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# Removal of Biochemical Oxygen Demand by Root Zone Treatment Technology from Domestic Sewage

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***Abstract:***

***Nowadays natural wastewater treatment technologies gain more significance. Root zone treatment technology for domestic sewage wastewater treatment has been proven to be effective and sustainable alternative for various conventional wastewater technologies. Increasing urbanization and human activities exploit and affect the quality and quantity of the water resources; this has been resulted in pollution of fresh water bodies. Due to increased use of water and thus release of domestic sewage. Treatment of domestic sewage is necessary to ensure that the receiving water into which the effluent is finally discharged is not significantly polluted.***

***During 2015, the estimated sewage generation in India was 61754 MLD as against the developed sewage treatment capacity of 22963 MLD. Because of the hiatus in sewage treatment capacity, about 38791 MLD of untreated sewage (62% of the total sewage) is discharged directly into nearby water bodies (CPCB 2016). As still we had not developed a planned strategy for waste water treatment completely.***

***Constructed wetlands have been developed for domestic sewage treatment. This technique exploits the natural ability of the reeds to transfer large quantities of oxygen from the atmosphere to its root zone. Where a variety of bacteria in the soil effect biological removal of pollutants. The objective of this study is to install pilot scale Root zone treatment system to treat domestic sewage by using an aquatic macrophyte Phragmites Australis. In the present investigation water samples were collected seasonally for the period of two years and treated it with Root zone treatment system, both influent and effluent samples were taken for BOD analysis. The maximum BOD reduction found 72.83 % in the winter season and the minimum BOD reduction found 59.66 % in the summer season.***

***Key words: Biochemical oxygen demand, Biodegradation, Domestic sewage, Phragmites Australis, Root zone treatment technology.***

## Introduction:

Various human activities are responsible for generation and release of objectionable materials into aquatic environment and causes water pollution. Almost 80% of the water supplied for domestic use, comes out as wastewater. In most of the cases wastewater is let out untreated and it either sinks into the ground as a potential pollutant of ground water or is discharged into the natural drainage system causing pollution in downstream areas. The composition of municipal sewage wastewater varies significantly from one location to another. On a given location the composition will vary with time. This is partly due to variations in the discharged amounts of substances. Municipal wastewater is mainly comprised of water together with suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are carbohydrates, lignin, fats, soaps, synthetic detergents, proteins and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries if the industrial untreated or partial treated effluent discharged directly in to the municipal or domestic sewage.

Most of the fresh water bodies all over the world are getting polluted due to domestic waste, sewage, industrial waste, agricultural and religious activities like idol immersion (*Vyas et al., 2007*). Several monitoring studies of water bodies reveal that the major source of pollution is the discharge of raw sewage (Belmont Metcalfe, 2002). Constructed Wetlands also known as Root-Zone system is or Bio-Filter Reed Bed system or Treatment Wetland system or Phytotechnology or Phytoremediation system (Brix *et al., 2002*). The horizontal sub-surface flow constructed wetlands (HF CWs) were commence by Seidel in the early 1960s and enhanced by Reinhold Kickuth underneath the name Root Zone Method in late 1960s and near the beginning 1970s and spread throughout Europe in 1980s and 1990s (Vymazal, 2005).

**Material and Methods:**

Root Zone Treatment technology are up-coming as alternative to traditional wastewater treatment because of lower construction and operating costs, more flexibility, less requirement for trained workers, and lower susceptibility to variations in waste loading rates. Water quality improvement can be achieved by elimination of plant nutrients. In the present investigation water samples were collected on the basis of heavy pollution load and large amount of sewage discharge site which is carrying all mixed sewage from city in to the Kham river.

**Construction of pilot scale Root Zone Treatment technology:**

In the present study, pilot scale Root Zone Treatment technology was installed, in the Department of Environmental Science, P.G. and Research center at S.B.E.S. College of Science, Aurangabad, Maharashtra. The structure of the units was made and the material of constructions of tank is propylene (P.P) 5 mm thickness with the following design characteristics: The dimension of the root zone treatment bed length is 1.0 meter long, width is 0.5 meter wide and the height of the tank is 0.5 meter.


**Figure 1:** View showing complete constructed/Fabricated Root Zone Treatment technology system.

**Results and Discussion:**

Kham river is one of the important river in Aurangabad city. Previously Kham river water was used for domestic purpose in Aurangabad. But now a day due to disposal of sewage and other human activities are deteriorating the water quality of Kham river (Jadhav and Khobragade, 2017).

| Seasons | (BOD mg/L) Before Treatment (Inlet) | (BOD mg/L) After Treatment (Outlet) | % Reduction |
|---|---|---|---|
| Monsoon | 187 | 71 | 62.03 |
| | 184 | 66 | 64.13 |
| Winter | 312 | 104 | 66.66 |
| | 217 | 74 | 65.89 |
| Summer | 292 | 157 | 46.23 |
| | 278 | 142 | 48.92 |

**Figure 2:** Table showing variations in Biological Oxygen Demand of the sewage sample observed seasonally during period of 2015-16 to 2016-17

