

WASTEWATER TREATMENT WITH BUOYANT WETLAND APPROACH

Submitted in partial fulfillment of the requirements for the award of Bachelor
of Engineering Degree in

Civil Engineering

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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APRIL - 2020



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SHRIMATHY. S (REG. NO. 37200070)** who carried out the project entitled "**WASTEWATER TREATMENT WITH BUOYANT WETLAND APPROACH**" under our supervision from December 2020 to April 2021.

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I, SHRIMATHY S(REG. NO. 37200070) hereby declare that the Project Report entitled "WASTEWATER TREATMENT WITH BUOYANT WETLAND APPROACH" done by us under the guidance of Dr. S. Packialakshmi is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

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ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. Devyani Gangopadhyay, B.Arch., M.T.P., Ph.D.**, Dean, School of Building and Environment and **Dr. S. Packialakshmi, M.E., Ph.D.**, and **Dr. R. Padmapriya, M.E., Ph.D.**, Head of the Department, Dept. of Civil Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide **Dr. S. Packialakshmi, M.E., Ph.D.**, for her valuable guidance, suggestions, and constant encouragement paved way for the successful completion of our project work.

We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Civil Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

The treatment of Industrial waste water poses numerous technical and operational challenges, particularly due to chemical dyes and pollutant inputs. Floating treatment wetlands (FTWs) are decontaminating the pollutants by intaking them as their food. FTWs utilize rooted, emergent macrophytes growing on a mat or raft floating on the surface of the water rather than rooted in the soil. Thus, they can tolerate the widely fluctuating water depths typical of wastewater systems, without the risk of the plants drowning. The roots hang beneath the floating mat and provide a large surface area for biofilm attachment. The authors provide a review of the FTW concept, structure, function, and treatment efficiency reported to date and discuss the potential advantages of this emerging technology for wastewater applications. Although the pilot studies on removal of key pollutants such as organic matter, suspended solids, nutrients, and metals shows that they can significantly enhance waste water quality and provide similar or better performance than traditional treatments. Further studies are needed to verify the apparent potential of FTWs treating wastewater at full scale. This concept can be implemented for all kind of waste water with different plants. Floating treatment wetlands using Rhizosphere-biodegradation (Phytoremediation) by different plants which is efficient(60-80%) in removing heavy metals like lead, chromium, nickel, cadmium, copper and zinc, also removing pollutants like PH,TDS, TH,TSS, Chlorides, Sulphates, COD, BOD.

Keywords: Floating treatment wetlands(FTWs), Bioflim, Phytoremediation, rafts.

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ABBREVIATIONS

L1 – LOCATION 1

L2 - LOCATION 2

FTW – FLOATING TREATMENT WETLANDS

TDS – TOTAL DISSOLVED SOLIDS

TSS - TOTAL SUSPENDED SOLIDS

TH – TOTAL HARDNESS

BOD - BIOCHEMICAL OXYGEN DEMAND

COD – CHEMICAL OXYGEN DEMAND

DO - DISSOLVED OXYGEN

CHAPTER 1

INTRODUCTION

1.1 GENERAL

About 70% of accessible contemporary resources worldwide are contaminated with organic and inorganic pollutants from the economic, agricultural, and domestic sectors. The situation is particularly severe in many developing countries where giant volumes of untreated waste matter square measure discharged into natural water bodies, wherever a number of that square measure been used as sources for drink or food production. The need to spice up this unhealthy state of affairs of widespread contamination has prompted a research for effective not withstanding low cost water treatment selections. FTWs put together observed as hydroponic root mats Associate in nursing eco technological suggests that to spice up water quality by victimization the purification processes related to natural wetlands. Floating treatment wetlands created of macrophytes a sort of buoyant mats, they put together might even be supported by artificial rafts. The roaring establishment of FTWs lies inside the choice of a plant species that dense and submerged root network inside the water body, the generation of a buoyant mat that is sturdy enough to carry vegetation, and thus the shut conditions for economical plant growth. they're going to be established in various types of impure water, together with domestic and industrial waste merchandise.

