Effective Use of Phytorid Technology In Water Treatment

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Abstract- *The water source plays a vital role in the developing technologies and growing environment, insufficient management of municipal and wastewater in immense environmental problems and increasing hygienic risks for the growing urban population thereby hampering poverty alleviation and a sustainable development of Indian society. But recently, the waste water is converted into a source for various purposes in different aspects by the use of Phytorid technology. Phytorid technology is a patented technology and being very effective in water treatment to reduce the pollution.It leads one step forward to sustainable treatment of wastewater in safe manner using Iris Pseudacorus (Yellow Iris) plants and natural source for the treatment without affecting the ecosystem. The Chrysopogonzizanioides is to increase the pH value and to reduce the nitrogen, phosphorous content. The coagulation and flocculation process is done by alum to have turbidity and to remove the suspended solids. This method is more advantageous of cost effective, negligible operation and maintenance with minimum electricity, smaller footprint. The main focus of the study is to avoid the scarcity of the irrigation water and to avoid the odor in the treated water and to enhance the quality of the water to prevent ground water pollution by analyzing the nominal water parameters that need to be satisfied for reusing the treated water with the references of IS 3025 code book.*

Keywords- Phytorid Technology, Ecosystem, Ground water pollution.

I. INTRODUCTION

The Phytorid technology was developed by NEERI (National Environmental Engineering Research Institute) and patented in Indian, European and Australian countries. The advantages of this technology is compensate and offset the rate of existing wetland loss, improve wetland quality provide flood control. The Phytorid technology is a subsurface flow type wherein water is applied to the cells/beds filled with porous media such as gravel and stones. The hydraulics is maintained in such a manner that water does not rise to the surface retaining a free board at the top of the filled media. These systems may include a wide variety of foliage in the form of aquatic, marsh, ornamental, herbs, grasses and also terrestrial plants known to grow in water logged condition.

Phytorid technology is 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) have had limited success. In recent years the application of specifically designed wetland based technology which is popularly known as Phytorid technology for treatment of wastewater- municipal, urban and agricultural, is becoming widely acceptable. The technology has been found to be very effective in water pollution control as it functions as water ‘pollutant sinks’ for sediments, nutrients and metals. It treats the wastewater without the use of chemicals. Phytorid technology is an improved wetland system for treatment of wastewater. The main objective of application of phytorid technology is to provide and boost a simple, feasible, practically sound, eco-friendly and cost effective technology for wastewater treatment and its reuse.

PHYTORID TECHNOLOGY

- CSIR-NEERI’s technology involves a constructed wetland exclusively designed for the treatment of municipal, urban, agricultural and industrial wastewater
- The system is based on the specific plants, such as Elephant grass (Pennisetumpurpurem), Cattails (Typha sp.), Reeds (Phragmitessp.), Cannas pp. and Yellow flag iris (Iris pseudocorus), normally found in natural wetlands with filtration and treatment capability. Some ornamental as well as flowering plants species such as Golden Dhuranda, Bamboo, Nerium, Colosia, etc. can also be used for treatment as well as landscaping purposes
- The Phytorid technology can be constructed in series and parallel modules / cells depending on the land availability and quantity of wastewater to be treated
- The Phytorid technology treatment is a subsurface flow type in which wastewater is applied to cell / system filled

with porous media such as crushed bricks, gravel and stones. The hydraulics is maintained in such a manner that wastewater does not rise to the surface retaining a free board at the top of the filled media

- The system consists of the following three zones:
  - Inlet zone comprising of crushed bricks and different sizes of stones
  - Treatment zone consisting of the same media as in inlet zone with plant species
  - Outlet zone
- The reduction in the treated effluent for the total suspended solids (TSS) varied from 70% to 80, BOD from 78% to 84%, nitrogen from 70% to 75%, phosphorus from 52% to 64% and faecal coliform from 90 % to 97%
- The treated effluent is useful for municipal gardens, fountains and irrigation
- The total area required for the system is approximately 35 sq. m. for 20 m3/day.
- This technology has been transferred to General Techno Services, Technogreen Environmental Solutions, Pune, BIOUMA, Goa and Devi Agencies, Aurangabad, and implemented to save water and cater the local people

OBJECTIVES

- To determine characteristics of wastewater before treatment.
- To study low cost Phytorid technique (low cost wastewater treatment system).
- To determine characteristics after treatment using Phytorid technology.

