HORIZONTAL FLOW CONSTRUCTED WETLAND FOR TREATING DOMESTIC WASTEWATER

Project Reference Number: **46S_BE_ 1492**

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Keywords: Reed Bed Technology, Acrylic Sheet Container, Phragmites Karka, Phragmites Austraulis

Introduction/Background:

Water is a valuable source, the large quantity up to 97% water in sea, 2% in snow and ice caps for ground water 0.31%, total 99.30 % of water source use to mankind. The other 0.7% delineate the fresh water resources is accessible for consumption. Major source of surface water also polluted due to human activity such as more use of natural products and discharge of waste into earth bound and aquatic environment. Now a days quality water monitoring results of surface water denote that water quality is affected for disposal of untreated waste in to the surface water bodies as a result there is high level pollute of water bodies constructed which is unsuitable for consumption.

Horizontal sub-surface flow CW (HSSFCW) is one of the most preferred types of wetlands and has been successfully used during the past few decades for the treatment of various types of pollutants from the wastewater. The use of macrophytes in such wetlands makes the system more efficient in comparison to the unplanted wetland. Overall, the performance and efficiency of CWs concerning pollutant removal from the wastewater are governed by its components like growth media, plant, microbes, and pattern of water flow in the wetland system.0

Reed bed system is the natural and economic technique for treating domestic waste water. It was first developed in the year of 1960s by Dr. Kathe Seidel in Germany. They use aquatic plants and

microorganisms to purify the waste water. This technology called as root zone technology. This technology is done through phytoremediation which means direct using of living green plants for removal or degradation of contaminants in water and soil. These are reported to be most suitable for colleges, schools, and for smaller communities. Reed bed system for waste water treatment is an effective and sustainable substitute for conventional waste water treating technologies. Reed plants takes oxygen from the atmosphere and transfer it into roots, and rhizosphere. This will create anaerobic and aerobic conditions in the soil to synthesize numerous bacteria, microorganisms, this further helps in oxidize and break down the compounds present in the waste water.

Objectives:

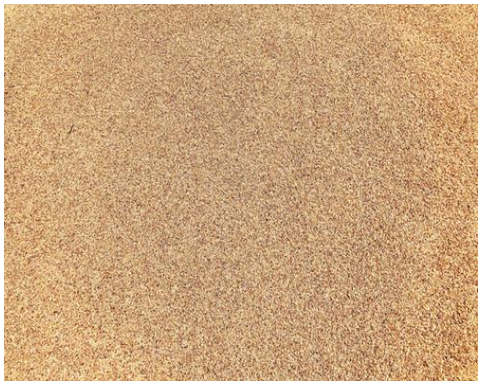
- Characterization of domestic waste water.
- Fabrication of reed bed system.
- To check the feasibility of phragmites karka a reed plant for the treatment of domestic waste water.
- To check the suitability of treated waste water for domestic and irrigational purpose.
- Suggestions for the scope of further studies.

Methodology:

Materials

- Acrylic sheet container
- Filter media
- Wetland plants (Phragmites karka and phragmites austraulis)
- Inlet and outlet arrangement

Materials	Figure	Explanation
Acrylic sheet container		The acrylic sheet of size 76.2cm x 70cm x 45.72cm is taken for preparing a container. Acrylics are significantly more substantial than other natural materials due to their chain-like structure, making them more preferable

		to use.
Filter media Gravel		The gravel of size 20mm is used in the filtering media. Gravel is often used in water filters because it helps to improve the quality of the water that passes through it.
Sand		Sand of sieved size of 2 mm used. Sand filtration is used for the removal of suspended matter, as well as floating and sinkable particles. The wastewater flows vertically through a fine bed of sand and/or gravel.
Saw Dust		Sawdust or wood dust is a by-product or waste product of woodworking operations such as sawing, sanding, milling, planing, and routing. It is composed of small chippings of wood.
Charcoal		Charcoal helps to remove chemical impurities. The charcoal plays the role of active carbon. The water filtration process uses multiple materials, from coarse to fine, to prevent clogging.

Soil		Soil is one of the principal substrata of life on Earth, serving as a reservoir of water and nutrients, as a medium for the filtration and breakdown of injurious wastes, and as a participant in the cycling of carbon and other elements through the global ecosystem.
Phragmites karka plants		For bioremediation process plant (phragmites karka) was used. In this we made use of this aquatic plant in constructed wetland for arsenic contaminated water to check its accumulation, tolerance and remediating capacity in soil. Phragmites karka is an emerging aquatic weed. It is promising emergent macrophytes for sustainable using wastewater treatment due to it rapid growth.
Inlet and outlet arrangement	 	To enhance the distribution of wastewater along the full cross-sectional area in the filter, horizontal PVC pipes (20mm diameter) with orifices across the whole breadth was laid at the surface of the inlet. For the collection of treated water outlet is provided at another side of the filter at height of 3 inches from bottom of 20mm diameter hole.

Methodology

The water in constructed wetland is treated by a combination of biological and physical processes such as adsorption, precipitation, filtration, nitrification, denitrification, decomposition, etc.

HFCWs, being water saturated filtering beds, are particularly efficient in suspended solids, carbon and pathogens removal, as well as for denitrification, whereas nitrification is limited.

