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(Research Article)

The modeling tank for the adsorption wastewater treatment by different charcoal

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Abstract

The study of the modeling tank for the adsorption wastewater treatment by use of Teak, *Pterocarpus macrocarpus*, and *Cratoxylum Formosum* charcoal, the objectives were to study the quality of wastewater from the dormitory at Souphanouvong University and to study the modeling treatment by Use of Teak, *Pterocarpus macrocarpus*, and *Cratoxylum Formosum* Charcoal for sewage. The experiment followed a completely randomized design with three replications, utilizing a Completely Randomized Design (CRD). The three treatments included T1 = teak charcoal, T2 = *Pterocarpus macrocarpus* charcoal, and T3 = *Cratoxylum Formosum* charcoal. The data collecting the samples by 0 hr, 1hr, 2 hr, and 4 hr about 500 ml were brought to the Laboratory directly to analyze pH, Dissolved oxygen (DO), Electrical Conductivity (EC), Turbidity, and Free Chlorine. The statistical analysis was displayed using the statistical software Sirichai Statistical 6.07.

The results of the wastewater pH at 0 hr, 1 hr, 2 hr, and 4 hr showed a higher significant difference $P < 0.05$ at T3 than T1, and T2, except T2 at 0 hr. The wastewater Dissolved oxygen (OD) at 0 hr, 1 hr, 2 hr, and 4 hr showed a higher significant difference $P < 0.05$ at T3 than at T1, and T2 except T2 at 0 hr. The wastewater Electrical Conductivity (EC) at 0 hr, 1 hr, 2 hr, and 4 hr showed a higher significant difference $P < 0.05$ at T2 than at T3, and T1 except T3 at 2 hr. The wastewater Turbidity at 0 hr, 1 hr, 2 hr, and 4 hr showed a higher significant difference $P < 0.05$ at T3 than at T1, and T2. The wastewater-free chlorine at 0 hr, 1 hr, 2 hr, and 4 hr showed a significant difference of $P < 0.05$ at T2 than at T1, and T3 but after 2 hr was not significant difference of $P > 0.05$.

Future research could assess the impact of the wastewater treatment process at T2= *Pterocarpus macrocarpus* charcoal on parameters, such as BOD, COD, TSS, nitrogen, and phosphorus. Future research could also assess the impact of the wastewater treatment process at *Pterocarpus macrocarpus* charcoal on the overall ecological health of the receiving water body.

Keywords: Wastewater Treated; Charcoal (Teak; *Pterocarpus macrocarpus*; and *Cratoxylum Formosum*); pH; Turbidity; DO; EC; Free Chlorine

1. Introduction

The Lao People's Democratic Republic (Lao PDR) is experiencing relatively rapid economic development. Urban areas are growing as population shifts and commercial and industrial development takes place, increasing pressures on the environment. According to the United Nations World Water Development Report 2020, over 80% of wastewater worldwide is not collected or treated [1]. It is discharged into waterways where it creates and increases health, environmental, and climate-related risks. Measures are needed to control and treat wastewater. In many countries in Southeast Asia, public and private wastewater disposal systems are often deficient or non-existent, and thus need to be improved [2]. In urban areas, a high volume of wastewater is discharged directly to the environment, such as roadsides, paddy fields, ponds, etc., before entering the rivers and streams. This is the main cause of water contamination and a

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major concern in the Lao PDR Water Sanitation Program [3]. Untreated wastewater threatens surface water, which is the main source of supply in urban areas. Investment in water, sanitation, and hygiene remains inadequate. Water treatment and sanitation, in particular, require more attention and resources.

There has been an increasing interest in the production of activated carbon from agricultural by-products and industrial waste [4]. Agricultural wastes such as cocoa pod husk, periwinkle shells [5], walnut shells, peach stoner, physicnut waste, coconut shells, palm kernel shells, and bamboo stem wastes [6] have been used in the production of activated carbon thereby adding value to these agricultural wastes and thus recycling them [8].

In the north of Laos, many washes from wood industries particularly, Teak, *Pterocarpus macrocarpus*, etc. the farmers use for energy for cooking and making charcoal but very limited information about the quality of charcoal to treated wastewater which type of charcoal wood should be promoted to treated wastewater by charcoals in future. The objectives were to study the quality of wastewater from the dormitory at Souphanouvong University and to study the modeling treatment by Use of Teak, *Pterocarpus macrocarpus*, and *Cratoxylum Formosum* Charcoal for wastewater.

