15th Specialized Conference on
Small Water & Wastewater Systems

7th Specialized Conference on
Resources Oriented Sanitation

IWA the international water association

Constructed wetland for phenolic wastewater treatment: Realizing its potential application in decentralized industrial effluent

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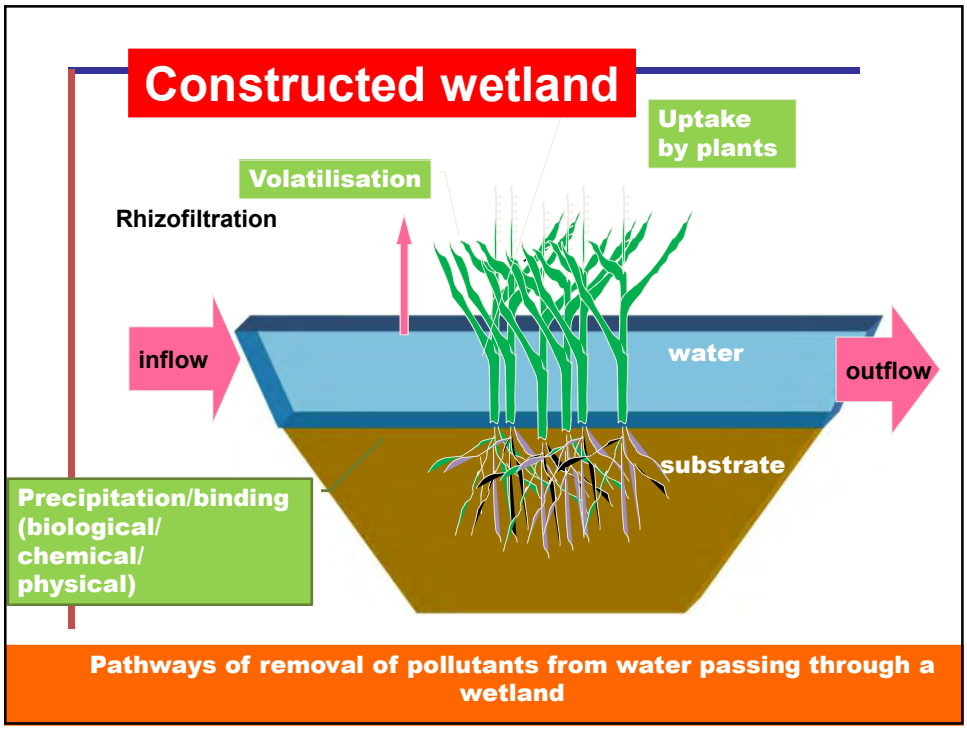
Haifa, 16/10/2018



Pathways of removal of pollutants from water passing through a wetland

Currently used substrates in CWs

Soil

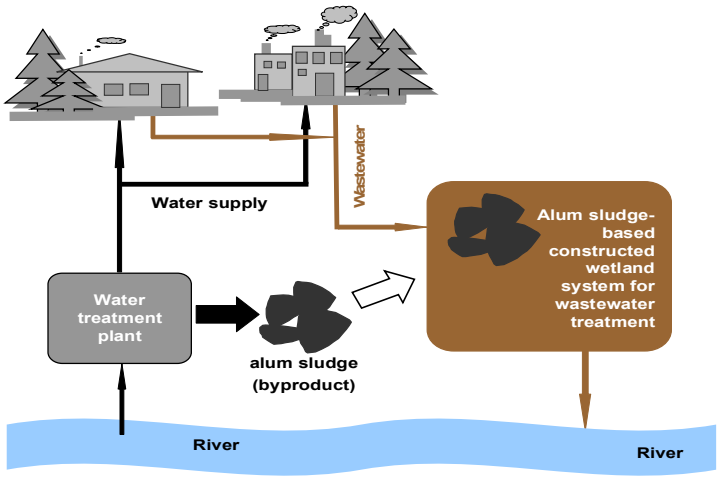
Sand

Gravel

Expected substrate:

1). Carrier for biofilm development
2). Medium for wetland plant growth…
3). Low-cost adsorbent

Novel constructed wetland system (CWs) for high strength wastewater treatment--idea



Alum sludge

- Alum sludge is an inevitable by-product from water treatment process.

