ORIGINAL RESEARCH PAPER

Engineering

TREATMENT OF WASTE WATER USING CONSTRUCTED WETLANDS

KEY WORDS: constructed wetlands, waste water management.

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ABSTRACT

Natural wetlands are being considered beneficial for food and habitat for wildlife, water quality improvement, flood protection and shoreline erosion control. There is increasing advocacy by environmental management scholars for the establishment of constructed wetlands in developing nations to combat this issue. A pilot scale model was designed and fabricated, in a plastic crate (600mmX 400mm x 450mm). In a total depth of 450 mm, the crate was filled with the subsequent layers (from the bottom): 300mm of Coarse Gravel (size: 40mm and 20mm), 150mm of River Sand and Typha Latifolia plants with their roots intact, where placed on the surface level. Suitable PVC piping was done for the inlet(influent), outlet(effluent) and for the distribution of the same. The influent chosen was the water from Dorai kere's lake. Initial testing for the various parameters like dissolved oxygen content, nitrate content, total solids, BOD, COD, pH value, etc. of the lake water was studied and recorded. The plants in the apparatus were watered daily by this influent. The retention time was one week, after the end of every week the effluent was tested and the results were obtained.

INTRODUCTION

Wetlands are intermediate areas between land and water. Wetlands includes marshes, flood fields, ponds tidal wetlands etc. More number of wetlands supports dense growth of plants which grow under wet conditions. With wetland vegetation plantations. As wastewater flows horizontally through the basin, the filter material filters out particles and microorganisms degrade the organics.

4.7% of the geographical land of India contributes to wetland, it is cost effective and natural way of treating waste water, about 97% of the earth is covered by saline water. 80% of the total water supplied for the domestic purpose is generated as waste water. By using wetland systems future fresh water demand can be achieved. Wetlands also treats 60% of the industrial waste water. In horizontal flow wetlands systems water flows horizontally through the basin gravel and sand works as substrate for filtration of waste water Whereas microorganisms degrades the amount of organics present. Constructed wetlands also treats petroleum refinery wastes, fishpond discharges ,industrial waste water compost, paper mills, textiles mills, applications of constructed wetlands is to treat primary and secondary domestic waste effluents.

1.1 OBJECTIVES

1. Design and fabrication of pilot scale horizontal subsurface wetland model.
2. Treatment of wastewater using wetland systems and to study the performance of treatment of wastewater using wetland systems.
3. To analyze various parameters like BOD, COD, DO, pH, turbidity, Total solids, Electrical conductivity, Nitrates and Phosphorous of the influent and effluent.
4. To increase dissolve oxygen which automatically enhances aquatic life in water.

2. Preparation of pilot scale model.

2.1 Preparation of filter media.

i.Gravel: The gravel of 40mm, 20mm and 10 mm of sizes, and should be washed to eliminate soil and other dirty materials that could block the void spaces, which leads to clogging of the organic nutrients/materials present in the waste water, rounded river substrate is recommended over sharp-edged crushed substrate because of the looser packing that the rounded substrate provides. Then it shall be place on as the base media in evenly layers.

ii.Sand: The sand passing through 4.75mm and retaining on 2.36mm sieve shall be used and should be washed properly and cleaned to remove all the dirt contents and soil, then the sand shall be used to place as a filter media evenly.

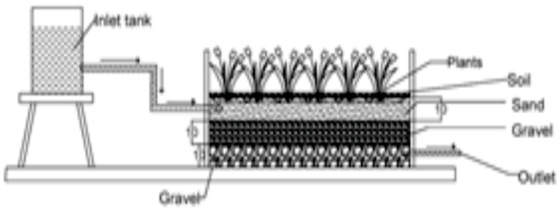

Fig 1: Cross-section of the model, showing different layer

2.2 CHARACTERISTICS OF THE PLANT.

Plant chosen was Typha latifolia, which is a perenial plant which grows inm water of depth not exceeding 0.6m.This plant creates aeroic conditions in the risosphere by introducing oxygen to the water logged substrate. Nitrates and phosphorous present in waste water are being used by plants for their growth.

