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Design of Hybrid Flow Constructed Wetlands for Domestic Wastewater Treatment (Phytoremidiation): A Review

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Abstract: ***Expanding population and quick industrialization growth there is adverse effect on environmental pollution in last few decades, the treatment of wastewater using conventional technologies very economical in developing countries. Constructed wetlands act as sustainable engineered systems for treatment of wastewater in developing countries [14]. Constructed wetlands are considered as successful, economical, cheap cost, are easily operated and maintained sustainable systems. In this paper is to design effectively treatment of a small village wastewater (municipal) by using vertical and horizontal subsurface flow of constructed wetlands. This hybrid constructed wetland is designed under topographical climate conditions. These hybrids constructed wetland system act as secondary and tertiary treatment units in wastewater treatment.***

I. INTRODUCTION

Constructed wetlands are wastewater treatment technologies by using natural energy. These systems considered as economic and environmental sustainable, biological treatment technology solution for treatment of wastewater release from small communities. Constructed wetland system consist of one or more treatment cells and fully controlled environment designed and constructed to treatment of wastewater. Generally constructed wetlands have been used many types of wastewater at separate levels of treatment. In the municipal wastewater treatment system, the constructed wetlands receive primary effluent and treat it to secondary effluent standards and better, in polishing wetlands, which receive secondary effluent and treat it further discharge to environment as per environmental standard norms.[13]

A. Ghermandi, D. Bixio

These paper provides or examined the Free Water Surface(FWS) constructed wetlands treatment performance based on the free floating and emerging macrophytes. The FWS system provide an ultimate successful depletion or lowering of conventional waste water treatment parameters like BOD and TSS.These paper studied many municipalities for a more efficient use of the water resources by using CNW.[1]

B. Jan Vymazal

Demonstrated how the Emergent Macrophytes play vital role in FWS CW. Therefore, they reduce the wind speed and hold up sedimentation and provide substrate for bacteria. This paper reported the vegetated lagoons or vegetated FWS CW'S is superior to un-vegetated lagoons.

Jan Vymazal was proposed commonly used macrophytes genera were Typha, Scinpus Phragnites. Jan Vymazal survey released that many FWS CW'S are planted with combination of different species. There is not mention clearly the specific use of plant species for a certain type of waste water. [2]

C. Sara G. Abdelhakeen

He studied the operating conditions of Vertical Subsurface Flow Constructed Wetlands (VSSFCW) with including vegetation and media type and the type of feeding. The pollutant's removal efficiently on vegetation area.

In this study especially determined the "Phragnites austral is" vegetation including the VSSFCW performance is high when compare to other species.

The COD, BOD, TSS and NH4 removing efficiency of VSSFCW under all tested conditions affected by vegetation. The substrate/type of media is affect's the removal of NH4, TP in the planted beds. [3]

D. Sohair I Abou-elela

He examined by three plant species mainly canna, phragmites australis and cyprus papyrus in VFCW. The VFCW is the effective technology for the removal of both physio-chemical and biological pollutants. Sohair stated that the native species in VFCW provided a efficient distribution of root system and mare microbial population for better removal rates. The treated effluent water followed to the national regulatory standards. [4]

E. Jan Vymazal

He expressed the treatment of various type of waste water using constructed wetlands. The constructed wetland is classified based on the vegetation type, hydrology and Direction of flow. Jan Vymazal demonstrated that the water pollution is reduced or removed through the processes in constructed wetland under controlled conditions when compare to natural wetlands. Expressed constructed wetlands were less efficient in removal of Nitrogen. In order the enhance the nitrogen removal by combination of different types of CWS. [2]

F. Franceso Morari, Lcigi Giardini

Franceso marari examined the treatment effect of vertical flow constructed wetlands on municipal waste water. The VFCF was planted with Typha latifolia and the other phragmites australis. The efficiency was assess following parameters PH, Electrical conductivity, Total Suspended Solids(TSS), Chemical Oxygen Demand(COD) and Bio-Chemical Oxygen Demand(BOD), Total Nitrogen(TN) and Nitrate(NO3-), Orthophosphate(PO43-), Sodium(Na), Potassium(K), Magnesium(Mg), Calcium(Ca). The VFCW's showed effective removal effenciences for COD, BOD, N and K, while less effective for magnesium(Mg) and calcium(Ca).

The removal efficiency of pollutant is showed good in VFCWS. The high massive macrophyte growth indicates the removal rates of nutrients.

