

Wastewater Treatment Using Tidal Flow Wetland

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ABSTRACT: Constructed wetlands are recognized as a reliable technology for rural wastewater treatment. However, conventional constructed wetlands face problems with low pollutant removal efficiency and limited oxygen transfer capability. Tidal flow wetlands are characterized by a recurrent fill and drain hydro period that facilitates passive aeration of fixed-film substrates. These advanced treatment wetlands have been under development and commercial deployment for over fifteen years. The present study undertaken by fabricating the lab scale model of tidal flow constructed wetland. The effluent of AmbaNala Amravati is treated with this system and wastewater characteristic like pH, DO, TS, BOD, COD with plant species studied. The results show reduction of 73.9 % in total solids, 49.29 % in BOD, 52.73 % in COD with *Typha Orientalis*.

I. INTRODUCTION

Water is extremely useful to human being providing us the luxurious and comforts in addition to fulfilling our basic necessities of life. Current and future fresh water demand could be met by enhancing water use efficiency and demand management. Thus, wastewater/low quality water is emerging as potential source for demand management after essential treatment. Similarly, only 60% of industrial waste water, mostly large scale industries, is treated. Performance of state owned sewage treatment plants, for treating municipal waste water, and common effluent treatment plants, for treating effluent from small scale industries, is also not complying with prescribed standards. Thus, effluent from the treatment plants, often, not suitable for household purpose and reuse of the waste water is mostly restricted to agricultural and industrial purposes. Constructed wetlands (CWs) are engineered systems that have been designed and constructed to utilize the natural processes involving wetland vegetation, soils, and the associated microbial assemblages to assist in treating wastewaters. They are designed to take advantage of many of the same processes that occur in natural wetlands, but do so within a more controlled environment. CWs for wastewater treatment may be classified according to the life form of the dominating macrophyte, into systems with free-floating, floating leaved, rooted emergent and submerged macrophytes. Further division could be made according to the wetland hydrology (free water surface and subsurface systems) and subsurface flow CWs could be classified according to the flow direction (horizontal and vertical).

Tidal-flow wetlands are the latest evolution of wetland technology, used to treat domestic, agricultural & industrial wastewater, including heavy load. The need of the hour is a suitable technology for recycling or reuse at least a reasonable quantity of the wastewater produced in the plant.

Oladipupo. S.Oladejo et, al;(2015) had prepared laboratory-scale free water surface-flow constructed wetland was set up at the Department of Civil Engineering; LadokeAkintola University of Technology (LAUTECH). The

experiment was carried out to demonstrate the enhanced removal efficiency for Water Lettuce with constructed wetland in treating kitchen wastewater, from a nearby Campus restaurant, for 10 days detention period. It was found that a 7- day detention time was optimal for the treatment of domestic wastewater from kitchen.

J. S. Sudarsan et, al; (2015)they studiedthree types of wetland setups, namely: single wetland cell, two-wetland cells in cascade and single wetland cell with adsorbent bed for varying hydraulic detention times (2 days, 4 days and 6 days) in batch mode. The percentage removal of all metals was found to be more than 80%. The effect of varying detention time was not found to improve the removal efficiency in all the three cells varying modes of treatment, thus indicating 2 days to be optimum detention time.

II. MATERIALS AND METHODS

a. Experimental Lab Set-up

Lab scale model of tidal flow wetland was fabricated and located at the Civil engineering laboratory of Prof Ram Meghe College of Engineering & Management, Badnera. The constructed wetland systems, including *Typhaorientalis*(Lesser Indian Reed Mace) with vegetation, the constructed wetland units made of G.I. sheet material, has dimension of (1.2 x1 x 1) m and bed assembly contains different layer of aggregate, coarse sand and fine sand. The schematic diagram of the wetland modules with *Typhaorientalis* as shown in the fig. 1. Top layer consist of Black cotton soil, before placing the soil in the bed it must be clean and free from the impurity. The soil media have the depth of 5 cm, below the soil layer the fine sand is placed, the depth of sand layer is 10cm, below the fine sand layer of coarse sand is provided. The depth of sand layer is 10cm. Before placing the sand it is clean and washes with the clean water, so as to remove the dust over it. The bottom of wetland unit is filled aggregate having size 16mm passed & 31.5mm retained having depth of 20 cm. Aggregate must be washing with the clean water and dried so as to remove the impurity over the surface of it.The samples are collected from a point, where the turbulence is thoroughly mixing up the sewage particles. Methods of sampling are highly dependent on source to be sampled and to a certain extent, on method of analysis for collect. Point Sampling method used for the collection of the wastewater sample.

