Treatment Of Grey Water Using Technique Of Phytoremediation

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Abstract- *Scarcity of water has become a major issue. With the increasing population water demand also increases. This report initiates natural method for grey water treatment called phytoremediation. The technique of phytoremediation is an engineered natural way to treat waste water using properties of wetland plants. For the remediation of grey water a small-scale unit is constructed and laboratory reports of various parameters are compared. Reports have promising results, including reduction in BOD and COD levels, complete removal of oil and grease, reduction in turbidity etc.*

Keywords- Grey water treatment, phytoremediation technique.

I. INTRODUCTION

At waste water treatment plant, water is dumped into *nallas* or nearby stream after treatment. From the domestic supply of 135lpcd, 80% is converted into waste water. This waste water includes 70% grey water. There are numerous biological methods for waste water treatment, such as activated sludge process, but these methods are costly and tedious to maintain at domestic level. Thus, the use simple and effective method would prove to be boon. The method of phytoremediation is natural process in the wetlands. Growth of plants such as cannas, dhopa, etc in the wetlands or natural ponds is common scenario. These plants have affection towards the metals, minerals and contaminant substances; which are present in the wetland water as well as soil beneath it. Phytoremediation technique is cost effective and eco-friendly.

II. TECHNIQUE OF PHYTOREMEDIATION

Utilizing the plant properties as a medium to remediate grey water benefits the plant in receiving their nutrients. The technique of phytoremediation works on the basic 6 strategies, namely Phytodegradation, Phytofiltration, Phytoextraction, Phytostabilization, Phytovolatilization, Rhizodegradation. Phytroids extracts the contaminants from the waste water and utilize some of them which are essential for their growth, other are entrapped in the cell wall and excreted as insoluble material. Other contaminants are transported to different parts of plants such as leaves and then transpired into atmosphere. The roots of these plants secrete enzymes which break down the heavy metals into simpler form. These strategies work altogether or sometimes one at a time depending upon the properties of grey water. In this project, cannas, dhopa, umbrella palm, and lemon grass are used, as there were available in the native environment.

Figure-1 Cannas plant and Umbrella palm

III. Design of phytoremediation chamber

135lpcd domestic water supply is required for average Indian city as per Indian standards and after utilization generates 80% waste water; which includes 70% grey water. For the design of phytoremediation units 70% of waste water generated is considered.

Q_S = Domestic water supply

Q_S =135lpcd

Q_W = Waste water generated

Q_W=80% of Q_S

$Q_W=\frac{80}{100} \times 135$

Q_W= 108lpcd

Q_D = Grey water generated / Design flow

Q_D=70% of Q_W

$Q_D = \frac{70}{100} \times 108$

Q_D =75.6lpcd

Design flow,

Q_D =0.0756m³/day/person

For 4 person, Q_D = 0.30m³/day

Hydraulic conductivity (KSS) = 259m³/day/m² (as water is flowing from the medium of coarse aggregate)

Hydraulic gradient (S) =0.01 (Assumed)

Cross-sectional area based on design inflow (AS) = $\frac{Q}{KSS} = \frac{0.3}{259 \times 0.01}$=0.1158m²

AS≅ 0.12m²

Assumed depth (d) = 0.3

Bed width (w) = $\frac{Area}{depth} = \frac{0.12}{0.3}$ = 0.4m

Aspect ratio (L:W) =1.5:1

Length (L) = (1.5)×(0.4) = 0.6m

The design phytoremediation chamber of 0.3m deep, 0.6m long and 0.4m wide with 2 phytroid plant can treat grey water generated by 4person at the initial stage of construction and after 10 to 15 days 1 plant could treat grey water generated by 4 people, the root network spreads wider.

IV. Construction and working of remediation unit

For the remediation of grey water generated at domestic level, an artificial sub-surface flow wet-land is constructed.

4.1 Construction

3 chambered treatment processes is incorporated as an assembly of drums and pipe-network. Figure no. 2 shows layout of treatment units.