2.3 FABRICATION OF PILOT SCALE MODEL

- A plastic crate of 0.6mx0.4mx0.45m open at the top to grow the plants is used for the pilot model.
- Two orifices of l" diameter, one for the inlet and another for the outlet is provided.
- The pipes made of PVC are used for inlet, outlet and distribution of the waste water throughout the model setup.
- Wheels are provided at the four corners for the mobility of the model.
- Gravel of size 40mm, 20mm and 10mm are used, sand as media and soil to help the plants to grow is used.
- The plant type used is Typha latifolea, Phragmites which are suitable to grow in wetlands efficiently by using the nutrients present in the waste water.

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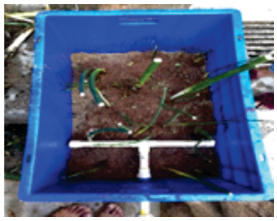

Fig2: Day 1

Fig 3: Day 28

Fig 4: The final setup of the model

3. RESULTS

i.COD: The COD of the effluent sample in the 1st week was constant compared to influent. The variation in COD for 1st week, 2nd week, 3rd week and 4th week was 11.34%, 30%, 54.62% and 70.58% respectively. There was a very good progresses in the reduction of COD by 4th week.

ii.BOD: The BOD of the effluent sample in the 1st week was constant compared to influent. The variation in BOD for 1st week, 2nd week, 3rd week and 4th week was 5%, 7.5%, 18.2%, 22% respectively.

iii.DISSOLVED OXYGEN(DO): Dissolved oxygen refers to the level of free oxygen present in water. The dissolved oxygen of the effluent sample was absent for first two weeks, later it stared gaining DO. The variation in DO for 1st week, 2nd week, 3rd week and 4th week was 0%, 0%, 8.2%, 10% respectively.

iv.ELECTRICAL CONDUCTIVITY: The electrical conductivity of the effluent sample varied from week 1-2 in decreasing order when tested using conductivity meter. The variation in electrical conductivity for 1st week, 2nd week, 3rd week and 4th week was 5.5%, 11.6%, 21.6%, 24.8% respectively.

v.pH: The pH of the effluent varied in a decreasing order from 1st week to 4th week. There was 4%, 9.6%, 21.15%, 27.88% of pH variation for 1st week, 2nd week, 3rd week and 4th week respectively, from alkaline to basic.

vi.TOTAL SOLIDS: The total solids of the effluent sample varied in a gradual manner, the variation in total solids for 1st week, 2nd week, 3rd week and 4th week was 5%, 7.3%, 17.4%, 27.5% respectively.

vii. TURBIDITY: The turbidity of the effluent sample in 1st week and 2nd week was constant. Further from 2nd week it started reducing in a decreasing order. The turbidity of the sample was tested using Nephelo turbidity meter. Table 5.10 gives the value of turbidity for different weeks. The variation in Turbidity for 1st week, 2nd week, 3rd week and 4th week was 2%, 2.5%, 14%, 40% respectively.

viii. NITRATES: The nitrates of the effluent sample values varied in a decreasing order. The nitrates sample was tested using spectrophotometer, the variation in nitrates for 1st week, 2nd week, 3rd week and 4th week was 2.5%, 8%, 20.5%, 30% respectively.

ix.PHOSPHOROU: The phosphorous sample was tested using a flame photometer. The variation in phosphorous for the 1st week, 2nd week, 3rd week and the 4th week was 7.5%, 10%, 27.5%, 47.5% respectively.

