GREYWATER TREATMENT BY PHYTOREMEDIATION

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ABSTRACT

The rapid growth of India's population, combined with a lack of technological and economic alternatives, is hastening the degradation of the country's water resources. Despite the existence of wastewater treatment legislation in India, the quality of the aquatic environment continues to deteriorate in all three contexts of urban, rural, and sub-urban. Uneven distribution of surface water bodies, substantial groundwater abstraction and contamination, recurring droughts, and poor surface water quality are only a few of the many factors that contribute to India's water scarcity. Water consumption has risen over time as a result of rising population, industrialization, agriculture, and living conditions. Water has been collected through the construction of dams and reservoirs, as well as the creation of ground water infrastructure such as wells. However, there is a growing recognition that 'finding additional water' and in wastewater has its limits.

Keyword: - *Sedimentation, Filtration, desorption Bacterial, Metabolism, Precipitation, Adsorption*

1. INTRODUCTION

Due to a lack of skilled manpower and challenges with electricity supplies, or lack of electricity supplies in rural areas, this involves the use of natural methods in ways that are highly efficient and well-structured. Phytoremediation is a self-sustaining wastewater treatment system based on the principles of a natural wetland. For treatment, the approach utilizes wetlands plants, gravel/ porous stone, and their associated microorganisms to mimic natural wetland ecosystem processes. It employs particular plants that can take nutrients directly from wastewater without the need for soil. These plants serve as fertilizer and waste removers. After treating sewage with Phytoremediation Technology, it is feasible to recover and reuse treated water for gardening applications. The process involves the biological, physical, and chemical action of plants on wastewater. Emergent vegetation's root system is supported by porous medium. Various plant species have been skillfully used to provide optimal efficiency in the treatment. The plants supply oxygen from the atmosphere through plants to the root zone, where particles of effluent or wastewater get attracted towards the roots and are absorbed by the roots as nutrients. Thus, the process of aeration, which is an aerobic reaction, takes place along with anaerobic in a natural way. The processed water is later collected after passing through various baffles to the collection tank. This collected water is later used for purposes like gardens, fountains, and irrigation. It can be constructed in series or parallel modules or cells depending on the land availability and quantity of wastewater to be treated. The phytoremediation technology treatment is a subsurface flow type in which wastewater is applied to a cell or system filled with porous media such as coarse aggregate, gravel, and fine sand. **Treatment Mechanism:**

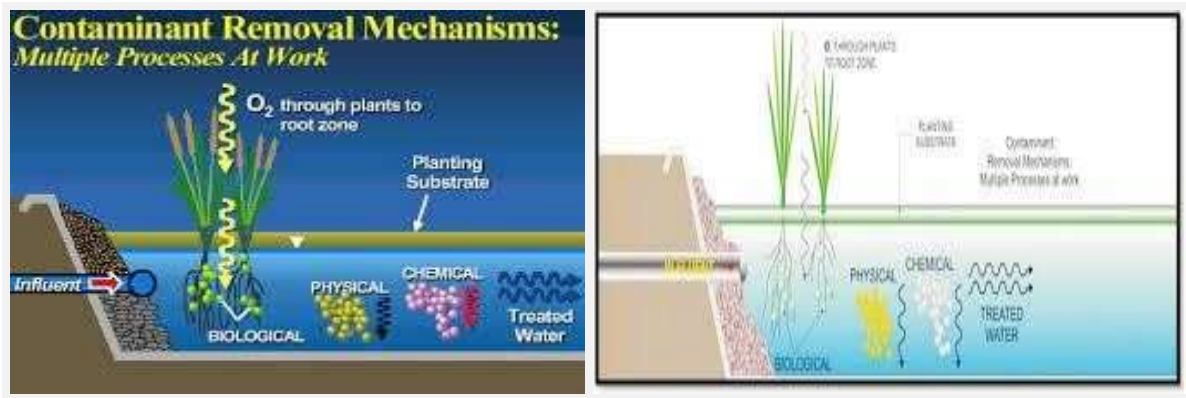


Figure: 1 Treatment Mechanism [jay Vymazal -2016]

The phytoremediation is a combination of the physical, chemical and biological processes which that into ultimate treatment for the wastewater.

