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REED BED TECHNOLOGY: A REVIEW

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***Abstract*— This article gives you information about reed bed technology. Reed bed is natural purifying decentralized waste water treatment. There is varies types of reed bed Horizontal flow and Vertical flow and use different types of macrophytes to treat waste water is also described in this method. Different type of aquatic plant spaces is used in this technology for treating waste water. At last this article gives some guidelines for construct reed bed technology.**

***Keywords*— Microphytes, Rhizosphere, Nitrification-Denitrification, Root-Zone**

I. INTRODUCTION

According to centre pollution control board in 2009, class 1 and class 2 cities generated 38,254 million litters per day of waste water. Sewage treatment plant had capacity of treat only 31 percent of this waste water. According to approximation, treating just 1 MLD sewage costs around Rs 1 crore thought the centralised system, excluding the land cost [5]. Reed bed technology is a good solution of this India's waste water problems.

A reed bed is essentially a basin that is lined with sand, gravel and planted with macrophytes such as reeds. Reed bed waste water treatment systems are biological treatment that works by combined action of bacteria and plants.Waste water passes through this basin where it undergoes treatment via physical, chemical and biological interaction between the waste water, plant, microorganisms, gravel and atmosphere. This technology is also called as construction wetland or root zone technology or Bio-filter. Reed bed technology are example of non-mechanised treatment system which are easy to built and operate and sustainable.

Reed bed Technology is a highly effective environmentally sustainable alternative to high energy mechanical treatment systems, resulting in dramatically lower operating costs and a reduced carbon footprint [3].

II. REED BED TECHNOLOGY

A. TYPES OF REED BED

Constructed wetlands are generally of two types as far as their water surface is concerned. They are either of the free water surfaces (FWS) type or of the submerged flow (SF) type and the direction of flow are either horizontal or vertical. Horizontal submerged flow type which is often preferred as it performs well, can be installed in relatively flat land and discourages the possibility of mosquito breeding that is likely with a free water surface. However, submerged flow wetlands are more expansive to construct because of the special gravel fill required and associated earthwork and are likely to suffer from plugging with time. Constructed wetlands of the vertical flow type are preferred where an adequate slope is available to accommodate vertical flow without pumping. Such wetlands are also preferred for larger flows as they are reported to require less land area per person[4].

B. MACROPHYTES AND ITS ROLE

Macrophytes play a major role in reed beds, influencing biological, chemical and physical treatment processes. The most important function of macrophytes in reed beds has been categorized by as physical and metabolic. Physical effects include: Filtration of suspended material, protection against erosion by reducing turbulence and flow velocities stabilization of sediments and providing the surface area for micro-organisms. Metabolic functions of macrophytes include nutrient uptake and O2 release from roots into the rhizosphere. Macrophytes have adapted to anaerobic conditions by developing internal air spaces which transport O2 to the root zone. These air spaces form an extensive system throughout the plant and can occupy 60% of the total tissue volume. Research differs on the potential for V. macrophytes to release O_2 from roots to the surrounding rhizosphere thus providing

aerobic conditions for plant nitrification to occur. A study by concluded that internal O_2 movement not only supplied to buried plant tissues but also leaked O_2 into the rhizosphere. Macrophytes can also provide habitat for flora and fauna and increase aesthetic appeal. Research differs on the significance of plant uptake in nutrient removal with nutrient loading is an important part in the proportion of nutrient removal by plant uptake [2].

C. AQUATIC PLANT SPECIES

The aquatic plant species cultivated should preferably be one of the native plant specoes which grows locally in that area. The selected species should have a relatively rapid growth rate, be tolerant rich feeds and be able to withstand wetlands conditions. Thus, one of the following species could be selected:

1. Phragmitesaustralis, Phragmitescommunis, Phragmiteskarka
2. Typha spp.(Cattail)
3. Schoenoplectusvalidus (Great Bulrush)
4. Juncusinges (Giant Rush)

In India, the Phragmitesspecies(locally called nanal in Tamil Nadu) have been reported to be successfully used. They can grow to a height of 3-4 m at full growth.

