RECLAMATION AND REUSE OF GREYWATER BY CONSTRUCTION OF WETLAND

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Introduction:

India has witnessed a rapid increase in the urban population during the last few decades. All towns and cities are augmenting sustainable water supplies and sanitation services to meet the increasing water demand. Due to inadequate wastewater treatment facilities the untreated sewage is disposed in lakes, river and other water bodies. The cumulative result of unmanaged wastewater that the system cannot cope with has negative effects on the health of both people and ecosystem. In this situation, pollution control is a near impossible task. The fact is that Indian cities have the opportunity to reinvent sewage paradigms and they can leapfrog into new ways of dealing with wastewater.

Decentralized Wastewater Treatment System (DWTS) may be defined as 'the collection, treatment, and disposal/reuse of grey water from individual homes, clusters of homes, isolated communities, industries, or institutional facilities, as well as from portions of existing communities at or near the point of waste generation' It will certainly conserve various resources and at the same time provide sustainable sanitation services in unsewered area typically seen in some Indian towns, cities and majorly in villages.

The socio-economic situation and the context of urbanization highlight the need for Decentralized Wastewater Treatment. In such circumstances, local reuse and recycle of treated wastewater too holds immense potential in terms of overall urban environmental sustainability. Primarywater source is polluted to a great extent through discharge of harmful substances. Out of the 31 diseases that are major cause of death in developed countries, as many as 21 are due to contaminated water.

The system of treatment by DWTS is certainly satisfied by construction of wetland for grey water treatment, which is most economical and efficient technique for treating the grey water at source, which follows biological breakdown process of grey water without utilizing

any chemical process for treatment, further treated effluent is used in many beneficial purposes. Constructed wetlands are engineered wetlands that have saturated or unsaturated substrates, emergent/floating/submerged vegetation, and has a large variety of microbial communities which are built for water pollution control.

The present study focuses on treatment of residential greywater by using the Vertical Flow Subsurface Constructed Wetland (VFSCW) with different operational mode such as batch mode to assess the potential for organic matter removal efficiency from residential wastewater.

Objectives:

1. To study the chemical and physical characteristics of the collected wastewater.
2. To design and develop a sustainable treatment system that is chemical free and environment-friendly.
3. To treat the greywater by wetlands which is cost efficient in terms of construction, operations & maintenance.
4. To bring necessary awareness among people about decentralized wastewater treatment system and to promote the effective use of treated grey water for other beneficial purpose like gardening, firefighting, street washing, vehicle washing, toilet flushing.
5. To carry out performance evaluation of developed system for residence wastewater treatment areas.

Methodology:

System Components

Grey water treatment in a DWTS by constructed wetland is achieved via:

a) Preliminary treatment (screening)
b) Primary treatment (sedimentation tank)
c) Tertiary treatment/ Biological treatment (subsurface vertical flow wetland systems)
d) Storage (post treatment usage purpose)

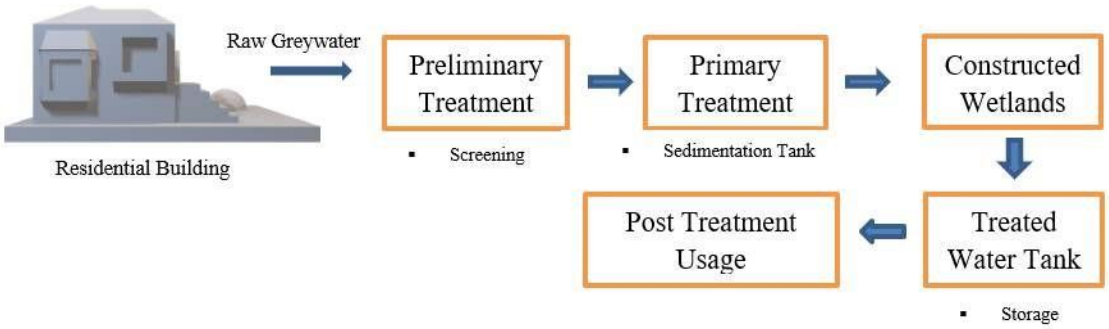

Figure 1. Operational Diagram of DWTS

Planning and Designing

Appropriate planning and designing are critical prior to construction of a DWTS.The planning for employing a DWTS should include:

- Identification of a site.
- Land availability of the proposed site.
- Source and volume of generated waste water.
- Local climate conditions
- Socioeconomic environment of local area and target population.
- Identification of reuse options.

