

USE OF ROOT ZONE TECHNOLOGY FOR VARIETY OF WASTEWATER TREATMENT: A REVIEW

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Abstract:

The water resources have been a large amount of exploited natural system since man strode the earth. Water bodies' pollution is growing gradually due to rapid growth of population, urbanization, industrial operations, increasing living standards and wide spheres of human activities due to increased use of water and thus release of domestic sewage and other variety of wastewater. Proper treatment of wastewater is necessary to ensure that the receiving water into which the effluent is finally discharged is not drastically polluted. Constructed wetlands have been used for decades mostly for the treatment of domestic or municipal sewage. However, recently constructed wetlands have been used for many other types of wastewater including industrial and agricultural wastewaters, landfill leachate or stormwater runoff. As many of these wastewaters are difficult to treat in a single stage system, hybrid systems which consist of different types of constructed wetlands staged in series have been introduced. (Vymazal, 2005). Root zone treatment system has been developed for variety of wastewater treatment. This technique accomplishes the natural capability of the plant species to transport large amount of oxygen from the atmosphere to its root zone, where a diversity of microorganisms present in the soil to eliminate pollutants from the wastewater.

Key words: Root zone technology, *Phragmites Australis*, microorganisms, Wastewater.

Introduction:

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). One of the usually found environmental problems in developing countries is water pollution caused by direct disposal of untreated wastewater. In India most of the centrally collected wastewater treatment plants such as CETP and STP are not functioning due to high cost of installation, operation and maintenance, spare parts, huge requirement of chemical additives, utility bills and lack off skilled human resources. 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. 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).

Wastewater Source Characterization:

The main sources of pollution can be categorized into three sectors: municipal, industrial and agriculture (Khairy *et. al.*, 2004). Each source has its own unique mixture of potential pollutants and varies according to location and site-specific circumstances. Municipal wastewaters consist of biodegradable organic matter, debris and a range of chemicals derived from the residential, commercial and industrial sectors (Environment Canada, 2001). Pollutants in industrial wastewaters vary according to the industry, but within one such industry, effluent will have a fairly consistent quality. Industrial wastewaters include: landfill leachate, pulp and paper wastewater, mine drainage, coal mine drainage, petroleum refinery wastewater, electroplating industries, textile production and pharmaceuticals. Usually, there is a pretreatment of these wastewaters within the industry, since most treatment centers could not remediate their elevated levels of biological oxygen demand (BOD), suspended solids (SS), and ammonium nitrogen (Kadlec and Knight, 1996; Carpenter *et.al.*, 1998).

Treatment of Domestic and Municipal Wastewater by Root Zone Technology/ Constructed Wetland System:

Root Zone Treatment/Constructed Wetlands treatments have become a conservative option for the treatment of domestic wastewater. Developing countries are threatened by environmental pollution due to lack of wastewater treatment facilities. Safe, economic and efficient treatment of sewage is one of the most challenging problems faced by world. There is a wide range of small scale onsite wastewater treatment technologies; constructed wetland is one of them. 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). In the recent years most of water bodies are polluted by direct discharge of domestic wastewater, because of anthropogenic activity.

Treatment of Industrial Wastewater by Root Zone Technology/Constructed Wetland System:

Root Zone Technology Constructed/ Wetlands are used for secondary or tertiary treatments of industrial wastewaters. Moreover, use of Constructed Wetlands is now recognized as an accepted eco-technology, especially beneficial to small towns or industries that cannot afford expensive conventional treatment systems (Jing *et.al.*, 2001; Karathanasis *et.al.*, 2004; Karim *et.al.*, 2004).

Treatment of Dairy Wastewater by Root Zone Technology/Constructed Wetland System:

The dairy industry is one of the important food processing industries and major source of waste water the problem is more serious, when it concerns waste water discharge before treatment from dairy or milk processing industry. It is one of the largest sources of industrial effluents in many countries like (Europe and India). The dairy industry generates large quantities of wastewater, as per liter of processed milk, 0.2 to 10 L of wastewater are produced (Vourch *et.al.*, 2008). India has the largest livestock population in the world. The dairy industry is a well-established industry. Almost all the dairy factories are facing the problem of wastewater treatment, recycle and reuse of the treated waste water. Disposal of waste water into rivers, land, fields and other aquatic bodies, without or with partial treatment, in crude tanks, will soon offer a serious problem to health and hygiene. Dairy wastewaters contain high concentrations of organic matter (e.g. fat, milk, protein, lactose, and lactic acid), minerals and detergents. Typical dairy wastewater characteristics include 4000-59000 mg/L COD, 70-800 mg/L TSS, 100-1400 mg/L TN and 25-450 mg/L TP (Vourch *et. al.*, 2008).

Treatment of Pulp and Paper Industrial Wastewater by Root Zone Technology /Constructed Wetland System:

The pulp and paper industrial waste waters are a major environmental concern. Paper factory effluent is one of the major pollutants on the earth. The pulp and paper mill effluent is highly colored. Choudhary *et.al.*, (2010) Reported the reduction in chemical oxygen demand (88%) and color load (97%) present in pulp and paper mill wastewater by using horizontal sub-surface constructed wetland planted with *Canna indica*.

Treatment of Agricultural Wastewater by Root Zone Technology/Constructed Wetland System:

Agriculture wastewater has been widely managed using constructed wetland systems (Hammer *et.al.*, 1993). Wetlands used to improve water quality within agriculture typically intercept and retain contaminants and nutrients from incoming waters through a series of vegetated ponds, before waterleaves or is reused in farm-scale operations (Knight *et. al.*, 2000). It has also been noted that CWs have now gained increased popularity in the treatment of agricultural wastewater in Ireland (Healy *et. al.*, 2007).

Treatment of Landfill Leachate by Root Zone Technology/Constructed Wetland System:

The landfill leachate is characterized with high nitrogenous pollutants content. Investigations have been done on its purification in constructed wetlands. Four vertical-flow wetlands under predominately aerobic conditions were used for a mass-balance study in the transformation of nitrogenous pollutants (Sun, and Austin, 2007). Landfill leachate was treated in a pilot-scale sub-surface CW planted with *Cyperushaspan* and three weeks retention time. Samples were tested various parameters such as pH, Turbidity, Color, TSS, COD, BOD₅, NH₄N, TP, TN, Fe, Mg, Mn, Zn and a high removal efficiency was obtained (Akinbile, Yusoff and Zuki, 2012).

Conclusion:

Variety of 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. 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.

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