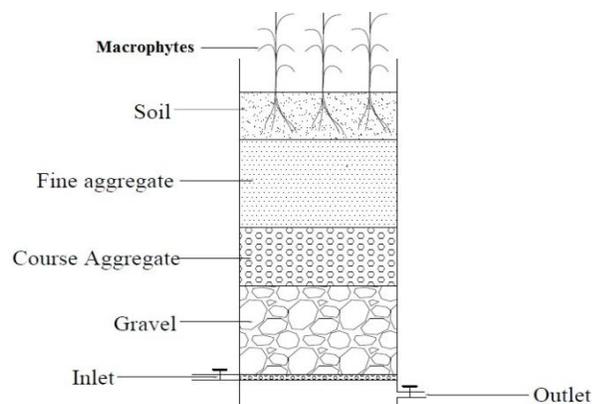


Fig 1: The schematic diagram of the wetland modules with *Typhaorientalis*

The constructed wetland was planted with *Typhaorientalis* it was obtained from the local natural field. The plant within the constructed wetland is the major component for the treatment process. The type of macrophyte chosen will vastly influence the efficiency and quality of wastewater. Plants provide an environment for microbes to live, they oxygenate the wastewater, providing nutrients for the microbes to survive, they stabilize the soil and they also take part in the reduction of nutrients.

b. OPERATION CONDITIONS OF WETLANDS

The raw wastewater from the different location was collected. The raw wastewater characteristics like pH, DO, BOD, COD, and TS was calculated using standard methods. The wastewater was allowed to pass over the surface of the bed, as the time progress the percolation of wastewater start into the bed. Percolated water from the bed collected from the outlet. The purified wastewater characteristics also studied by using standard methods. The bed was studied for three different detention period of 3 days, 5 days and 7 days.

III RESULTS AND DISCUSSION

The raw wastewater was collected from different locations in Amravati City. The various tests were conducted on the raw wastewater like pH, BOD, COD, T.S, as per standard methods. The results are enlisted in Table.1. From the table it is observed that the waste is moderate in strength and needs the treatment before discharging into stream.

Table 1:Raw wastewater characteristics of AmbaNala

Parameter	MIDC	Rajapeth	Rukhmini Nagar	Badnera	Laxmi Nagar
pH	6.69	7.20	7.15	7.50	7.35
Total Solid (mg/l)	1660	1400	1456	1280	1485
BOD (mg/l)	480	380	415	376	390
COD (mg/l)	770	635	648	598	615

From the result it is observed that the waste is moderate in strength and needs the treatment before discharging into stream.

The characteristics of the raw wastewater in the inlet and the characteristics of the treated wastewater at the outlet were studied for the detention period 3 days. For the TS, it was found that percentage removal was in the range of 57.69 %. The percentage removal of COD was in range of 30.9 %. The percentage removal of BOD was 34.3%, the percentage removal of BOD for the detention period 3 days. The fig 2 shows percentage removal of TS, BOD & COD for 3 days.