1.2 BUOYANT WETLAND- INTRODUCTION

Urbanization, waste treatment, landscape changes, agriculture, and resource extraction cause runoff of nutrients, contaminants, crude oil merchandise, and organic materials to fresh lakes round the world. In several developing countries, there square measure restricted or short waste matter treatment infrastructures. Floating treatment wetlands (FTWs) are often an economical phytoremediation approach to treat numerous kinds of waste matter. The buoyancy of the FTWs is thanks to full rhizomes and also the defence of gas bubbles by the interlocking roots, which

may be supported additionally by rafts. Biological treatment by harnessing the aptitude of plants and microbes to soak up nutrients (such as phosphorus and nitrogen) and break down contaminants through biological processes referred to as bioremediation. The employment of wetlands for bioremediation to capture and take away contaminants and nutrients is widely practiced round the world. Wetlands will improve the water quality of stormwater runoff and manage watershed nutrients, in addition as treat waste matter and different industrial contaminants. It depends upon natural, microbial, biological, physical, and chemical processes to treat waste matter. The use of wetlands for bioremediation to capture and take away contaminants and nutrients is widely practiced round the world. Wetlands will improve the water quality of storm water runoff and manage watershed nutrients, in addition as treatment of waste matter and different industrial contaminants. Wetlands think about natural processes to biologically filter water because it passes through shallow areas of dense aquatic vegetation and pervious bottom soils. The first mechanisms for nutrient removal square measure transformation and uptake by microbes and plants. Aquatic plants, each higher than the water and submerged, take up and take away these parts from the sediment and water column into their material or biomass. It is the foremost cost-efficient methodology to cut back sludge property removal method. No pollution and environmental impact, Nature - friendly approach. Low price for operation (Affordable, operable, reliable). These FTWs square measure of low maintenance. Floating treatment wetlands square measure easy in style and need no extra land leading to savings compared to conventionally created wetlands. The immersed rhizomes and roots of macrophytes offer an oversized expanse to develop a biofilm, that plays a key role within the removal of suspended contaminants from the water. Moreover, the roots of some plants provide dissolved into the water body benefiting the expansion of aerobic microorganisms, that break organic substances down.

CHAPTER 2

LITERATURE REVIEW

2.1 REVIEW OF LITERATURE

Munazzam Jawad Shahid et al. (2018) have reviewed that Floating treatment wetlands (FTWs) are sustainable alternatives for the treatment of water containing various sorts of pollutants. Although its pollutants removal mechanisms are almost like surface flow wetlands, its floating nature made it applicable for ponds, lakes, and rivers with fluctuating water levels. The plant roots system plays an important role in the removal of pollutants from wastewater by their direct uptake. Plants provide nutrients for the event of microbial biofilm, and filtration of the polluted water. FTWs are efficient in both tropical and temperate climates, coldness in temperate climates can reduce the performance of FTWs. Depending upon the knowledge of researchers, availability of local material of floating raft, and indigenous plants there are similar systems. there's a requirement to develop some standards about the sort of macrophytes, their nutrients uptake potential, structure and material of floating mat, plants density, plants harvesting and disposal procedure, hydraulic loading rate, retention time, and suitability of FTWs for his or her application at pilot scale for various sorts of wastewater.

Dotro et al.,(2017) illustrated that treatment systems that cost little which have few environmental impacts are developed and researched, for instance, constructed wetlands (CWs). These are often defined as engineered systems designed and operated to treat different types of polluted water, which use and optimize processes present in natural environments with low operation and maintenance requirements. almost like CW using free-floating plants, in FTW the plant's roots are directly and permanently in touch with the water. In these systems, macrophytes absorb nutrients directly from the water. A biologically active area is provided by the plants through a dangling network of roots, rhizomes, and therefore the attached biofilm, which are liable for both biochemical processes and important physical processes like filtering and therefore the capture of particulates from pollutants.

