Vertical Flow Constructed Wetland For Domestic Wastewater Treatment (VFCW)

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Abstract

Constructed wetlands are an acceptable way for the treatment and reuse of domestic wastewater. because of removal efficiency, his height constructor low-cost maintenance and low-cost operation compared to traditional systems for domestic wastewater treatment in constructed wetlands to the main classification is there are surface flow and subsurface flow in subsurface plus two types are horizontal and vertical flow constructed wetlands ability to transfer a high amount of oxygen in bed compared to horizontal flow constructed wetlands the plants used in a wetland in an Indica the solid removal efficiency Is there 60 percentage in body removal in 80% and 70 percentage.

Key Words: *Vertical Flow Constructed Wetland, COD, BOD, treated wastewater, Nutrients, Canna Indica.*

1. INTRODUCTION

The number of plants increased in recent decades to treat domestic and industrial wastewater. The increase in the use of treatments helps the minimizing environmental impacts. Such as the release of effluents on the water bodies. In wetlands they are mainly 2 types they are natural wetlands and constructed wetlands. In constructed wetlands 2 types they are surface flow and subsurface flow constructed wetland. The subsurface flow may be classified according to direction flow horizontal flow constructed wetlands and vertical flow constructed wetlands. In this research treatment plant used (lab scale model), vertical flow constructed wetland. Constructed wetlands alternative for wastewater treatment.

on one hand and into soil sand and gravel-based wetlands, subsurface systems are also referred to as planted filter reed beds, root zone method, gravel bed hydroponics filters vegetative submerged bed are artificial wetlands. VFCW is normally a secondary treatment and is efficient in removing organic matter. It is also a cost-effective technique with low maintenance. Vertical Flow Constructed Wetlands require a smaller area, which results in higher oxygen transfer capability and simpler hydraulics.

2. MATERIALS & METHODS

In this wetland, all the materials were housed in 2 different crates made up of plastic and it was thick and durable. The 2 different crates consisted of fine aggregates 1.45mm in size and the soil used was 0.5 microns. The soil was black in colour with a sieve size of no more than 0.5 microns. The setup used for equal distribution of wastewater all over the bed of plants/soil was prepared from irrigation pipes which were drilled with holes of around 2mm diameter and connected to a supply tank waste-water reservoir which was situated side the lab scale model of vertical flow wastewater.

The study was conducted under ambient Environmental conditions. The Domestic wastewater sample was collected from the kalaburagi 40 MLD sewage treatment plant at Nandikur. Kalaburagi city.

1. There is a layer of the plants, which consists of Canna Indica with 10 plants planted.
2. All the plants are very well spaced so as to ensure the uniform growth of each plant.
3. The second layer after the soil in which plants are planted and fine aggregates, which has a height of 5 cm, The soil layer in which plants are planted is 15 cm in height.
4. The layers are separated by a small thin layer of mesh, which helps in retaining the materials in their own layers as it also prevents the mixing and outflow of the material in the treated water sump. The mesh helps in preventing one layer from touching another.
5. The crates in which all these materials are situated have a dimension of 40cm x 30cm x 30cm.
6. At the bottom of the crate, there are 8 mm diameter holes spaced 5 cm horizontally and vertically.

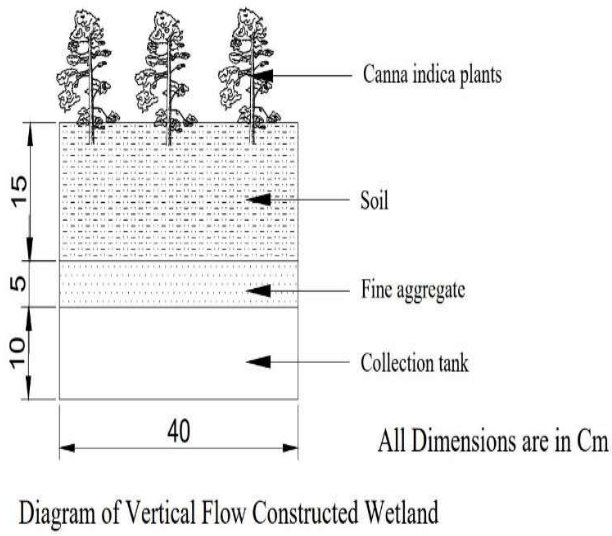

Fig 1: Vertical flow constructed wetland

3. EXPERIMENTAL RESULTS AND DISCUSSION

Experiments are conducted using Canna indica plants in the constructed wetland system for a hydraulic retention time of 1, 2, 4, and 6 days. Water is allowed to stand in the constructed wetland so that plants absorb the nutrients present in the domestic wastewater. The treated water is collected from the outlet in the collection tank and taken for the analysis of different samples in the main laboratory.

