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Waste-water treatment by phytorid technology

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Abstract*—Constructed wetlands are artificial wastewater treatment system of shallow experimental tanks, ponds or channels that are planted with locally available wetland plants. They work on natural capacity of plants to treat wastewater from different sources. In view of rising concern about pollution of water bodies due to discharge of waste in them, it is necessary to initiate alternative thinking as conventional methods through STPs (sewage treatment Plants) had limited success. In recent years the application of specifically designed wetland based technology (popularly known as Phytorid technology) for treatment of wastewater-municipal, urban and agricultural, is becoming widely acceptable. It treats the wastewater in natural manner without the use of Chemicals. Phytorid technology is an improved wetland system for treatment of wastewater. The main objective of present research work is to provide and popularize a simple, feasible, practically sound, ecofriendly and cost effective technology for wastewater treatment. Phytorid technology is such a type of system, which reduces the impact of sewage and converts into useful water for gardening and irrigation purpose*.

***Keywords*—Constructed wetland, Reed-bed technology, Root-zone technology, Phytorid technology, Phytorid species.**

I. INTRODUCTION

Water is needed in all aspects of life and hence forms an essential part of human well-being. Nationally and internationally organizations and institutions are making efforts to provide adequate supply of potable development. India has witnessed a rapid increase in the urban population during last few decades. All towns and cities are augmenting water supplies to meet the increasing water demand. But the lack of adequate wastewater treatment facilities is resulting untreated sewage disposal into 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 ecosystems and is a challenge. The fact is that Indian cities have the opportunity to reinvent sewage paradigms and they can leapfrog into new ways of dealing with wastewater pollution is a major global problem which requires continuous evaluation and special attention. Water pollution affects the entire biosphere-plants and organism living in these water bodies. It not only affects individual species but affects the entire biological community as a whole. Primary water source is polluted to a great extent through discharge of harmful substances. It is estimated that every Cubic meter of contaminated water once discharged into water bodies will contaminate further 8 to 10 cubic meter of pure water.Phytorid technology is such a type of constructive wetland. It was developed by National Institute of Environmental Engineering Research (NEERI) and Council of Scientific and Industrial Research (CSIR) in the year 2007, based on 5 years of research and development and 7 years of field experimentation on various plants. Use of plant species along with their root system along with the natural attenuation processes can be combined together to get the Phytorid Technology.

Problem concerning water sanitation stem from the rise in urban migration and the practice of discharging untreated wastewater. The uncontrolled growth in urban areas has made planning and expansion of water and sewage systems very difficult and expensive carry out. In addition, many of those moving to the city have low incomes, making it difficult to pay for any ware system upgrades.

It is common practice to discharge untreated sewage directly into water bodies of water or put onto agricultural land, causing significant health and economic risks. Water-related diseases include dengue, filariasis, malaria, and yellow fever etc.

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- To treat the Waste Water.
- To reduce the spread of diseases cause by pathogens organisms.
- To reduce the threat of Water pollution.
- To Survey the selected site.
- To collect the waste water sample from these respective resources.
- To perform physical test on waste water samples.
- To collect the various plants species.

II. LITERATURE REVIEW

2.1 "Root-zone Technology", Binita Desai, and Pratibha Desai, in International Journal of Pharmacy & Bioscience, (2014)

The main objective of this study was to identify energy-efficient design parameters for a conventional STP and comparison of construction, operation and maintenance cost of STP by phytorid technology. The mechanism of the treatment process involved: extraction of contaminants from soil or groundwater, degradation of contaminants by 12 various biotic or abiotic processes. , breakdown action carried out by microorganisms dwelling at the root zone degrade /breakdown pollutants. , filtration process / biofilm formed at surface of pebble /gravel / coarse sand bed. , processes like adsorption / absorption in soil strata or their combination. Vertical and horizontal flow patterns & another possible mechanism for contaminant degradation is metabolism within the plant.

2.2 "Using Box-Behnken experimental design", Mhaske, A.R., Taley, International Journal of Innovative Research in Science, Engineering and Technology, 1 January 2017

Removal of phosphorous (P) from sewage water by phytorid sewage treatment plant was studied at Agriculture College, Maharajbag, Nagpur to examine the efficacy of the phytorid sewage treatment plant in P-concentration removal from the sewage water, and to determine the optimum condition using response surface methodology during 2013-14. A Box-Behnken model was employed as an experimental design. The effect of three independent variables hydraulic loading

or flow (50 – 150 m3. d-1), dilution (10 - 80 %) and spatial length (16 - 100 %) was studied on P-concentration removal from the sewage water in bench mode of the experiment. The optimal conditions of the P-removal were found to be flow: 55.74 m3 d-1, dilution: 40.59 per cent and spatial length: 100 per cent. Under these experimental conditions, the experimental Pconcentration removal obtained was 1.321 mg L-1. The proposed model equation using the RSM has shown good agreement with the experimental data, with a correlation coefficient (R2) of 98.21 per cent. The result showed that optimised condition could be used for the efficient removal of the P from the sewage water.

