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Phytorid Technology

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***Abstract*-Demand for water is increasing day by day, we need to develop various low-cost technologies which could be implemented at point source as well as at individual houses so that wastewater could be treated and reused at house-hold levels and hence reducing the loads on sewage treatment plants. Also, at various places treated wastewater from sewage treatment plants is disposed in natural waterways such as rivers, lakes and hence they are polluted and increases risk of hygiene. Hence in order to reduce pollution and to make smart use of wastewater for future purposes one technology which is used is Phytorid Technology. This technology is a patented technology and is dependent on various plant species. The aim of this project is providing a system which is low-cost, low-maintenance, and which works without disturbing ecosystem. To improve the quality to water without causing ground-pollution is done by considering various water parameters which should be satisfied for reusing the water for various purposes with reference of IS 3025 code books.**

***Keywords*-Phytorid Technology, ecosystem, pollution, quality of water.**

I.INTRODUCTION

Primary water source is polluted to a great extent through discharge of harmful substances. It is estimated that every 1 m3 of contaminated water once discharged into water bodies will contaminate further 8 to 10 m3 of pure water. Out of the 31 diseases that are major cause of death in developed countries, as many as 21 are due to contaminated water. The above facts highlight the need to find improved water treatment to meet the problems of food security, water availability and use of water efficiently. It is beyond any doubt that energy will be the main concern of the nations in coming years.

Identification and adoption of appropriate technology to overcome these pressures is therefore essential. Th-e object of sewage treatment is to stabilize the organic matter present in sewage to produce an effluent liquid and sludge, which can be disposed-off into the environment without causing health hazard or nuisance. The endeavour should be to adopt modern and cost- effective technologies and equipment to achieve value for money and maximum user satisfaction.

The septic tanks which treat the sewage by pure anaerobic process can be considered as preliminary STP. The requirement for better treatment of sewage coupled with development of technology lead a way forward towards aerobic process. This requires pumping and blower operation which is energy consuming. Thus, conventional STP requires energy for achieving better results. The aerobic process requires oxygen to be provided to the bacteria.

It is important to appreciate the fact that only 3% of the world's water is fresh & roughly one-third of it is inaccessible. The rest is very unevenly distributed & the available supplies are increasingly contaminated with the waste & pollution from industry, agriculture & households. This project report deals with the design of Phytorid technology for MIT-ADT University IOD building.

Over the years, increasing population, growing industrialization, expanding agriculture & rising standards of living have pushed up the demand for water. Efforts have been made to collect water by building dams & reservoirs & creating ground water structures as wells. However, there is a growing realization that there are limits to 'finding more water' & in the long run, we need to know the amount of water we can reasonably expect to tap & also learn to use it efficiently.Hence, it very essential to reuse the wastewater for various purposes using various advanced techniques from which Phytorid technology is the one.

II. OBJECTIVE

To design low cost Phytorid technique (low cost wastewater treatment system).To develop the lab scale model of Phytorid technology in MIT-ADT University.To determine characteristics of wastewater before treatment and after treatment using Phytorid technology.To design Phytorid technology for IOD (Institute of Design) building.

III. TREATMENT MECHANISM

The 'Phytorid Technology' is a combination of the physical, chemical and biological processes which resulted into ultimate treatment for the wastewater.

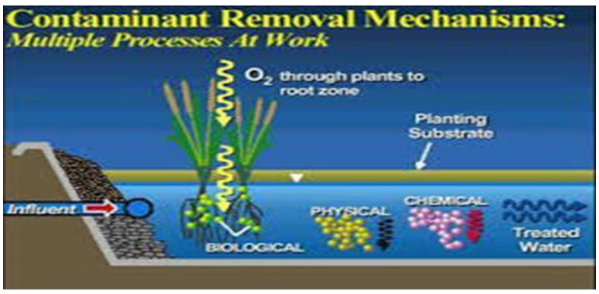
Table 1 Treatment Mechanism.

Physical	Biological	Chemical
Sedimentation	Bacterial	Precipitation
Filtration	Metabolism	Adsorption
Adsorption	Plant Metabolism	Hydrolysis
	Plant Absorption	Oxidation/Reduction

1. Role of plant species for treatment mechanism:
The most significant functions of plant species in relation to water purification are the physical effects brought by the presence of the plants. The plants provide a huge surface area for attachment and growth of microbes. The physical components of the plants stabilize the surface of the beds, slow down the water flow thus assist in sediment settling and trapping process and finally increasing water transparency.

