Experimental Study of Wastewater Treatment by Reed Bed System using Plants

N. Swetha[1] U. Sridevi[2] S.Sowndarya[3] J. Ronisha[4] N. Vinoth Kumar[5]
[1,2,3,4,5]Department of Civil Engineering
[1,2,3,4,5]Valliammai Engineering College

Abstract— As global water resources decline, reuse of domestic grey water for the irrigation of home gardens is quickly becoming widespread in many parts of the world. Nowadays treatment plants are costly, need high trained man power and high electricity. Alternatively for those cost expensive treatments, we are choosing reed bed wastewater treatment system. Reed bed process-a recent techniques can be used for treatment of wastewater. This system seems to be one of the potential solutions in discharging the huge amount of waste. The main aim of the project was treatment of wastewater through vertical subsurface flow constructed wetland and compare the efficiency of two different plants. The pilot scale model of vertical subsurface flow constructed wetland. Sand and gravels were used as bed media and plants used for experiment were Canna Indica and Phragmites Austrails. In this paper, we are evaluated performance of Pharagmites Austrails and Canna Indica in subsurface flow systems for removal percentage of pollutants such as Chemical oxygen demand (COD), Biochemical oxygen demand (BOD5), Turbidity, pH, Total suspended solids (TSS), Total dissolved solids (TDS), phosphrous and ammonia nitrogen. It has to be noted that growing reed does not require cultivable land. Hence waste and uncultivable land can be used for this whole process. The process is eco-friendly without use of chemicals, special equipments, electricity and also with zero operational and maintenance cost.

Key words: TDS, COD, Reed Bed System

I. INTRODUCTION

Due to the rapid increase in the population of the country and the need to meet the increasing demands of irrigation, domestic and industrial consumption, the available water resources in many parts of the country are getting depleted and the water quality has deteriorated.

Nowadays treatment plants are costly, need high trained man power and high electricity .Alternatively for those cost expensive treatments here we are choosing reed bed wastewater treatment system.Reed bed system are a natural, low-cost, eco-technological biological wastewater treatment processes found in natural wetland ecosystems, which is now standing as the potential alternative for supplementary systems for the treatment of wastewater.

II. REED BED SYSTEM

A. Reeds

Reeds are coarse grasses that are commonly found in wetlands that has extentive root system which has the ability to treat wastewater. Reeds are aquatic plants that are grown in lakes, rivers, estuaries etc.

Plants like Scirpus Grossus, Phragmites Australis,Canna Indica are some wetland plants in which Phragmites Australis and Canna Indica are most commonly used wetland plants in reed bed.

B. Reed bed

Reed bed system also known as bio-filters, constructed wetland system and root zone system. Reed bed system contains gravel filled, shallow beds, planted with plants. Wastewater (black or grey water) is passed through the root zone of the reeds where it undergoes treatment.It is made up of three layers- gravel of 20mm and 10mm,sand of 2.75mm in which plant is sowed.

C. Types of Reed Bed System

1) Horizontal Flow

This type of reed bed filter is most commonly used for aerobic post treatment of domestic wastewater and can take a higher hydraulic load than a surface flow reed bed filter. In order to dissolve solid organic matter anaerobic pre-treatment in a septic tank is required a thick layer of gravel above the aquifer holds a layer of stagnant air and prevent odour nuisance in the vicinity. Aeration take places as in surface flow reed bed filter. The waste water is however forced to pass through the matrixes ensuring intensive contact between wastewater and the bacteria in the root zone of the plants. In this manner all wastewater treated as no short circuit flow is possible. When accurately designed, provide can extremely reliable low cost aerobic post treatment solution which is applicable all over the world.

2) Vertical Flow

It is usual for there to be two reed-beds installed, one after the other down the slope of the site. Vertical flow ones can be used to treat septic tank effluent. Typically these systems are used for secondary treatment of sewage after a septic tank or settlement tank, or tertiary treatment of sewage treatment plant effluent, but usually involve the use of electric pumps unless the site has reasonable gradient.

3) Advantage of Reed Bed System

1) Reed bed system are less expensive as compare to other treatment method.
2) Initial investment is low. Operation and maintenance cost is low.
3) Operational and maintenance require only intermittent, rather than continuous monitoring.
4) More effective on low strength pollutant

III. EXPERIMENTAL SETUP

A. Experimental Setup

The experimental setup consists of a two units of reed bed system. The pilot scale model of vertical subsurface flow reed bed system has been built in open air at a site of "Valliammai engineering college, Kanchipuram, India". The size of each tub was 0.47mX0.30mX0.27m and vertical bucket to hold the wastewater. To enable the flow of

wastewater gravitationally from inlet to outlet, a longitudinal slope of 2%.The vertical pipe was placed above the tub for equal flow of wastewater.

The two pilot units were filled with gravel and sand. First reed bed system was planted with Canna Indica plant and Phragmites Austrails plant. The experimental setup is shown in fig 1.