Alum sludge

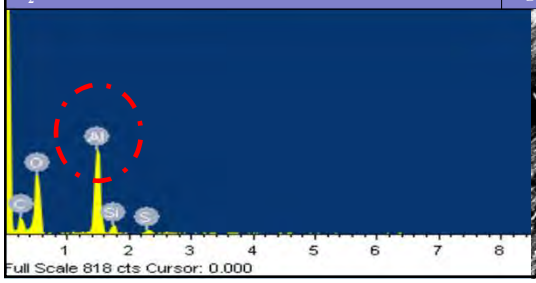
- Alum sludge in Ireland:
  - 15,000 – 18,000 t (dried solids)/pa
  - As a waste
  - Landfilled

Easily, locally & largely available

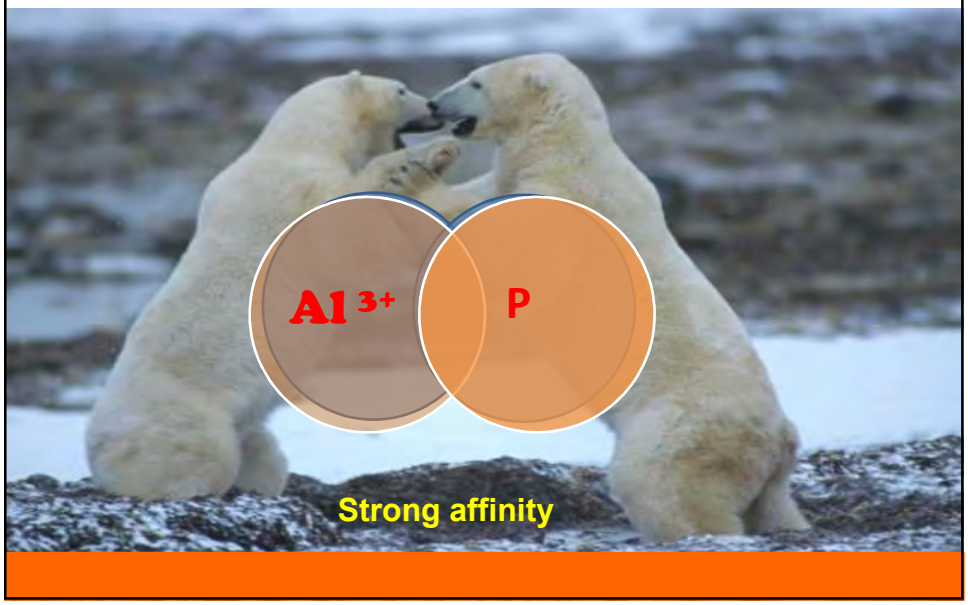
Alum sludge

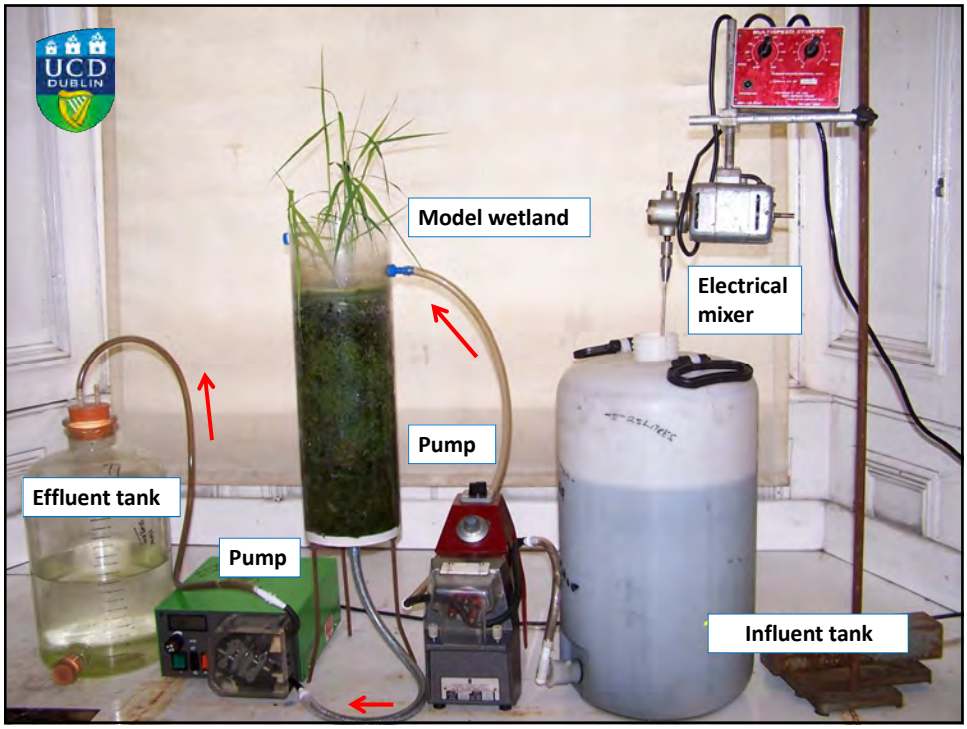
Moisture content 72-75%

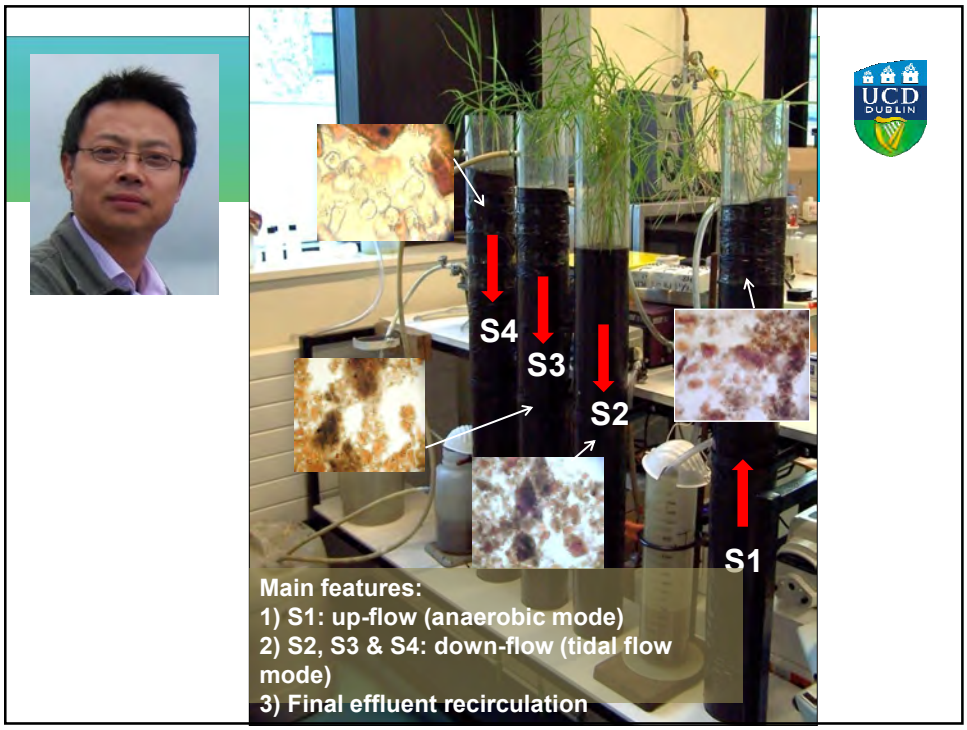
Chemical composition	Unit	Amount
Aluminum (as Al_2O_3)	mg/g	260-463
Iron (as Fe_2O_3)	mg/g	11.9-12.3
Calcium (as CaO)	mg/g	11.6-11.7
Magnesium (as MgO)	mg/g	7.4-7.6
Humic acid (as TOC)	mg/g	96.4-98.5
Cl^-	mg/g	16.0-16.2
SO_4^{2-}	mg/g	8.2-8.4
SiO_4^{2-}	mg/g	10.6-11.8
H_2O at 105°C (moisture content)	%	10.2
H_2O at 1000°C	mg/g	260-270