II. LITERATURE SURVEY

1. **Sanjay Murlidhar Karodpati, Alka Sunil Kote**/ energy-efficient and cost-effective sewage treatment using phytorid technology / international journal of advanced technology in civil engineering, issn: 2231 –5721/ 2013 / volume-2, issue-1/ page no. 69-72. the conventional type of stps employing the aerobic, anaerobic or combination both can be made efficient by advanced technologies and intelligent supervision but this in turn increases the total cost. the entire problem of energy requirement, maintenance and supervision in conventional stps is saved by adopting phytorid technology.
2. **Swapnil S. Navaghare, Vipul A. Kadam, Suraj T. Sawant, SaurabhSwamy And Prof. Archana N. Mahajan**new invention on reuse of sewage and wastewater by phytorid technology /international journal on recent and innovation trends in computing and communication issn: 2321-8169 / volume: 4 issue: 4 / april 2016/ page no. 273 – 276 phytorid technology systems offer a range of low cost to high tech sanitation options which are hygienically safe, comfortable to use, environmentally friendly and often more economical than conventional systems. in addition, they ideally enable a complete recovery of nutrients in household wastewater and their reuse in agriculture.
3. **Anuradha Manikrao Patil, Sagar Gawande** implementation of sewage treatment plant by using phytorid technology/ international journal of innovative research in technology issn: 2349-6002/ june 2016 / volume 3 issue 1/ page no. 121-123 the design of the phytorid tank as well as the details of the plant is taken from this journal. the technology is a natural treatment system, as the result operation is mostly passive and requires little operator intervention. maintaining uniform flow across the treatment cells through inlet and outlet adjustment is extremely important to achieve optimum treatment performance. sampling of inlet and outlet will be carried out for a period of 6 months for every month
4. **Balpande, S.S. And Ashok Mhaske**quality of sewage water and phytorid technology for its reuse in agriculture / journal of global biosciences issn 2320-1355 / 2017 / volume 6, number 6/ page no. 5114-5119 Pollution load of raw sewage water varies with the location and season. use of raw sewage water for irrigation may cause soil and groundwater pollution problems. treated sewage water through phytorid sewage treatment plant can safely be utilised for irrigation.

III. METHODOLOGY

PHYTORID is a systematic treatment developed by the science of waste disposal water includes Physical, Biological and Chemical processes. The system is running over gravity. General Design Features The design concept of the Phytorid system can be modified according to details and land acquisition. An underground flow type, Phytorid system is proposed for treatment domestic sewage or sewage will have a basin or ditch where a barrier to water flow, but system beds \ cells \ contain the appropriate depth porous sources. A basic and basic medical facility will also be built in order to effectively remove solids and thus reduce the BOD side. The hollow media also supports the root formation of growing plants. Design the Phytorid system assumes that the water level in the cells will always be below on top of the media filter. The raw material to be used for this Phytorid program is very important. Different types of aquatic plants have been used to achieve high efficiency household waste management. These include species such as Pramitesaustralis, Pahlavi's arundinacea, glyceria maxima, Typhaspp, Scirpus spp., other common grasses etc.

Fig. Cross sectional view of phytorid treatment system

Plants Used:

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

Canna Indica: Canna Indica is a perennial growing to between 0.5 m and 2.5 m, depending on the variety. Canna Indicasps 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: Canna Indica

Pampas Grass: An attractive ornamental grass that is popular in many landscapes and used for removing N © 2020 IJSRET 2798 International Journal of Scientific Research & Engineering Trends Volume 6, Issue 5, Sept-Oct-2020, ISSN (Online): 2395-566X [Nitrogen] from wastewater. The response of Pampas grass is 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.

