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Review: Performance Evaluation of Single Species and Multispecies Constructed Wetland by using Septic Tank Effluent

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ABSTRACT
In developing countries, the most of the wastewater being generated in the outskirt areas of cities and rural area is directly disposed into the surface water bodies without treatment. It will leads to serious degradation of aquatic ecosystem and impair the water quality. The present paper states that constructed wetland provides better secondary treatment to the domestic wastewater with different media and plant species. For single species constructed wetland, in retention time of 11 days, it was found that the maximum removal efficiencies of 93.17 % for BOD, 78 % for COD and 96.49 % for total suspended solids for different plant species and media. For multispecies constructed wetland, in the retention time of 11 days, it was found that the maximum removal efficiencies of 93.6 % for BOD, 92.9 % for COD, 94 % for total suspended solids.

Keyword: *Subsurface constructed wetland, Single species and multispecies constructed wetland, domestic wastewater, removal efficiencies.*

I. INTRODUCTION
At present, there are growing issues of water environment including water shortage, water pollution and degradation of water resources worldwide. Moreover, the situation is becoming more serious due to the combined effects of worsening environmentally-unfriendly activities and large population especially in developing countries [14]. Historically, traditional centralized sewage treatment systems such as activated sludge process, membrane bioreactors and membrane separation have been used successfully for water pollution control in most countries [2]. However, the most of the wastewater being generated in the outskirt areas of cities and rural areas, where sewerage system is not employed, is directly discharged into surface water bodies without treatment, and the poor collection and treatment of these sewages will leads to serious degradation of aquatic ecosystem and impair water quality for drinking, industry, agriculture recreation or other purposes [4]. In the out skirt areas of cities and rural areas, the septic tank is commonly utilized for sewage treatment but the performance of septic tank is not consistent and effluent coming from the septic tank are very dangerous and unsafe if they are disposed directly into water bodies or land. Also the employment of the secondary treatment for septic tank effluent by using traditional centralized treatment system is practically difficult in such areas because of poor sewage collection and expenses associated with them. Therefore, for this regions, constructed wetland (CWs) is a feasible option for treating septic tank effluent and it attracts more attention because of lower cost and less operation and maintenance requirement.

A wide variety of aquatic plants are used in constructed wetland systems designed for wastewater treatment. The plants in constructed wetland provides insulation to the bed during winter, substrate for growth of attached bacteria, releases oxygen and uptake nutrient [13]. In particular, knowledge of role played by plant in the treatment is still lacking, and little research has compared different plant species or species in mxtures in promoting treatment [3].

In this study, effectiveness of single species and muiltspecies constructed wetland has studied.

II. LITERATURE REVIEW
Sohair I. Abou-Elela et al (2015) studied the performance of horizontal subsurface constructed wetland and vertical subsurface constructed wetland

by using municipal wastewater treatment. These two units were planted with plants namely, Cana, Phragmits and Cyperus. It was found that the average parcentge removal of COD, BOD and TSS in horizontal flow constructed wetland were 91.5 %, 92.8 % and 92.3 % while it was reached 92.9 %, 93.6 % and 94 % in vertical flow constructed wetland. They stated in their article that the vertical flow constructed wetland for the removal of COD, BOD and TSS.

Coleman et al. (2001) studied the two wetland gravel depths (45 & 60 cm) and five planting treatments (Each species in monoculture, an equal mixture of the three species and controls without vegetation. The wetlands were planted with Juncus effuses L., Scirpus validus L., and Typha latifolia L.). They stated in their article that there was a 70 % reduction in total suspended solids (TSS) and biochemical oxygen demand and 50 to 60 % reduction in nitrogen (TKN), ammonia, and phosphate. They also stated that, gravel alone has provided significant wastewater treatment but vegetation also improved many treatment efficiencies.

Rahmadyanti Erina et al. (2012) was carried study on three constructed wetland reactor having different stem density with detention time 4, 5, 6, 7 and 8 days with single species plant " Cyperus papyrus & aggregate. They stated in their article that, the Cyperus papyrus plant reactor neutralize the p H by 8.4 to 7.0, reduce BOD upto 93.17 %, reduce TSS upto 96.49 % and reduce NH_3 –N upto 99.13 % from domestic wastewater.