Plants play a vital role in the removal and retention of nutrients and help in preventing the eutrophication of wetlands. A range of plants has shown their ability to assist in the breakdown of wastewater. Cattail (Typhaspp) are good examples of marsh species that can effectively uptake nutrients. These plants have a large biomass both above (leaves) and below (underground stem and roots) the surface of the substrate.

The sub-surface plant tissues grow horizontally and vertically, and create an extensive matrix, which binds the particles and creates a large surface area for the uptake of nutrients and ions. Hollow vessels in the plant tissues enable oxygen to be transported from the leaves to the root zone and to surrounding soil.This enables the active microbial aerobic decomposition process and the uptake of pollutants from the water system to take place. Decomposing plant biomass also provides a durable, readily available carbon source for the microbial populations.



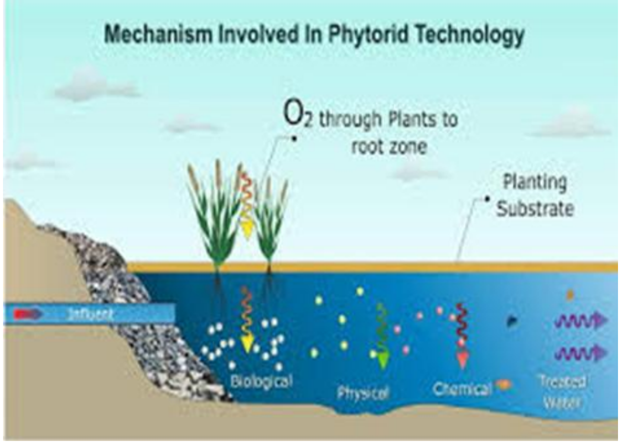


Fig 1 Treatment Mechanism of Phytorid Technology.

IV. MATERIALS USED

1. Coarse Aggregate of 20 mm effective diameter: It is used for road construction as a lower layer beneath the asphalt surface. Currently this fraction is the most commonly used in Ukraine's construction industry. It is used both for small private construction and for construction of large industrial spaces. Aggregates of this fraction are used as sub-bases in construction of highways and railways and in production of concrete and massive structures from reinforced concrete. It is used as filler for parking areas and bases for foundations when building work areas for the operation for heavy construction machinery and as filler for increased strength concretes.
Coarse aggregate was provided at layer of 200mm as base layer and was collected from college site

2. Fine Aggregate (Fine sand) of 2.36 mm size: When the aggregate is sieved through 4.75mm sieve, the aggregate passed through it called as fine aggregate. Natural sand is generally used as fine aggregate, silt and clay are also come under this category. The soft deposit consisting of sand, silt and clay is termed as loam. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.Fine aggregate was provided at middle layer of 200mm as middle layer and collected from college site.

Coco-peat soil: Coco-peat is a multipurpose growing medium made from coconut husk. The fibrous coconut husk is prewashed, machine dried, sieved and made free from sand and other contaminations such as animal and plant residue. Coco-peat is a very good alternative to traditional peat moss and Rock wool. Its air-filled porosity and high-water holding capacity make it, an ideal growing medium for the plant crops. It is 100% organic and eco-friendly, free from soil borne pathogen and weed. It was provided at top layer at 200mm & was bought from sanjay nursery.

3. Garden- soil: Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Earth's body of soil, called the pedosphere, has four important functions: as a medium for plant growth, as a means of water storage, supply and purification, as a modifier of Earth's atmosphere, as a habitat for organisms. Darkened topsoil is also called as garden soil. It was mixed in some quantity with coco-peat.

4. Plants Used:

4.1. Bamboo palm: It is the most sustainable bio resource. It is the fastest growing plant in the world having advantage over deforestation. It has excellent adsorbent capacity; which makes it useful in cosmetics. It can remove harmful gases and absorbs unpleasant smell from surrounding that is why it is used in refrigerators and deodorants. It has highly porous structure and ability to trap many harmful compounds in it. It adsorbs benzene, ethyl benzene, methanol, ammonia, 2, 4-di-chloro hydroxyl benzene and chloroform. Because of these ultimate properties, bamboo palm is used in purification of water and wastewater treatment. Experiments also showed that biological bamboo charcoal can remove arsenic and fluoride ions completely from water in single run. In present scenario every country is facing scarcity of clean water and billions of moneys is invested in the treatment of wastewater, as well as in purification.