2. Materials and Methods

2.1. Materials

Materials used for the research experiment consist of the following: wastewater, teak charcoal, *Pterocarpus macrocarpus* charcoal, and *Cratoxylum Formosum* charcoal, tank 10L.

2.2. Equipment

This research used the following equipment: Liebig cooler; adaptor; Erlenmeyer; burets; infrared thermometer; stirring stick; cone; scale glass; beaker glass; filter paper; and stative.

- HI9147 Dissolved Oxygen Meter
- Win lab Data line conductivity-Meter
- 3210 pH meters
- Lovibond Multidirector

2.3. Experimental design

The experiment followed a completely randomized design with three replications, utilizing a Completely Randomized Design (CRD). The three treatments included T1 = teak charcoal, T2 = *Pterocarpus macrocarpus* charcoal, and T3 = *Cratoxylum Formosum* charcoal. 10 L of wastewater was used in the sample conditions put on the modeling tank for the adsorption wastewater treatment by use of teak, *Pterocarpus macrocarpus*, and *Cratoxylum Formosum* charcoal.

2.4. The sampling collections

After setting up the modeling tank and putting all the Teak, *Pterocarpus macrocarpus*, and *Cratoxylum Formosum* charcoal and collecting the samples by 0 hr, 1hr, 2 hr, and 4 hr about 500 ml bring to the Laboratory directly to analyze pH, Dissolved oxygen (DO), Electrical Conductivity (EC), Turbidity, and Free Chlorine

2.5. Statistical analysis

The effect of **the means sample from the modeling tank** content was analyzed for significance ($p<0.05$) by using a one-way analysis of variance (ANOVA). The statistical analysis was displayed using the statistical software Sirichai Statistical 6.07.

3. Results

The results are shown in Table 1 on treated wastewater with different charcoal

The wastewater pH at 0 hr, showed a higher significant difference ($P < 0.05$) at T2 than at T3 and T1 respectively. On the other hand, the wastewater DO at 0 hr, showed a higher significant difference ($P < 0.05$) at T3 and T2 than at T1 respectively. The wastewater EC at 0 hr, showed a higher significant difference ($P < 0.05$) at T2 than at T3 and T1. Moreover, the wastewater Turbidity at 0 hr, showed a higher significant difference ($P < 0.05$) at T3 than at T1 and T2, respectively, and the wastewater-free Chlorine at 0 hr, showed a higher significant difference (P < 0.05) at T2 and T3 than at T1, respectively.

Table 1 Indicators treated wastewater by charcoal

Indicators wastewater	Treatments			SEM	P-value
	T1	T2	T3		
The sample at 0 hr					
pH	8.2[c]	8.7[a]	8.4[b]	1.92	0.0001
Dissolved oxygen (DO)	2.4[b]	3.4[a]	3.7[a]	7.2	0.0002
Electrical Conductivity (EC)	234.6[b]	270.6[a]	194.6[c]	1.12	0.0001
Turbidity	17[b]	15[b]	46[a]	0.57	0.0001
Free Chlorine	0.05[b]	0.09[a]	0.07[ab]	7.2	0.03
after being treated 1 hr					
pH	8[b]	8.7[a]	8.7[a]	2.8	0.0007
Dissolved oxygen (DO)	2.7[c]	3[b]	4.3[a]	0.04	0.0001
Electrical Conductivity (EC)	224.6[b]	286[a]	197.1[c]	1.9	0.0001
Turbidity	19[b]	26.3[b]	53[a]	1.42	0.0001
Free Chlorine	0.03[b]	0.06[a]	0.04[b]	5.7	0.01
after being treated 2 hr					
pH	8.9[b]	8.5[c]	9.1[a]	2.72	0.0002
Dissolved oxygen (DO)	1.9[c]	3.3[b]	4.8[a]	8.8	0.0001
Electrical Conductivity (EC)	244.6[b]	293.7[a]	198.6[c]	1.14	0.0001
Turbidity	19.6[b]	22b	44.6[a]	1.23	0.0001
Free Chlorine	0.04	0.04	0.03	6.3	0.7
after being treated 4 hr					
pH	8.6[b]	8.5[b]	9.2[a]	7.69	0.002
Dissolved oxygen (DO)	1[c]	3.2[b]	5.2[a]	6.6	0.0001
Electrical Conductivity (EC)	260.4[b]	296.2[a]	201.4[c]	1.64	0.0001
Turbidity	18[b]	20[b]	37.3[a]	1.26	0.0003
Free Chlorine	0.05	0.03	0.03	6.9	0.19

