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DOMESTIC WASTE WATER TREATMENT BY REED BED TECHNOLOGY

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ABSTRACT

The goal of this project is to determine which wastewater treatment method is the most cost-effective in comparison to traditional wastewater treatment methods. The conventional method isunsuitable for rural areas due to its high cost. One of the alternative wastewater treatment technologies is the Root Zone /Reed Bed technology. This Treatment process is simple to use, requires littleinstallation, and requires little maintenance. It is also less expensive than traditional treatment systems. To reap the benefits of this technology and ensure long-term development, it must befully utilized in developing countries such as India.

I. INTRODUCTION

Water is the fundamental source of life. The sizable oceans include 93% of the overall amount of water 4% is underground water, 2% is saved in the shape of icebergs and ice caps, and much less than 1 % isavailable as freshwater, Environmental safety has acquired quite a few attention in current years because of globalization (Climate Change report, 2002). The main water bodies around the world are polluted through the release of home sewage and industrial wastewater. Water treatment technology is effective and eco-friendly. Growing populace, industrialization, and urbanization are the primary resources of pollutants in India. In urban areas, wastewater treatment plants are available, but in rural areas, sewage drains are without delay related to water bodies. Root zone technology with aquatic plants certain to be a beneficial treatment and alternative treatment technology for wastewater treatment. Root zone technology is a technique for purifying waste as it flows through a man-made wetland area. These systems use wetland plants, Macrophytes, soils, and associated microorganisms to remove contaminants and impurities from wastewater. These plants are essential parts of the wastewater treatment process. The larger aquatic plants growing in wetlands are usually called aquatic macrophytes. These include aquatic vascular plants, aquatic mosses, floating and some larger algae. Thepresence or absence of aquatic macrophytes is one of the characteristics used to define wetlands, and as such macrophytes are an indispensable component of these ecosystems. As the most important removal processes in constructed treatment wetlands are based on physical and microbial processes, the role of the macrophytes is important for treatment process. There is no need for machinery or electricity, there are no operating costs, low maintenance costs, it improves the landscape, provides anatural habitat for birds, and there are no odor issues. The project uses root zone technology, aquatic macrophytes (Colocasiaesculenta) for treatment to analyze the wastewater characteristics.

Rootzone / Reed beds / Constructed wetlands: The root zone / filter plant is a biological filter, where the natural treatment of waste water takes vicinity in a soil quantity, it's penetrated via roots. The idea is composed by appropriate plant species it's beneficial if the optimum varieties of those species are selected. The turnover of the herbal substances takes place with help from a various, aerobic and anaerobic, microbial activity in the soil. The aerobic oxidation happen with oxygen from the plant roots further through the floor of the device. Therefore, aerobic activity is focused near the plant roots, while anaerobic activity prevails in some distance from the roots. This mosaic of aerobic and anaerobic wallet affords foremost conditions for a huge variety of energetic microbial organisms. Aerobic in addition to anaerobic groups of organisms are required for the desired down-break of the waste water components and may be in comparison with the anaerobic and aerobic steps in a biological waste water treatment device. In biological treatment flora, the two techniques are usually separated. Within the root zone / filter system, the above mosaic shape allows all approaches to develop inside the same soil quantity.

Root zone technology process the root zone procedure features according to the legal guidelines of Nature, to correctly purify domestic and industrial effluent. Root-Zone encompasses the life interactions of numerous species of micro organism, the roots of the reed plants, Soil, Air, Sun and of course water. Reed flora have potential to soak up oxygen from ambient air and developing several bacteria. Same bacteria oxidize and purify the waste water. Because the system occur underground inducing distinct forms of chemical reactions, the process capabilities as a reflect of self-regulating, purifying method located in nature. Three included components arecrucial on this system i.e., the reeds, Root-Zones and Microbial organisms.

Types of Root Zone System Flow:

- Free water surface flow
- Horizontal Subsurface Flow
- Vertical Subsurface Flow
- Hybrid Systems

Free water surface flow: Water will flow across the surface of the bed between the stems of the reed plants planted in the soil. The water is visible above the land and has a depth of approximately 150 to 200 mm (Abou-Elela, 2013). The high efficiency of removing wastewater characteristics via horizontal flow Root Zones for "tertiary treatment." They're like a gravel-filled stream that's always flooded. Dirty water enters one end horizontally, flows through the bed, and exits the other end. Surface horizontal flow is the most effective in removing suspended solids and only moderately successful at eliminating pathogens, nutrients, and other contaminants like heavy metals.

