PERFORMANCE OF HORIZONTAL SUBSURFACE FLOW CONSTRUCTED WETLAND FOR HOUSEHOLD WASTEWATER

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Wetland construction, Wastewater treatment, Oil and Grease, Neem leaves powder

Introduction

The present situation anticipates a rise in water scarcity, primarily attributed to escalating urbanization and industrialization. Constructed wetlands act as a sustainable solution to control water scarcity by treating wastewater. These systems use natural processes, involving plants and microbes, to filter contaminants, improving water quality. Constructed Wetlands (CWs) are one of the natural wastewater treatment methods. The use of constructed wetlands for wastewater management is becoming more popular all over the world. Constructed wetlands (CW) is an environmentally friendly technique for removing pollutants from wastewater and has been applied to municipal wastewater, petroleum refinery wastewater agriculture drainage, acid mine drainage, etc.

The main functions of CWs are to improve wastewater quality by degradation or by the sorption, control the flood by creating storage for the storm rainfall and surface runoff and recycle nutrients. However, the values of wetlands include providing recreational areas and providing suitable data for research and education. The advantages of CWs include, the low construction cost compared to other remediation methods, an environmentally friendly approach that is viewed with favour by the public, high flexibility in the landscape design to provide habitat for wildlife and organisms. Although they have great advantages, there are some limitations

of CWs that include, requiring large land areas compared to the other remediation methods, the inconsistency of the treatment compared to the other wastewater treatment methods, not suitable to treat if the discharge should meet specific standards, ammonia and pesticides have detrimental effects on the plants and microorganisms, and low tolerance of near-complete drying conditions.

Scope / Objectives of the project:

- To investigate the physicochemical characteristics of grey water, focusing on wastewater generated from the household in the Bagalkot region.
- To develop and implement a laboratory-scale model for treating grey water using Horizontal Subsurface Flow Constructed Wetlands (HSSF- CWs).

To evaluate the efficiency of the constructed wetland model for the removal of nutrients like phosphorous, sodium, BOD, COD, Oil and grease from grey water.

Methodology

Materials:

- Sample Collection The household wastewater of approximately 200 lit was collected from Bagalkote region. The wastewater from the individual household is gathered for analysis and treatment.

- Plant-Canna Indica is a strain of the Cannabis plant known for its relaxing effects, shorter stature, broader leaves, and potential therapeutic properties, often associated with aiding sleep and relaxation.

- Construction materials Constructed wetlands for wastewater treatment typically require a variety of gravel sizes to create a layered substrate. Coarse, medium, and fine gravel play essential roles in wetlands.

- Chemicals-All chemicals are used laboratory grade.

- Neem leaves powder-The dried neem powder is used to remove oil and grease from wastewater.

Construction of wetland Horizontal sub surface flow

The amount of wastewater generated by a household can vary based on factors like the number of occupants, water usage habits, and local regulations. On average, a single-family home might produce around 800-1000litres of wastewater per day. The gravel media were stratified by coarse gravel (40-60 mm dia) layer at the bottom, medium gravel (20-40 mm dia) layer at the centre, and fine (less than 20mm) layer at the top. The base of the wetland slopes towards the outlet with 2% gradient. The valves will be fixed to inlet and outlet to maintain the flow. The plants will be used for the wetland is canna indica, macrophytes. From this removal of physical, chemical, biological pollutants from the water like BOD, COD, TSS, PH, TDS, TN, Organic matter, nutrients, oil and grease.