- **Settling tank-** Opaque plastic drum with top opening with lead is used and has provided with provisions for sludge outlet.
- **Phytoremediation chamber-** Coarse aggregates of angular size are provided as layer of 0.2m thick in which the phytroid plants are supported to stand. Sub-surface flow of waste water is provided from

about 0.05m below the top surface of aggregate level.

- **Collecting tank-** Water after phytoremediation is released in the collecting tank.

Figure no. 2 Layout of phytoremediation

4.2 Working- The complete process is of 24 hrs after settling of sludge. The complete process is as follows-

- The first unit consist of sedimentation tank where raw water from kitchen sinks, bathrooms, cloths and utensils washing is collected.
- The raw water is allowed to remain still, so as to settle down the larger particles, in form of sludge. The duration for settlement of particles is 24 hr.
- After 24 hrs, water is released in phytoremediation chamber. This chamber contains 15 cm layer of coarse aggregate in which the plants of umbrella palm, lemon grass, cannas and dhopa are planted, which acts as treatment unit.
- Then water is released to another tank after 24 hrs.
- The raw water sample and the treated sample of the same batch were tested on certain parameters in the laboratory. The comparative study of both the reports is discussed further. Water samples for testing is collected as mentioned in Is 3015 (Part 1) : 1987 Methods Of Sampling And Test (Physical And Chemical) For Water And Wastewater.

V. Laboratory test reports

Grey water sample (figure no.3) and remediated grey water sample (figure no.4) are laboratory tested to determine the chemical as well as physical impurities present in water. Comparative test report of both the sample is given (table no. 1) and is discussed with the help of graphs.

Figure no 3. Grey water sample after phytoremediation

Figure no 4. Grey water sample after phytoremediation

5.1 Comparative report of grey water before and after phytoremediation

Table no. 1 shows the comparison of reports of grey water before and after phytoremediation.

Sr. No	Characteristic (Parameters)	Unit	Analysis result	
			Before treatment	After treatment
1	pH	-	8.2	8.3
2	Electrical conductivity	µmhos/cm	1225	1207
3	Turbidity	NTU	20.2	9.8
4	Total alkalinity (as $CaCO_3$)	mg/L	480	440
5	Chloride (as Cl)	mg/L	80.0	70.0
6	Total hardness (as $CaCO_3$)	mg/L	340	320
7	Calcium (as Ca)	mg/L	86.6	79.8
8	Magnesium (as Mg)	mg/L	30.1	29.2
9	Carbonate (as $CaCO_3$)	mg/L	0	16
10	Bi-carbonate (as $CaCO_3$)	mg/L	480	424
11	Total solids	mg/L	792	738
12	Total dissolved solids	mg/L	760	722
13	Total suspended solids	mg/L	32	16
14	Ammonical nitrogen	mg/L	0.12	0.10
15	Total phosphorous	mg/L	0.240	0.200
16	Iron (as Fe)	mg/L	0.32	0.24
17	Sodium	mg/L	61.6	54.0
18	Sulphate (as SO_4)	mg/L	70.0	62.0

Continued ....

Sr. no	Characteristic (parameters)	Unit	Before treatment	After treatment
19	Boron (as B)	mg/L	0.24	0.16
20	BOD	mg/L	80	44
21	COD	mg/L	640	210
22	Oil and grease	mg/L	4.0	Nil

From the above results following graph is plotted, showing results of chloride, turbidity, oil-grease, COD and BOD. Characteristics graph is plotted as follows,