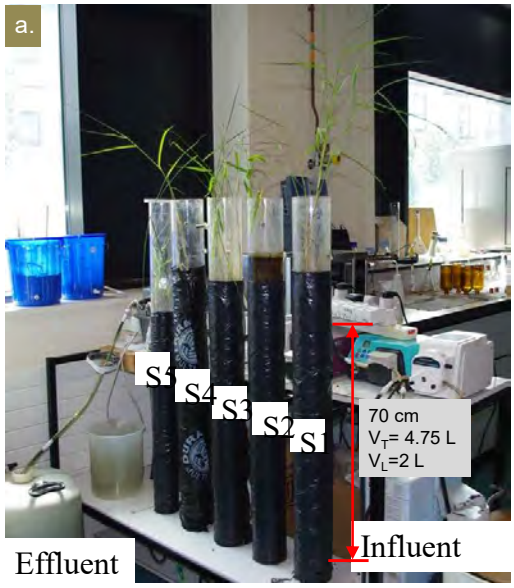


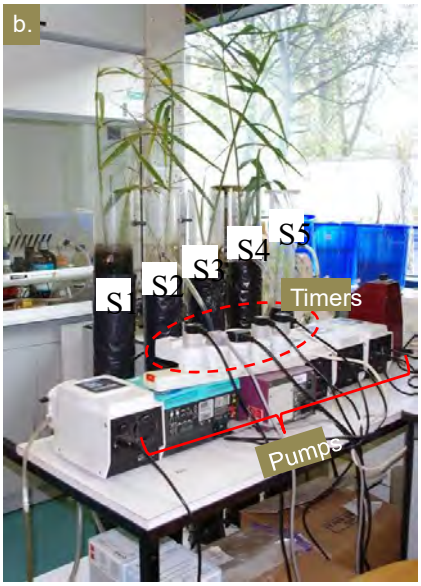
Alum sludge & Phosphorus




Model wetland
Electrical mixer
Pump
Effluent tank
Pump
Influent tank


S4
S3
S2
S1
Main features:
1) S1: up-flow (anaerobic mode)
2) S2, S3 & S4: down-flow (tidal flow mode)
3) Final effluent recirculation


a.
S4
S3
S2
S1
70 cm
V_T= 4.75 L
V_L=2 L
Effluent
Influent


b.
S5
S4
S3
S2
S1
Timers
Pumps


UCD
DUBLIN
95 cm
105 cm
110 cm
Medium: 65 cm Al-sludge
Support: 10 cm gravel


2 months later


4 months later

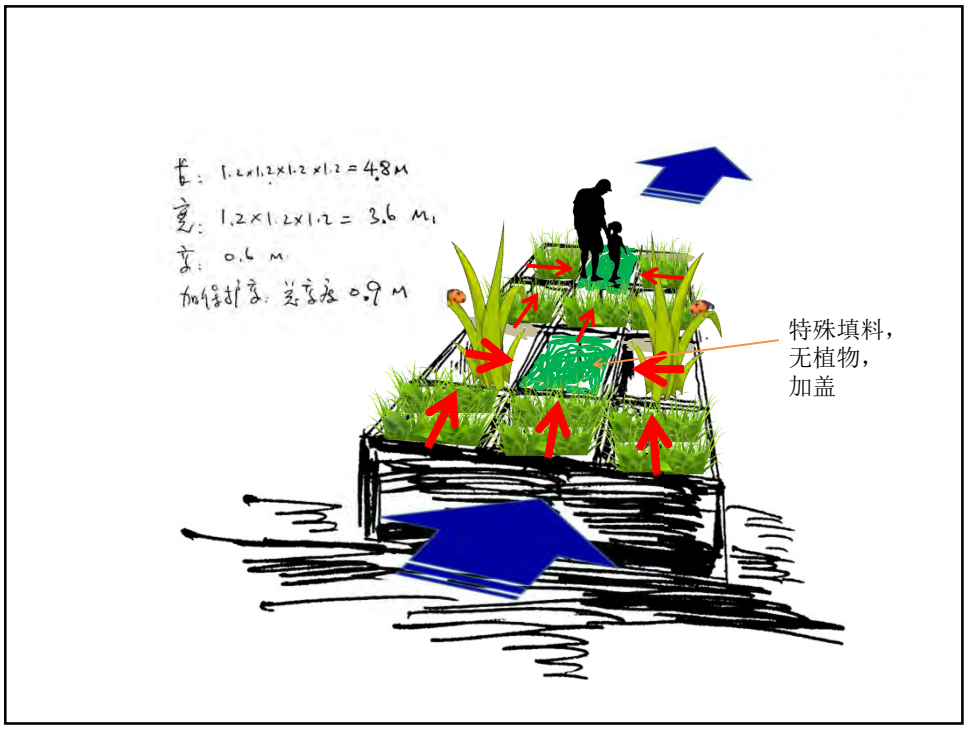
This is a win-win technique & contributed to sustainable development…