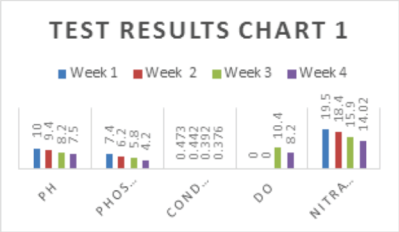

Chart 1: tested values vs week

This represents that the parameters like pH being7.5 from 10 in 4 weeks, similarly phosphorous to 4.2 mg/l from7.4 mg/l, electrical conductivity from 0.473 m-Mhos/cm to 0.376 m-Mhos/cm and nitrate from 19.5 mg/l to 14.02 mg/l , Most important parameter which is Dissolved oxygen is increased to 10.4 mg/l maximum and helps for aerobic activities.

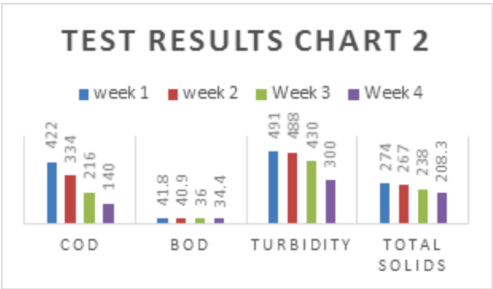

Chart 2: tested values vs week

This shows us that COD drops down to 140 mg/l from 422 mg/l, Bod from 41.8 mg/l to 34.4 mg/l, turbidity to 491 NTU to 300 NTU and total solids to 208.3 mg/l from 274 mg/l.

The drawn graph shows us that pH, COD, BOD, Total solids, Nitrates, Phosphorous, conductivity and turbidity has reduced significantly which helps the treated water can be used for agricultural purposes.

4. CONCLUSIONS

1. Hence in India the amount of sewage produced per day surpasses way above the amount of sewage that actually gets treated by the government bodies per day wetlands might be a good additive to them.
2. The chemical parameter concentration is reduced by using economical and efficient constructed wetlands naturally.
3. The following results have been achieved over a time span of 4

weeks by using the pilot scale model of a constructed wet land:

- The total decrease in the pH over 4 weeks of testing, was recorded to be - 27.88%.
- The total decrease in the COD over 4 weeks of testing, was recorded to be - 70.58%.
- The total decrease in the BOD over 4 weeks of testing, was recorded to be - 22%.
- The total increase in the DO over 4 weeks of testing, was recorded to be - 10%.
- The total decrease in the turbidity over 4 weeks of testing, was recorded to be - 40%.
- The total decrease in electrical conductivity over 4 weeks of testing, was recorded to be - 24.8%
- The total decrease in the nitrate content over 4 weeks of testing, was recorded to be - 30%.
- The total decrease in the phosphorus over 4 weeks of testing, was recorded to be - 47.5%.

4.FUTURE SCOPE OF THE PROJECT:

i.To study the design standards for various Indian villages.
ii.To study the removal of the heavy metals, present in wastewater.

5.REFERENCES

1. BODY C. HODDINOTT BSC. (2006). "HORIZONTAL SUBSURFACE FLOW CONSTUCTED WETLANDS FOR ON SITE WASTE WATER TREATMENT." Public Health Wright State University Dayton Ohio, 1(1-27).
2. GUNTER LANGERBRAGER. (2009). "MODELLING OF PROCESSES IN SUBSURFACE FLOW CONSTRUCTED WETLANDS." VADOSE ZONE JOURNAL, 7(13).
3. SENGUPTA, N. AND DALWANI, R. (2008). "CONSTRUCTED WETLAND SYSTEMS FOR WASTEWATER TREATMENT." 12TH WORLD LAKE CONFERNCE 1004-1009, 1(5).
4. UN-HABITAT, (2008). "CONSTRUCTED WETLANDS MANUAL". Water for Asian Cities Program Nepal, Kathmandu.
5. R KAUR, SP WANI, AK SINGH and K LAL. (2014). "Wastewater production, treatment and use in India". New Delhi, India ,1(1-13).