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Utilization of Root Zone Technology (RZT) for Wastewater Treatment

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ABSTRACT

The quality and quantity of water resources are being compromised by the growing urbanization and human activities. This has led to the contamination of freshwater bodies as a consequence of higher production of domestic waste, sewage, industrial waste, and similar pollutants. This article examines the Root Zone Treatment System (RZTS), which comprises soil-filled fiber beds and serves as an environmentally friendly method for efficiently treating domestic and industrial waste.

Keywords : Root Zone Treatment System, Fiber, Root Zone Technology

I. INTRODUCTION

Root zone technology is effective technology called Decentralized Wastewater Systems (DEWATS)

- It was developed in 1970s in Germany and has been successfully implemented in different countries mainly in Europe and America.
- The root zone wastewater treatment system makes use of biological and physical-treatment processes to remove pollutants from wastewater.
- Due to its natural process, there is no need to add any input such as chemicals, mechanical pumps or external energy. This reduces both the maintenance and energy costs.
- Approximately 70% of domestic water is released as wastewater, most of which can be recovered if it is properly treated.
- Domestic wastewater can be mainly classified into two categories
- Grey water - wastewater generated from kitchens, laundry, bathrooms, etc.
- Black water - wastewater from toilets containing faecal matter and urine, which is also called as "sewage"

AIM:
To assess the viability of implementing root zone technology for wastewater treatment in the absence of any preliminary treatment.

OBJECTIVE:
1. The primary goal is to examine the utilization of Root Zone Technology (RZT) for wastewater treatment, explore different methodologies within

RZT, evaluate the efficiency of RZT, and develop RZT design strategies.

2. The objective is also to facilitate the utilization of the Root zone technology for the treatment of waste water from various sources and also to study a cheaper alternative for waste water treatment using local available materials and also intend to study design parameters, which further leads to reduce the upcoming water treatment load on STP.

II. LITERATURE REVIEW

Sr.No	Title (Year)	Author	Review
1	WASTE WATER TREATMENT(2000)	Dipu S	This study aimed to compare the effectiveness of different aquatic macrophytes (Typha sp., Eichhornia sp., Salvinia sp., and Pistia sp.) in treating effluents from a dairy factory using constructed wetlands. After the treatment, significant reductions ($p<0.01$) were observed in biological oxygen demand, chemical oxygen demand, nutrients, and total solids of the dairy effluent. Among the tested macrophytes, the treatment system utilizing Typha demonstrated the highest efficiency in removing pollutants from the effluent. Thus, it can be concluded that emergent species outperformed floating macrophytes in the context of constructed wetland technology.
2	WASTE WATER TREATMENT	Trivedy R.K.	Investigated that using constructed wetlands, wastewater can be treated at lower costs than other treatment options, with lowtechnology methods where no new or complex technological tools are needed. The system relies on renewable energy sources such as solar and kinetic energy and wetland plants and microorganisms, which are the active agents in the treatment process. There are inherent limitations to the effectiveness of rhizosphere treatment system for wastewater treatment. Nevertheless, rhizosphere treatment is often the best choice for treatment
3	RECYCLING OF KITCHEN WASTE WATER THROUGH ROOT ZONE TREATMENT (2012)	Nischita V. K	In this study it is seen that the average BOD removal efficiency of designed unit (modified design of RZTS and trickling bed) is 85.25%up to 0.5m root zone bed depth, and is of average 79.45%for total 1.5m combined bed depth. The average COD removal efficiency of designed unit (modified design of RZTS and trickling bed) is 85.25%upto 0.5m root zone bed depth, and is of average 79.45% for total 1.5m combined bed depth. The average TSS removal efficiency of designed unit (modified design of RZTS and trickling bed) is 91.83%up to 0.5m root zone bed depth, and is of average 83.07%for total 1.5m combined bed depth.

4	WASTE WATER TREATMENT BY ROOT ZONE TECHNOLOGY	Jan Vmazal	This study focused on two Horizontal Sub-Surface Flow Constructed Wetlands (HFCWs) named Ondrejov and Spalene Porici, which have been operational since 1991 and 1992, respectively. These systems are the oldest of their kind in the Czech Republic. CW Ondrejov is designed to treat sewage from 362 Population Equivalents (PE) and consists of a single 806 m2 bed planted with Phragmites Australis. CW Spalene Porici initially treated wastewater from 700 PE from a combined sewerage system until 2001. In 2002, an additional section was completed to cater to another 700 PE. Currently, there are six beds in CW Spalene Porici with a total area of 5000 m2, planted with a mixture of P. australis and Phalaris arundinacea.

III. METHODS AND MATERIAL

Methodology :

The integrated system proposal focuses on the productive use of treated waste water . Consequently and depending on particular situation of every case, the greatest effort of the team responsible for study will be oriented towards defining the fesealibility which involves the exploration of real & potential options.

The analysis of project strength & weakness will allow the establishment of strategies to handle its technical, environmental, social, economical & institutional aspects. Factors that determine the fesealibility of integrated system are as follows,

Wastewater parameters :

This chapter deals with procedure that is adopted in the execution of the work. It gives a detailed procedure regarding the preparation of pilot scale model and testing of waste water at particular interval of time. Methodology also involves the cost comparison between conventional waste water system and root zone technology system which is further used for the cost effective analysis. Wastewater contains a variety of inorganic and organic substances from domestic sources. The wastewater parameters namely BOD, COD, TDS, TSS and pH were analyzed. The procedure followed for calculating the parameters are the STANDARDISED methods.

The methodology of this study also includes a cost comparison between conventional wastewater systems and root zone technology systems, which is then used for cost-effectiveness analysis. The wastewater under investigation contains a range of inorganic and organic substances originating from domestic sources. Parameters such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), and pH were analyzed. The standardized methods were employed to calculate these parameters.