2. METHODOLOGY

2.1 **SOURCES OF WASTEWATER**

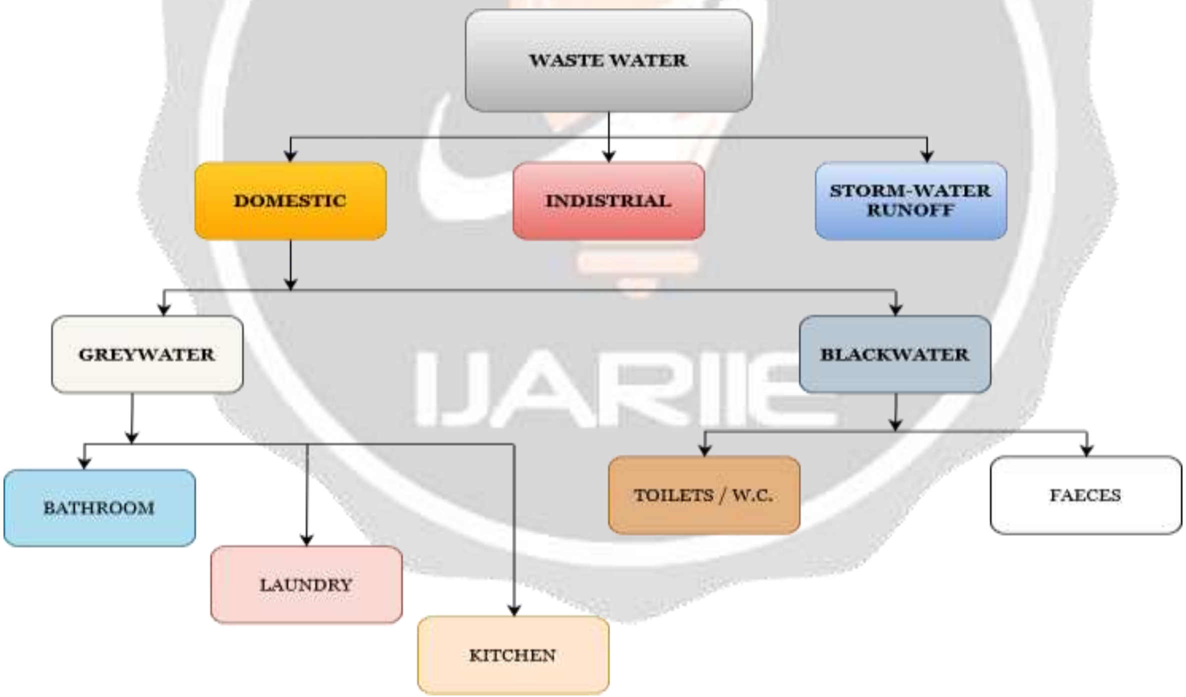


Figure 2 Sources of Wastewater [Joshua N. Edokpayi-2017]

2.2. TYPES OF WASTEWATER

Wastewater comes in three main types namely Black water & Grey water.

Black water:

Backwater discharge is any waste from toilets or urinals. It is defined either as treated or untreated (raw), and contains disease-causing bacteria and viruses that can result in human illness from direct contact, or by consumption of affected fish and shellfish. It contributes to nutrient build-up in ecosystems that result in changes to habitat and the proliferation of nuisance pest species.

Greywater:

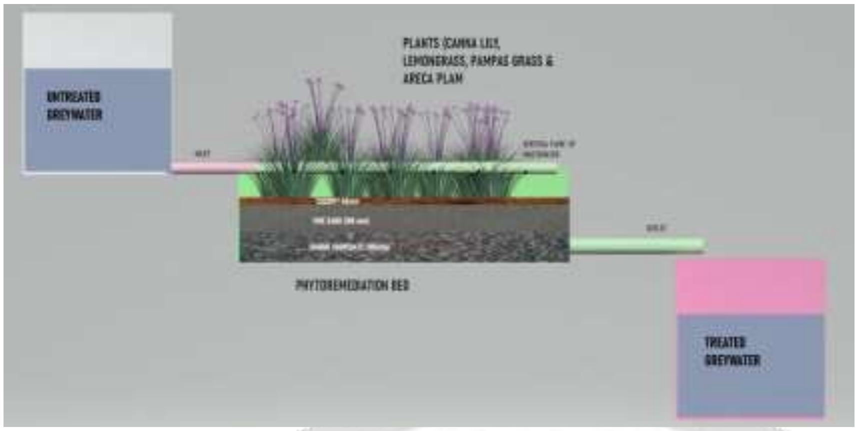
Greywater are highly variable; Greywater amount varies from 50% to 70% of the wastewater volume produced by households. Greywater refers to domestic wastewater generated in households from streams that are free of farces, i.e. all streams except toilet wastewater. Sinks, showers, bathtubs, washing machines, and dishwashers are examples of greywater sources. Greywater may contain traces of dirt, food, grease, hair, and certain household cleaning products. While greywater may look “dirty,” it is a safe and even beneficial source of irrigation water in a yard. Keep in mind that if greywater is released into rivers, lakes, or estuaries, its nutrients become pollutants, but to plants, they are valuable fertilizer.