2.3 "Application of Natural Methods for Sewage Treatment andPolishing of Treated Waste-water", R. Biniwale, Journal forApplication of Natural Methods, 2012

Phytorid Treatment Systems have been found to be effective in treating BOD, TSS, Nand P as well as for reducing metals, organic pollutants and pathogens. The principalpollutant removal mechanisms in treatment systems include biological processes such as microbial metabolic activity and plant uptake as well as physio-chemical processessuch as sedimentation, adsorption and precipitation at the water-sediment, rootsediment and plant-water interfaces. Microbial degradation plays a dominant role inthe removal of soluble/colloidal biodegradable organic matter in wastewater.Biodegradation occurs when dissolved organic matter is carried into the biofilms thatattached on plant root systems and surrounding media by diffusion process. In furtherdevelopment after filing of the patent 2003, further improvement was undertaken toreduce the residence time of the overall system as also to improve the technology. Thisdevelopment involved use of isolated bacterial consortia in the system to mainlyreduce the Suspended Solids load. t also leads to reduction in BOD as well.Suspended solids are removed by filtration and gravitational settlement. A pollutantmay be removed as a result of more than one process at work. Conversion of nitrogencompounds (Nitrification / Denitrification) occurs due to planned flow of wastewaterthrough anaerobic and acrobic zones. Phosphorus is present in wastewaters asOrthophosphate, Dehydrated Orthophosphate (Polyphosphate) and OrganicPhosphorus. The conversion

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of most Phosphorus to the Orthophosphate forms iscaused by biological oxidation. Although plant uptake may be substantial, the sorption of Phosphorus (Orthophosphate P) by anaerobic roducing sediments appears to be themost important process. Pathogens are removed mainly by sedimentation, filtrationand absorption by biomass and by natural die-off and predation. Evapotranspirationslows water flow and increases contact times, whereas rainfall, which has the opposite effect, will cause dilution and increased flow.

III. Material and Method

3.1Materials

Coarse aggregate, stone chippings, phytorid plant, glass tank, PVC pipes, aerator etc. materials are used for making a phytorid plant.

3.1.1Coarse aggregate

Coarse aggregate of size 40 mm and 20 mm diameter are used.The main objective of using aggregates is to provide support to the roots of the plants and filtration of the waste water also to allow easy passage of water through the tank.

3.1.2 Phytorid Plants

A] Reed

- Species – phragmittes spp.
- Phragmitties as a native plant in North America.
- The erect stems grow to 2-6 meters.

B] Cattail

- Species – Typhalatifolia .
- It is found as a native plant species in North and South America, Europe, Eurasia, and Africa.
- The plant is 1.5 to 3 meters high and it has 2–4 cm broad leaves.

FIGURE 1:Common Reed

FIGURE 2:Cattail

3.1.3Stone Chippings

The smallest granite aggregates fractions are used, besides the road construction, for decoration and paving paths, for covering sports grounds and children's playgrounds.

3.1.4 Aerator

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A fish tank aerator was used to provide the air supply in the bed, through a perforated PVC pipe.

3.1.5 Glass Tank

Tank is of rectangular shape of size 0.6m x 0.3m x 0.4m.According to the weight of aggregates and volume of sewage the thickness of glass is determined.