Fig: 2 Bamboo Palm

4.2. Canna Indica: Canna Indica is a perennial growing to between 0.5 m and 2.5 m, depending on the variety. Canna Indica sps can be used for the treatment of industrial waste waters through constructed wetlands. It is effective for the removal of high organic load, colour and chlorinated organic compounds from paper mill wastewater. Canna Indica is a perennial growing to between 0.5 m and 2.5 m, depending on the variety. It is hardy to zone 10 and is frost tender. The flowers are hermaphrodite. Canna Indica plant can be used for the treatment of industrial waste waters through constructed wetlands. It is effective for the removal of high organic load, colour and chlorinated organic compounds from paper mill wastewater. It forms branched rhizomes 60 cm long that are divided into bulbous segments and covered in two lines by pale green or purple flaky leaves.

The very large grains of starch stored there can supposedly be seen with the naked eye. Cannae indicae reach, depending on the variety, stature heights of up to about 2 meters. They form an upright, unbranched stem or the overlapping leaf sheaths form a pseudo trunk. The alternate and spiral or two-line arranged, very large, simple leaves are divided into leaf sheaths, short petioles and leaf blades. The surface of the rhizome is carved by transverse grooves, which mark the base of scales that cover it; from the lower part white and apex rootlets emerge, where there are numerous buds, the leaves sprout, the floral stem and the stems.

Fig: 3-4 Canna Indica & Pampas Grass.

4.3. Pampas Grass: An attractive ornamental grass that is popular in many landscapes and used for removing N

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[Nitrogen] from wastewater. The response of Pampas grass, an important exotic invasive plant of the western United States, to experimental variations in soil nitrogen (N) and water availability. Given its ability to invade a wide variety of ecosystems in southern California, we hypothesized that Pampas grass would have higher water and N use efficiency under conditions of low water and N availability but rapid growth and resource use under conditions of high water and N availability. Such flexibility in resource use could allow Pampas grass to persist in low-resource environments and expand as resource levels increase.

Almost all ornamental grasses are perennials, coming up in spring, from their roots, which have stored large quantities of energy, and in fall or winter go dormant. Some, notably bamboos, are evergreen, and a few are annuals. Many are bunch grasses and tussock grasses, though others form extensive systems of many-branched rhizomes. The bunching types are often called "clump-forming" or "clumping", distinct from the rhizomatous types, called "running". Sizes vary from a few centimetres up to several meters; the larger bamboos may reach 20 m or more tall.

V. METHODOLOGY

Pre-treatment of waste-water sample was carried out. Aggregates were washed with water thoroughly. Phytorid Bed was prepared: Bottom Layer: Coarse Aggregates (200mm). Middle Layer: Fine sand (200mm) Top Layer: Plants with Coco-peat, soil (100mm). Sample was collected in 20 litres bucket and allowed to flow through pipe under gravity in the Phytorid bed. Later immediate sample was collected. 24 hours Sample was also collected. Collected samples were tested for BOD, COD, TDS, TS, Ph, DO.

Then values of pre-treatment and post- treatment were compared with Maharashtra Pollution Control Board. For a capacity of 18 litres, rough dimensions were taken as 0.5m×0.325m×0.6m (0.0325m3). Now, keeping the top freeboard as 0. 20m. Volume of the tank = 0.5m×0.325m×0.6m = 0.0325cubic meters. Total dimensions of the model: 0.5m×0.325m×0.6m. Flow Rate is Calculated by Bucket Method: Time=200sec. In 200 sec we collected 18 litres of water. Q= V/t=7.63 m3/day Peak Flow is 7.63 m3/day. Design for 10 m3/day. Volume of Phytorid RCC tank= 2.5× 2 ×2.2 Cubic Meters Inlet and Outlet Tank: 10000 litres Capacity, Diameter=1.09mHeight=1.21m .

Fig5 Coarse Aggregates.