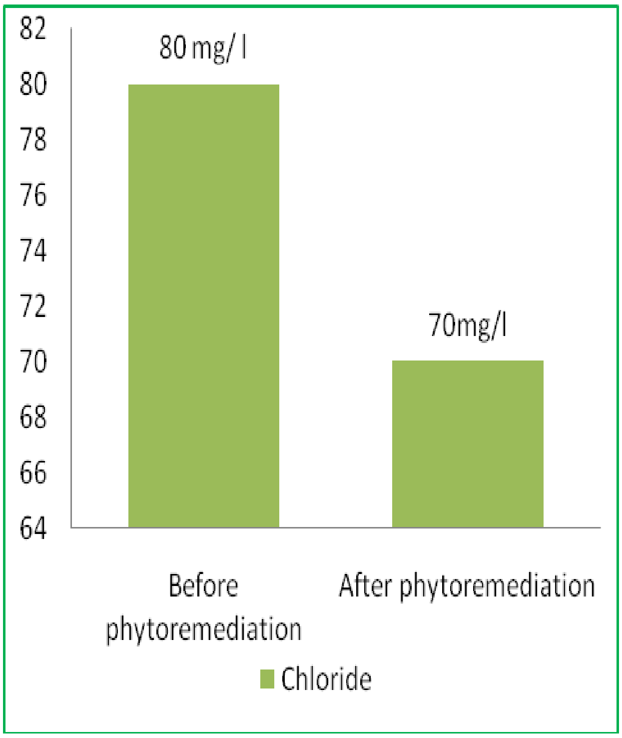

Chart no. 1 Graph showing result of chloride reduction

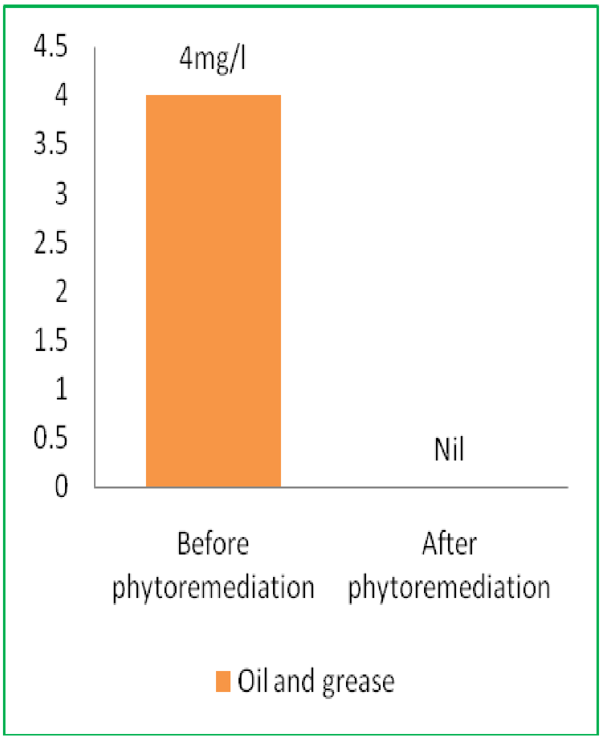

Chart no. 2. Graph showing result of oil and grease removal

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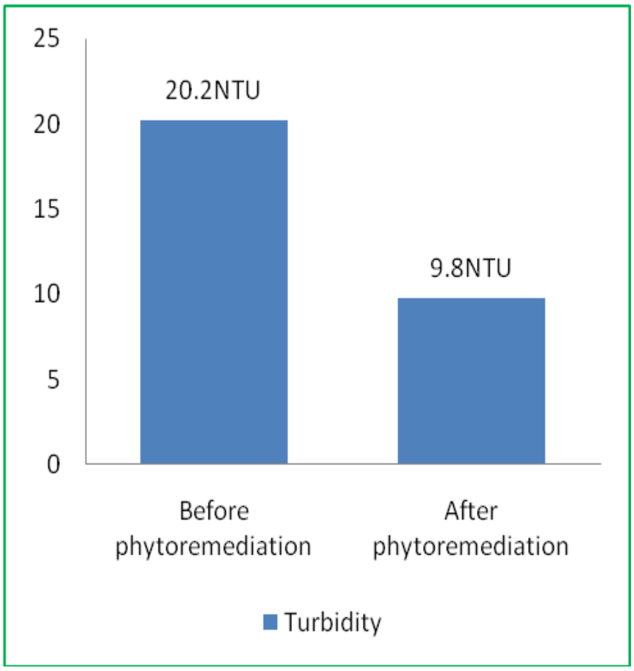