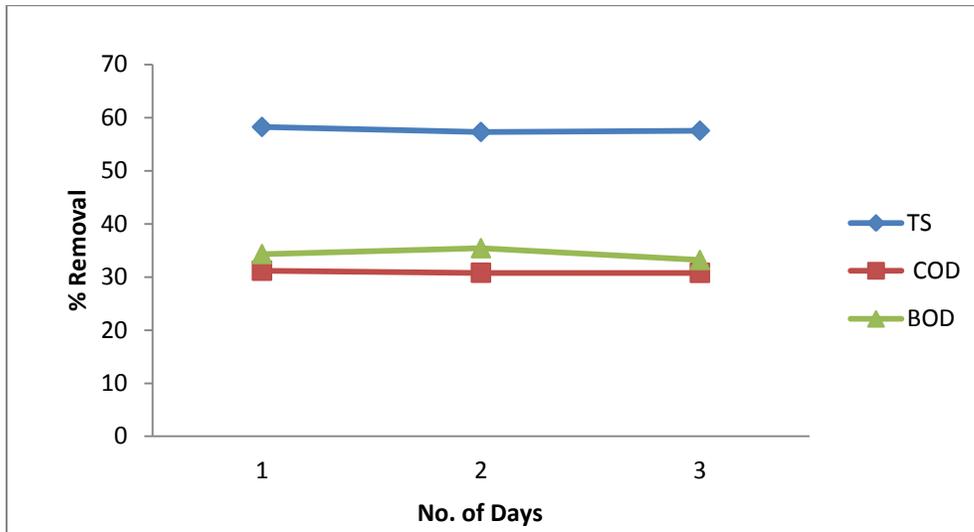


Fig 2 % Removal for TS, BOD & COD for Detention Period of 3 Days

The characteristics of the raw wastewater in the inlet and the characteristics of the treated wastewater at the outlet were studied for the detention period 5 days. For the TS it was found that percentage removal was in the range of 59 %. The percentage removal of COD was 52.58%. The percentage removal of BOD was in range of 48.18%. Fig 3 shows % removal for TS, BOD & COD for Detention Period of 5 Days.

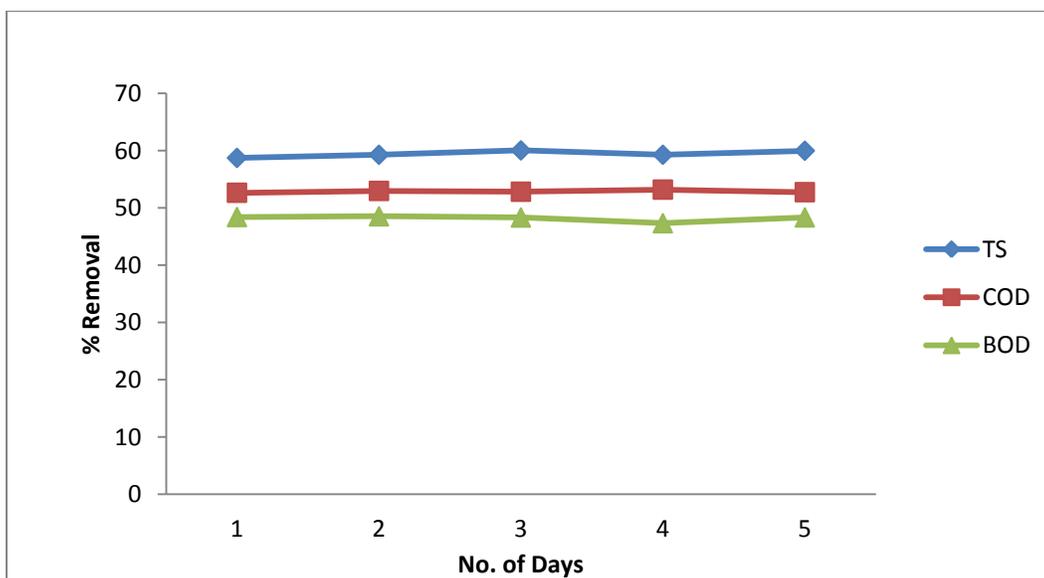


Fig 3 % Removal for TS, BOD & COD for Detention Period of 5 Days

The characteristics of the raw wastewater in the inlet and the characteristics of the treated wastewater at the outlet were studied for the detention period 7 days. For the TS it was found that percentage removal was in the range of 73.9 %. The percentage removal of COD was to 52.73%. The percentage removal of BOD was in range of 49.29 %. Fig 4 shows % removal for TS, BOD & COD for Detention Period of 7 Days.