Material Used:

Aggregate: Filter aggregates generally consist of sand, gravel or crushed rock. Manufactured aggregates are also occasionally used and these often include blast furnace slags.
Although filter materials for water and effluent treatment works are often used in relatively small quantities, the high quality of aggregate normally required is not always readily available from commercial production processing, which may

be designed to yield a satisfactory general purpose aggregate at least cost. On the other hand, drainage layers in major civil engineering works, such as embankment dams, are usually designed to make the best use of the available natural materials with the minimum of processing.

Charcoal: Water filters use a special type of charcoal known as 'activated charcoal' to purify water. Activated charcoal works through the process of adsorption.

Note that adsorption is different to absorption. Adsorption binds impurities chemically on the surface of the charcoal filter rather than physically absorbing them.

Activated charcoal is the ideal water filter because it removes toxins from the water without stripping the water of salts and important minerals.

Advantage of Charcoal:

a) The good stuff stays.
b) It makes your water taste better - removes chlorine and nasty odours. Chlorine is vital to ensure our water supply remains free of bacteria and viruses; however, we don't need to drink chlorine/it's a disinfectant.
c) It's relatively inexpensive
d) It's easy to maintain

Sand: Sand filtration is used for the removal of suspended matter, as well as floating and sinkable particles. The wastewater flows vertically through a fine bed of sand and/or gravel. Particles are removed by way of absorption or physical encapsulation. If there is excessive pressure loss on the filter, it must be rinsed.

A distinction can be made between continuous and discontinuous filters. In continuous filters (often upward-flowing filters), the polluted sand is removed, rinsed and re-used continuously, without interrupting the filtration process. Discontinuous filters (often downward-flowing filters) are stopped, and a rinse takes place in the opposite direction. Air bubbles are blown into the sand bed to make it swirl around. Filtered water then flows through the filter bed in the opposite direction. The polluted matter is released and flows away along with the rinse water. The filtration process can then resume.

The yield of a sand filter is determined by two sand filter functions, namely surface filtration and depth filtration. Surface filtration involves collecting the particles above the filter bed. These particles jointly form a macro-porous lump, which is able to collect new particles in a very effective manner. Depth filtration generally involves smaller particles that are more difficult to collect, and which are bound to the sand particles by adsorption. Dirt from surface filtration is easier to remove during reverse rinsing compared to dirt from depth filtration.

The main benefit of a sand filter is the simple system which, in many cases, can be used to obtain considerable yields. A sand filter can be placed in various phases of water management - as a pre-treatment, as side-stream filtration and as a polishing filter. A sand filter often provides an effluent with potential for re-use.

IV. TEST AND RESULT

Test Performed

1. pH (IS: 3025- Part 11- Reaffirmed 2002) The term pH refers to the measure of hydrogen ion concentration in a solution and defined as the negative log of H+ ions concentration in water and wastewater. The values of pH 0 to a little less than 7 are termed as acidic and the values of pH a little above 7 to 14 are termed as basic. When the concentration of H+ and OHions are equal then it is termed as neutral pH.
2. Total Dissolved and Suspended The term total dissolved solids refer to materials that are completely dissolved in water. These solids are filterable in nature. It is defined as residue upon evaporation of a filterable sample. The term total suspended solids can be referred to materials which are not dissolved in water and are non-filterable in nature. It is defined as residue upon evaporation of non- non-filterable samples on a filter paper.
3. Chemical Oxygen Demand The chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers), making COD a useful measure of water quality. It is expressed in milligrams per litre (mg/L), which indicates the mass of oxygen consumed per litre of solution. COD is the measurement of the amount of oxygen in water consumed for chemical oxidation of pollutants. COD determines the quantity of oxygen required to oxidise the organic matter in water or wastewater samples, under specific conditions of oxidising agent, temperature, and time. This method covers the determination of COD in ground and surface waters, domestic and industrial wastewaters. The applicable range is 3-900 mg/L.
4. Biochemical Oxygen Demand The biochemical oxygen demand determination is a chemical procedure for

determining the amount of dissolved oxygen needed by aerobic organisms in a water body to break the organic materials present in the given water sample at a certain temperature over a specific period of time. BOD of water or polluted water is the amount of oxygen required for the biological decomposition of dissolved organic matter to occur under standard conditions at a standardised time and temperature. Usually, the time is taken as 5 days and the temperature is 20°C. The test measures the molecular oxygen utilised during a specified incubation period for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidise inorganic material such as sulphide and ferrous ions. It also may measure the amount of oxygen used to oxidise reduced forms of nitrogen (nitrogenous demand).