Chart no. 3Graph showing result of turbidity reduction

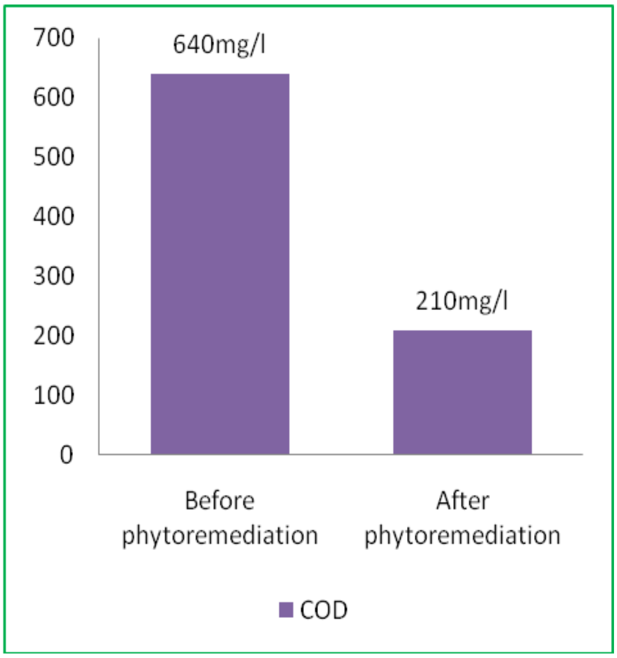

Chart no. 4 Graph showing result of COD reduction

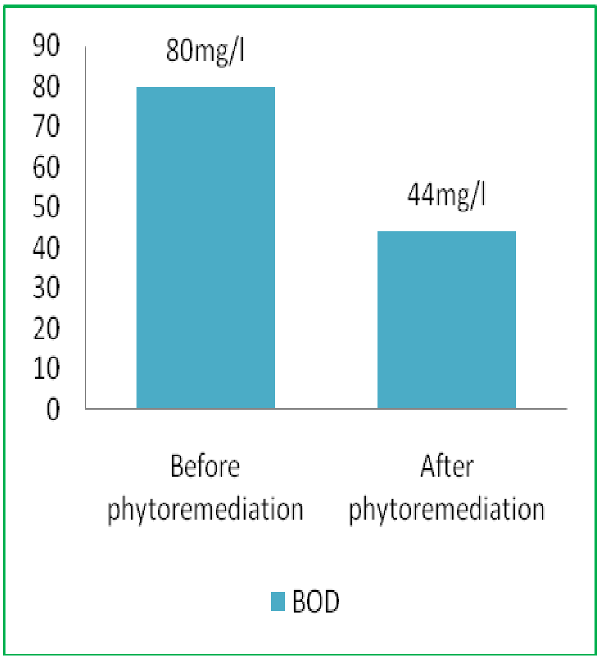

Chart no. 5 . Graph showing result of BOD reduction

VI. Advantages of phytoremediation-

- It provides aesthetic view and the process is hygienic as sub-surface flow is provided.
- It requires less maintenance and is faster in the work process.
- Electrical or mechanical energy is not required
- It acquires less space for complete unit as compared to other systems.

VII. *Conclusion-*

- The laboratory test reports show promising results in the reduction of the contaminants.
- The micro-elements for agriculture such as magnesium, calcium, boron, manganese, sulphur, nitrogen, potassium, calcium iron and phosphorus, etc
- Also, parameters such as nitrogen, iron, sulphate, magnesium, chloride and boron are within the standards of drinking water as per I.S. specifications.
- Bod and COD are reduced upto 75%

VIII. *Acknowledgement*

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