Greywater is often safer to handle and easier to treat and reuse onsite for toilet flushing, landscape or crop irrigation, and other non-potable purposes since it contains less pathogens than domestic wastewater. Greywater may still include pathogens from filthy garment laundry or cleansing the anal area in the shower or bath.

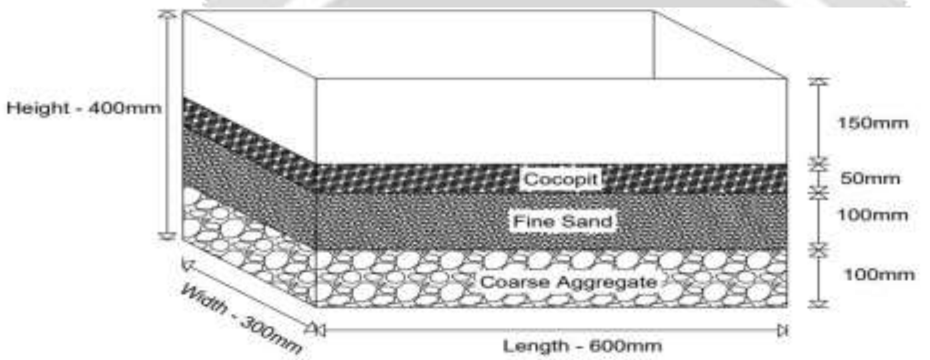
Figure: 3 Black Water And Grey Water [C. Boutin-2016]

3. EXPERIMENTAL SETUP

Lab Scale Model



Process Of Phytoremediation



Layers of Media

1. Aggregates were thoroughly cleaned with water.
2. The Phytoremediation Bed was made:

- Coarse Aggregates in the Bottom Layer (100mm).
- Fine sand in the middle layer (100mm)
- Plants with Coco-peat and soil in the top layer (40mm).

3. The sample was collected in a 20-liter bucket and gravity-fed through a conduit in the Phytorid bed.
4. A subsequent instantaneous sample was obtained.
5. Treated Day 1, Day 2, Day 3, Day 4 and Day 5 sample were taken.
6. Collected samples were tested for BOD, COD, TDS, TS, ph and DO.

