

STUDY OF THE INFLUENCE OF SUBSTRATE GRANULOMETRY ON THE BEHAVIOR OF WETLANDS

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Abstract

This research compared the performance debugging of three pilot systems, one of Flow Horizontal and two Vertical Flow. Each of the pilot units had different particle size and presence or absence of vegetation. With the results obtained was tested as vertical flow systems are more efficient than horizontal, removing carbonaceous and nitrogenous as well as the biggest influence on the results of the substrate grain planting or not available at the same.

Keywords: constructed wetlands, granulometry, wastewater treatment, small agglomerations

Introduction

Constructed wetlands are now debugging technology more degree of implementation is having, in small towns at the international level (Puigagut *et al*, 2007). The most widespread classification of them is made based on the movement of water to treat, there are two types i) Surface flow constructed wetlands (also known as Free Flow) which are flooded and the water surface exposed to air, and ii) Subsurface flow constructed wetlands, those in which the water flows below the surface. In the latter, and following the direction of water flow is horizontal and vertical flow. In all modes there are three common elements that star treatment processes, the substrate, vegetation and water circulation. The arrangement and type of substrate, presence or absence of it vegetation and the characteristics and flow of water to be treated are, along with the weather conditions on location, the factors determining the different systems in the effluent reached the desired values in, concentrations of pollutants.

Methods

For the investigation has proceeded to the construction of three artificial wetland pilot units (Pidre, 2010) in Experimental Plant Centa. The main features of each are listed in Table 1. It has been used to study the urban wastewater from the town of Carrión de los Céspedes (Sevilla, Spain).

This wastewater is subjected to pretreatment (grinding, sandblasting and degreasing) and primary treatment consisting of an Imhoff tank. With the effluent from this tank were fed the three wetlands, controlling the flow using electromagnetic meters. To evaluate the performance of purification samples were taken fortnightly for three years both the influent, and the Imhoff tank effluent and each of the Wetlands. The analytical methods used for the characterization of the samples taken are those set out in Standard Methods for Examination of Water and Wastewater (Standard Methods, 1995).

Table 1. Characteristics of Artificial Wetlands studied

	granulometry	thickness	total surface	vegetation present
HV1	sandy 1–2 mm	5 cm	317 m ²	<i>Phragmites australis</i>
	gravel 4–12 mm	60 cm		
	gravel 25–40 mm	15 cm		
HH2	gravel 12 – 20 mm	60 cm	277 m ²	no
	gravel 4–12 mm	30 cm		
HV3	gravel 3–8 mm	30 cm	288 m ²	no
	gravel 4–12 mm	10 cm		
	gravel 25–40 mm	15 cm		

HV1: Artificial Wetland Vertical Subsurface Flow n°1

HH2: Subsurface flow constructed wetlands Horizontal n°2

HV3: Artificial Wetland Vertical Subsurface Flow n°3

Results and discussion

Influent characterization noted that urban waste water treated with the concentration typical of small populations (Salas *et al*, 2007). The percentages of pollution reduction achieved in the Imhoff tank was customary for these types of systems (Vymazal *et al*, 2008), 36% for BOD₅, 35% for COD and 51% in Total Suspended Solids.

The surface organic load applied during the study period was 10.7 g DBO₅/m².d in the case of HV1, from 10.6 to 8.4 for HV3 and the HH2. Regarding the solid surface charge values were 5.2 g TSS/m².d applied in the HV1, HV3 and 5.3 in the 4.1 for the HH2. For total nitrogen the average surface charge applied was 2.5 g Nt/m².d for HV1 and HV3 and 1.9 for the HH2.

In recent publications, to calculate the removal efficiencies of various pollutants, it is chosen to represent and perform a load analysis (Kadlec *et al*, 2009). Thus integrated into a single value different influencing factors such as size of wetland and flow rate, this allows a better comparison between different systems. We proceeded to perform the analysis in each of the systems studied, both for the surface charge of organic and total suspended solids. The slopes of the lines obtained indicate the percentage reduction in each case (Figure 1). The values are summarized in Table 2.

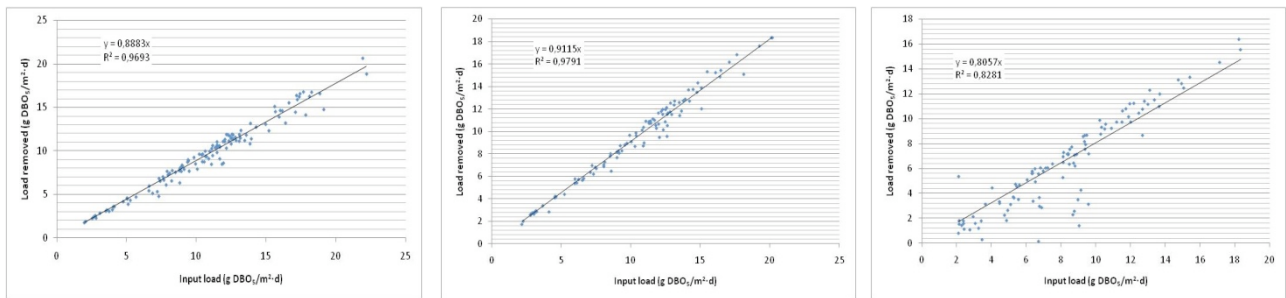


Figure 1. Removed organic load versus input load in the HV1, HV3 and HH2 respectively

Table 2. Mean values of reduction of contaminants studied Artificial Wetlands

	% BOD ₅ reduction	% SST reduction	% Nt reduction
HV1	89	80	61
HH2	81	90	26
HV3	91	83	61

Conclusions

The mode of Vertical Flow Wetland has presented a better performance than the horizontal flow. Even operating at higher load levels in Vertical Flow Wetlands have achieved higher removal efficiencies of organic matter and nitrogen.

It has been found in Vertical Flow Wetlands under study (planted and unplanted), the filter media type used, particle size and thickness, exert a greater influence on purification yields are achieved, the fact that have or not to vegetation.

In summary, it can be concluded that the technology of constructed wetlands is a valid solution for the treatment of wastewater generated in small agglomerations. Featuring a very robust to cope with the sharp fluctuations in flow and loads to be treated, typical of this population range

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