Horizontal Subsurface Flow: Horizontal Flow systems only work with low-strength effluent. They also do not affect ammonia levels, but they can reduce BOD (Biochemical Oxygen Demand) and SS (Suspended Solids) levels in sewage treatment plant effluent. They should not be used to treat septic tank effluent because it is too strong. A horizontal flow Root Zone receives effluent at one end and discharges it at the other. The bed is always soaked with water. The water level in the Subsurface Flow type is carefully controlled so that it is always 25-50 mm below the surface of the gravel media. Horizontal flow Root Zones have low oxygen content and will de-nitrify the effluent, converting nitrogenous compounds into free nitrogen gas that escapes into the atmosphere. Horizontal flow Root Zones can occasionally stink. It will always eventually clog and fail. These beds have a life expectancy of 5 to 15 years, depending on the strength and quality of the effluent used on them. Those exposed to strong effluents containing a high level of suspended solids will become clogged more quickly. The media in these types of blocked beds must be completely replaced *(*Garcia *et al*., (2004)).

Vertical Subsurface Flow: Subsurface vertical flow is appropriate for secondary treatment, which involves adding oxygen to the effluent and casting off pollutants. Vertical flow Root Zones are more green and can take care of better strength effluent than horizontal flow Root Zones. They could lessen ammonia levels as well as BOD and SS vertical flow structures can deal with septic tank effluent. A properly designed and maintained vertical glide Root Zone system will not smell. Aerobic vertical flow Root Zones cast off instead of create odors. A vertical flow Root zone is a form of Root sector in which the effluent is dosed uniformly over the floor of the bed often the use of a community of pipes. The effluent percolates vertically down through the media and is amassed at the bottom with the aid of drainage pipes that discharge to the following Root zone within the series or directly into a watercourse. The bed is then without water till the following dose is run. The bed's matrix is made up of sand and gravel layers. Vertical flow Root Zones are designed to be aerobic and to nitrify ammonia into nitrates and nitrites. Vertical float Root Zones can remain indefinitely if properly sized. Whilst blockages do arise, they may be commonly restricted to the top 25 mm of the surface sand layer, which is effortlessly removed and changed.

Hybrid Systems: The water flows thru the floor of the root Zone, that is planted with a network of pipes and both pumping or a siphon system. This machine gets rid of BOD, ammonia, heavy metals, and other pollutants more efficiently. Whilst water flows down through the bed, hybrid go with the flow creates a good bacterial surroundings. Because of the comparative subsurface horizontal drift, this system calls for less creation location. Due to the fact Seidel invented this system in Germany; it's also referred to as the Seidel system. In recent times, hybrid structures are gaining recognition no longer only in Europe but all over the world. Subsurface horizontal float is appropriate for "tertiary treatment" The hybrid flow is the most effective for removing BOD, ammonia and heavy metals (Brix, H. (1987)).

Advantages of Root Zone Technology and Aquatic Macrophytes Treatment:

1. Zero energy, carbon neutral solutions: As our Root region system consume no energy, so we are enforcing a wastewater treatment alternative which leads to decreased greenhouse fuel emissions and therefore a discounted carbon footprint.

2. Highly aesthetic, odourless living and growing systems: From the floor Root Zone appear like a lush garden bed with reeds swaying in the breeze, and they're completely odourless. Under the surface of the bed contaminant and cleansing tactics are taking location. The plant life make use of available vitamins and water from the enter waste circulation to thrive and reproduce. Those natural water treatment systems are highly liked via the general public as they cause accelerated visual amenity and a greater public realm average. The range of various flowers utilized in Root region layout and the ensuing constructed wetlands permit for carbon sequestration and contribute to a rich and lively biodiversity.