Rigorous analysis of construction, operational and maintenance costs.

Preliminary Treatment (screening) Screen is the device used to retain solidsfound in the influent wastewater to the treatment plant. The main purpose of screening is to remove solid materials that could cause damage to other process equipment, reduction in efficiency of the whole system and contaminate waterways.

Figure 2. Screening

Primary Treatment (rectangular sedimentation tank) It is designed to remove organic and inorganic solids by the physical processes of sedimentation which reduces the strength of sewage, settleable solids & BOD.Baffle walls are provided to hold wastewater at low velocity, under aerobic conditions for minimum detention time of 1.5-3 hours.

Figure 3. Sedimentation Tank

The wastewater percolates through the gravel, giving better access to the plant roots and rhizomes and exposure to oxygenated conditions in the rhizosphere. The alternating oxidized-reduced conditions of the substrate stimulate nitrification/denitrification processes and phosphorus adsorption. When properly designed and operated, wastewater stays beneath the surface of the media, flows in contact with the roots and rhizomes of the plants, and is not visible or available to wildlife.

Tertiary Treatment (Constructed Wetland)

Results and Conclusions:

The greywater sample was collected from the residential building at Muchkandi Cross Bagalkot. The before and after treatment sample was analysed for physical-chemical and biological parameters, by using standard methods. The various parameters of greywater and their values are as listed below in table 1.

Table 1: Characterization of wastewater before and after treatment.

Sl. No	Retention Time	Treatment	pH (No unit)	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	TDS (mg/l)
1	0 hours	Before Treatment	7.83	285	884	608	836
2	24 hours	After Treatment	6.99	92.8	213	114.8	272.3

Colour Analysis Result:

The colour of wastewater at the inlet of wetland model is not clear, when collected in transparent bottle. And after the treatment colour of wastewater at outlet of wetland is clear which is shown in below figure 5a & 5b.

• BEFORE TREATMENT

Figure 5a. Before Treatment

• AFTER TREATMENT

Figure 5b. After Treatment

Conclusion:

1. Constructed wetlands is designed and operated to remove a wide range of pollutants from greywater.
2. The initial BOD & COD of greywater was 285 mg/l, 884 mg/l and after the treatment it was reduced to 92.8mg/l,213mg/l respectively.
3. In the study we found that BOD, COD, TSS & TDS removal efficiency 67.44%, 75.90%, 81.11% & 67.43% respectively was observed.
4. It is very economical process as Canna Indica is naturally available in abundance in our area & low-cost material is used for construction of wetland.
5. Cost of construction, operation, maintenance, energy requirement is less & no skilled labour is required.

6. The treated water can be used gardening, vehicle washing, firefighting, street washing, toilet flushing.
7. This method is suitable for rural, undeveloped areas, industry (Sugar, Pulp& Paper) and can be
8. Effectively used for isolated households or apartments as it is compact in size.

Scope for future work:

1. Based on the above analysis, it can be concluded that constructed wetland technology has a successful approach towards reuse of wastewater. Moreover, the treated water has application in gardening, flush tanks, street washing, cooling ponds and for other useful amenities other than potable purpose.
2. Unlike conventional process, constructed wetlands can be installed and operated with same performance efficiencies even for small and isolated communities.
3. The flexibility in designing constructed wetlands for wide ranging treatment capacities offers the advantage of achieving effective wastewater management and environmental protection irrespective of geographic and socio-economic constraints.
4. This type of treatment systems is having excellent scope in future since the operational, construction and maintenance cost is very meagre, when compared with other treatment process.