Gustavo S. Colares et al., (2020) have analyzed that Floating treatment wetlands represent an emerging technology that has proved applicable to many functions, including wastewater treatment, bioremediation, and stormwater treatment. Their relatively simple construction and operation also because the smaller area required for them to function render them a stimulating choice to be integrated with treatment ponds and with traditionally constructed wetlands. However, just one research article combining FTW with a hybrid CW system was found during this study, hence combining FTW with other technologies, such as advanced oxidation processes should constitute a neighborhood for further research, especially when the main target is water reuse. Although numerous research articles using FTW were found, very few applied or monitored these systems on a true scale and instead largest focused on laboratory or pilot scale. Thus, one of the main challenges for research regarding FTW is to continue research projects by applying the bench-tested systems on a more realistic scale, to gauge macrophyte and floating support behavior, where the environment tends to be more aggressive than on a laboratory scale. this may help to confront problems like macrophyte death, deformation and/or sinking of the floating supports, plant predators, and lots of others. Other research aspects that ought to be investigated comprise the combination of various macrophytes within the same system, as planting plays a crucial role in pollutant removal during this system, mainly by processes associated with the basic system and mostly during plant growth. Thus, it's important to explore in greater detail the relations between treating water conditions (DO, pH, toxicity) and plant development for each plant species to maximize treatment performance and biomass generation. Increasing the number of plant species during a system should increase microorganism diversity within the roots, which may also improve treatment efficiencies. Also, few authors have investigated the consequences of harvesting the aerial part of plants and there is still no data for several potential plants. Experimental projects for using the harvested biomass remain scarce, such as pruning or harvesting the biomass, besides increasing treatment performance, also can increase operating costs. On the other hand, the recovery of nutrients from the biomass or its application for animal feeding or energy consumption also can generate income and thus reduce the general system costs. Therefore, even with increased numbers of publications in recent years,

further research remains required to know the removal mechanisms present in FTW also because of the aspects required to optimize treatment performance, improve durability, and reduce costs.

Ladislav et al.,(2014) have studied Floating treatment wetlands for heavy metal removal in highway stormwater ponds assessed the technical feasibility of using floating marshes for in place implantation, particularly in existing water runoff ponds. Results showed this sort of floating system to be resistant under real field conditions and capable of accumulating metal pollutants in both aerial and root plant parts. The aquatic macrophytes utilized in the system, *J. effusus*, and *C. Riparia*, were able to adapt to the environmental conditions imposed by the retention basin and had very similar rates of metal accumulation. However, the higher plant biomass production observed in *Carex Riparia* showed its superior adaptation and led to a greater transfer of metals from the aqueous phase to the roots of this species. Root systems growing within the water column play a key role in eliminating metal pollutants, whether dissolved or particulate. Indeed, in addition to taking over metal, the basic network also filters fine particulate matter, that sedimentation is slower than for larger particles. Through the biofilm that forms on the surface of the roots, significant biological activity develops and will intervene within the process of biodegradation of other pollutants, such as hydrocarbons. When plants are utilized in this sort of system for the treatment of heavy metals in stormwater, they need to be mowed yearly to reap biomass and recover pollutants. This biomass might be used, for example, as fuel during a pyrolysis system to supply energy.

Ryan J. Winston et al.,(2013) have experimented on analysis of floating treatment wetlands as retrofits to existing stormwater retention ponds were 2 wet retention ponds in Durham, NC, were evaluated for waste matter concentrations for fourteen months before and when retrofitting with floating treatment wetlands. Temperature observation in open water and directly to a lower place the FTWs unconcealed very little distinction between open water temperature and underneath FTW water temperature. The shading provided by FTWs was vital in reducing lake water temperature at varying depths. Similarly, the disparities in land plant biomass

between the 2 ponds might even be attributed to the amount of daylight received. The shaded repository lake created less biomass than the lake, which received full daylight throughout the day. As usually|this can be} often one in all the first field studies of FTWs among the literature, viewing this study's findings cumulatively suggests that FTWs have the potential to make modest enhancements to water quality for choose pollutants. whereas still speculative, probable reasons for this area unit root systems and their impact on flow and gross filtration. It will seem that additional substantial water quality advantages would need an even bigger proportion of FTW coverage than tested herein.

Natalia Pavlineri et al., (2016) have analyzed the foremost common technique in the construction of floating frames or rafts is thru sealed plastic pipes or tubes (made of PVC, letter of the alphabet, and PP) or cinnamene foam pontoons. However, a reasonable and effective difference for frame construction includes naturally buoyant materials, In CFWs, the suspended roots among the water column will physically take away nutrients either by incorporating them into their tissues through biogenesis or by subsiding, caused by rhizofiltration. The photo-uptake capability depends on the anatomical and physiological properties of plant species, like uptake efficiencies for nutrients, rate of growth, translocation issue from below water to higher than water tissues, chemical change rates, and root varieties. As plant harvest home could also be a method for removing nutrients from the system, each vegetation behavior (tendency in accumulating nutrients in tissues or roots) and seasonal patterns in nutrient allocations have to be compelled to be examined thus on optimize the system's potency. Harvested biomass may well be used directly as an animal or human food supply. Notwithstanding, national levels for hygienic standards disagree and such an approach might finish in metal bioaccumulation. Such utilization of biomass needs any analysis assessing the impacts of long-run consumption of elevated state nutrients and metals. Moreover, biomass may well be used in agriculture close to providing energy via bioenergy plants.