In horizontal flow system the waste water is fed at the inlet zone, usually by gravity, and flows horizontally through the porous filter medium, remaining under the surface of the bed and without any contact with the atmosphere, until it reaches the outlet zone. To avoid clogging of the wetland, pre-treatment is necessary to separate solid materials, grease or oils from the liquid. The basins are waterproofed by a plastic liner to avoid soil contamination and planted with aquatic plants (Phragmites is the most common).

Tests Conducted

1. pH paper method
2. Alkalinity
3. Acidity
4. Turbidity
5. Total hardness
6. Chloride
7. Dissolved oxygen (DO)
8. Biochemical oxygen demand (BOD)

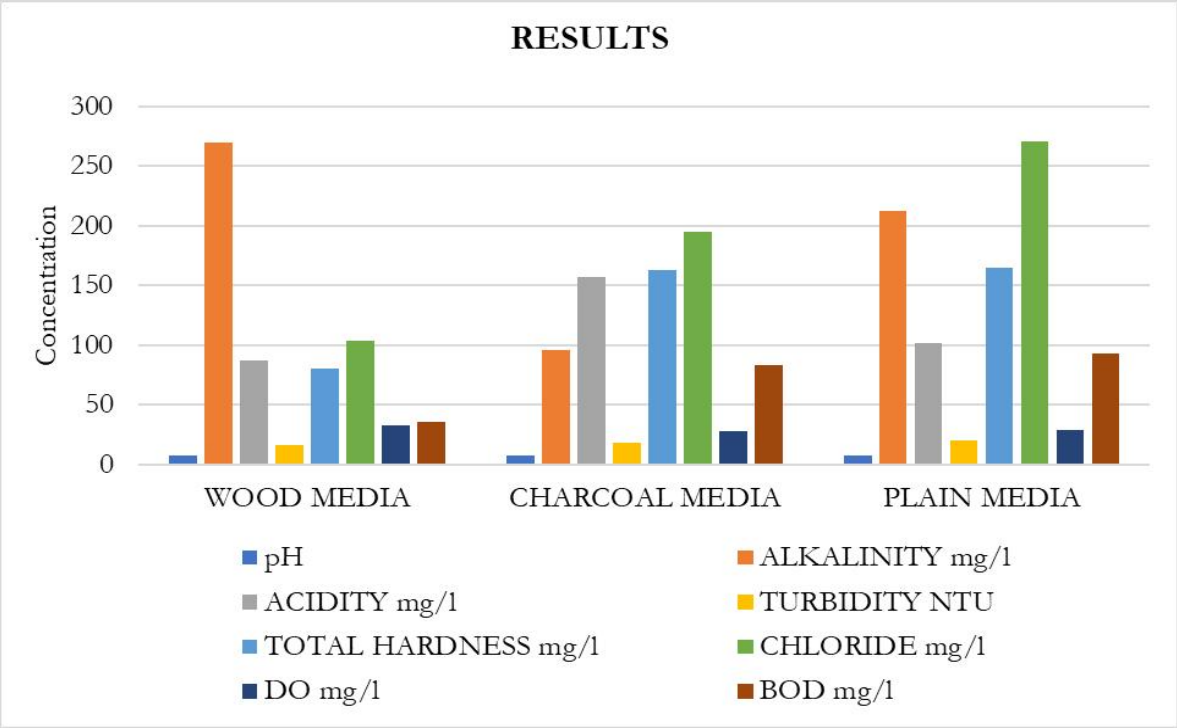
Results and Conclusions:

Results:

The wastewater was collected from college campus. The test was carried out to reduce physical and chemical qualities of domestic waste water. The below graph was obtained from various tested parameters like pH, alkalinity, acidity, turbidity, total hardness, chloride, DO and BOD. The result shows the reduced levels of parameters after the water treated in the various filter media after 15 days.

Parameters	Wood Media	Charcoal Media	Plain Media	Permissible Limit
pH	7	7	7	5.5-8.5
Alkalinity mg/l	270	96	212	200-600
Acidity mg/l	87.4	157	102	250
Turbidity (NTU)	16.5	17.9	19.7	5.0-10

Total Hardness mg/l	80	163	165	300
Chloride mg/l	103.2	195	271	250
DO mg/l	33.04	27.6	28.8	>8
BOD mg/l	36	83	93	100



Conclusions:

- The treated wastewater was found to be disinfected to levels which allow a safe reuse of the wastewater for various applications.
- It is observed that from all the filtering medias the average removal efficiencies for the different measured parameters were found to be 46% of alkalinity, 25% of acidity, 76% of turbidity, 30% of hardness, 39% of chloride, DO increase of 69% and reduction of 54% BOD.
- Parameters like pH, alkalinity, acidity, turbidity, hardness, chloride, DO and BOD$_5$ were found to be well within the limit compared to BIS standards for disposal on to the land, on to the running water and to the public sewer and hence treated wastewater is suitable for various uses, such as irrigation, aquaculture services, cleaning purposes, and process application and all other secondary purposes.

Scope for future study:

This method is suitable for treating the domestic wastewater compared to other conventional methods like physical wastewater treatment, biological wastewater treatment, chemical wastewater treatment and sludge treatment method. Because it doesn't require any electric equipment's, chemicals and it is a natural way of creating the domestic wastewater by using naturally available resources like gravel, sand, charcoal saw dust and sand for treating the domestic wastewater.