In the constructed wetland, the influent (I), effluent (E), and per cent removal (%R) of chemical oxygen demand, BOD, total dissolved solids, nitrate, phosphate, and pH are measured. As shown in Table 1.

Table 1: Treatment Parameters of Domestic wastewater for Constructed wetland

Retention Time in Days	PH		TDS			COD			BOD		
	I	E	I	E	%R	I	E	%R	I	E	%R
1	7.2	7.1	1816	800	55.95	544	136	75	270	105	61.11
2	7.5	7.3	1848	780	57.79	560	104	81.43	240	90	62.5
4	7.4	7.3	1868	740	60.39	460	88	80.87	255	75	70.59
6	7.6	7.4	1908	622	67.4	480	72	85	285	60	78.95

Retention Time in Days	Nitrate					Phosphate				
	I	Soil	I+Soil	E	%R	I	Soil	I+Soil	E	%R
1	25.5	2.65	28.15	9.2	67.32	16.42	5.25	21.67	5.62	74.07
2	21.94	2.65	24.59	6.36	74.14	17	5.25	22.25	4.42	80.13
4	31.52	2.65	34.17	5.66	83.44	18.56	5.25	23.81	4.22	82.28
6	32.22	2.65	34.87	3.94	88.70	16.56	5.25	21.81	3.84	82.39

3.1 Test results of Untreated vs. Treated wastewater

- **pH And Total Dissolved Solids**

Domestic wastewater is always acidic in nature. The result showed after the treatment of wastewater for a retention period of 1, 2, 4, and 6 days was 7.1, 7.1, 7.2, and 7.4 respectively. And total dissolved solids in the domestic wastewater are removed more effectively with increasing retention time, i.e., the retention time of 6 days has more removal efficiency than that of 1, 2 and 4 days, as shown in below fig. The removal efficiency observed for different retention times was 55.95%, 57.79%, 60.39%, and 67.40%, respectively.

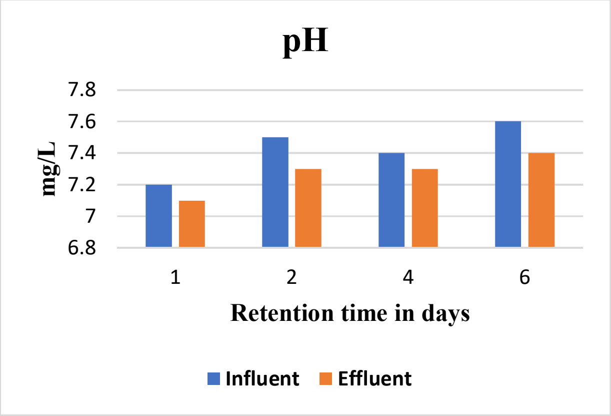

Fig-2 pH of treated vs. untreated wastewater.

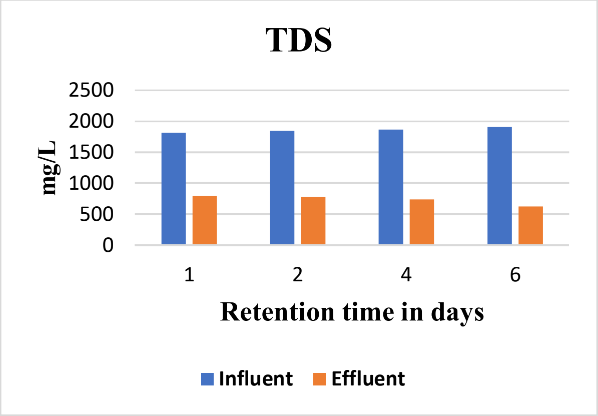

Fig-3 TDS of untreated vs. treated wastewater

- **Biological Oxygen Demand And Chemical Oxygen Demand**

The rate of removal of BOD and COD with retention time varies as shown in the below table. The higher removal efficiency was observed during the 6-day retention time in both parameters. The removal efficiencies for BOD and COD were 61.11%, 62.50%, 70.59 %, 78.95% and 75%, 80.43%, 81%, 85% for the retention times of 1, 2, 4 and 6 days, respectively, as shown in fig-4 and 5.

