



# **Developing a Pilot Scale Horizontal Sub Surface Flow Constructed Wetlands for Phytoremediation of Primary Lagoon Effluents**

**Oluseyi E. Ewemoje and A. Y. Sangodoyin**

**Agricultural and Environmental Engineering Department  
Faculty of Technology, University of Ibadan, Ibadan, Nigeria.**

# Presentation Outline

- Introduction
- Problem statement
- Specific objective
- Methodology
- The design
- Preliminary Results
- conclusion

# Introduction

- Constructed wetlands
- Alternative to activated sludge treatment
- Low cost associated with maintenance, operation and energy requirement
- Alternative to expensive chemical fertilizers
- Conventional high-technology wastewater treatment system

# Problem Statement:

- Treatment requirement
- In developed countries, the goal is elimination of all pollutants
- constructed wastewater systems are suitable since they can be efficient in removal of BOD<sub>5</sub>, pathogens and nutrients

# The specific objectives

- this study aims at developing a pilot scale horizontal subsurface flow constructed wetlands system for treatment of primary lagoon effluent (sewage)
- To design, construct and conduct operational testing of horizontal subsurface flow treatment wetlands.

# Methodology

- Experimental set up would consist of 3 vegetated cells and 1 non-vegetated cell
- Each bed will be X m long, Y m wide and Z m deep. Size of matrix of the SSHF to be constructed depends on influent BOD<sub>5</sub>, TSS and NO<sub>3</sub><sup>-</sup> concentrations of the wastewater according to Metcalf & Eddy (2004), Katayon et al., (2008)
- Treatment area would be packed with 5-10mm  $\phi$  pea gravel while 20-50mm  $\phi$  will be used at inlet and outlet
- Surge tank of 1000l capacity will receive wastewater while 2 settling tanks of 500l capacities each would be connected to surge tank

# Methodology Cont'd

- **The Design:**
  - The design of constructed wetlands has been carried out with different models
  - This study applied the “rule of thumb”. Though it is a conservative design model, easily applicable and can guarantee good quality effluents, it tends to increase the investment costs



# Figure 1: Anaerobic Lagoon for Sewage Treatment





# Preliminary Results

- Preliminary study on the primary lagoon effluents showed the following physico-chemical and microbiological parameters (Table I) of treated sewage wastewater

**Table1: Characteristics of the Primary Lagoon Effluents**

<b>Parameter</b>	<b>Effluent Ranges</b>	<b>FEPA Limit</b>
COD	420 – 450	80
BOD <sub>5</sub>	245 – 287	30
Total Solid	3050 – 3165	-
Total Dissolve Solid	1050 – 1160	2000
Suspended Solid	1997 – 2005	20
Turbidity ((NTU)	95 – 193	-
Total Coliform Count (cfu/100ml)	2.2 - 3.3	500
Ammonia	200 – 215	-
Nitrate	103.5 – 110	20

All parameters in mg/l except where stated

Source: Ewemoje and Sangodoyin (2009)

- Rule of thumb according to Vymazal (2008) gave:

$$A_h = Q_d (InC_{in} - InC_{out}) / K_{BOD}$$

Where;  $A_h$  is surface flow of bed ( $m^2$ );  $Q_d$  is average flow ( $m^3 d^{-1}$ );  $C_{in}$  is influent  $BOD_5$  ( $mg l^{-1}$ );  $C_{out}$  is effluent  $BOD_5$  ( $mg L^{-1}$ ); and  $K_{BOD}$  is the rate constant ( $md^{-1}$ ).

- Therefore,  $A_h = 5.08m^2 PE^{-1}$
- However, Fowler (2003) gave: Area =  $3W^2$
- Therefore  $5.08 = 3W^2$ ;  $W = 1.30m$
- $W$  currently being used is less than 1 (Vymazal, 2008) Hence a  $W$  value of 0.75m is chosen , for ease of construction, with a surface area of  $2.25m^2$  for effective  $BOD_5$  removal (Katsenovich, et al., 2009)
- Thus actual area of wetland designed is  $2.25m^2$  (i.e.  $0.75 \times 3.0m^2$ )

# Conclusion

- This is an ongoing first year PhD research work and design considerations with wetlands treatment bed size matrix which is one of the set out objectives has been achieved.



*Thanks for listening*