CW service-Leitrum project


CW service-Leitrum project


CW service-Leitrum project


Full scale alum sludge-based
CW systems in China


特殊填料，
无植物，
加盖

2017:
Modular CW promotion

2017:
Modular CW

2017:
Modular CW


2018
Modular CW


2017
Modular CW

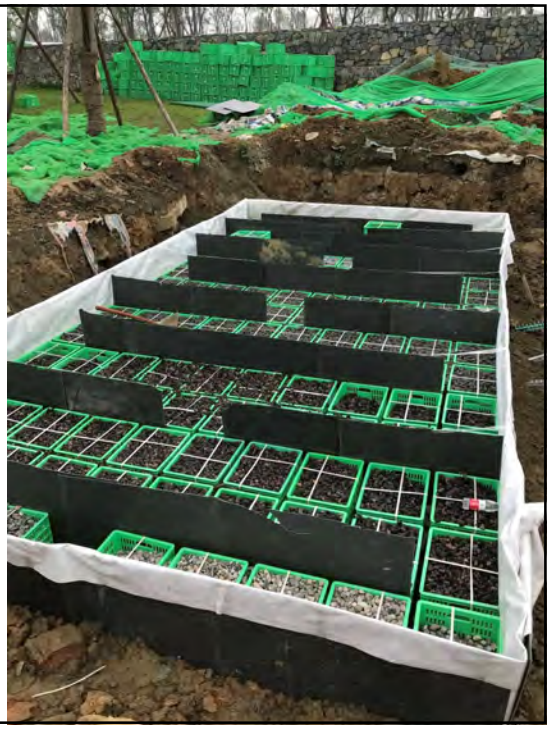

2018
Modular CW