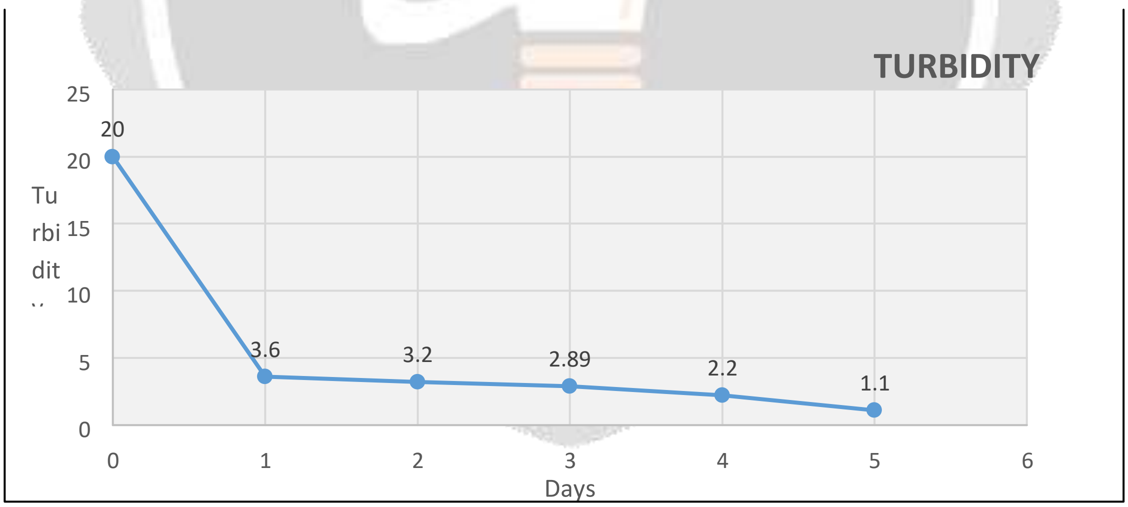
- Total dimension of tank = 0.6m x 0.3m x 0.45m =0.08m3
- Volume = 20 litre = 0.02 m3
- Time (t) = 3 min 40 sec = 220 sec = 0.0025 day
- Rate of flow = V / t = 0.02 / 0.0025 = 8 $m^{3/}$ day
- Keeping freeboard -150mm
- Actual model size -8.334m x 3.5m x 0.6 m Scale down for lab scale model - 1: 8
  1.04m x 0.437m x 0.075m

- By taking depth of bio-filter - 0.2m
  Bed size -0.6m x 0.3m x 0.2m =0.036 m^3
- Providing vertical flow in lab scale model
- Half inches pipe is used
- 2 pipe are provided of 0.6m with holes at 5cm for equal flow
  0.6 /0.05 =12 holes should be provided. So, 6 holes is provided on each pipe

Vertical Flow On Bio-filter

1. Turbidity

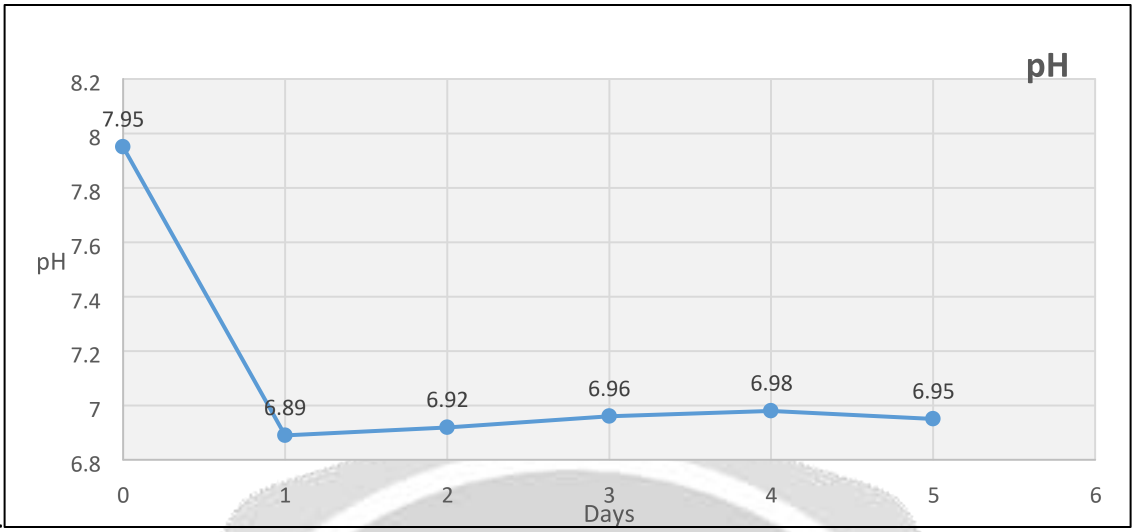
This graph illustrates the gradual decrease in the parameters for the testing of wastewater, before treatment, it was 20 NTU after 5 days of treatment, and it gradually decreased to 1.1 NTU. The y-axis indicates turbidity, while the x-axis indicates the number of days. Lab model results show reduction parameters per MPCB limit.



