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PERFORMANCE OF AERATED FLOATING AQUATIC PLANT SYSTEM IN WASTEWATER TREATMENT

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ABSTRACT

A simple lab-scale experiment was conducted to study the performance of aerated and non-aerated water hyacinth systems in treating domestic wastewater. The aerated water hyacinth system showed higher removal efficiencies than the non-aerated water hyacinth system. This may be due to aeration induced mixing of water which allow a greater portion of the wastewater to contact the root zone of the plant, and also increase in microbial activities.

INTRODUCTION

One of the principal floating aquatic plants used in aquatic treatment system is the water hyacinth (*Eichhornia crassipes*). From previous experiments conducted at UTM, the plant were found to be able to remove between 80 % - 90 % of organic and inorganic parameters from domestic wastewater. As the plant requires oxygen and carbon dioxide for their growth, supplementary aeration can be used with the floating aquatic plant system to maintain aerobic conditions necessary for increasing removal efficiency. This study was designed to determine and compare removal efficiencies of water hyacinth system with and without aeration in treating domestic wastewater.

MATERIALS AND METHODS

In this laboratory scale experiment domestic wastewater from an oxidation pond at UTM was treated using an aerated water hyacinth (AWHS) and non-aerated water hyacinth system (NWHS). A total of four 60 litre buckets were used for this purpose. All of the buckets were filled with approximately 55 l wastewater in which two of the buckets were filled with approximately 450 g water hyacinth. each. The depth of each of the wastewater filled buckets was about 50 cm. The plants used in the experiment were also taken from the pond. One bucket with water hyacinth and one bucket without water hyacinth was provided with aeration using a small air pump fitted with a small tube and diffuser. The detention time for the experiment was set at 5 days with continuous aeration. Samples from each buckets were collected an analysed on the first and fifth day. The parameters analysed for the experiment were BOD_5, COD, Fe, Mg, Cu.

RESULTS

The objective of this study was to compare changes in parameters and to find out removal efficiencies of water hyacinth systems with and without aeration. Table 1A & B shows relatively high average percent removal of all parameters for AWHS compared to NWHS. Both aerated and non-aerated water hyacinth system showed high percent removal efficiencies especially for COD and Fe. The AWHS managed an average of 86.2 % and 89.6 % removal of COD and Fe, respectively. Where as the average COD and Fe percent removal for NWHS were somewhat lower than the AWHS at 75.4 % and 81.5 %, respectively. In terms of metal removal (Fe, Mg and Cu) the AWHS showed an average of 7.5 % higher removal efficiency than NWHS. It was also noted that the amount of plants in the AWHS system increased 20 % more than the amount of plants in the NWHS.

Although the aerated control system also showed high average percent removal when compared to non-aerated control (Table 1C &D), the average percent removal for the aerated control did not exceed 30 % for any parameters.

DISCUSSION

The results of this experiment demonstrated an increase in treatment efficiencies of aquatic plant system using aeration.. Reed (1988) also reported that providing supplemental aeration to aquatic floating plant water systems can accelerate the treatment and allow increased loadings and shorter detention times.

For organic parameters removal , the plants do not themselves directly remove BOD, rather they serve as host for a variety of attached growth organisms, and it is this microbial activity that is largely responsible for organic decomposition. Although, many floating aquatic plants have the ability to translocate oxygen from the upper leaf areas into the roots, thus providing an aerobic zone around the roots (Wolverton, 1991). The additional aeration would help to increase aerobic biological activity for organic decomposition.

Although, the AWHS showed remarkable metal removal capability, the water hyacinth itself may not be the lone factor in metal removal. Other mechanisms such as precipitation also play important role in removing metal. In this experiment the increase efficiency in metal removal for AWHS can also be explained by the aeration induced mixing of water which allows a greater portion of the contained wastewater to contact the root zone of the plant.

REFERENCES

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Table 1 Removal efficiencies of (A) Aerated Water Hyacinth System-AWHS, (B) Non-Aerated Water Hyacinth System-NWHS, (C) Aerated Control and (D) Non-Aerated Control

a) AWHS

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD_5 (mg/l)	Exp. 1	100	20	81.6 %
	Exp. 2	108	18	
	Exp. 3	98	18	
COD (mg/l)	Exp. 1	180	27	86.2 %
	Exp. 2	186	23	
	Exp. 3	176	25	
Fe (mg/l)	Exp. 1	0.800	0.085	89.6 %
	Exp. 2	0.852	0.085	
	Exp. 3	0.812	0.086	
Mg (mg/l)	Exp. 1	0.126	0.032	77 %
	Exp. 2	0.124	0.028	
	Exp. 3	0.118	0.024	
Cu (mg/l)	Exp. 1	0.468	0.078	82 %
	Exp. 2	0.525	0.098	
	Exp. 3	0.473	0.088	

b) NWHS

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD_5 (mg/l)	Exp. 1	100	40	65 %
	Exp. 2	108	33	
	Exp. 3	98	39	
COD (mg/l)	Exp. 1	180	51	75.4 %
	Exp. 2	186	45	
	Exp. 3	176	42	
Fe (mg/l)	Exp. 1	0.800	0.155	81.5 %
	Exp. 2	0.852	0.145	
	Exp. 3	0.812	0.156	
Mg (mg/l)	Exp. 1	0.126	0.042	70.5 %
	Exp. 2	0.124	0.034	
	Exp. 3	0.118	0.032	
Cu (mg/l)	Exp. 1	0.468	0.120	74.2 %
	Exp. 2	0.525	0.150	
	Exp. 3	0.473	0.108	

c) Aerated Control

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD_5 (mg/l)	Exp. 1	100	80	22.3 %
	Exp. 2	108	83	
	Exp. 3	98	75	
COD (mg/l)	Exp. 1	180	146	26.1 %
	Exp. 2	186	145	
	Exp. 3	176	123	
Fe (mg/l)	Exp. 1	0.800	0.598	23.3 %
	Exp. 2	0.852	0.674	
	Exp. 3	0.812	0.618	
Mg (mg/l)	Exp. 1	0.126	0.1	21.3 %
	Exp. 2	0.124	0.097	
	Exp. 3	0.118	0.092	
Cu (mg/l)	Exp. 1	0.468	0.340	27 %
	Exp. 2	0.525	0.386	
	Exp. 3	0.473	0.344	

d) Non-Aerated Control

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD_5 (mg/l)	Exp. 1	100	88	11.5 %
	Exp. 2	108	96	
	Exp. 3	98	87	
COD (mg/l)	Exp. 1	180	165	11.2 %
	Exp. 2	186	170	
	Exp. 3	176	158	
Fe (mg/l)	Exp. 1	0.800	0.720	8.8 %
	Exp. 2	0.852	0.782	
	Exp. 3	0.812	0.745	
Mg (mg/l)	Exp. 1	0.126	0.114	12.3 %
	Exp. 2	0.124	0.103	
	Exp. 3	0.118	0.106	
Cu (mg/l)	Exp. 1	0.468	0.428	7.8 %
	Exp. 2	0.525	0.493	
	Exp. 3	0.473	0.430	