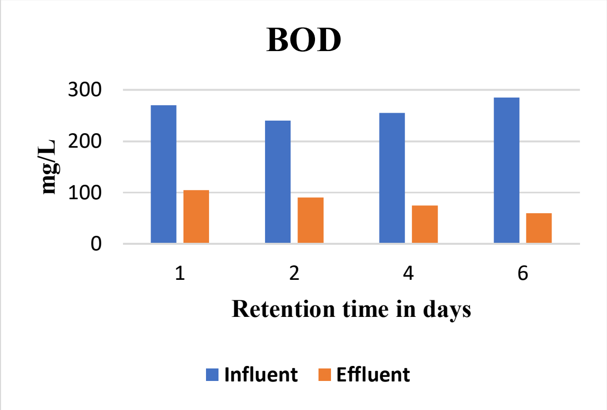

Fig –4 BOD of untreated vs. treated wastewater

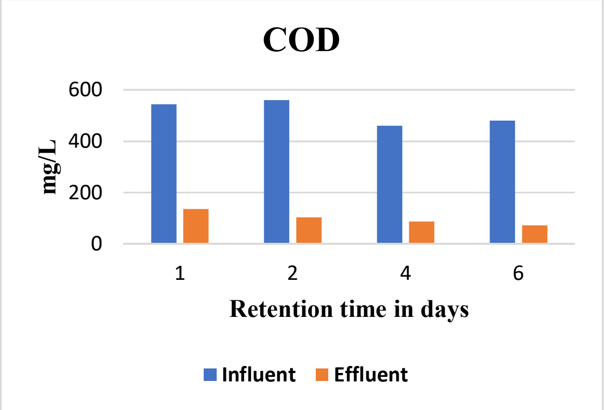

Fig –5 COD of untreated vs. treated wastewater

- **Nitrate And Phosphate**

The removal efficiency of the above parameters in the given domestic wastewater was observed to be effective in the constructed wetland. These were observed by the Canna indica plant in a wetland for their growth. After the analysis of treated water, it was observed that nitrate and phosphate removal were 67.32%, 74.14%, 83.44%, 88.70 and 74.07%, 80.13%, 82.28%, 83.39 respectively for the retention times of 1, 2, 4 and 6 days, as shown in fig-6 and 7. It shows that as the retention time increases, the removal efficiency also increases.

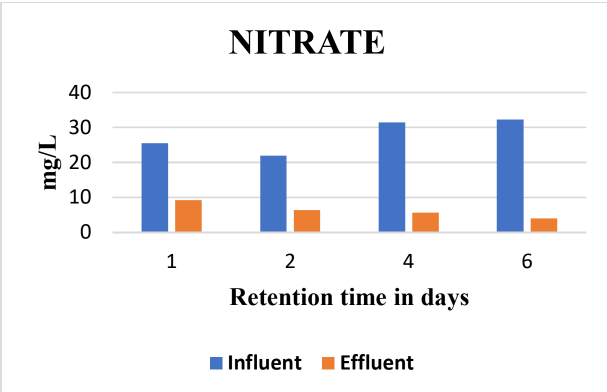

Fig-6 Nitrate of untreated vs. treated wastewater

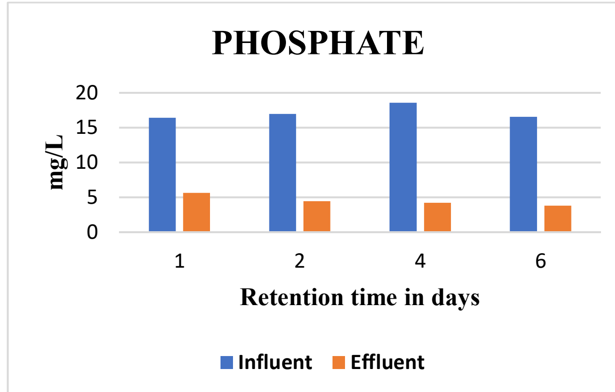

Fig-7 Phosphate of untreated vs. treated wastewater

4. GROWTH OF THE PLANTS

The growth of the plants was measured using the heights of the plants as they showed good height during the operational phase. Also, there were shoots developing in the canna Indica and they were used to develop the flowers of red colour. The height of the plants was during the initial stage of the growth, they had a registered height of 25 cm and as the operation started and the wastewater was added to them, they had a total growth of 50 cm in a time span of 1 month.

5. CONCLUSION

Natural materials like sand, soil, and aquatic plants like Canna indica used in the constructed wetland have high performance for the treatment of domestic wastewater. The chemical and biological parameters such as BOD, COD, phosphate, nitrate chloride, and TDS can be successfully removed to the desirable standard limits for irrigation as shown in the above figures. From the test reports, it was observed that all the pollutants were reduced by 50–90%. The highest BOD and COD removal occurred at a retention time of 6 days. The Canna indica plant showed good efficiency in removing minerals like nitrate and phosphate, with a removal efficiency of 60–80%. The average removal of TDS, nitrate, and phosphate for a retention time of 1, 2, 4, and 6 days was 60%, 70%, 80%, and 85%, respectively. The treated water can be used safely for household work and irrigation purposes as the test results were within the IS standard limits. There was an increase in the height of the plant of about 2-3 cm on average from the actual height. Hence, the overall removal efficiency of plant elephant ear was proved to give better efficient compared to conventional plants. This method can be used for small-scale municipal wastewater treatment.

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