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Waste Water Treatment Using Reed Bed System

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Abstract

The waste water generated from the quarters, school hostel and college hostels in University campus were collected and analyzed. Conventional treatment method and the method of purification using Reed bed for the treatment of effluent were compared. The plant used for this purpose was Phragmitis australis which is locally known as NANAL. The experiment was conducted with the Primary treated sewage taken from the Sewage Treatment Plant. From the experiment it is found that the one with Reed Bed system gives a better quality treated water vis-à-vis the treated water. Hence, the filter bed of STP is planted with Phragmitis australis as a trial run. The project presents the method of construction of root zone bed and the effectiveness of removal of various contaminants using this root zone treatment process. The results for raw water and treated water samples were compared and discussed.

Keywords: *Waste Water, Reed Bed System, Treatment*

INTRODUCTION

Reeds are coarse grasses growing in wet places. Reed bed is one of the natural and cheap methods of treating domestic, industrial and agricultural liquid wastes. Reed bed is considered as an effective and reliable secondary and tertiary treatment method where land area is not a major constraint (Wood, A. and L.C.Hensmann.1988). Generally reed bed is made in shallow pits, installed with a drain pipe in a bed of pieces of lime stones and filled up with pebbles and graded sand (Crites R.W., 1994). In this sandy body, reed plants generally with hollow root which bring oxygen into the filter bed are planted (Lawson, G.J. 1985).

Application of root zone technology (RZT) is finding wider acceptability in developing and developed countries, as it appears to offer more economical and ecologically acceptable solution to water pollution management problems. Root zone systems whether natural or constructed, constitute an interface between the aquifer system and terrestrial system that is the source of the pollutants. These are reported to be most suitable for schools, hospitals, hotels and for smaller communities (Horner, 1996). The country's reportedly first RZT system was designed by NEERI at Sainik School, Bhubaneshwar, Orissa. It has reportedly been giving a very good performance of removing 90% BOD and 63% nitrogen (CPCB The objective of this work is to analyse the wastewater generated in the university campus and evaluate the suitability and effectiveness of treating effluents by root zone system and compare the results with conventional methods of treating waste water with STP.

MATERIALS, METHODS AND PROCEDURES:

Wastewater Parameters

Wastewater contains a variety of inorganic and organic substances from domestic sources. The wastewater parameters namely BOD, COD, TDS, TSS and pH were analyzed. The procedure followed for calculating the parameters are the STANDARDISED methods APHA (1992)

Significance of Root Zone Treatment:

- It is odourless. There is no frequent maintenance required.
- It has high treatment efficiency. It does not need any mechanical, electrical or chemical equipment.

FUNCTIONS OF PHRAGMITES AUSTRALIS

First, the very existence of root zone system creates channels for the water to pass through. Secondly, the roots introduce oxygen down into the body of soil and provide an environment where aerobic bacteria can thrive. These organisms are necessary for the breakdown of many types of compounds in particular in the oxidation of ammonia to nitrate; this is the first step in the biological breakdown of nitro compound. Thirdly, the process of nitrification takes place i.e. the plants themselves take up a certain amount of nutrient from the wastewater.

In the spring and summer about 15% of the treatment capacity for sewage effluent occurs through this root zone treatment. Most degradation of nutrients is however undertaken by the

microbes. The plants are also capable of accumulating certain heavy metals, an area where there is currently a great deal of research (Babbit, H.E. and E.R. Baumann, 1960). In essence Reed beds can help to achieve a better standard of water quality through

- High level of bacterial and viral removal
- Decreased biological oxygen demand
- Reduction of suspended solids

REED BED SYSTEM

Principles of reed beds

- Common reed (Phragmites australis) has the ability to transfer oxygen to root zone.
- Large population of microorganism found in root zone.
- Pollutants digested and rendered innocuous by a range of organisms similar to conventional sewage works.

Fig 1: Wetland Unit Tub

Fig 2: Aggregates in Tub

Fig 3: Sand in Tub

TYPES OF REEDS

The various reeds include aquatic reeds, common reed, and aquatic plants.

ADVANTAGES OF REED BED:

- Operation does not require electricity or fuel supply. No mechanical systems are involved.
- Reed beds do not breakdown. Set up is visually unobtrusive (aesthetical good) and provides growth of microorganisms.
- The plants, especially the species that grow naturally and under harsh environment conditions, offer a simple and economic method of wastewater treatment.
- Root zone plants can also be effectively used for the treatment of small volumes of municipal wastewater, particularly where construction of sewage collection system to an adjacent waste water treatment is needed.