All these aquatic plants have the characteristic ability of transporting air (oxygen) from the atmosphere to the roots from where a part diffuses into the liquid substrate. They have relatively deep roots and rhizomes which create a large volume of active rhizosphere per unit surface area. They supply oxygen to the micro-organisms in the substrate, and help stabilize the organic matter applied. The plants create oxidized micro-organisms perform, stabilizing organic matter and promoting nitrification-denitrification also.

As the roots and rhizomes penetrate through the soil, they loosen the soil and improve percolation, thus helping in stabilizing the hydraulic conductivity at a level reported to be resembling coarse sand, within 2-5 years regardless of the initial porosity of the soil.

The reed beds also promote evapotranspiration in the growing season (up to 10-15 mm/day or 100 to 150 m3/ha-d). In the tropics, the rate could be higher and the outflow from the bed would get reduced accordingly. One can also conceive of ‘zero’ discharge in a tropical area through this is not the principal objective of a reed bed. In moderate climates Europe, systems designed at 8 m2 per population equivalent are reported to produce almost no effluent during summer time[4].

D. REED BED TECHNOLOGY PROCESS

The Root Zone process functions according to the laws of Nature, to effectively purify domestic and Industrial effluent. Root Zone encompasses the life interactions of various species of bacteria, the roots of the reed plants, Soil, Air, Sun and of course water. Reed Plants have capacity to absorb oxygen from ambient air and creating numerous bacteria. Same bacteria oxidize and purify the waste water. Since the process occur underground inducing different types of chemical reactions, the process functions as a mirror of self regulating, purifying process found in nature. Three integrated components are essential in this system.

1) The reeds
2) The reed beds
3) Microbial organisms.

The process involves the raw effluent (after removing grit or floating material) which is passed horizontally or vertically through a bed of soil having impervious bottom. The effluent percolates through the bed that has all the roots of the wetland plants spread very thickly. Nearly 2,500 types of bacteria and 10,000 types of fungi, which harbour around roots get oxygen from the weak membranes of the roots and aerobically oxidize the organic matter of the effluent. The characteristics of plants of absorbing oxygen through their leaves and passing it down to roots through their stems which are hollow, is utilized as a bio-pump. Anaerobic digestion also takes place away from the roots. The filtering action of the soil bed, the action with fungi etc. and chemical action with certain existing or added inorganic chemicals help in finally obtaining very clear and clean water. The system of plants regenerates itself as the old plants die and form useful humus. Hence the system becomes

maintenance free and can run efficiently for several years [1].

E. GUIDELINES FOR REED BED TECHNOLOGY

1. Selection site:-

- The selected site should not impair the drinking Water sources.
- The site must be safe from flooding.
- The ground at the site should be flat and at a lower level than the source of waste water.
- If properly design and built, CW does not create any order or nuisance in the vicinity.
- It must be possible of the treated waste water at the selected site as per the standards set by the concerned regulatory agency.
- The site should be accessible for maintenance.

2.Shape:-

- It is preferred to construct the CW planted filter bed rectangular in shape with more length than breadth. This allows an increase in the flow path that helps in treatment efficiency.
- However in case of space constraint, either an alternative shape can be given to the filter bed such as Zigzag or vertical flow CW can be developed.

3.Selection for suitable filter media:-

- Rounded gravel should be chosen. Sharp edged media can lead to the damage of liner.

Size of the filter media should be 2-4 cm.

Effective grain size should be> .2 mm.

- Different size of filter media in a proportion of 1:3 should be used that will give an effective pore space of 30 per cent.

4. Depth and Dimension:-

- For the dimensioning of the planted filter bed, two factored have to be considered.

1. Volume of wastewater
2. Organic load [5]

III. CONCLUSION

Reed bed technology is very efficient method for treating decentralised waste water treatment for domestic waste water. It has been observed that In India BOD removal efficiency in horizontal flow varies from 80-96 per cent,TSS removals are better than 75 per cent in most cases, In Pathogen and coliform almost 100% removal can be expect. Reed bed is treat water in natural manner not requirement of much money, not requirement of much energy, not requirement of complicated set up.

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