Impact of variables surface load rates on the vertical-flow constructed wetlands and intermittent sand filters.

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Abstract: This paper is studying the optimal surface loading rates in the constructed wetlands with the vertical flow which is suitable for the local conditions in the Syrian Arab Republic and compares the results of the constructed wetlands with the results of the intermittent sand filters by studying the efficiency of these ponds in removing organic pollutants, organic matter, suspended solids and nutrients, this study have been accomplished By construct a pilot plant that simulates the reality .

Keywords: Bed, filter, surface load rate ,constructed wetlands ,media

1 Introduction

The classification of the constructed wetlands depending on the direction of water flow via media is divided as follow :

- Free water surface (FWS)
- Subsurface horizontal flow (SHF or HF)
- Subsurface vertical flow, usually referred to as (SVF or VF).
- Multi-flow basins (horizontal + vertical) Hybrid system.

. In this study, we will study the constructed wetlands Subsurface with vertical flow

Studies have shown that these plants show high removal rates for BOD, COD and pathogens, while these studies show low removal ratios for nutrients P, N, Can be attributed to differences in loading rates and differences in nutrient forms (nitrogen, organic phosphorus, or inorganic nitrogen NO3, NH4 or PO4)

Treating the waste water by using constructed wetlandds is an imported technique for the developed countries, especially Syria. Therefore, many studies have to be conducted to find the optimal design which is suitable for local condition , therefore a pilot plant has been constructed in Homs City in the middle of the Syrian country .

Fig.1. Experimental model

2– Sources and methods:

The pilot plant is consist of :

1- Tow vertical basines the first is planted with cane while the other is sand filter .
2- The basin dimension is (1.5*1.5*1) m
3- Each basin is provided with the following:
   A- Drainage pipes : three perforated ductile iron pipes (2inch dia for the main line and 1 inch for the branches) shown in fig 2 .

Fig.2 drinage networks

   B- Watering pipes : Four perforated pipes (2inch dia for the main line and 1 inch for the branches) shown in fig 3

Fig.3 watering networks .

C- water pump : shown in fig 4

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Fig.4 :The water pump

D : three Shutter valves to control the flows passed to each treatment basin according to the applicable surface loading rate shown in figure [5].

Fig5 :The Used valve

E : tow vertical Airation pipes : shown in fig 6

Fig 6 :The Airation pipes

4- Each basin is consist of tow layers of gravel and a layer of sand between them shown in fig 7

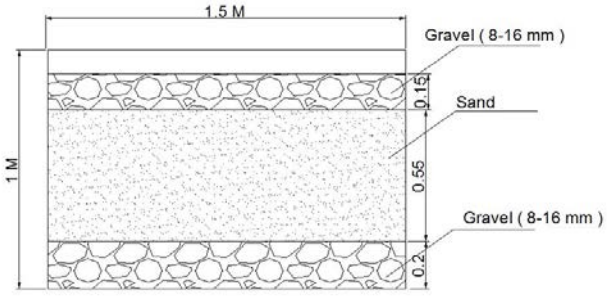

Fig 7 :Cross section in the basin

The experiments were divided into four series each indicating a surface loading rate calculated according to the design area per person as shown in the following table

Table (1) shows the variable applied asueface load

SERIES NO.	SURFACE LOAD RATES ($m_3/m_2.d$)	SURFACE LOAD RATES(CM/D)	Designed Area per person (m_2/p)	Flow (l/d)
1	0.1	10	1	225
2	0.125	12.5	0.8	281.24
3	0.167	16.7	0.6	375
4	0.25	25	0.4	562.5

- The pilot plant were feeded by using waste water (this water pass through the primary sedimentation basin)
- The study was conducted in natural climatic conditions
- The study was achieved through 360 days .
- The cane was planted at the begninng of spring .
- The tow basins were waterd by using clean water .
- After that the tow basines were waterd regulary by using waste water ,and the (COD,SS,Po4,No3) were measured at the inlet and out let of the two bassines .

