

LOW COST SEWAGE TREATMENT BY ROOT ZONE TECHNOLOGY

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Abstract - Increasing urbanization and human activities exploit and affect the quality and quantity of the water resources. This has resulted in pollution of freshwater bodies thanks to increased generation of domestic waste, sewage, industrial waste etc. Large quantity of sewage is generated in urban and semi urban areas. Due to the shortage of cost effective treatment methods, the planet is facing problem of sewage treatment and disposal. Much advancement has taken place within the treatment technology both in aerobic and anaerobic methods. However, huge capital investment is required for providing treatment facilities; also disposal of the treated effluents may be a major problem. The operation and maintenance cost just in case of conventional sewage treatment plant is estimated to about Rs. 12 per 1000 litres. As treatment cost is high, sewage is directly discharged into the rivers or nearby water bodies and polluting the sources of water available to the society. The conventional methods are not feasible for small cities and towns. Hence there's a requirement of cost effective method for sewage treatment. Waste water treatment by Root Zone Technology (RZT) is emerging because the alternative low cost method which involves use of plants species for treatment of sewage. Studies were conducted to assess the feasibility of Root Zone Technology for sewage treatment. The study is conducted with pilot scale reactors on differing types of plant species. Plants species were planted within the reactor and were irrigated initially with water. There is a requirement to take advantage of this technology during a developing country like India to its maximum to realize its benefits and for sustainable development.

Key Words: Urbanization, Sewage, Low Cost Treatment Technologies, Root Zone Technology, Cost Effective Method

1. INTRODUCTION

Environment pollution is one of the serious problems that the world is facing in this era. In India, major problem leading to environment pollution is increasing population, industrialization and urbanization. Collection, treatment and disposal of domestic and industrial wastewater are the serious issues to be handled for preventing damage to the environment. A study finds that discharge of untreated sewage is single most important cause for pollution of surface and ground water in India. Sewage/ waste water may be a major carrier of disease (from human wastes) and toxins (from Industrial wastes). The safe treatment of sewage is thus crucial to the health of any Community. There is an outsized gap between generation and treatment of domestic

wastewater in India. There is lack sufficient treatment capacity and also the existing sewage treatment plants are not operated properly and maintained in good running condition. The wastewater generated within these areas normally percolates in the soil or evaporates. The uncollected wastes accumulate in the urban areas cause unhygienic conditions and release pollutants that leach to surface and groundwater. Normally traditional waste water treatment plant includes processes like primary sedimentation, aeration, secondary treatment and chlorination. This form of treatment plants requires high initial investment. Moreover their maintenance cost is high and treatment plant requires large acreage . For the functioning and proper maintenance of the plant skilled labours are required. Overall the treatment plants are costly affair and results are not up to the mark. Treatment of waste water by traditional method is very costly and hence neglected by most of the public bodies. The wastewater discussed in this section is predominantly of domestic origin. Varying amounts of commercial and laboratory wastewaters are often collected and treated with the sanitary sewage. The primary purpose of the treatment of sewage is to stop the pollution of the receiving waters. Many techniques have been devised to accomplish this aim for both small and large quantities of sewage The main objective of this study is to develop cost effective treatment technology for sewage treatment. Assessment of root zone technology for sewage treatment and disposal is conducted. Reeds are coarse grasses growing in wet places. Reed bed is one among the natural and cheap methods of treating domestic, industrial and agricultural liquid wastes. Reed bed are natural habitats found in floodplains, waterlogged depressions and estuaries. Artificial reed beds are used as a way of removing pollutants from grey water. Reeds, Phragmites australis is considered to be the best plant because of its roots form horizontal rhizome that guarantee a perfect root zone filter bed Reed bed is considered as an efficient and reliable secondary and tertiary treatment method where acreage isn't a serious constraint. Generally reed bed is formed in shallow pits, installed with a drain pipe during a bed of pieces of lime stones and filled up with pebbles and graded sand. In this sandy body, reed plants generally with hollow root which bring oxygen into the filter are planted. The term Root Zone encompasses the life interactions of varied species of bacteria, the roots of reed plants, soil, sun and water. They are also known as constructed wetlands or subsurface flow systems. In this system, these plants conduct oxygen through their stems into their root systems and make favorable conditions for the expansion of bacteria. Application of root

zone technology (RZT) is finding wider acceptability in developing and developed countries, because it appears to supply more economical and ecologically acceptable solution to pollution management problems. Root zone systems whether natural or constructed, constitute an interface between the aquifer system and terrestrial system that's the source of the pollutants. These are reported to be most suitable for schools, hospitals, hotels and for smaller communities. The wastewater flow through the basis zone during a horizontal or vertical way, where the organic pollutants are decomposed biochemically by the bacteria present within the rhizosphere of root plants. The filter media are selected carefully to provide favourable conditions for both plants and bacterial growth and to avoid clogging. Organic pollutants are removed drastically from wastewater and are reduced to their elemental forms. It also has potential to accumulate heavy metals in the root zone. The root zone treatment systems have wide selection of applications in treatment of various sorts of waste waters like domestic and industrial waste water containing biodegradable matter including some, which are difficult to treat by other means. There are various benefits of using root zone technology like follows low capital costs, low operating and maintenance costs, no need of technical expertise, environmentally safe and friendly method. No by-products are produced in this method and it is long lasting. The country's reportedly first RZT system was designed by NEERI at Sainik School; Bhubaneswar, Orissa. It has reportedly been giving a really good performance of removing 90% BOD and 63% nitrogen (Central Pollution control panel in 2000). The objective of this case study is to research the sewage water/wastewater generated 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.