The ET losses affects the water quality in outflow water. Franceso morari expressed that the pre-treatment systems required for that reduce effect of ET on outflow water and to enhance the removal efficiencies on water quality.

Vertical subsurface wetlands for waste water purification M.M. Perez Villar examination of waste water and show high concentration of nutrients and organic matter as well as less concentration of dissolved oxygen. A vertical subsurface wetland with substrate the red ferralitic soil. The result concludes that the treatment appropriate removal of pollutant in waste water and also removal of the main polluting agents. [5]

G. Lihua Cui

This study investigates the removal of nitrogen and phosphorous from waste water under three different substrates (i.e., Blast Furnance Artificial slang(BFAS), Coal Burn Artificial slang(CBAS) or Midsized Sand Artificial slang(MSAS)), as well as with and without planting canna indica. In this study expressed the BFAS substrate is high efficiency to remove the Total Pollutants(TP) due to high content of Ca and Al in substrates. The CBAS is more efficiency to removal of Total Nitrogens (TN) due to nitrification and denitrification process.

This study gives the HRT is the important parameter for nitrification and denitrification process. This suggest that the slag substances efficiency removed TP more than the nitrogen species and the more nutrients are removed from the influent in the presence of canna indica plant when compared in the absence of that plant. Influence of septic tank attached growth media on total nitrogen removal in a recirculating vertical flow constructed wetland for treatment of domestic waste water. [6]

H. Iyad Al-Zreiqat

Iyad introduced the Re-circulating vertical flow constructed wetland for de-nitrification by circulating the nitrified effluent back into the recirculation tank.

This study illustrates or describes the removal of nitrification and denitrification efficiency of contact time with and without attached growth media.

This study gives the increased the denitrification efficiency of introduction media in recirculating vertical chamber and conclude that the pre-treatment of waste water degree lower into which the recirculating VFW effluent was mixed, greater denitrification rate and lower TN concentration in the effluent. Treatment of domestic waste water and production of commercial flowers in vertical and horizontal sub-surface flow constructed wetlands. [7]

I. F. Zurita

Zurita discussed the treating waste water by using economically benefit plants in constructed wetlands. These plants with vertical and horizontal substrate flow direction cell's respectively. The result for the significantly removal of pollutant is higher in the vertical subsurface flow wetlands. The horizontal subsurface flows wetlands significantly removal efficiency for Total Suspended Solids(TSS) and nitrates.

This study suggest that the type of vegetation and environmental conditions influence the operation efficiency of wetlands. This study suggests that the possible to produce flowers in constructed wetlands to remove higher concentration of pollutants without reducing efficiency of the treatment system. Nitrogen and Phosphate mass balance in a subsurface flow constructed wetlands for treating municipal waste water. [8]

J. A.K.C Chung

In this paper investigated that the treating of municipal waste water using subsurface horizontal flow constructed wetlands with two different hydraulic retention times (with and without plant species) and different type treatments. The result of the planted treatment system gives the removal efficiencies of nutrients were better than the unplanted treatment systems. The HRT higher could removes the efficiency of nitrogen and phosphorous taken up by plant. [9]

K. Alberto Barco

This study evaluated treating municipal waste water in a full scale hybrid constructed wetlands. The horizontal subsurface flow bed vegetated with evergreen species (prunus laurocerausus) connected with a sedimentation pond vegetated with Lema Spp. The results indicate the effective application for abating [g TN, NH4-N, NO3-N and COD concentrations from municipal waste water. [10]

L. Cristina Avila

Cristina expressed the hybrid constructed wetland system consisting of two vertical flow beds and horizontal subsurface flow of an alternating bed. Author suggest partial by pass from the Imhoff tank to the horizontal subsurface flow wetlands, so as to provide a carbon source to promote denitrification. In warm and cold seasons, the organic pollutants and Ammonium removal both in hybrid CNW. In the winter season the reduced nitrate retention took place in horizontal surface wetlands. VF wetland achieved great BOD removal and nitrification. However, almost negligible denitrification occurred within HFW systems. In general hybrid constructed wetland treatment system has suitable for the treatment of waste water of characteristics in small communities under warm regions. [11]

II. CONCLUSION

By studying above literature I have concluded to design wetland with various types of flow with different plants in different cells to increase effective performance. Constructed wetlands are cost effective and maintenance cost is less when compare to conventional treatment systems. This review demonstrate the constructed wetlands are eco-friendly effective wastewater treatment systems, especially in developing countries to stimulate the sustainable wastewater management system. In the Vertical subsurface flow of wetland cell removes the suspended solids and ammonium compounds. In the horizontal subsurface flow of wetlands cell effective in the removal of nitrates (denitrification process) and other parameters like BOD and COD also removes. Therefore, combination of vertical and horizontal subsurface flow type of wetland systems were effective to treatment of wastewater in constructed wetland systems.

