependent variable was BOD and COD were remove. Reactor in HRT value of 1 day (24 hours) had a debit of 0.41 ml / sec and reactor in HRT value of 2 days (48 hours) had a debit of 0.20 ml / sec.

This research experiment uses a reactor made of glass. The plants used consist of 3 types of aquatic plants (hydrophyta) which have aesthetic values and growing requirements suitable with the environmental conditions of Makassar City, namely Canna indica, Iris pseuadocorus and Epipremnum aereum. Whereas the microorganisms used are mycorrhizal fungi which have mutualistic symbiosis ability with various types of plants. Variations in mycorrhizal inoculation consisted of 4 concentrations of 0, 10, 15 and 20 grams / plant. Experimental variations and reactor design are presented in Table 1 and Figure 1.

Table 1 Experiment Variation

Mycorrhizal Concentration	**Hydraulic Retention Time**	
	T1 **1 day**	**T2** **2 day**
Control (without plant and mikorrhiza)	T1Ko	T2Ko
M0 0 g/ plant	T1M0	T2M0
M1 10 g/ plant	T1M1	T2M1
M2 15 g/ plant	T1M2	T2M2
M3 20 g/ plant	T1M3	T2M3

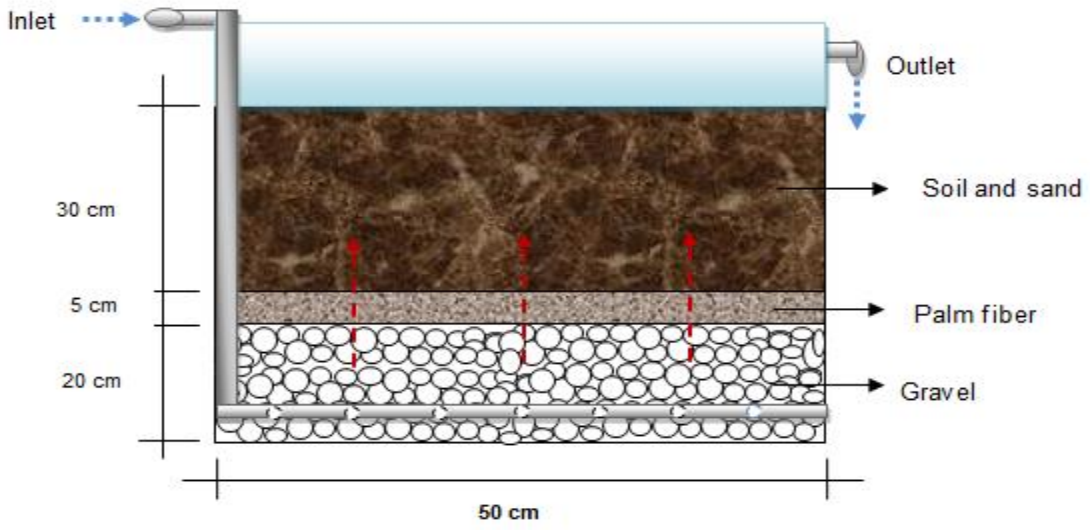

Figure 1 Reactor Constructed Wetland

3. RESULTS AND DISCUSSION

3.1. Analysis of BOD_5 Greywater Removed

The BOD concentration in waste water reveals the amount of organic. BOD inffluent of 184 mg / L, which include the medium-grade wastewater class [10]. The wastewater which include the greywater category, derived from kitchen and bathroom waste it is generally does not contain high concentrations of pollutants, especially organic[15]. The result of laboratory analysis shows that there are some differences of BOD_5's concentration effluent from greywater tretment in each constructed wetland reactor and two of them have fulfilled the standard of T2M1 and T2M2. The decrease in the concentration of organic matter in the wetland system occurs due to the mechanism of activity of microorganisms and plants [17].

Table 2 Average of BOD_5 Greywater

Experiment Variation	Influent (mg/L)	Effluent (mg/L)	Removal Efficiency (%)
T1Ko		80	56,52
T1M0		64	65,22
T1M1	184	40	78,26
T1M2		44	76,09
T1M3		48	73,91
T2Ko		60	67,39
T2M0		48	73,91
T2M1	184	28	84,78
T2M2		24	86,96
T2M3		32	82,61