5. Chlorides (IS:3025-Part32-Reaffirmed 2003) Chlorides are widely distributed as salts of calcium, sodium and potassium in water and wastewater. In potable water, the salty taste produced by chloride concentrations is variable and dependent on the chemical composition of water. The major taste producing salts in water are sodium chloride and calcium chloride. The salty taste is due to chloride anions and associated cations in water. In some water which has only 250 mg /L of chloride may have a detectable salty taste if the cat-ion present in the water is sodium. On the other hand, a typical salty taste may be absent even if the water is having very high chloride concentration, for example 1000 mg /L. This is because the predominant cation present in the water is not sodium but either calcium or magnesium may be present.
6. Sulphates (IS:3025-Part 24 - Reaffirmed 2003) Sulphates is widely distributed in nature and may be present in natural waters in concentration ranging from few hundred to several thousand mg/L. Sulphates occur naturally in numerous minerals, including barite, epsomite and gypsum. These dissolved minerals contribute to the mineral content of drinking-waters. Acid Mine Drainage (AMD) may contribute large amounts of sulphates through pyrite oxidation. Sulphate is the second most abundant anion in seawater. Its high concentration owes to the high to moderate solubility of the salts that it forms with the major cations in seawater, namely, Na, Mg2+, andCa2+ .

Performance of Phytorid for sewage water treatment -: Pollutant Performance (% removal) Total suspended solids 75-95 Biochemical oxygen demand 70-80 Chemical oxygen demand 60-75 Total nitrogen 60-70 Phosphate 50-60 Fecal coli form 85-95

Sr. No	Characteristics	Unit	Phytorid Value (Outlet)	STP Value (Outlet)
1	pH	-	7.15	7.21
2	Total Suspended Solids	mg/lit	06	10
3	Chemical Oxygen Demand (COD)	mg/lit	13	20
4	Biochemical Oxygen Demand (BOD)	mg/lit	30	40
5	Total Dissolved Solids	Ppm	1900	2000
6	Chlorides (Cl)	Ppm	600	850
7	Sulphates (SO4)	Ppm	950	900

V. CONCLUSION

- However, the maintenance cost varies significantly among aerobic, anaerobic and Phytorid technology. Sewage treatment by Phytorid technology uses only 20% of the energy as compared to conventional sewage treatment plants.
- The details gathered and enumerated in a table of comparisons points to a clear choice of Phytorid technology as the STP of the future.
- Phytorid technology systems offer a range of low cost to high tech sanitation options which are hygienically safe, comfortable to use, environmentally friendly and often more economical than conventional systems. In addition, they ideally enable a complete recovery of nutrients in household wastewater and their reuse in agriculture.
- This system not only conserves vital resources which are otherwise simply wasted but also creates employment opportunities. In spite of the fact that it requires minimum maintenance as compared to other prevalent systems. The new paradigm in sanitation must be based on ecosystem approaches and the closure of material flow cycles rather than on linear, expensive and energy intensive end-of-pipe technologies. Sanitation systems are part of several cycles, of which the most important cycles are the pathogen cycle, water cycle, nutrient and energy cycle.
- In order to ensure public health, sanitation approaches primarily aim at interrupting the life cycle of pathogens. In addition, the new approach is recognizing human excreta and water from households not as a waste but as a resource that could be made available for reuse, especially considering that human excreta and manure from husbandry play an essential role in building healthy soils and are providing valuable nutrients for plants.
- While conventional sanitation restricts health security to the in-house environment and sometimes leads to a disastrous situation in the neighbourhood or the receiving water body, the new approach is aiming at sanitising the

products instead of exporting problems and applying a health oriented multi-barrier concept of treatment, crop restriction and exposure control.

- Phytorid technology system offers a range of low cost to high tech sanitation options which are hygienically safe, comfortable to use, environmentally friendly and of ten more economic than conventional systems. In addition, they ideally enable a complete recovery of nutrients in household wastewater and their reuse in agriculture.