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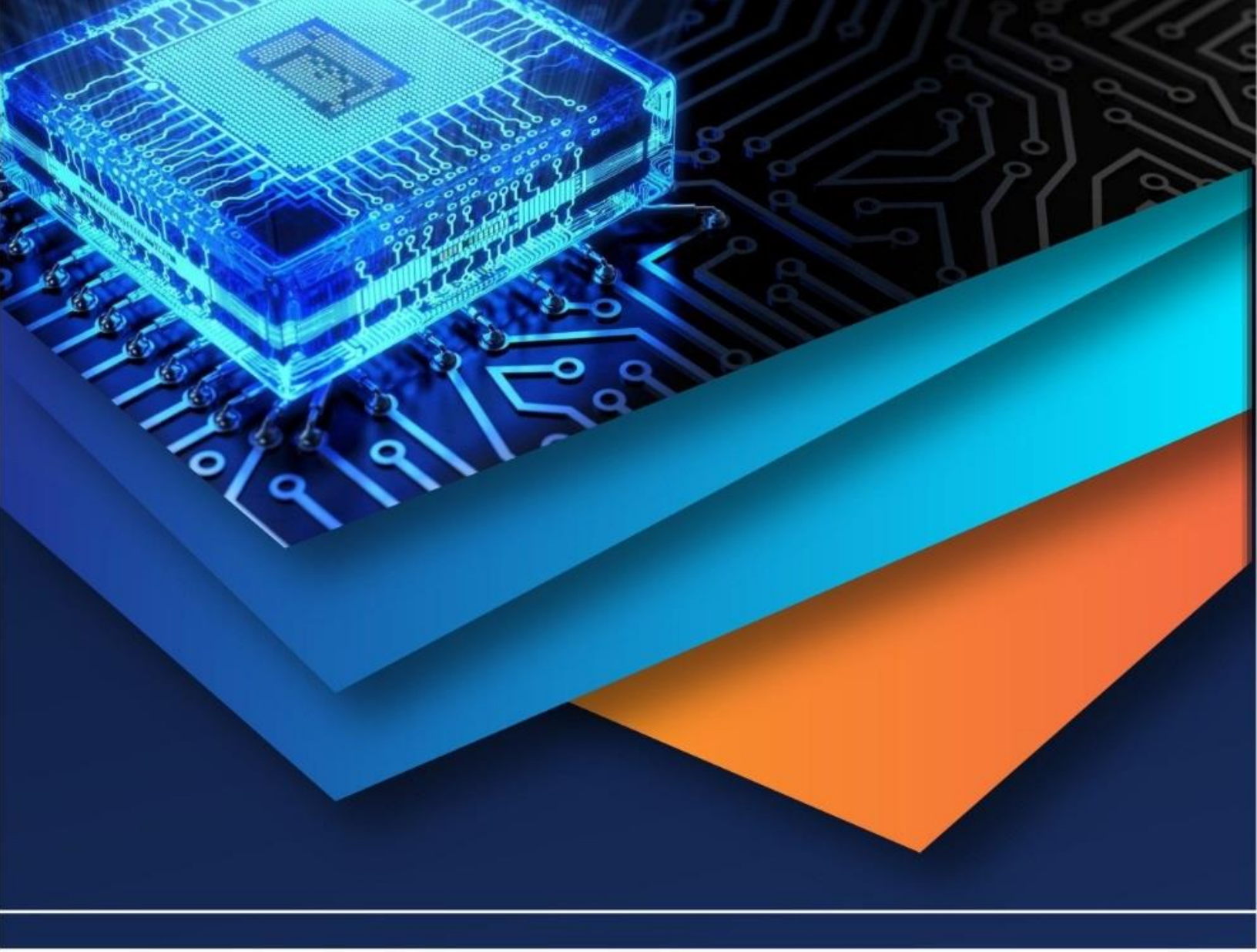

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