Fig. 1: experimental setup

PARAMETER	DIMENSION	UNITS
LENGTH	0.47	m
WIDTH	0.3	m
HEIGHT	0.27	m
HYDRAULIC RETENTION TIME	24	HOUR

Table 1: Specification of reed bed system

LAYER	MEDIA TYPE	EFFECTIVE DEPTH(m)
1st	WASHED GRAVEL(SEIVE SIZE 20mm)	0.15
2nd	WASHED GRAVEL(SEIVE SIZE 10mm)	0.15
3rd	MEDIUM SAND(2.75mm)	

Table 2: Filtration media

IV. TREATMENT PROCESS

Vegetation plays a vital role in the wetlands as they provide surfaces and a suitable environment for microbial growth and filtration. Pollutants are removed within the wetlands by several complex physical, chemical and biological process.

Settlable and suspended solids that are not removed in the primary treatment. They are effectively removed in the wetland by filtration and sedimentation. Attached and suspended microbial growth is responsible for the removal of soluble organic components, which are degraded biologically both aerobically(in presence of dissolved oxygen)as well as anaerobically (in absence of dissolved oxygen). The oxygen required for aerobic degradation is supplied directly from the atmosphere by diffusion or oxygen leakage from the vegetation root into the rhizosphere, however, the oxygen transfer from the roots is negligible.

V. RESULT AND DISCUSSION

The samples are tested in the laboratory to determine their characteristics. The tests such as pH, Turbidity, BOD, COD, Total Suspended Solid, Total Dissolved Solid, Ammonia Nitrogen and Phosphrous were conducted.

TEST/ UNITS	UNTREATED EFFFLUENT	TREATED EFFLUENT		PERMISSIBLE VALUE FOR IRRIGATION
		CIRB	PARB	
pH	7.8	5.8	6.5	6.5-8.5
Turbidity (NTU)	58	9	3	10
BOD (mg/l)	138	38	32	100
COD (mg/l)	106	30	23	250
TDS (mg/l)	560	90	85	2100
TSS (mg/l)	111	25	17	200
Ammonia nitrogen (mg/l)	93.6	8	6	10-20
Phosphate (mg/l)	7.04	4	5	8.6

Table 3: Compare the waste water and treated water characteristics

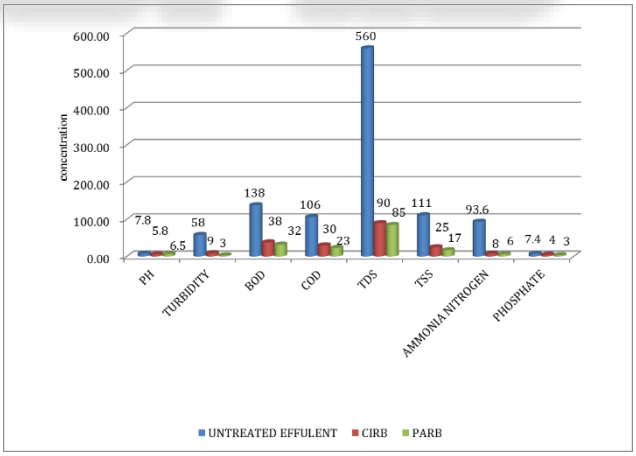

Fig. 2: comparison of characteristic of wastewater and treated water

VI. CONCLUSION

Reed bed system with root zone treatment was employed a lab scale to treat wastewater. The treated sample is analyzed and compared with untreated sample were pH, TSS, TDS, BOD, COD, phosphorous, ammonia nitrogen, turbidity shows a large variation.

The analysis of result shows that most of the parameters of wastewater are within permissible limit for

discharge. The pH range of effluent from Plant 1 and plant 2 was 5.8 and 6.5 respectively.

The maximum BOD_5 removal for Plant 1 and plant 2 was 77% and 73% respectively. The maximum COD removal for plant 1 and plant 2 was 50% and 55% respectively.

The maximum solids removal efficiency for plant 1 was 84% and 78% for total dissolved and suspended respectively. The maximum solid removal efficiency for plant 2 was 85% and 85% respectively.

The maximum phosphorous removal was found in plant 1 and plant 2 were 31% and 48% respectively.

The wetland with Phragmites Austrails plant is more efficient in treating the wastewater compared to the wetland with Canna Indica plant.

It has to be noted that growing reed does not require cultivable land. Hence waste and uncultivable land can be used for this whole process. The process is eco-frienldly without use of chemicals, special equipments, electricity and also with zero operational and maintenance cost.

REFERENCE

[1] Hammer, D.A.(1989)."Constructed wetland treatment: municipal, industrial and agriculture".
[2] Hartman, M.C. and W.Eldowney, 1993, assessment of the root zone method of wastewater.
[3] Kivaisi, A.K.,2001."The potential for constructed wetland for wastewater treatment and reuse in developing countries".
[4] Vasudevan et al(2011). Constructed wetland, a cost effective and environment friendly method of wastewater treatment.
[5] Steiner G.R. and J.T. WATSON.(1993).general design, construction, and operation guidelines: constructed wetland wastewater treatment systems for small users including individual residences/united states.