Construction and Working of Reed Bed

The unit was constructed by placing separate layers of bricks (bricks or brick bats) stone chips, sand, stone dust, after arranging the layers the plants were planted in the unit. Further the growth of plants was monitored. During the growth period of one month, only plain water was sprinkled. Then sewage water was let into the root zone system and the samples were collected at the outlet, The results were analyzed and presented in the table.

Type of Reed Beds

There are two types of reed beds HORIZONTAL REED BED and VERTICAL REED BED. The horizontal reed bed is the one in which the filter water is collected in horizontal manner as shown in fig 1. The vertical reed bed is the one in which the filtrate is collected in the bottom of the apparatus.

PRINCIPLE OF HORIZONTAL PLANTED FILTERS

- Continuous diffusion of atmospheric air to the upper surface layer only.
- Anaerobic condition in the lower parts of the filter.
- Roots of reed plants provide favorable environment for bacteria, which take dissolved organic matter and thus the BOD load is further reduced.

Planted horizontal gravel filters are also referred to as subsurface flow wetlands (SSF), constructed wetlands or root zone treatment plants. The horizontal planted filter is simple in principle and requires almost no maintenance. However, design and construction requires a thorough understanding of the treatment process and knowledge of the filter medium.

Planted filters are suitable for pre-treated (pre settled) domestic or industrial waste water of COD content not higher than 500 mg/l (CPCB 2000) and (APHA 1992).waste water must be pre treated especially with respect to suspended solids so as to prevent the clogging of filter media.

Filter bed should not be deeper than the depth to which plants roots can grow (30-60 cm), as water tends to flow faster below the dense bed of roots. Shallow filters are more effective compared to deeper beds of the same volume. To prevent percolation of wastewater in ground, the bottom must be sealed. While the top part of the filter media in a planted filter is kept horizontal, constructed bottom slopes down from inlet to outlet preferably by 1%.

Bed Preparation: The bed should be prepared by giving a longitudinal slope of 1 in 40 for free flow of sewage in the soil from inlet to outlet.

PHRAGMITES AUSTRALIS

Name of the species used in the system is Phragmites australis. This species has hole from the leaves throughout the stem to the root zone. It takes the oxygen from the atmosphere and supplies to the root zone. So the oxygen supply in the root zone is sufficient to support the growth of aerobic bacteria. These bacteria consume the oxygen and break the organic compounds. The existing conditions favour the growth of the bacteria and they multiply easily. As the anoxic zone in the system is comparatively low the nuisance due to the anaerobic decomposition is also low.

SEWAGE FLOW

The sewage from the collection tank is passed continuously to the filter. It filters through the graded stone layer and enters the prepared bed where the treatment takes place. After passing through the bed the treated sewage is allowed to filter through the down end filter. It rises up to the initial level maintained. It is collected in a tank by using a pump and discarded to the farmlands. The particles present above the stone layers are scraped and disposed.

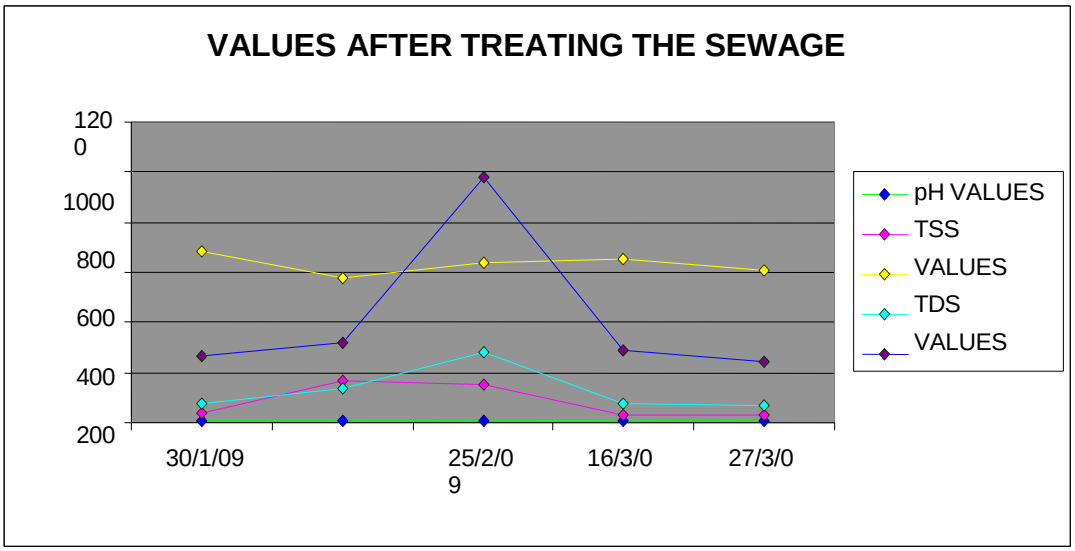
GROWTH OF REEDS

The reed grows quickly; it produces large clumps of thick rhizomes, oxygen transfers through the roots may be sufficient. Due to thick and sturdy rhizomes it is planted to help control soil. The reeds have many leaf blades, which are linear in shape.