3. Remove a range of contaminants or target a particular contaminant: We layout Root Zone for the treatment of home wastewater, wastewater sludge, industrial wastes, infected wastes, and mine waters. Our Root region take away a variety of different contaminants including organic loads (BOD), solvents, suspended solids and sediments, metals, and nutrients. Root region are usually covered and then packed with an inorganic substrate such as sand or gravel. The substrate itself is tremendously inert however presents a strong media for plant roots and a massive surface area for microorganisms. The substrate media may be specifically selected to goal a specific contaminant of concern.

4. Reed Bed/Root Zone Technology can be customized to suit ours needs: Root zone technology Root Zone system can be constructed in a number shapes and scales and designed to match in with the encircling landscape. As an example, in fairly urban regions they are able to have a 'tough side' form to suit the streetscape, while in outer suburbs and greater rural settings they may be large sufficient to manipulate wastes from complete communities a townships and to offer sizable flora and fauna habitat. Root zone can be positioned at periods during a community or located at the main outfall to treat the community's entire waste load the use of a greater centralized technique.

5. Our Reed Bed/ Root Zone Systems do not clog: Bad performance of many older and badly designed horizontal flow system together with issues with clogging, water logging, and odour have given Root zone a bad recognition in India. At Root Zone Technology, we've evolved our very own structures and technology which might be tailored for the Indian climate and do now not shows off any of these complex houses. Root Zone Technology focuses mainly on vertical float structures. Our structures do now not clog, have miles longer lifestyles span and are a great deal less complicated to preserve and perform as compared with horizontal flow structures.

6. We implement vegetation that is suited to a harsh and varied climate: Our Root Zone is planted out with aquatic reeds (aquatic macrophytes) and rushes which can be selected in particular for the cruel Indian weather and are capable of resist flooding and extended periods of dryness. Colocasia plants are commonly used due to the fact it is fast developing, has a splendid root shape, and an immoderate evapotranspiration rate. But, there are various other aquatic plants that can be used counting on the environment we're handling.

7. Our sludge treatment Root Zone halve the footprint required & use land less than half the size of that of unplanted drying pans: We utilize flora that serve to maintain the infiltration properties of the media and save you clogging. The ensuing Root Zone systems promote drainage and evaporation, main to a considerably decreased footprint and land required (compared with drying pans). Wastewater and sludge treatment may be handled the use of the equal system, meaning that no additional space or strength is needed for sludge.

8. Little or no moving parts and on-site treatment of wastewater: Being natural, environmentally sustainable systems, our Root Zone don't have any shifting elements and this equates to decreased noise and preservation, in addition to reduced pollution and greenhouse gas emissions compared to mechanical treatment systems. Root Zone technology also incurs low capital expenses and decrease operational expenses as compared to housed mechanical structures. As wastewater treatment and dewatering of sludge is performed on-site switch costs are minimized.

9. Beneficial reuse of high quality bio solids (composting) product: Sewage sludge is a by-product of waste water treatment. While treated to limit health dangers and enhance useful traits this by-product is called bio-solids. Due to the fact it's far rich in organic matter and vitamins including nitrogen, phosphorous, potassium, and trace metals, bio-solids have valuable reuse properties. Root Zone Technology's passive sludge treatment structures produce a high first-class bio-solids spinoff with reduced pathogen concentrations and a substantially reduced unstable solids load. Dilute sludge with less than 1% solids is transformed to a usable spinoff the usage of our low preservation and low cost system. The give up result a rich valuable resource with wonderful advantages for the rural, horticultural and municipal sectors, rather than simply an infected waste requiring disposal.

10. Robust water treatment systems: Our revolutionary Root Zone structures are prepared to address intermittent flows and manage fluctuating water nice efficiently.

11. The macrophytes stabilize the surface of the beds, provide appropriate situations for physical filtration, prevent vertical go with the flow systems from clogging, insulate the floor towards frost at some point of iciness, and provide a large surface area for attached microbial growth.

12. It provides natural habitat for birds, after few years offers an appearance of bird sanctuary and additionally affords leisure and academic areas.

II. METHODOLOGY

Material Used:

Feed water: Wastewater produced by Domestic waste water was used as feed water for thisexperiment.

Plastic container, Plastic PVC pipe, Taps, Buckets, Plastic Bottles, etc.