REFERENCES

[1] A.R. Mhaske "Removal of turbidity from sewage water by phytorid sewage treatment plant study using the response surface methodology". (Department of Agricultural Engineering, Agricultural College, NAGPUR (M.S.) INDIA) (October 2014)/International Journal of Agricultural Engineering/ Volume: 7/ Issue: 2/ Page no. 365-372.

[2] Alaknanda Technologies, Designing & Implementation of a Sewage Treatment Plant Using Phytorid Technology,2012.

[3] Amol B. Mankoskar, Prof. Sagar M. Gawande "Reed bed system an efficient treatment removal of sewage wastewater parameters". (AnantraoPawar College of Engineering & Research, Pune, Maharashtra, India.)(Jan-2016)/ IRJET/ Volume: 3/ Issue: 1/ Page no. 1250-1252.

[4] Anuradha Manikrao Patil, , Sagar Gawande "Implementation of sewage treatment plant by using Phytorid technology" (AnantraoPawar College of Engineering & Research, Pune, HOD, AnantraoPawar College of Engineering & Research, Pune.,) (June 2016)/ IJIRT/ Volume: 3/ Issue: 1/ Page no. 121-123.

[5] Balpande SS and Ashok Mhaske," Quality of sewage water and phytorid technology for its reuse in agriculture" of Agriculture College Nagpur, India Corresponding author: SS Balpande, College of Agriculture Nagpur, India,) (April 03, 2017)/ Journal of Global Biosciences / Vol. 6(6)/ Page no. 5114-5119.

[6] Binita Desai and Pratibha Desai "Root-zone technology as energy efficient and cost effective for sewage water treatment". (Department of Microbiology, Shree Ramkrishna Institute of Computer Education and Applied Sciences, Surat.Gujarat-India) (June 2014)/ BMR Journals/ Volume: 1/ Issue: 1/ Page no. 1-6 Borkar. R. P 1 ,Mahatme.P.S "Wastewater Treatment with Vertical Flow Constructed Wetland"

[7] Biniwale, R.B., (2012), Application of Natural Methods for Sewage Treatment and Polishing of Treated Wastewater, National Environmental Engineering Research Institute (NEERI), pp (216-218).

[8] Central Pollution Control Board, Guidelines on construction, operation, and application of Root Zone Treatment systems for the treatment of municipal and industrial wastewater, (2003), Central pollution Control Board, pp (21- 29).

[9] Deepa, V.T. and Sudarshan, J.S., (2015), Performance and cost evaluation of constructive wetland, SRM University, Chennai, pp (1071-1073).

[10] Desai, Binita and Desai, Pratibha (2014), Root-zone technology as energy efficient and cost effective for sewage water treatment, Department of Microbiology, Shree Ramakrishna Institute of Computer Education and Applied Sciences, Surat, pp (1- 6).

[11] Devi, Mekhlagayatri and Samad, Madar, (2013), Wastewater treatment and reuse: an institutional analysis for Hyderabad, India, World Urban Forum, Vancouver, Canada, pp (514-517).

[12] Giraldi D. and Iannelli R (2009), Short term water content analysis for the optimization of sludge dewatering in dedicated constructed wetlands, Science Direct, pp (929-931). • Haji, Aslam (2015), STP details in Proposed Residential & Commercial Construction Project at Plot 662, Wagholi, Pune, pp (7- 12).

[13] Mankoskar, Amol B., (2015), "an energetic and low-cost system red bed technology used for wastewater treatment" a review, AnantraoPawar College of Engineering & Research Parvati, Pune, pp (186-188).

[14] Mhaske, A.R., Taley, S.M. and Biniwale, R.B. (2014). Removal of turbidity from sewage water by phytorid sewage treatment plant: A study using the response surface methodology. Internat. J. Agric. Engg., 7(2) pp (365-372).

[15] Shrivastava, Asheesh and Tandon, Shalini A. (2015), Water Quality Management Plan for Patalganga River for Drinking Purpose and Human Health Safety, National Environmental Engineering Research Institute, Worli, Mumbai, pp (71-73).