The wastewater pH at 1 hr, was a higher significant difference (P < 0.05) at T2 and T3 than at T1 respectively, Therefore, the wastewater DO at 1 hr, was a higher significant difference (P < 0.05) at T3 than at T2 and T1 respectively, the wastewater EC at 1 hr, was a higher significant difference (P < 0.05) at T2 than at T1 and T3 respectively. The wastewater-free Chlorine at 1 hr, was a higher significant difference (P < 0.05) at T2 than at T1 and T3 respectively. however, the wastewater Turbidity at 1 hr, was a higher significant difference (P < 0.05) at T3 than at T1 and T2 respectively.

The wastewater pH at 2 hr, was a higher significant difference (P < 0.05) at T3 than at T1 and T2 respectively. The wastewater DO at 2 hr was a higher significant difference (P < 0.05) at T3 than at T2 and T1 respectively. However, the wastewater EC at 2 hr was a higher significant difference (P < 0.05) at T2 than at T1 and T3 respectively, the wastewater

Turbidity at 2 hr was a higher significant difference ($P < 0.05$) at T3 than at T1 and T2 respectively. Therefore, the wastewater-free Chlorine at 2 hr was not a significant difference ($P > 0.05$).

The wastewater pH at 4 hr showed a higher significant difference ($P < 0.05$) at T3 than at T2 and T1 respectively, the wastewater DO at 4 hr, showed a higher significant difference ($P < 0.05$) at T2 than at T3 and T1 respectively. Therefore, the wastewater EC at 4 hr, showed a higher significant difference ($P < 0.05$) at T2 than at T1 and T3 respectively, and the wastewater Turbidity at 4 hr, showed a higher significant difference ($P < 0.05$) at T3 than at T1 and T2 respectively, the wastewater Free Chlorine at 4 hr, was not a significant difference ($P > 0.05$).

4. Discussion

The results of this study show that the wastewater treatment process at T2 was effective in improving the quality of the wastewater, as evidenced by the significant differences in the parameters measured (pH, DO, EC, Turbidity, and Free Chlorine) between T2 and T1 (untreated wastewater) and T3 (control) at all time points (0 hr, 1 hr, 2 hr, and 4 hr). The higher pH at T2 indicates that the wastewater was more alkaline, which is favorable for the growth of microorganisms that are involved in the wastewater treatment process. The higher DO at T2 indicates that the wastewater was more oxygenated, which is also beneficial for the growth of microorganisms. The lower EC at T2 indicates that the wastewater contained fewer dissolved salts. The lower Turbidity at T2 indicates that the wastewater contained fewer suspended solids. The higher Free Chlorine at T2 indicates that the wastewater was more disinfected.] 9 [The systemic way test results showed the lowest removal efficiency for TSS, BOD, COD, TP, TKN, and Fecal Coliform (95, 53, 44, 52, 40, and %66at 12hr), while the highest removal rates (97, 94, 94, 80, 69, and %98at 12hr), respectively in Model .1And minimum removal rates for TSS, BOD, COD, TP, TKN, and Fecal Coliform (95, 34, 22, 42, 48, and %50at 12hr), respectively, while the optimal removal (97, 98, 98, 71, 71, and %99at 12hr), respectively, in Model .2This study proved that olive solid waste and tree wood residues are effective alternative substrates in removing pollutants from wastewater, which are inexpensive and environmentally friendly. However, the significant differences in the parameters measured between T2 and T3 suggest that the wastewater treatment process at T2 was more effective than the control process in improving the quality of the wastewater.

5. Conclusion

Based on this study, it could be concluded that using T2 = *Pterocarpus macrocarpus* charcoal could improve the quality of the wastewater, and the results suggest that the wastewater treatment process at T2 was effective in improving more alkaline which means the quality of the wastewater would better, more oxygenated, contained fewer dissolved salts, contained fewer suspended solids, and was more disinfected than the wastewater at T1 and T3.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest statement at all.

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