3– RESULT AND DESCUSSION :

3-1 : studying the COD changes with surface loading rate change:

Table (2) shows the COD changes with variable surface load

Assumed area per person (m_2/p)	surface load rates(cm/d)	Removal efficiency for planted filter %	Removal efficiency for sand filter %
1	10	91	85
0.8	12.5	85	71
0.6	16.7	78	64
0.4	25	71	60

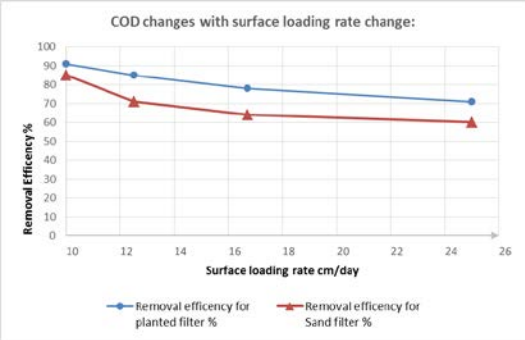

Fig 8 :COD changes with variable loading rates

3-2 : studying the SS changes with surface loading rate change:

Table (3) shows the SS changes with variable surface load

Assumed area per person (m2/p)	surface load rates(cm/d)	Removal efficiency for planted filter %	Removal efficiency for sand filter %
1	10	87	85
0.8	12.5	87	83
0.6	16.7	84	79
0.4	25	81	71

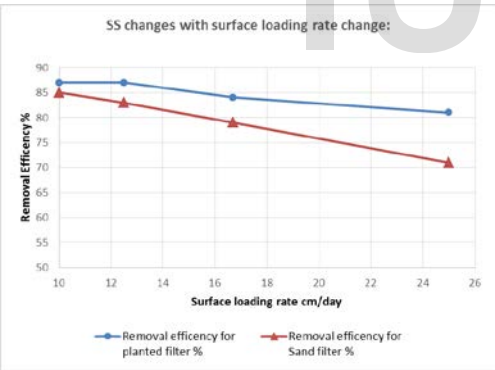

Fig 9 :SS changes with variable loading rates

3-3 : studying the TN changes with surface loading rate change:

Table (3) shows the TN changes with variable surface load

Assumed area per person (m2/p)	surface load rates(cm/d)	Removal efficiency for planted filter %	Removal efficiency for sand filter %
1	10	87	85
0.8	12.5	87	83
0.6	16.7	84	79
0.4	25	81	71

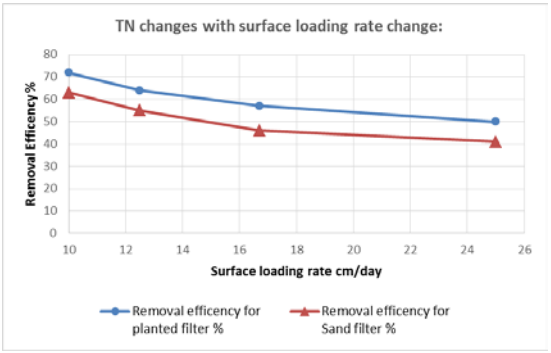

Fig 10 :TN changes with variable loading rates

3-4 : studying the Po4 changes with surface loading rate change:

Table (4) shows the Po4 changes with variable surface load

Assumed area per person (m2/p)	surface load rates(cm/d)	Removal efficiency for planted filter %	Removal efficiency for sand filter %
1	10	53	41
0.8	12.5	49	39
0.6	16.7	40	30
0.4	25	32	22

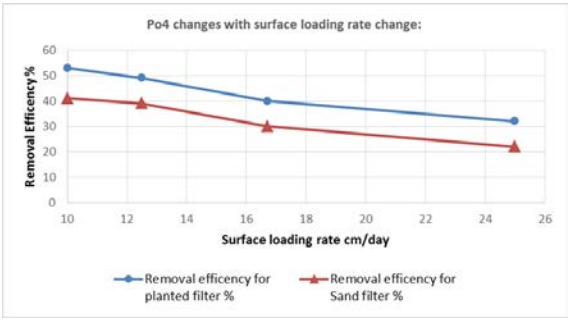

Fig 11 Po4 changes with variable loading rates

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4– CONCLUSION :

The constructed wetlands are very efficient especially at low surface loading rate in the removal of organic material and Suspended solids, while these effectiveness will go down when we have to remove nutrients (TN , PO_4), As we suppose the planted filter give higher Efficiency than the sand filter , but these difference was simple

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5– RECOMMENDATIONS:

- constructed wetlands in our country (Syria) should be designed with consideration of applying low surface loading rate (at least 1 m^2/p) .
- Raw water should be hydrated when the influent have high Concentrate of Contaminants .
- We can replace the planted filter with Sand filter because of the low differences in the efficiency of the both filters .
- The constructed wetlands can be used As an advanced treatment especially in the state of stabilization pond.

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