Selection of Plant Species:

Following list of species can be tried:

- Phragmites Austrails (Reed).
- Colocasia esculenta (Reed).
- Arundo Donax (Mediterranean reed).

- ➢ Typha Latifolia (Cattail).
- ➢ Typha Augustifolia (Cattail).
- ➢ Iris Pseudacorus.
- ➢ Canna species.

Functions of Phragmie Austrails:

There are several key factors associated with the root zone system. Firstly, the system itself creates pathways for water to flow through. Secondly, the roots play a crucial role by introducing oxygen into the soil, creating an environment conducive for the growth of aerobic bacteria. These bacteria are essential for breaking down various types of compounds, particularly in the oxidation of ammonia to nitrate. This step is a vital part of the biological breakdown of nitrogen compounds. Thirdly, nitrification occurs within the system, wherein the plants themselves absorb a certain amount of nutrients from the wastewater.

Graded Filter:
A graded filter is provided over the pipe to stop entry of the mud into the treated water. Graded filter is made of aggregate size 40 mm, 20 mm, 10mm and 5mm and layers are inclined in nature. At first the 40 mm aggregate layer was provided and the layer was spread up to half of the length of the reactor and over this layer 20 mm aggregate layer was provided and void to large extent were filled. After laying this layer a mixture of 10 mm and 5 mm aggregate were laid on top of 20 mm layer filling all voids and these layers were compacted properly.

Fig 1: First layer of 40 mm aggregate

Fig 2 : Second layer of 20 mm aggregate

Fig 3 : Third layer of 10 mm and 5 mm aggregate

Reactor Arrangement:

After graded filter is arranged in the reactor, a mud layer of 20 cm is laid in the reactor and then a thin layer of

fertilizer is laid on this mud layer and again a layer of 20 cm is laid with a thin layer of fertilizer on the top.

Fig 4 : Layer of Mud

Fig 5 : layer of Fertilizer

Plantation was done after these layers were laid and plants were watered.

Fig 6 : Pilot model of reactor with Phragmite austrails

TEST RESULTS :

(for phragmite austrails): Results for sewage and for treated effluent

Sr No.	Test Parameter	For Sewage	For Treated Effulent	Standar Value As per IS code For treated waste
1	Total Solids	520 mg/l	160 mg/l	480 PPM
2	Total Dissolved Solids	120 mg/l	20 mg/l	100 PPM
3	Total Suspended Solids	400 mg/l	140 mg/l	100 PPM
4	COD	220 mg/l	26 mg/l	200 PPM
5	BOD	125 mg/l	15 mg/l	100 PPM

All test parameter results

IV. RESULTS AND DISCUSSION

1. Hydraulic Loading Rate of Root Zone Technology plant is worked out to be 67.35l/m /day. COD of sewage waste was 220 mg/l and that of treated effluent is 26 mg/l. Hence there is 88 % of reduction in COD between raw sewage and treated effluent.

2. BOD reduction was found to be 87% with raw sewage having BOD 125mg/l while BOD of treated effluent is 15 mg/l for Colocasia esculenta. Same way COD of sewage waste was 190 mg/l and that of treated effluent is 28 mg/l. Hence there is 80 % of reduction in COD between raw sewage and treated effluent.

3. BOD reduction was found to be 86% with raw sewage having BOD135mg/l while BOD of treated effluent is 120 mg/l for Canna Indica. Cost required for treatment is Rs 3.5/m3 which is very less compared to cost incurred in conventional methods.

V. CONCLUSION

Based on the experimental results, the following conclusions can be drawn:

1. This study successfully showcased the effectiveness of the designed sub-surface horizontal flow constructed wetland system for treating campus

wastewater. Constructed wetlands can serve as efficient treatment facilities for campus wastewater.

2. The sub-surface horizontal flow constructed wetland demonstrated commendable performance by further reducing the levels of major physicochemical pollution parameters. The presence of plants played a significant role in the treatment process.

3. The treatment efficiency was influenced not only by seasonal variations but also by changes in influent quality and quantity.

4. The overall experimental findings provide evidence supporting the feasibility of implementing subsurface horizontal flow constructed wetlands as a treatment unit for campus wastewater. Consequently, root zone treatment can be employed either independently or as a supplement to conventional treatment methods, ensuring comprehensive wastewater treatment.

VI. REFERENCES

[1]. Firdous Tasneem, Diana Hubert, Dorothy G. W.,Nischita V.K., Shobha Reddy, Suba G. A. Manuel and Radha D. Kale (2012), "Recycling of kitchen waste water through Root zone treatment".

[2]. Budapest, Hungary Csilla Todorovics, Tamas M Garay, Zoltan Bratek (2009), "Theuse of the reed (Phragmites australis) in wastewater treatment on constructed wetlands" from Department of Plant Physiology and Molecular Plant Biology, Eotvos Lorandi University.

[3]. Brandon Kiracofe. The Charles E. Via, Jr.from Department of Civil andEnvironmental Engineering (2004), "Performance Evaluation of the Town of Monterey Wastewater Treatment Plant Utilizing Subsurface Flow ConstructedWetlands".

[4]. R.K.Trivedy Journal of Industrial Pollution Control (2007), "Low cost and energysaving technologies for water and waste watertreatment".

[5]. Kumer S. Makvana1, Manish K. Sharma (2013), "Analysis of Inlet and Outlet WaterQuality of Domestic Waste Water Treated with Root Zone Methods (RZM)".

[6]. S. Dipu, A. Anju, V.Kumar and Salom Gnana Thanga from Department of Environmental Sciences, University of Kerala, Kerala, India.(2000),

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