2018
Modular CW

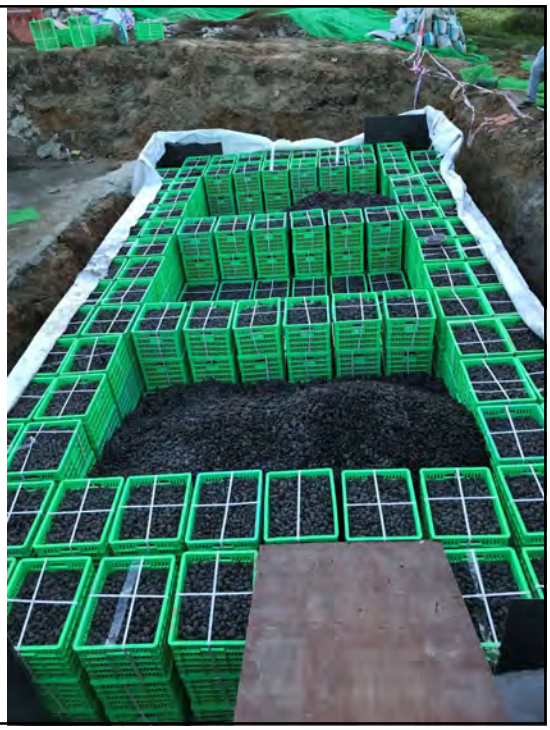

2018
Modular CW


2018
Modular CW

2018
Modular CW



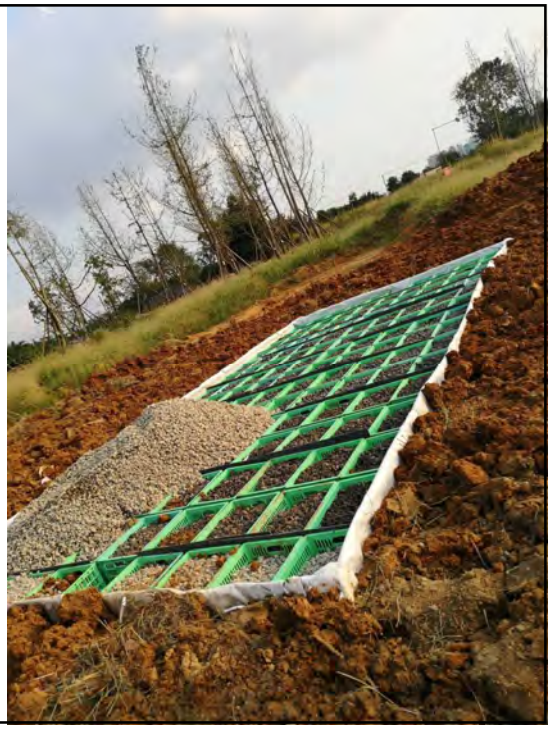
2018
Modular CW



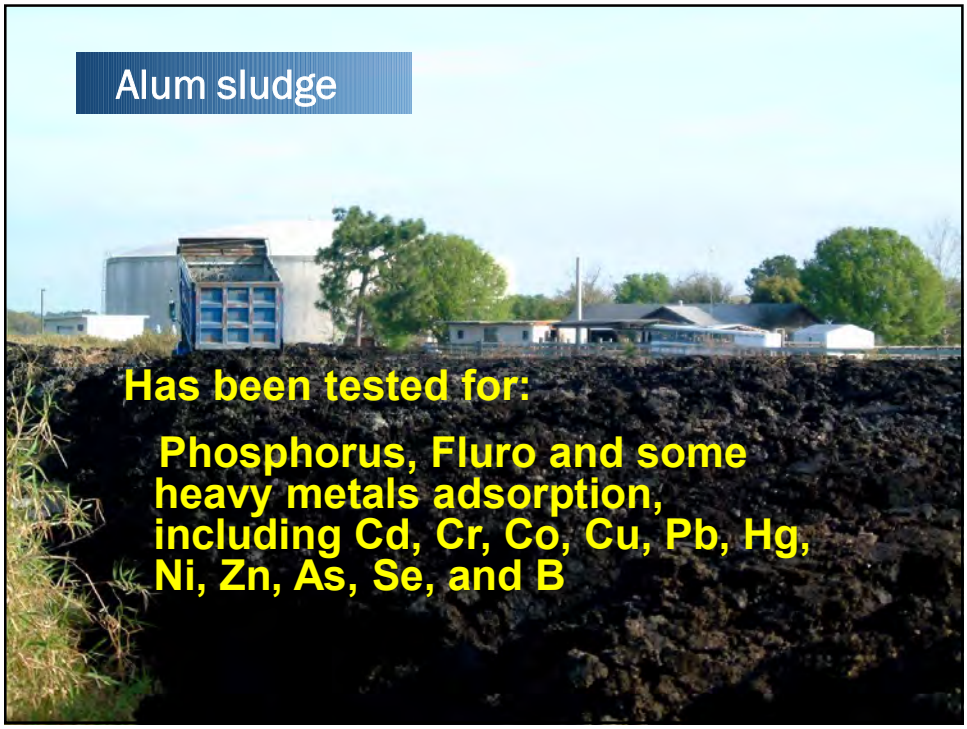
2018
Modular CW

2018
Modular CW

2018
Modular CW



Alum sludge



Has been tested for:

Phosphorus, Fluro and some heavy metals adsorption, including Cd, Cr, Co, Cu, Pb, Hg, Ni, Zn, As, Se, and B

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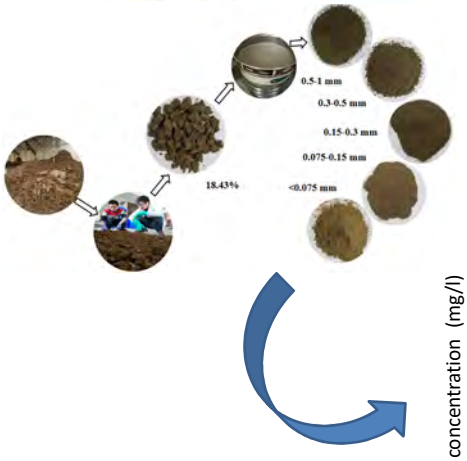

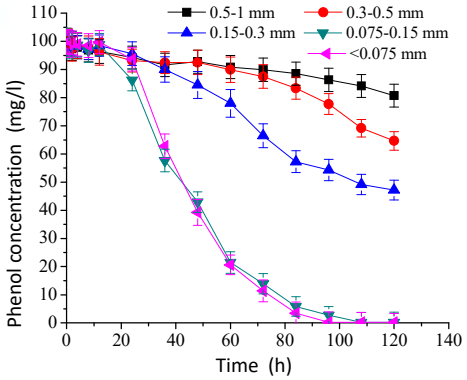

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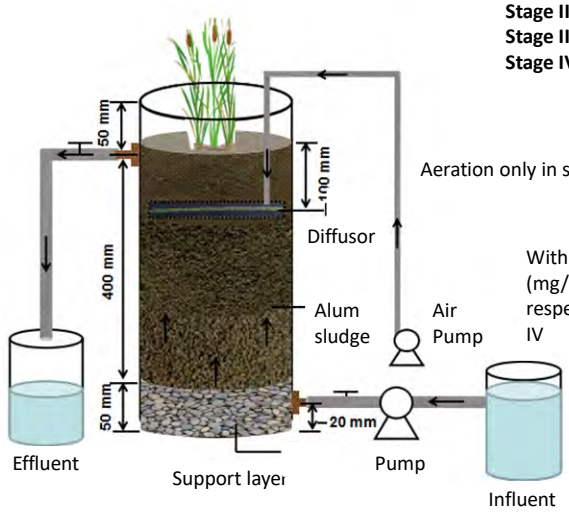
Stage I: 0-61 days
Stage II: 61-126 days
Stage III: 126-189 days
Stage IV: 189-220 days



Aeration only in stage IV

With phenol concentration (mg/l) of 3,5,10 and 10, respectively in stage I, II, III and IV

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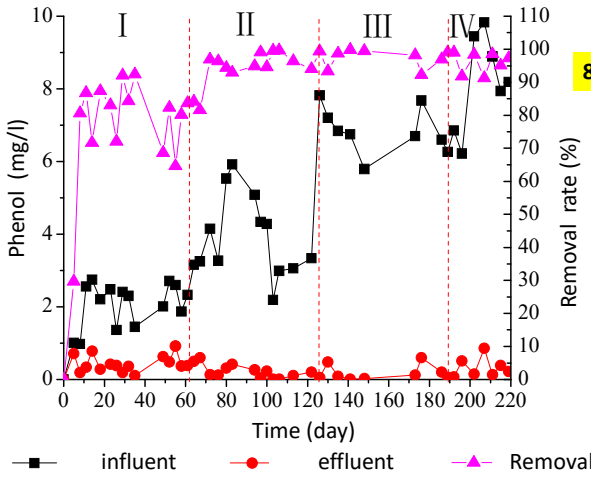

89.37±10.48 %

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We propose the following flow chat for the Phenol WW treatment in practice:

1) Current process

Influent → Per-treatment → Biological treatment → Effluent

2) With high Phenol concentration

Influent → Per-treatment → Biological treatment → CWs → Effluent

3) With low Phenol concentration

Influent → Per-treatment → Alum sludge-based CWs → Effluent