2. LITERATURE REVIEW

The literature review pertaining to survey of root zone technology system and literature related to pure experimental aspects of waste water treatment with various methods are presented below.

2.1 Constructed Wetland an Efficient Treatment Method for Domestic Wastewater Treatment

- 1) Author: Mr. Rajnikant Prasad¹, Prof. Rangari P J², Asst. Prof. Dilendra Jasutkar³
- 2) They have worked on lab scale model for Mundhwa area.
- 3) Constructed wetlands are engineering systems which are designed to treat wastewater from various sources.
- 4) The aim of this study is to find out the economical method of treatment of domestic wastewater and to compare the efficiency of naturally aerated and artificially aerated constructed wetland.

5) The lab model was filled with filter media and one unit was given artificial aeration. The present study was done for the mundhwa area by constructing lab scale model.

6) The parameter like colour, odour, pH, COD and DO was checked.

2.2 Wastewater Treatment through Root Zone Technology with Special Reference to Shahpura Lake of Bhopal (M. P.), India

1) Author: Kalpana Kumari Thakura, Avinash Bajpaib and Shailbala Singh Baghela (International Journal of Applied Science and Engineering 2014) 12, 3: 169-175

2) This study investigated the effectiveness and Feasibility for level flow constructed wetland/Root Zone Unit which was constructed by Environmental Planning & coordination organization (EPCO) at Ekant Park, Bhopal.

3) In present study samples of wastewater from Inlet and Outlet of Root Zone System situated at Ekant park, Bhopal (M. P.) were collected quarterly from June 2011 to May 2012. Some physico-chemical parameter namely dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrate and phosphate were analyzed using standard methods.

4) The result obtained indicates that the basis Zone System works effectively and treated water are often used for recreational activities like washing clothes, fishing, swimming, irrigation etc.

2.3 Introduction to Waste Water Treatment by Root Zone Technique

1) Author: Mahesh Mane¹, Bhupen Patil², Mohit Pawar³, Yatin Gohil⁴, Akshaya Ghalimath. (Year-2017) International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 03 | Mar -2017

2) This paper reviews the Root Zone Treatment System which are planted filter beds consisting of soil gravel, sand and fine aggregate. This Technique uses a natural way to effectively treat domestic and industrial effluents.

3) RZTS are well known in temperate climates and are easy to operate having less installation, low maintenance, and operational costs and incorporates the self-regulating dynamics of an artificial soil eco-system.

4) This technology has been successfully running in several countries. Use of constructed wetlands can now be recognized as an accepted low-cost eco-technology, especially beneficial as compared to costly conventional treatment systems.

5) There is a need to exploit this technology in a developing country like India to its maximum to gain its benefits and for sustainable development.

3. METHODOLOGY OF RESEARCH

3.1 Data Collection

- Reviewing available techniques and their performance to treat sewage.
- Finding out relevant plants for root zone technology.
- Detailed study on available literature for root zone technology with different plants.
- The study will be focused for pH, Total Dissolved Solids ,DO, BOD and COD according to Standard Methods for Waste and Waste water Examination.

3.2 Construction and Working of lab scale demo model for constructed wetland

- The unit will be constructed by placing separate layers of stone chips, charcoal, sand, stone dust, after arranging the layers the plants will be planted in the unit.
- One model will be planted with reeds and second model will be planted with Cola cassia plant.
- Further the growth of plants will be monitored.
- During the growth period of one month, only plain water will be sprinkled.
- Then sewage water will let into the root zone system and the samples were collected.

3.3 Sample collection and analyzing the characteristics of samples

- After stabilization of models with grown plants, I will take samples from both the plants.
- Samples will be analyzed for TSS, TDS, COD, pH, BOD, etc.
- Comparative study will be presented with reed bed and cola cassia plant.
- Cost benefit analysis will be presented for conventional STP and root zone based STP.

3.4 Action of plants with waste water Action of plants with waste water

- First, the very existence of root zone system creates space 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.

Reed beds can help to achieve a better standard of water quality through.

- High level of bacterial and viral removal
- Decreased biological oxygen demand and reduction of suspended solids.
- Reduction of nitrogen concentrations and removal of metals.

4. CONCLUSIONS

- Best recommended For Septic tank outlet treatment.
- Treatment of polluted streams, nallas, rivulets and water-Bodies (floating beds may be recommended)
- Bathroom water recycling. In combination with specific / simple pre-treatments it can be used as polishing treatment for treatments.
- It can be used as polishing treatment for any waste water. E.g.-Brewery, Sugar factories.

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