Turbidity graph

2. PH

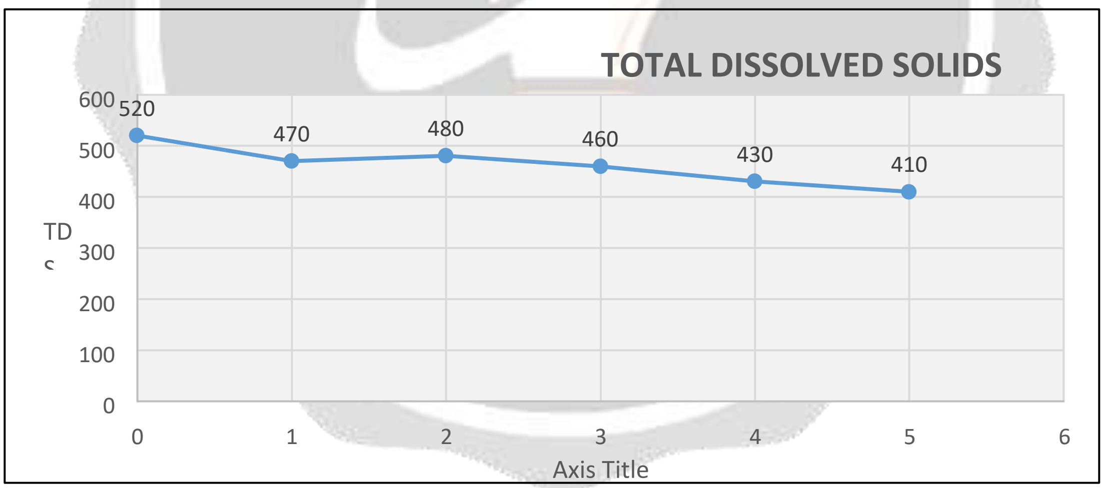
This graph illustrates the gradual decrease in pH of grey water. Before treatment, it was 7.95 after 5 days of treatment, and it gradually decreased to 6.95. The y-axis indicates pH, while the x-axis indicates the number of days. Lab model results show reduction and maintaining pH parameters as per MPCB limit.



pH graph

3. Total Dissolved Solids:

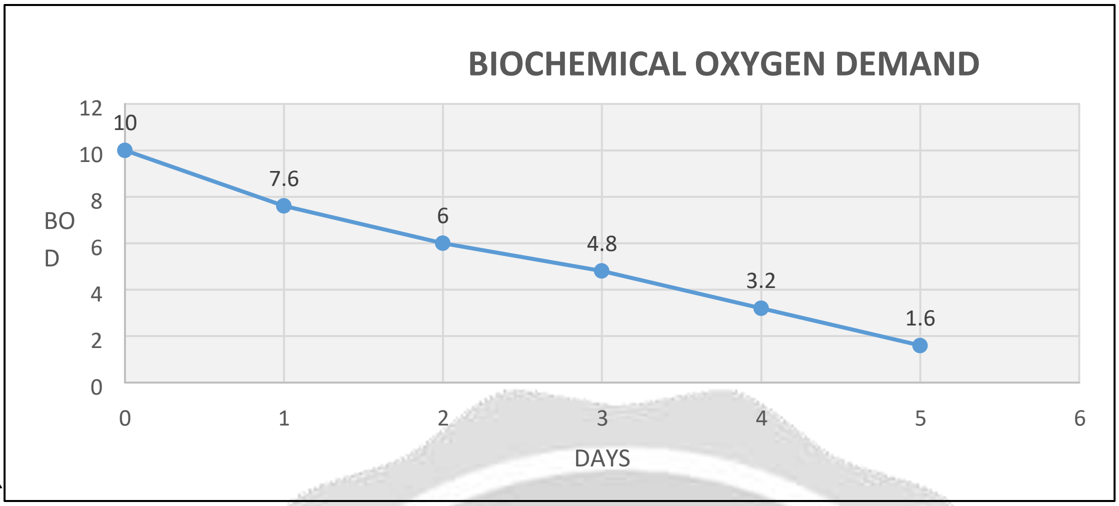
This graph illustrates the gradual decrease in total dissolved solids of grey water. Before treatment, it was 520 mg/l after 5 days of treatment, and it gradually decreased to 410mg/l. The y-axis indicates total dissolved solids, while the x-axis indicates the number of days. Lab model results show reduction parameters, but do not meet the per MPCB limit



Total Dissolved Solids (TDS) Graph

4. Biochemical Oxygen Demand

This graph illustrates the gradual decrease in BOD of grey water. Before treatment, it was 10 mg/l after 5 days of treatment, and it gradually decreased to 1.6 mg/l. The y-axis indicates BOD, while the x-axis indicates the number of days. Lab model results show reduction parameters as per MPCB limit.