Arfan Arshad et al.,(2017) have studied that property arises among the case of floating land system, as a result of the treated effluent area unit usually used for irrigation functions throughout a district that undergoes a high threat of pollution and water shortage. throughout this study, the energetic technique associated with the

energetic technique helps to match 2 styles of effluent treatment systems. The study shows that the floating land system is value effective and energy economical than the commercial effluent treatment plant and the land system additionally provides further environmental advantages. The low cost-benefit magnitude relation shows that if we tend to replace effluent treatment systems with floating land, then the energy value can considerably drop. The analysis indicates that if we tend to use treated effluent for irrigation functions then we'll save an enormous quantity of water provides. it's suggested that the land system ought to be tailored to convert effluent into chance in cities wherever a vast magnitude of effluent is generated. pure mathematics of floating land system: throughout this study, floating land consists of multi cells operating throughout a parallel due to retaining the water in balance as seasonal variation happens. throughout the recent climate, once additional water evaporates, it area unit usually balanced by taking a non-public channel, and the retention time area unit is usually reduced. In Multi flow cells maintenance of the system additionally easier, i.e. if one unit is underneath maintenance at a similar time all different units will work properly.

Sujatha Kalubowila et al.,(2013) have analyzed that the applying of this analysis will so be doable to shine waste stabilization lake effluent economically to re-use for varied useful uses except for potable use. The introduction of land causes less star intensity to be offered for protoctist growth thus a reduction in protoctist densities. Therefore, it area unit usually over that a floating land consisting of hydrophytic plant plants is true to manage washout of alga from waste stabilization ponds. Further, the root zone of vegetation cowl activated microbic assimilation of carbonic compounds thereby reduction of form and COD. thus the introduction of the land has tried to be AN honest technique even to cut back the organic loading flowing into the receiving water body or in different words land looks to be a smart possibility for sprucing effluent quality before discharge into water bodies. it is also tried that usually[this can be} often an ideal technique to cut off excessive nutrients from escaping to receiving water bodies which could otherwise contribute to eutrophication incidences throughout a batch.

Stefani et al.,(2011) have experimented that the Performance of a floating treatment land for in-stream water betterment in the NE Italian Republic supported that the right choice and installation of vegetation could also be a key issue for floating

wetlands to confirm fast institution and root development, that is very important for the prompt functioning of the system. higher performances are achieved with native species, well-tailored to the atmosphere, like reed, cattail, sedges, and herb. stunning however promising results area unit obtained with orchardgrass, a species ordinarily used for pasture however not noted for phytodepuration functions. Indeed, it had been able to speedily develop a deep and subtle rootage even living directly in water. This wasn't expected as a result of orchardgrass is understood to be sensitive to water-logging among the primary experiment, it colonized the floating system most likely as a result of the nice natural atomic number 8 accessibility of the water wasn't limiting for root growth. Despite severe weather events throughout the project, no harm to the systems was determined. A floating land system might even be used as AN in-stream water treatment that is simple to place in and manage and effective in dominant pollutants if appropriate vegetation is chosen and planted.

Despite the large success of FTWs in removing a large variety of organic and inorganic contaminants, FTWs stay less possible structures for the rectification of microbic pathogens. this can be notably true once the inflowing is of top quality, i.e., encompasses a very little microbiological load. Instead, in such things, FTWs act as sources of infective contamination. to beat these problems, slow sand filters were introduced as a most popular alternative as they develop a biological layer of microorganism feeding microflora. Hence, for simpler results, hybrid systems area unit suggested for effluent containing high organic, inorganic, and microorganism pollution. Ghermandi et al., (2007)

Piyush Gupta et al.,(2012) have reviewed that Treatment of Water exploitation water orchid, pistia, and Vetiver Grass ascertained that phytoremediation of waste matter exploitation the floating plant system could also be a predominant methodology that is economic to construct, needs very little maintenance, and increase the multifariousness. several researchers have used water orchid, pistia, and vetiver grass for the removal of water contaminants however their treatment capabilities rely on numerous factors like climate, contaminants of assorted concentrations, temperature, etc. Vetiver grass is commonly full-grown as floating within the water while not the soil

media (hydroponic way). The removal potency of contaminants like toxic shock, TDS, BOD, COD, EC, hardness, significant metals, etc varies from plant to plant. Plant rate of growth and hydraulic retention time will influence the reduction of contaminants. Therefore, a chunk of accessible data and techniques for the removal of water contaminants and advances in waste matter treatment are typically integrated to assess and manage pollution.