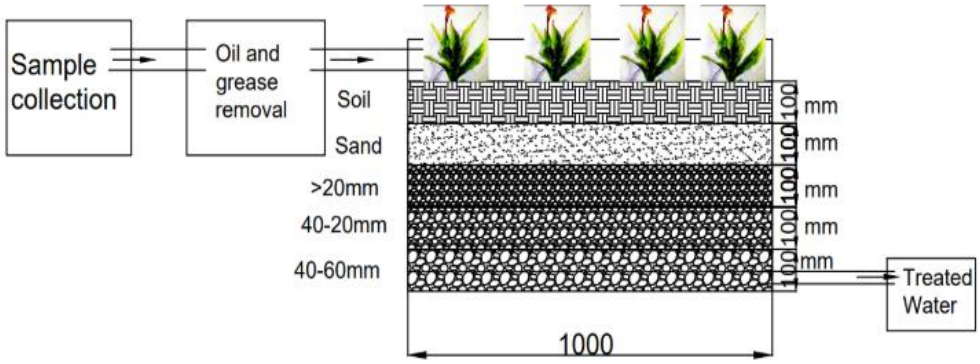

Fig. 1 Construction of wetland Horizontal sub surface flow

Flow measurements and operation

- The volumetric flow rate to each of the HSSF-CWs was estimated using data collected on water consumption in the kitchen.
- The wastewater was transported to the experiment site using cans. We added 2g/l of neem leaves powder to the wastewater to facilitate the removal of oil and grease.
- After removing the floating portion of neem powder, the wastewater is transferred to the first chamber and then to the wetland, where it passes through each layer which has coarse, fine gravel and soil due to this it gets purified.
- The purified water is then taken for physical and chemical characteristics testing to ensure its quality.

Results and Conclusions

Parameters	CPCB Standards	Raw wastewater	Day 1	Day 2	Day 3	Day 4	Day 6	Day 8	Day 10
Color (mg/L)	-	Light brownish						Colorless	
Odor (mg/L)	-	Unpleasant odor					Pleasant odor		
pH	5.5-9.9	6.8	7.3	7.5	7.9	8.1	8.2	NS	NS
TDS (mg/L)	2100	2500	1465	1250	1100	974	910	NS	NS
Electrical conductivity (µs/m)	2500	2200	1800	1600	1500	1200	1100	NS	NS
COD (mg/L)	250	1120	960	880	800	720	600	560	520
BOD (mg/L)	30	750	570	510	450	360	300	270	210

NS: Not studied

Conclusions:

The horizontal sub surface flow constructed wetland (HF-CW) for the treatment of domestic wastewater evaluated under the climatic conditions these serve as good choice for secondary treatment of wastewater. The greywater treatment train including slow sand biofilters, sand, and plant. The pretreatment reduced the TD, pH, turbidity effectively thereby reducing the clogging and maintenance in the filtration stage. The filtration stage reduced the TDS, turbidity, BOD, COD effectively. We observed significate reduction in organic matter. The removal efficiency were observed in planted HSSF-CWs are pH 7.3,7.5,7.8 and 8.1, BOD 24%,32%,40%, and 52% and COD 14.2%,21.42%,28.5%, and 35.7% for 4 days.

Scope for future work.

- The scope for constructing wetlands is broad and multifaceted. They can be created for various purposes, including wastewater treatment, flood control, habitat restoration, and recreation.
- Additionally, they can provide ecosystem services like improving water quality, supporting biodiversity, and mitigating the impacts of climate change.
- The feasibility and design of wetland construction projects depend on factors such as site characteristics, regulatory requirements, community needs, and available resources.

Applications

- Water Quality Improvement: Wetlands can be built to treat wastewater from urban and industrial sources, improving water quality by filtering

pollutants and excess nutrients.

- Flood Control: Constructed wetlands can mitigate flood risks by absorbing and storing excess water during heavy rainfall events, reducing downstream
- Habitat Creation: Wetlands provide vital habitat for a diverse range of plant and animal species, including birds, amphibians, and fish.
- Constructing wetlands can help restore lost habitat and support biodiversity conservation efforts.
- Stormwater Management: Wetlands can be designed to capture and slow down stormwater runoff, reducing erosion and sedimentation in nearby water bodies while also improving groundwater recharge
- Recreational Amenities: Well-designed wetlands can offer opportunities for recreation such as birdwatching, fishing, hiking, and kayaking, enhancing the quality of life for nearby communities
- Erosion Control: Wetlands help stabilize shorelines and riverbanks, reducing erosion and protecting adjacent land from damage caused by waves and currents.
- Future sodium, phosphorus, potassium and oil and grease test should be carried out.

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