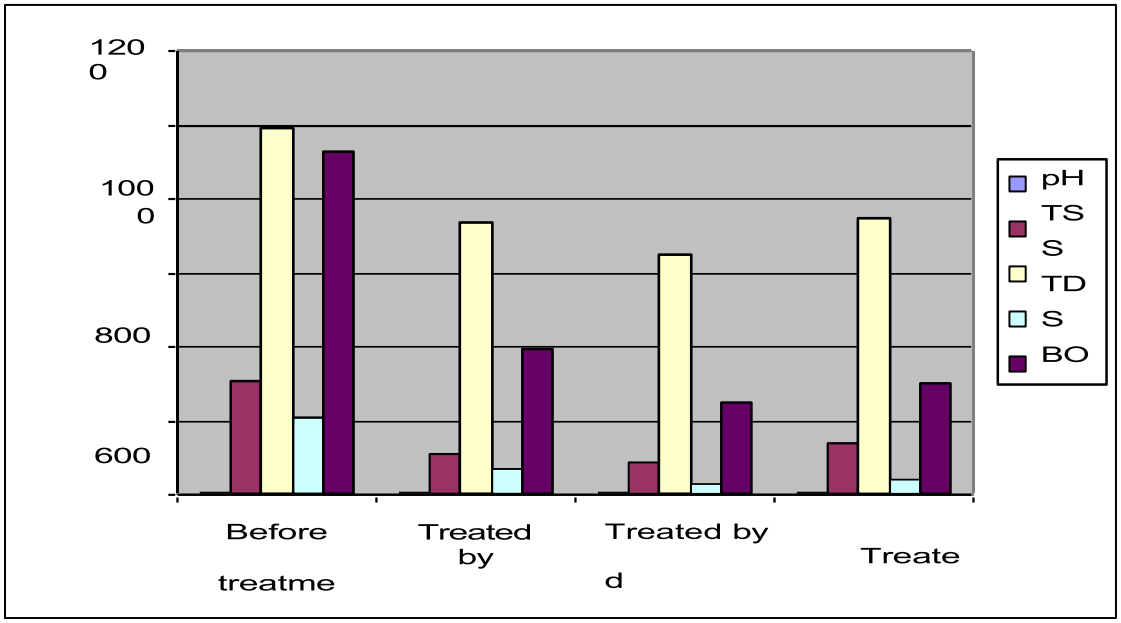
Fig 4: Reed Unit at Time of Planting

Fig 5: After 68 Days (End of Project)

The date inscribe treated samples are taken at equal intervals (like 20-02-09, the treated water is taken from bed after 5 days)



Graph 1: Values before treating the waste water



Graph 2: Values after Treating the Sewage Waste Water

DISCUSSION

The results show the concentrations of five parameters for wastewater treated by conventional treatment plant, root zone system and simple filter bed system. It is clear that the use of Reed bed system is best for the treatment of all parameters when compared to the other two. There is a remarkable reduction in pH, B.O.D, C.O.D by Reed bed treatment and the treated water has become fit enough to be let out directly into a receiving water body as the concentrations are below allowable limits. Thus the root zone treatment can be used independently or as an addition to conventional treatment so as to make the final output fit

enough for discharge into a natural water body. A sudden change in values of TSS and BOD on Feb 20th and 25th are noted. This is due the fact those two days shows peak college activity combined with some amount of rainfall on 20th morning. A sudden Rise in values of COD on Feb 25th may be due to the discharge of chemicals from our college labs.

FROM GRAPH NO 3.

There is a remarkable reduction in pH, B.O.D, C.O.D by Reed bed treatment and the treated water has become fit enough to be let out directly into a receiving water body as the concentrations are below allowable limits.

- Whereas, for the water treated by conventional plant, some more treatment is needed before it can be discharged.
- Thus the root zone treatment can be used independently or as an addition to conventional treatment so as to make the final output fit enough for discharge into a natural water body.
- Root zone system achieves standards for tertiary treatment with no operating cost or any hidden cost included in its operation. For Example: there is no consumption of electricity.

CONCLUSION

The waste water discharged in our campus setting was analyzed to determine characteristics. The wastewater from campus shows variation in concentration according to student's strength. TSS, BOD and COD particularly show a large temporal variation. The root zone method was employed on a lab scale to treat the waste water. The results were compared with the conventional treatment. It is seen that the root zone treatment can be utilized independently for a small scale unit or as an additional unit to conventional treatment system for complete treatment of waste water.

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