3.2 Methodology

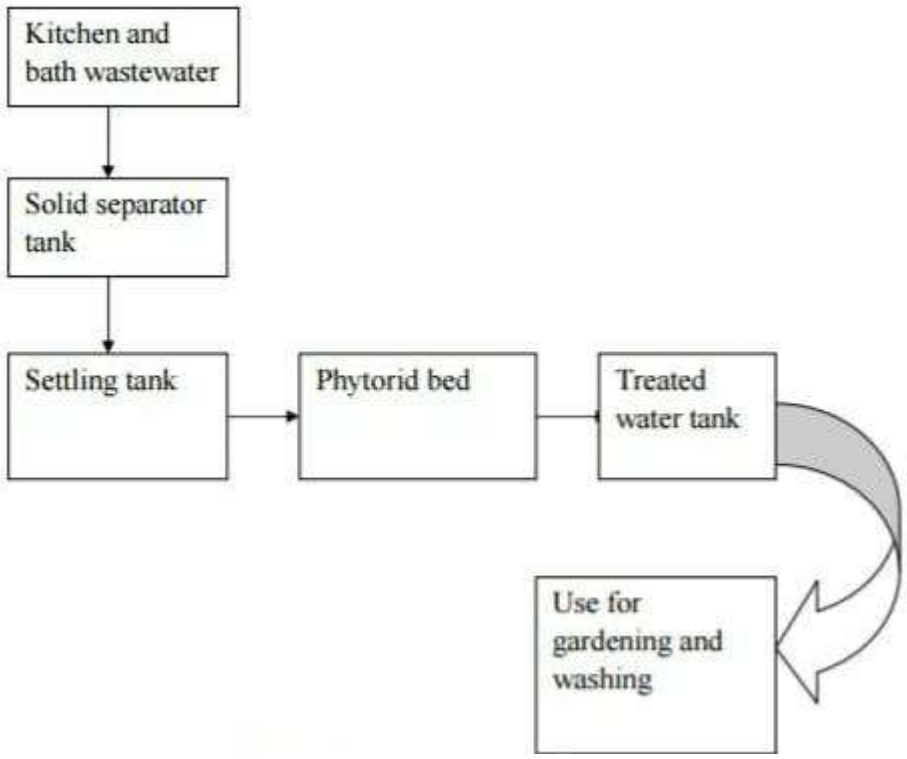

FIGURE 3:Flow Chart of Phytorid System

3.2.1Working model

1. Firstly the waste water is collected from sources and stored in the sedimentation tank where sedimentationof suspended solids takes place under the process of anaerobic decomposition.

2. After this waste-water is allowed to enter in the phytorid tank by regulating valve with designed velocity. Once the water is passed through the root zone of canna indica actual treatment process is started.

3. When roots of plants come in contact with wastewater they uptake the nutrients present in waste water which are in form of nitrates, potash etc and used as food.

4. Simultaneously oxygen is added in waste water from roots due to process of photosynthesis and hence B.O.D removal takes place after the 24 hrs detention period treated water is collected into storage tank.

5. Treated water can be either send for tertiary treatment or directly used for gardening, etc.

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3.2.2 Design of Phytorid Bed

Volume of sewage: 30 litres.

Source: At post Chikhle, vadakatipada, Dahanu

Volume of phytoridtank : 60 litres. It depends upon quantity of sewage. (Note: Volume of tank equals to two times the volume of sewage with 24 hours, detention time).

Use of baffle walls: Baffle walls are provided to increase the travel time in order to maintain the detention period i.e. 24 hours, they are spaced at 12 cm, 18 cm, 18 cm, 12cm from inlet to outletrespectively.

Size of phytorid tank:

Depth of tank = 50 cm

Length of tank = 60 cm

Breadth of tank = 30 cm

Sedimentation tank: Volume of the tank is equals to volume of sewage (i.e. 30 lit.)

Aggregate: Aggregates of two different sizes are provided in three different layers. Number of layers are decided from depth of tank. Three layers of aggregates are provided of depth 12mm, 13mm, 15 mm from bottom to top of size 40 mm, 20 mm respectively and third layer of stone chippings.

IV. OBSERVATION AND RESULT

Collection ofwaste water from sink and bathroom and it was collected in 1 litre plastic bottle. The plant species are collected from Patil Nursery Mulund (E). The species which are collected from nursery are Reed, Cattail and Seed of alfalfa. Chemical characteristics ofwaste water was tested byVarni Lab.

TABLE 1

RESULTS OF TEST ON WASTEWATER SAMPLE

Sr. No.	Parameter	Value of untreated water	Permissible value of treated water
1	PH	5.45	Permissible (6.5 – 8.5, as per B.I.S)
2	Turbidity	1170 NTU	Permissible (5 NTU, as per B.I.S)
3	Hardness	410.0 mg/l	Permissible (300 mg/l , as per B.I.S)
4	Chloride Concentration	197.7 mg/l	Permissible for Irrigation and Dilution (250 mg/l, as per B.I.S)
5	Total Dissolved Solids	642.0 mg/l	Permissible (85 - 95%, as per NEERI)

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V. CONCLUSION

Based on the above analysis,It can be concluded that the testperformed on waste untreated water should be between permissible value after treating the water. It can be concluded that phytorid technology is a kind of constructive wetland and a successful approach towards decentralization and reuse of wastewater, which gives fair quality results. Moreover, the treated water has its application in: Irrigation, River dilution, Flush tanks, Gardening etc.Water of high quality can be obtained if the retention period is increased (48 or 72 hours according to NEERI). The materials and methodology used to treat the wastewater with phytorid technology.

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