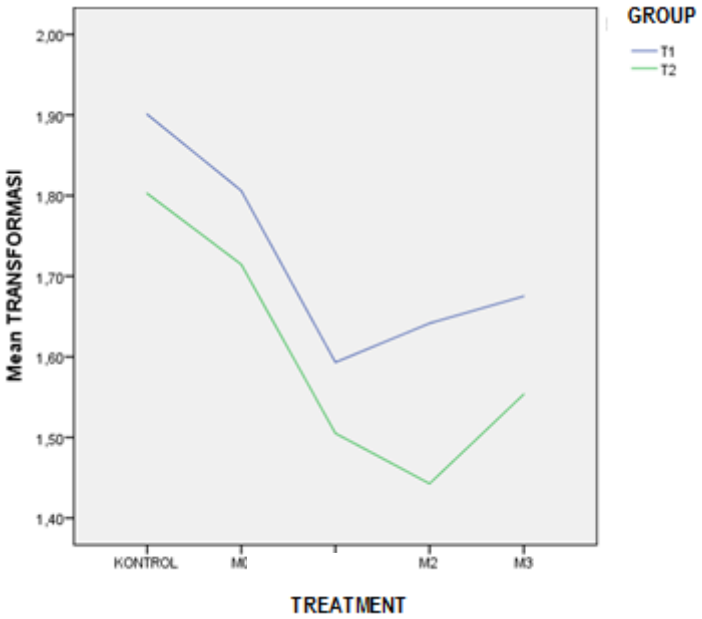

Figure 2

Anova test shows that symbiotic mutualism of plants and mycorrhiza had a positive effect on BOD5 removal. BOD removal of household waste in phytoremediation by plants occurs due to the decomposition of organic and inorganic materials and it is also helped by microorganisms that occur on the roots of plants. Biological degradation mechanisms occur due to microbiological activity at the root [14]. Various enzymes are produced by mycorrhizal fungi can be used to degrade organic materials [9]. The previous research finding showed that

mycorrhiza which in touch with decomposition of soil organic matter will ultimately provides improved land quality [13].

3.2. Analysis of COD Greywater Removed

Chemical oxygen demand (COD) is one of oxygen which is required to oxidize organic substances in the samples. The results of COD quality analysis of wastewater in inlet and outlet of constructed wetland reactor can be seen in Table 3.

Table 3 Average of COD Greywater

Experiment Variation	Influent (mg/L)	Effluent (mg/L)	Removal Efficiency (%)
T1Ko		144	50,00
T1M0		116	59,72
T1M1	274	104	63,89
T1M2		96	66,67
T1M3		112	61,11
T2Ko		124	58,11
T2M0		92	68,92
T2M1	280	64	78,38
T2M2		56	81,08
T2M3		68	77,03

The everage data of COD levels in Table 3 indicate that there are five constructed wetland reactors which various treatment showed high removel capabilities and have fulfilled the standards of T1M2, T2M0, T2M1, T2M2 and T2M3

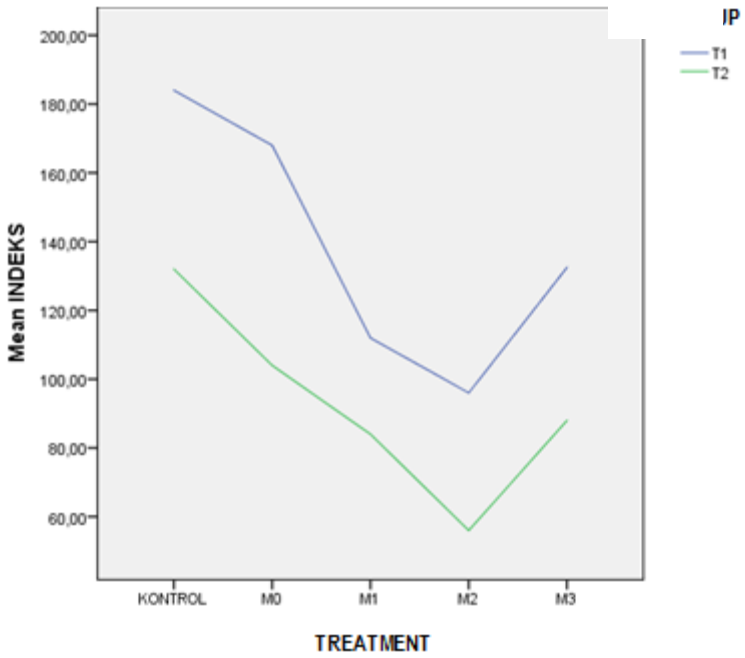

Figure 3 COD Effluent Greywater

Anova test showed that the symbiotic mutualism of hydrophyta with mycorrhiza indicated a positive effect on COD removal. COD removal in the constructed wetland system occurs due to a biological removal mechanism by microorganisms around plant roots in the reactor medium. In this case the organic compounds in the waste are broken by microorganisms into other simpler compounds which are later used as nutrients by plants [12]. The process of

breaking or decomposing organic compounds into simpler one decreases the value of COD indirectly [2]

4. CONCLUSIONS

The symbiotic mutualism of hydrophyta and mycorrhizal fungi give influence the increased of remove efficiency in greywater contaminant in the constructed wetland system. The various treatment to Hydrophyta with 15 g / plant mycorrhiza concentrations showed the highest BOD and COD removal efficiency.

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