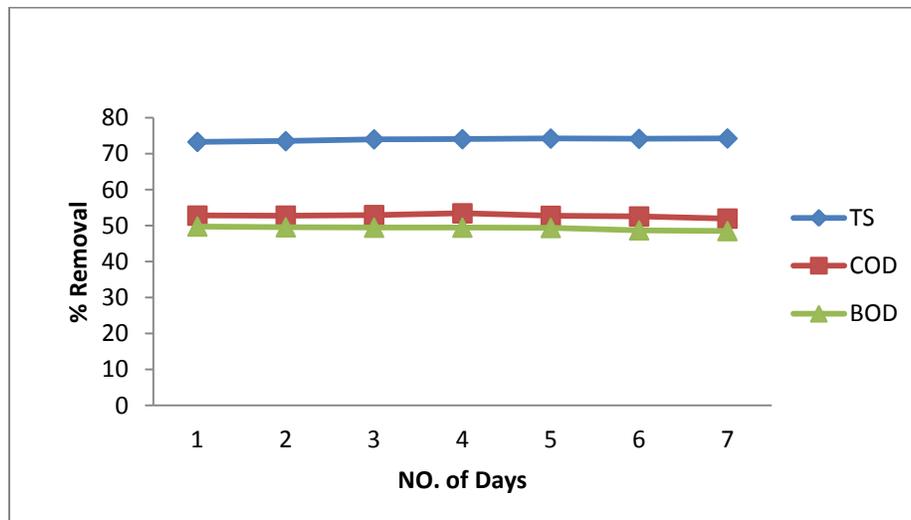


Fig 4 % Removal for TS, BOD & COD for Detention Period of 7 Days

IV. COMPARISONS FOR DIFFERENT DETENTION PERIOD

During the comparison of different detention period it was found that the maximum percentage removal of the total solid was found to be 73.9% and it was for the detention period of 7 days. The fig5shows the percentage removal of TS for the different period.

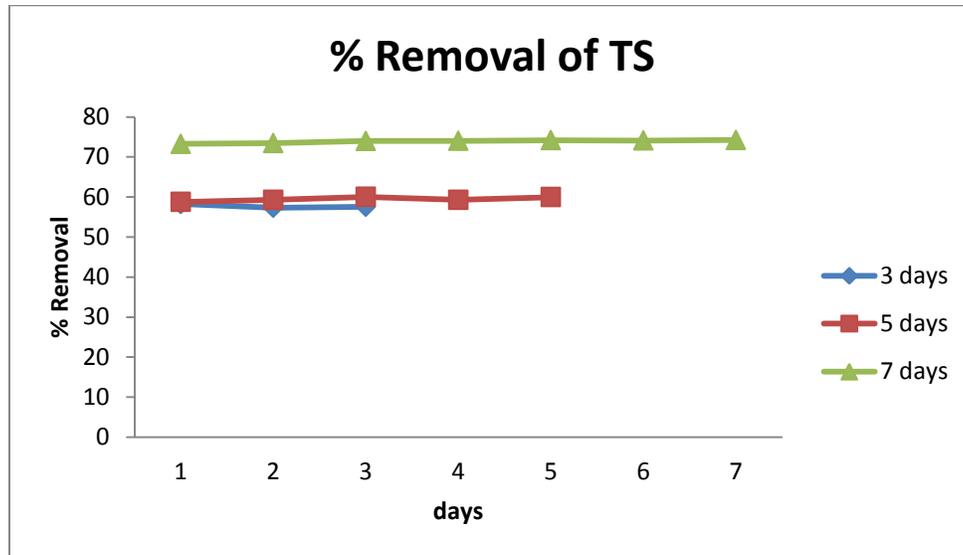


Fig5 % Removal of TS for different detention time

For the COD the maximum percentage removal was found to be 52.73% for 7 days and the minimum percentage removal was found to be 30 % for the detention period 3 days. Fig 6 shows the percentage removal of COD for the different detention period.