Fig. 6 Fine Sand.

Fig. 7 Various Plants Used.

Fig. 8 Lab set-up of Phytorid Technology.

VI. TYPICAL DESIGN FEATURES

1. Factors to be considered for design:
Keep the design simple. Complex technological approaches often invite failure. Design for minimal maintenance. Design the system to use natural energies, such as gravity flow. SITE SELECTION: Phytorid Bed

should be constructed on plain ground. Following are the components of Sewage Treatment Plant using Phytorid Technology. Water flows from top to bottom of the bed. Pipe is inserted inclined to check the level of water below the top surface of the bed.
Seven days are required for the growth of plants after planting. Plants have fibrous roots to absorb sludge particles. Water flows under gravity by providing slope to the bed. Final Storage Tank: Treated water is collected in this final storage tank. Checking of sample of treated water is done after every month. Efficiency of Phytorid technology is 90%.

Design flow Rate=200 m3/day
BOD3=15 mg/l
For determining BOD5 we use y=Lo(1-e-KT)
K- reaction rate constant =0.3
Lo= 15/1-e-0.3*27 = 25.27 mg/lit, y5= Lo (1-e-kt), y5= 25.27 (1-e-0.23*5) =17.26 mg/lit
BOD5= 17.26 mg/lit TS=341 mg/l
Determine BOD5 loading: (17.26 mg/L) (200 m3) (103) (1/106) = 3.452 kg/day

Determine basin surface areas required: From constructed wetlands design manual: US EPA/625/1-88/022 SEP 1998
Hence assuming: 40 kg/ha-d BOD5 for entire area

Total area required = (3.452 kg/d) ÷ (40 kg/ha-d) =0.0863 ha
Area of Phytorid Bed= L÷ W = (L) (L/3) = L2÷ 3
= (0.0863ha) (10,000 m2/ha) = L2÷ 3; =L2÷3; L
= 50.88m=51m; W =51÷3 =17m
Total Phytorid bed depth = 0.8 m. Assumed
Volume of Phytorid Bed=
Area of bed * Height=25*10*0.8; V=200 m3.

Determine the hydraulic detention time in the "effective" treatment zone:
t = 2*(200 m3) / (200 m3); t= 2days

Check hydraulic loading:
(200 m3/d) ÷ (0.0863 ha) =2317.49 m3/ha-d>200 m3/day
No of plants= Assuming area of one plant= 1m2= 1/0.020= 50 Plants. Using Polyvinyl Chloride PVC with smooth inner walls. For Diameter of Pipe we require using Mannings equation= (1.49/n) * R2/3 * S1/2 A= π/4 D2; P= Πd; R=A/P = D/4; Q=V/t; Where n=0.011; V=0.138 m/s; S=0.02; 0.138= (1.49/0.011) * D/42/3 * 0.02; D= 0.09m = 90mmHence Using Pvc pipe of 90mm diameter at both inlet and outlet.

VII. RESULTS

From the experimental analysis, the values for various parameters were obtained. These values were compared with the standard values given by NEERI, and the results are as follows:

Table: 2 Result

Parameters	Raw water	Treated water with 24hrs. HRT	Unit	MPCB Limits as per consent
pH at 25?	7.43	7.52	-	5.5-9
Total solids	341	6	Mg/l	<100
Biochemical Oxygen Demand at 27? for 3 days	15	7	Mg/l	<30
Chemical Oxygen Demand	50	39	Mg/l	<100
Dissolved Oxygen	3.6	4.1	Mg/l	6.5-8

VIII. CONCLUSION

Based on above analysis, it can be concluded that wastewater treatment through Phytorid technology resulted in significant reduction of BOD, total solids, COD and improves DO content after 24 hrs. of treatment time. Treated wastewater can be used for gardening, flush tanks, used for land of irrigation, cleaning roads, but it cannot be disposed of in natural water bodies as it is harmful for aquatic lives. Developing countries, due to various investment priorities, will not be able to use high-cost technology at a large scale for wastewater treatment. Therefore, at minimum cost, this technology could be a better alternative for treatment of wastewater in a sustainable manner. Thus, plant-based low-cost eco-technology of Phytorid Technology may be applied in developed and developing countries for sewage treatment at small and large community levels to conserve aquatic resources.

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