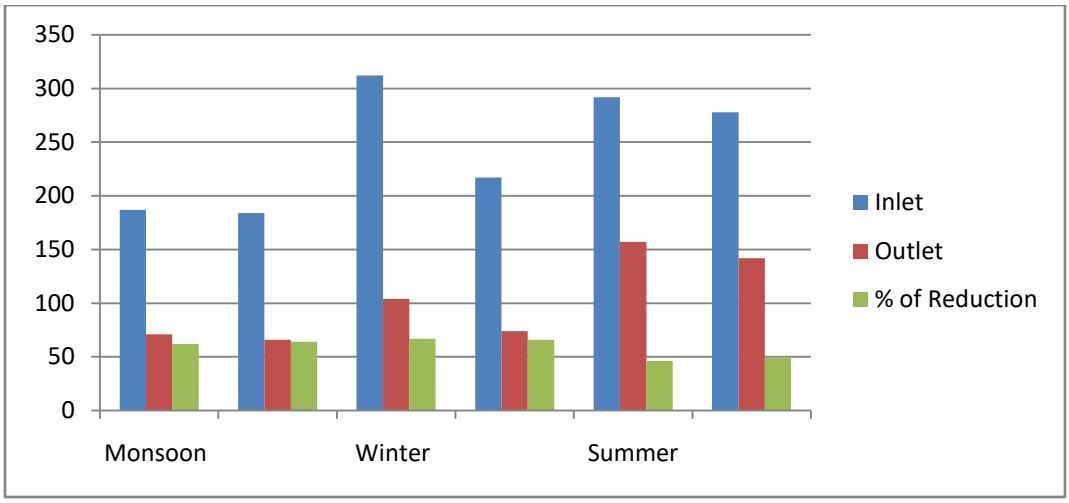


**Figure 3:** Graph represent the variations in Biological Oxygen Demand of the sewage sample observed seasonally during period of 2015-16 to 2016-17

In the present investigation during period of 2015-16 to 2016-17 Biological Oxygen Demand of the sewage sample before treatment were ranged from 184 to 187 mg/L. After treatment of Root Zone Treatment technology the BOD of treated sample varied 66 to 71 mg/L, maximum percentage of Biological Oxygen Demand reduction was found 66.66% in monsoon season. During winter season the Biological Oxygen Demand of the sewage sample before treatment were ranged from 217 to 312 mg/L and after treatment at outlet of Root Zone Treatment technology the BOD observed 74 to 104 mg/L, maximum percentage of Biological Oxygen Demand reduction was observed 64.13%. During summer season the Biological Oxygen Demand of the sewage sample before treatment were ranged from 278 to 292 mg/L and after treatment at outlet of Root Zone Treatment technology it observed 142 to 157 mg/L and maximum percentage Biological Oxygen Demand reduction was found 48.92%.

The use of wetlands in water pollution control is a cost effective treatment option that is widely used around the world (Vymazal, 2006; Kadlec and Wallace, 2009). Constructed wetlands have been found to be able to remove various pollutants and nutrients from polluted waters, and they are also cost-effective, robust and capable of operating with minimal maintenance or supervision (Brix *et.al.*, 2007; Vymazal, 2005). Since then there have been several treatment wetlands developed in the various provinces for domestic wastes (Pries, 1994). This treatment technology was adopted in North America not only for municipal wastewaters but all kinds of wastewaters (Kadlec and Wallace, 2008).

The percentage of reduction in Biochemical oxygen demand ranged between 50 to 78.6 has been observed by Vipat and his co-workers, (Vipat *et al.*, 2008). Efficiencies of $BOD_5$ elimination by Constructed Wetland treatment found 87 to 99% Occurred, with a mean value of 94%. The country's reportedly first Root zone treatment system was designed by NEERI at Sainik School; Bhubaneshwar, Orissa. It has reportedly been giving a very good performance of removing 90% biological oxygen demand (CPCB, 2000).

**Conclusion:**

The Root Zone Treatment Technology has shown considerably high contaminants/ pollutants removal efficiency ranging from 46 to 66%. As a result it is very efficient technology for treatment of domestic sewage. The efficiency of Root zone treatment system to remove the pollutants from the wastewater mainly depends on the root zone interactions between soil, contaminants, helophyte roots and a diversity of microorganisms. The soil is the main supporting material for plant and microbial growth. According to available data and earlier research the Constructed Wetland/ Root Zone Treatment technology with *Phragmites Austrails* plant species is more efficient for the treatment of wastewater.

Consequently it is considered as cost effective treatment system because of low operation and maintenance cost, no electricity and chemicals are required for its operation, unskilled labor also operate this system. The domestic sewage or wastewater is purified by the roots of wetland plants technology with well-organized utilization of this method, domestic wastewater will be recycled, reused and water saving will be improved. With the expansion of the natural wastewater treatment systems to be established in urban and rural areas, where lacking of adequate sewage treatment system. Adverse effect of environmental pollution by wastewaters will be prevented; also regional landscape will be enriched by plantation of non-agricultural lands.

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