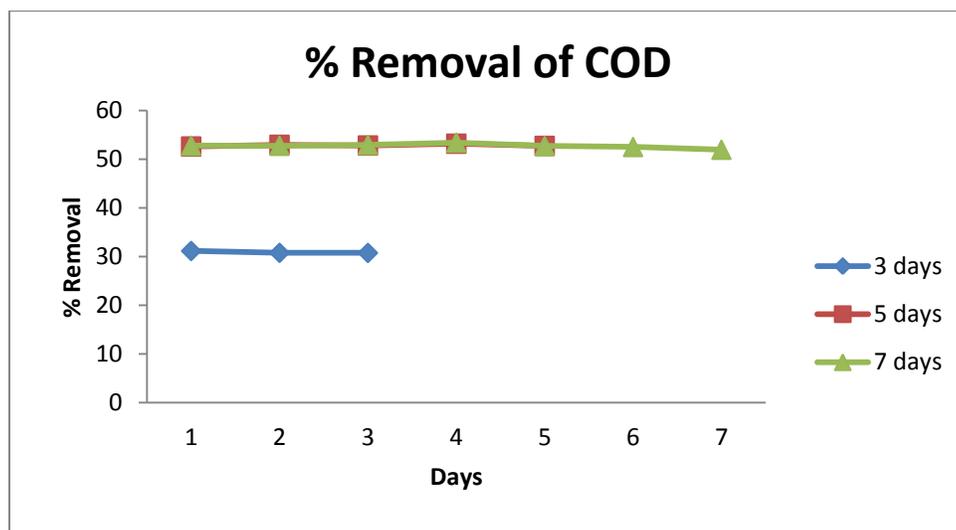


Fig 6 % Removal of COD for different detention time

For the BOD the maximum percentage removal was found to be 49.29 % and the minimum percentage was found to be 34 % for the detention period 7 days and for the detention period 3 days respectively. Fig 7 shows the percentage removal of BOD for the different detention period.

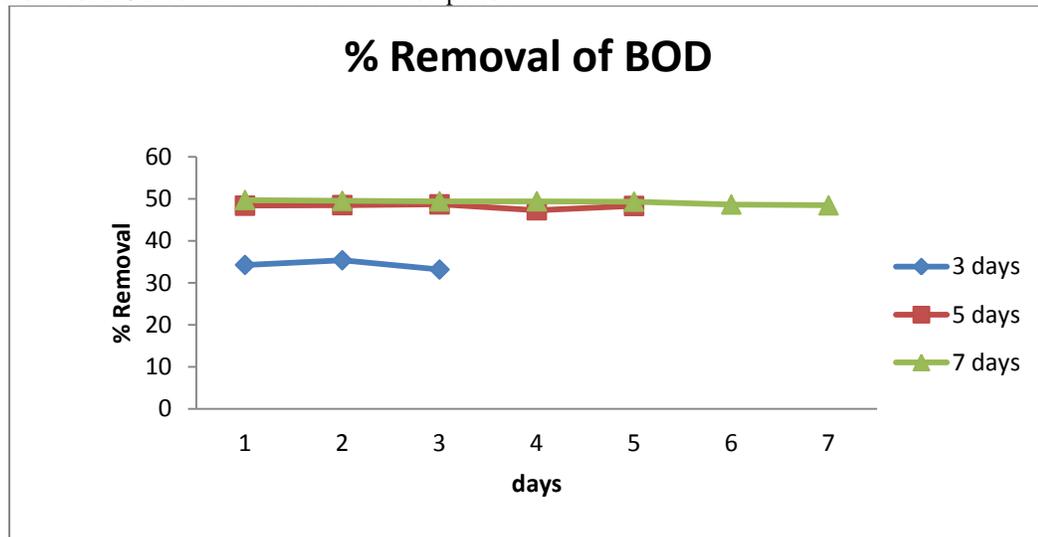


Fig 7 % Removal of BOD for different detention times

IV CONCLUSIONS

From the study following conclusion are drawn.

1. After treating waste for detention period 3days, 5 days, 7days the average percentage removal for TS, BOD, COD are 73 % , 49 % , 52.73% .
2. From this observation, it was found that for certain increase in detention period the percent removal is remain constant.
3. It was found that the overall percentage removal of all pollutant were good for the detention period 7 days as compare to the other detention time.
4. BOD, COD, was best removed constructed wetland in natural method, it is because of the oxygen diffusion from roots of the typha.
5. Based on the study it can concluded Tidal flow constructed wetland system can be effectively used for the treatment of waste.

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