Biochemical Oxygen Demand Graph

4. RESULT AND DISCUSSION

Greywater was poured into a bio-filter and on the same day, samples were analysed for the performance of phytoremediation treatment, which resulted in a reduction of BOD, COD, total suspended solids, total dissolved solids, total solids, turbidity, and an improvement in pH and dissolved oxygen, which meets the irrigation standards for treated greywater samples.

The result of the bio-filter was carried out by using phytoremediation technology.

	Number of days								MPCB Limits as per consent	Efficiency
		Units	**Raw water**	**1**	**2**	**3**	**4**	**5**		
Parameters	**Turbidity**	NTU	20	3.6	3.2	2.89	2.2	1.1	< 5	95.5%
	pH	-	7.95	6.89	6.92	6.96	6.98	6.95	5.5-9	-
	TDS	Mg/l	520	470	480	460	430	410	<100	22%
	TSS	Mg/l	190	110	70	60	50	40	<100	79%
	TS	Mg/l	710	580	550	520	480	450	<100	37%

	DO	Mg/l	6.2	7.9	7.7	7.4	7.1	6.9	6.5 >	-
	BOD	Mg/l	10	7.6	6	4.8	3.2	1.6	<30	84%
	COD	Mg/l	24.32	16.3	14.51	10.19	8.55	5	<100	79%

5. CONCLUSIONS

- The phytoremediation bio-filter is efficient for the removal of Turbidity, TSS, BOD and COD of greywater. The Turbidity, TSS, BOD, and COD removal efficiency was 95.5%, 79%, 84%, and 79% respectively
- The removal efficiency was low for TDS, TS at 22% & 37% respectively.
- No change in pH and DO was observed.
- Treated greywater can be used for land irrigation as well as can be discharged into inland surface water and this treated water can be used for gardening if TDS, TS is within the permissible limit.

6. REFERENCES

1. Hasrul Hazman Hasan, Siti Fatin Mohd Razal. Performance of Greywater Treatment Using Iron Removal Media (IRM) and Cattail Typha Angustifolia. Pertanika J. Sci. & Technol. 30 (2): 1421 - 1438 (2022)
2. Gautam, S.; Makhitha, L.M.; Gupta, A.; Brema, J.; James, E.J.; Chellaiah, G. Treatment and Effective Utilization of Greywater: A Preliminary Case Study. Appl. Syst. Innov. 2021, 4, 16. https://doi.org/ 10.3390/asi4010016
3. Jaya S. Pillai and A. N. Brijesh Nair. Performance of Vertical Flow Constructed Wetlands

   Planted with Indigenous Species for Decentralized Wastewater Treatment and Biomass

   Production in Kerala, India. Nature Environment and Pollution Technology An International Quarterly Scientific Journal. e-ISSN: 2395-3454. 2021
4. Philiphi de Rozari, Denik Sri Krisnayanti, Refli , Krispianus V. Jordan's , Maria Ratu Rosari Atie. The use of pumice amended with sand media for domestic wastewater treatment in vertical flow constructed wetlands planted with lemongrass (Cymbopogon citratus). https://doi.org/10.1016/j.heliyon.2021.e07423. 2405-8440.(2021)
5. F. Boano, ulvio Boano, Alice Caruso, Elisa Costamagna, Luca Ridolfi, Silvia Fiore, Francesca Demichelis, Ana Galvão, Joana Pisoeiro, Anacleto Rizzo, Fabio Masi. A review of naturebased solutions for greywater treatment: Applications, hydraulic design, and environmental benefits. Science of the Total Environment 711 (2020) 134731. https://doi.org/10.1016/j.scitotenv.2019.134731
6. Pranav Yadav. Removal of Various Pollutants from Grey Waste Water using Canna Lily

   Plants: A Concise Review. International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653.(2020)

7. R. Kaalipushpa, S. Karthika, S. Revathi. Domestic Wastewater Treatment using Phytorid Technology. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181. (2018)