Coarse Aggregate: 40 mm, 20 mm, 10 mm size of aggregate is to be preferred by acting the same as a filtering agent.

Moringa plants charcoal.

Common plants clean charcoal.

River sand: 0.4 to 0.6mm size sand to be used for the filter. The size of sand promotes the movement of water and prevents it from logging.

Soil: Soil preferably to be used for the growth of plants and also good in high nutrient value.

Colocasia Esculenta Plants: To destroy harmful micro-organism by their roots and providing oxygen to effluent. A Healthy-looking young plant of Colocasia esculenta (Taro) was used as aquatic macrophyte in the constructed wetland for this experiment. As this is a native species region this is abundant locally. Further, the qualities such as tolerant to local weather conditions and varying water quality parameters even with toxic elements favored the use of it in constructed wetlands (Madera-Parra et al. 2015).

- **Wastewater Sample:** Collect a sample of wastewater in a plastic bottle for treatment from domestic house outlet.

Fig. 1: 40 mm Size Coarse Aggregate

Fig. 2: 20 mm Size Coarse Aggregate

Fig. 3: 10 mm Size Coarse Aggregate

Fig. 4: River Sand

Fig. 5: Moringa plant coal

Fig. 6: Normal wood coal

Fig. 7: Soil

Fig. 8: Colocasia Esculenta Plant

Working Model: Steps involve during Construction of working model:

- A Root Zone system model made by constructing a required dimension pit.
- The unit will be constructed by placing separate layers of Coarse Aggregate, Riversand, soil, after arranging the layers the plants will be planted in the unit.
- A PVC pipe and a tap are included with the inlet unit.
- Only plain water will be sprinkled during the one-month growth period.
- The wastewater was then allowed to enter the root zone system, and sampleswere collected.
- Action of Colocasia Esculenta Plant with Waste water.
- For starting, first, the root zone system's very existence creates space for water topass through.
- Second, the roots provide an environment for aerobic bacteria to thrive by introducingoxygen into the soil's body. A range of chemical processes, including the conversion of ammonia to nitrate, need these organisms. (The first stage of nitro compound biological breakdown).
- The nitrification process occurs, in which the plants absorb a certain number of nutrients from the wastewater.

III. RESULTS AND DISCUSSIONS

The wastewater sample collected was characterized for various water quality parameters. The study is being carried out in order to identify alternative sources of waste water treatment systems so that a similar methodology can be effectively implemented as a waste water treatment solution for Domestic and municipal waste water.

Table 1: Parameters of wastewater before and after treatment

Parameters	Wastewater Sample	
	Before Treatment (Sample 1)	After Treatment (Sample 2)
Colour (Hazen Unit)	60.0	35.0
Odour	Smell	Few Smell
pH at 25^0 C	6.73	6.78
BOD (mg/Lit) 3 Days at 27^0 C	376	182
COD (mg/Lit)	476	204
TDS (mg/Lit)	824	576
TSS (mg/Lit)	203	129
Nitrogen (mg/Lit)	53.4	28.9
Phosphate (mg/Lit)	32.7	24.7

Table 2: Percentage Reductions after Treatment

Parameters	% Reduction after Treatment
	Sample 2
BOD mg/lit	51.60 %
COD mg/lit	57.14 %
TDS mg/lit	31 %
TSS mg/lit	36.45 %
Nitrogen mg/lit	45.88 %
Phosphate mg/lit	24.46 %

IV. CONCLUSION

From the experiment it is observed that after the treatment pollutants such as BOD, COD, TDS, TSS and chlorides were removed significantly from domestic and wastewater sample in the reed beds. The pollutant removal efficiency of control bed is effective. Reed Bed is demonstrated to be extraordinarily reliable in treating wastewater, specifically from the domestic supply. A good reed bed design will supply a higher threat to attain higher removal efficiency of pollutants by providing higher herbal oxygen alternate. The utility of reed bed treatment become shown to have a functionality in removing TSS, COD, BOD, overall Nitrogen, and also bacteria. The overall performance of reed bed in removing pollution can't be separated from the functionality of the concerned vegetation species. The interaction between pollutant, medium, plant life performs an critical position in treating wastewater the usage of the reed bed system.

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