Plant treatment is often applied through many mediums as well as land, water, and land. Land medium treatment involves the exploitation of waste matter to irrigate land with plants or trees growing on that. This methodology has been applied effectively at landfills and with small-scale domestic waste material treatment. Water medium treatment involves the employment of floating beds of plants that will grow in water. These beds are put in ponds of water in want of treatment. Nutrients are assimilated hydroponically through the plant's rootage. created land medium treatment, because the name implies, runs inflowing waste matter through a land specifically designed to encourage microbic activity in conjunction with plant nutrient uptake. the employment of every medium depends chiefly on inflowing characteristics, climate, and land accessibility. (Zhao et al., 2012)

Meera Prajapati et al.,(2017) have assessed the performance of Associate in Nursing aborning (*Phragmites australis*), floating (*Azolla filiculoides*, water cabbage, *Lemna minor*), and edible (*Lactuca sativa*) plants in a very system for domestic waste matter treatment. They aimed to see the waste matter potential of the foundation, the free water column, and gravel and sludge zone in five hand-picked plant systems within the FTW, judge the chance of exploitation the edible plant (*L. Sativa*) for waste matter treatment, and confirm the microbic activity in multiple compartments of FTWs for various plants, and compare potential nitrification and denitrification activities within the root, water, gravel, and sludge-associated biofilms for various plant species.

Xiaofeng Huang et al.,(2017) have experimented with the Removal of Cu, Zn, Pb, and chromium from river body of water exploitation the *Phragmites australis* Artificial Floating Wetlands, the watercourse Chang Jiang, Chang Yangtze, Yangtze River, Yangtze Kiang river has become a main significant metal receiving and capturing space

once the significant metal pollutants coming back from the economic waste and residential waste pooled into this river. The areas of salt marsh have considerably been reduced thanks to the body of water environmental issues (e.g., human activities, native industrialization, and urbanization) within the past decades. particularly, the cement was accustomed to construct the dam on the reservoir, and the *P. australis* and different salt marsh plants cannot survive during this space. However, the *P. australis* community contends some typical ecological functions, like giving surround and ecological service. This water plant will take away the significant metals and radionuclides within the surroundings, particularly in a very large-scale space and low concentration of pollution sites. per the various capacities of metal uptake, the *P. australis* was able to accumulate comparatively significant metal concentrations within the surface tissues that might be sensible candidates for phytoremediation. during this experiment, the little scales artificial floating land was with success created within the body of water, and therefore the significant metals were also focused within the totally different tissues. It indicated that this technology presents property use of natural and/or created ecosystems for environmental protection and restoration. this study implicit that the *P. australis* artificial floating land has enough potential to be used for significant metals contaminated areas on the body of water.

Hefni Turk et al.,(2017) have experimented with the crude spilled water treatment with *Vetiveria zizanioides* in a very floating land are often finished that crude spilled water might support the expansion of *V. zizanioides* higher than that within the water while not crude contamination. Vetiver might flourish in crude-contaminated water by utilizing crude oil undergoing decomposition, as nutrients for growth. the employment of grasses for phytoremediation is taken into account appropriately since they supply rhizosphere zone increase thanks to their multiple ramified root systems. Hence, this supports the location for additional microbic activity around the root zone. within the tropics, since weather conditions favor microbic growth and activity, bioremediation is honestly a promising technology for handling pollution. many plants will render stuff in soil harmless via extraction or stabilization, thence creating it out of stock for different creatures and reducing damage to the surroundings, in a very method known as phyto remediation.