Juan Alfredo Jacome et al. (2016) carried out an experimental study on horizontal subsurface flow constructed wetland which was used to treat the domestic wastewater as a secondary treatment. The wetland is having two cells in parallel. One is having wetland surface area of 350 m^2 and other is having surface area of 280 m^2, constructed with a depth of 0.6 m filled with gravel of average size of 30 mm and planted with common reeds. The wetland was analyzed from June 2011 to September 2015. The wetland was operated with average nominal detention time (HRT) of 10.5 days. They were found in their article that the average primary effluent BOD_5, COD, Total suspended solids (TSS) and total nitrogen (TN) and Total phosphorous (TP) concentration in (mg/L) were 105,197, 43, 29 and 3.4 respctively and average secondary effluent BOD_5, COD, TSS, TN and TP values (in mg /L) were 19, 44,12, 14.3 and 1.9 respectively.

A. S. Juwarkar et al (1995) conducted study on constructed wetland which consists of emergent macrophytes Typha latifolia & phragmites carca. The constructed wetland was made of cement pipes of having 0.1256 m^2 and 0.8 m deep filled with 30 % soil and 70 % sand. They was found that BOD removal efficiency of 78- 91 % and nitrogen was reduced from 30.8 mg / L. Phosphate was reduced from 14.9 mg /L to 9.6 mg /L.

M. E. Kaseva (2014) conducted study on horizontal flow subsurface wetland to treat effluent from upflow anaerobic sludge blanket reactor plant. Out of three units, two units were planted with Phragmites mauritianus and Typha Latifolia respectively and one unit was used as control. He conducted experimental study for Chemical Oxygen Demand (COD), Nitrate (NO_3), Nitrite (NO_2-N), Ammonium (NH_4-N), fecal coliforms (FC), Total coliforms (TC), p H, Temperature & Dissolved oxygen (DO). He stated that the nutrients removal was least in all three units and COD removal rate was 33.6 % for control unit, 56.3 % for phragmites mauritianus unit ,60.7 % Typha latifolia unit. His experimental study also showed that p H increased from influent to the effluent and D.O increase was related to the decrease of temperature.

P. G Sonavane et.al (2007-08) studied the feasibility of constructed wetland of size 3m×1.2m×1m to treat the septic tank effluent from the college campus with Cana indica as a plant species and gravel (6mm-12mm) as media with 0.60m deep. During hydraulic retention time,they were found that BOD reduction from 65 - 82 % with 55 % - 90 % suspended solids. 26 – 66 % TKN and 12 -26 % phosphorus.

J. S. Sudarsan et al. (2015) studied the constructed wetland on pilot scale in which Phragmites australis as a plant species and gravel as media to treat domestic wastewater. They conducted six field trials with each having retention time of 24 h, 48 h, 72 h, 96 h and 120 h. After experimental study, they were found that the average removal efficiency of 75.99 % for BOD, 76.16 % for COD, 57.34 % for TDS, 62.08 % Nitrate, 58.03 % for phosphate, 57.83 % for potassium.

Shubiao Wua et al. (2011) conducted study on integrated household constructed wetland (IHCW) system which was planted with willow to treat household domestic wastewater in rural villages in northeran china. They stated in their article that the removal efficiencies for BOD_5, TSS, NH_4-N and TP were 96.0 %, 97.0 %, 88.4 % and 87.8 % respectively.

III. DISCUSSION

It was found that both single species and multispecies constructed wetland provides better secondary treatment to the domestic wastewater with different media and plant species. The different plant species and media have different removal efficiencies with different HRT. For single species constructed wetland it was found that in the retention time of 11 days, the maximum removal efficiency is equal to 93.17 % for BOD, 78 % for COD, 96.49 % for total suspended solids. For multispecies constructed wetland, in retention time of 11 days, it was found that the maximum removal efficiency is equal to 93.6 % for BOD, 92.9 % for COD and 94 % for TSS. As the retention time increased, the removal efficiencies of pollutant from the wastewater is also increased.

IV. CONCLUSION

The study has concluded that both single species constructed wetland and multispecies constructed wetland has proved to be suitable option for treating the domestic wastewater. The different plant species and media have different pollutant removal efficiencies for hydraulic retention time.

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