CHAPTER 3

AIM AND SCOPE

AIM:

Urbanisation and industrial development plus increasing world population have junction rectifier to intensive demands on water resources. Consequently, enlarged volumes of waste product have provided the motivation to explore economical strategies of assortment, treatment and disposal, benefiting public health and therefore the surroundings. Floating treatment wetlands (FTWs) might give appealing different to the additional standard treatments in industrial waste water treatments as a result of FTWs don't claim extra surface area. This study examined the contribution of plant uptake to overall removal capability of FTWs. This study demonstrates that FTWs are acceptable ecotechnology for the large-scale cleanup of industrial waste water.

OBJECTIVES OF THE STUDY:

By conducting an intensive literature survey, the following objectives are formulated:

- To design a floating rafter to create an easily deployable and retrievable aquatic plant growing system that can be used to treat pollutant in waste water.
- To analyse amount of contamination reduced by buoyant wetlands by Rhizosphere-Bio remediation using aquatic plants to analyse the effectiveness of plants.
- To assess the efficiency of treatment technique by comparing pre and post treated waste water.
- To suggest the treatment technique of low cost with less chemicals as a sustainable approach.

CHAPTER 4

MATERIALS AND METHODS

4.1 METHODOLOGY

The methodology adopted in this study is discussed below in Figure 4.1 and it was adopted to achieve the objective of this study.

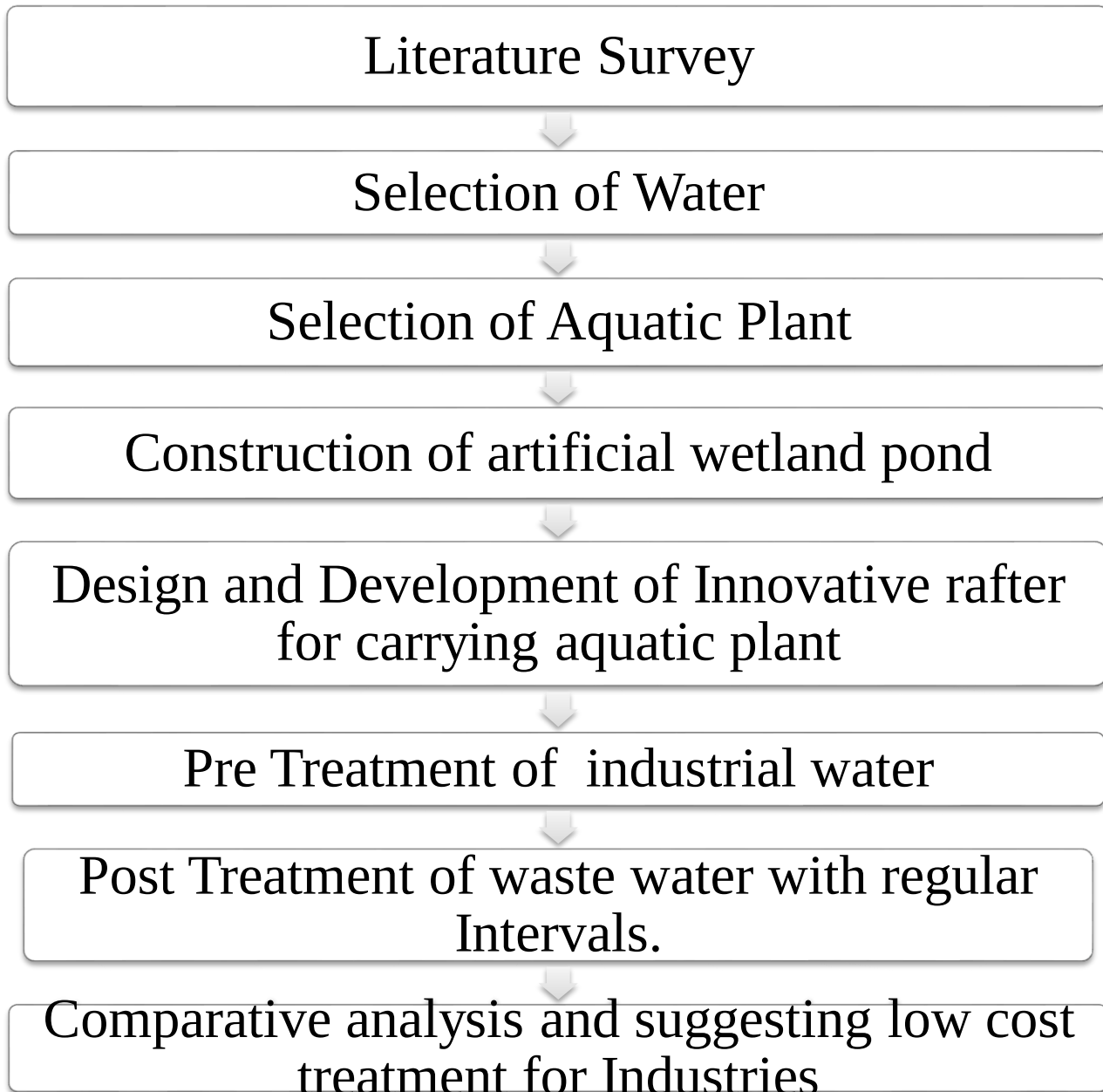


Figure 4.1 Methodology framework

4.2 SELECTION OF INDUSTRIAL WATER:

Textile Industry water that plays very important role to spice up the economy of developing countries and developed countries, effluents generated by textile process sectors is answerable for large destruction of aquatic ecology. A typical textile process includes a series of processes like pre-treatment, coloring and finishing. Bleaching is that the very important method that is administered before coloring for removing coloring impurities and to extend the material achromatic color. This method to be followed for all materials whether it's sold as white or colored. I actually have conjointly taken another printing industry water that conjointly possesses same composition of chemicals however relatively less relying upon the chemicals usage during a explicit industry. Among alternative bleaching agents like hypochlorite, hydrogen per-oxide has dominant share in industrial bleaching method. It's been found that 37% of water in textile wet processing Industry is employed throughout bleaching method. Therefore large magnitude of waste water is released from the bleaching method. Approximately 73 billion plenty of industrial waste water is generated once a year by textile industry. Treatment of textile waste water before its discharge into present water bodies is very fascinating. Several physico-chemical and biological techniques like filtration, adsorption, and clotting natural process, chemical reaction and chemistry strategies are being exercised to treat textile waste water. However, these strategies have limitations with relevance operational and maintenance value, demand of delicate man power and generation of unsafe sludge that makes downside of its safe disposal. Compared to those capital and labor intensive physiochemical ways that, bioremediation is an eco-friendly, less costly and handy approach to treat textile waste water for each organic and inorganic pollutants.

4.3 SELECTION OF AQUATIC PLANT:

Macrophytes were chosen on the subsequent criteria: (1) native and non-invasive species; (2) perennial plants; (3) plants with the flexibility to thrive in an exceedingly hydroponic environment; and (4) plants tolerating brackish water, This choice method for appropriate nascent macrophytes is vital not solely to ensure

effective nutrient and waste material removal however conjointly to assure the native system integrity. Thus, environmental conditions like climate and hydrology influence how a floating wetland is planted and installed. (e.g. anchoring), however don't limit the alternatives of installation sites expressly. It removes pollutants like hydrogen ion concentration, TDS, TH, TSS, Chlorides, Sulphate, COD, BOD. The growth of plant involves in decontaminating pollutants. Plants are locally available. Plant species can make a significant difference in effectiveness and efficient removal of contaminants. Floating treatment involves soil-less planting. Plants will absorb/uptake high nutrient load by phyto- remediation.



Figure 4.2 Eichhornia Plant



Figure 4.3 Plantation in good water

4.3 METHODOLOGY EXPLANATION

The water samples are collected from industries at Vilarasampatti(L1) and kaikattivalasu(L2) in Erode, Tamilnadu. There are two water samples collected. One water sample is collected by 50L cans in the L1 and another one sample at L2. The general parameters tests are performed for the analysis of general parameters like pH,

temperature, electrical conductivity, colour, odour, TDS, total hardness, sulphates, chlorides, nitrates, iron and fluoride are taken for consideration for physiochemical parameter analysis. Then plant Eichhornia (water hyacinth) is grown in industrial sample water and tested for 10days, 20days also 10days,15days and 20days respectively. It is observed that how much pollutant are absorbed by plants and percentage of plants absorbed are calculated. We have planted 15 Eichhornia(L1) and more than 60 Eichhornia plants(L2) in the effected industry water to absorb the contaminants by phytoremediation. They are planted and allowed to grow, also analyzed at post-treatment and pre-treatment.

4.4. PARAMETERS INVOLVED IN TEST

- Colour
- Odour
- pH
- Total dissolved solids
- Electrical conductivity
- Temperature
- Total hardness
- Chlorides
- Sulphate
- Calcium
- Magnesium
- Nitrate
- Iron
- Fluriode

4.4.1 pH

pH is measure of how acidic/base water is. The range goes from 0-14, with 7 being neutral. pH of less than 7 indicates acidity, where as a pH of greater than 7 indicates base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water.

4.4.2 Electrical conductivity

Conductivity of substance is defined as the ability or power to conduct or transmit heat, electricity, or sound. Its units are siemens per meter [S/m] in SI and millimhos per centimetre [mmho/cm] in U.S. customary units. Its symbol is K or s Electrical conductivity (EC).

4.4.3 Total dissolved solids

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates and some small amounts of organic matter that are dissolved in water.

4.4.4 Total hardness

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates and some small amounts of organic matter that are dissolved in water.

4.4.5 Sulphates

Sulphate is one of the major dissolved components of rain. High concentrations of sulphate in water we drink can have a laxative effect when combined with calcium and magnesium the two most common constituents of hardness.

4.4.7 Chlorides

It is formed when the element chlorine (a halogen) gains an electron or when a compound such as hydrogen chlorides is dissolved in water or other polar solvent. Chloride salts such as sodium chloride are often very soluble in water.

4.4.8 Colour

The colour of water varies with the ambient conditions in which that water is present. While relatively small quantities of water appear to be colourless, pure water has a slight blue colour that becomes a deeper blue as the thickness of the observed sample increases. The blue hue of water is an intrinsic property and is caused by

selective absorption and scattering of white light. Dissolved elements or suspended impurities may give water a different colour.

4.4.9 Odour

Odour in drinking water may be defined as that sensation that is due to the presence of substances that have an appreciable vapour pressure and that stimulate the human sensory organs in the nasal and sinus cavities. As odour cannot be measured objectively, a maximum acceptable limit for drinking water has not been specified.

4.4.10 Temperature

Water temperature, of course, expresses how hot or cold the water is. Increasing temperature indicates increasing energy, or molecular motion, of water. Water temperature is based upon climate of the region. Water temperature has a tremendous impact on water density. Differences in water temperature and density cause stratification.

4.5. PHYTOREMEDIATION

Phytoremediation techniques have been briefly depicted in many literatures or articles. The generic term “phytoremediation” consists of the Greek prefix phyto (plant), attached to the Latin root remedium (to correct or remove an evil). Generally, according to the above researchers, phytoremediation is defined as an emerging technology using selected plants to clean up the contaminated environment from hazardous contaminant to improve the environment quality. The uptake mechanisms of both organics and inorganics contaminants through phytoremediation technology. For organics, it involves phytostabilization, rhizodegradation, rhizofiltration, phytodegradation, and phytovolatilization. These mechanisms related to organic contaminant property are not able to be absorbed into the plant tissue. For inorganics, mechanisms which can be involved are phytostabilization, rhizofiltration, phytoaccumulation and phytovolatilization.

CHAPTER 5

RESULT AND DISCUSSION

5.1 ANALYSIS OF INDUSTRIAL WASTE WATER

The industrial waste water collected from the industries are tested before treatment and after treatment by phytoremediation. Then the results were analysed as below:



Figure 5.1 Plantation in waste water



Figure 5.2 Plantation in wastewater@10days



Figure 5.3 Plantation in wastewater@20days

TABLE 5.1: Results of Untreated and Treated water- L1

Physical and Chemical Parameters	Before Treatment	10 Days of Treatment	20 days of treatment
Appearance	Slightly Turbid	Slightly Turbid	Slightly turbid
Colour	Yellow colour	Yellow colour	Yellow colour
Odour	Unpleasant smell	Unpleasant smell	Nil
pH	7.67	7.42	7.45
Electrical Conductivity (mho/cm)	7082	5466	8015
Turbidity (NTU)	7	5	3
Total dissolved solids (mg/l)	4957	3826	5611
Total Alkalinity (mg/l)	680	676	776
Total Hardness (mg/l)	280	200	160
Calcium (mg/l)	48	46	40
Magnesium (mg/l)	38	19	14
Nitrate (mg/l)	4	1	2
Chloride (mg/l)	1830	1240	1950
Sulphate	98	95	97

The graph below shows that the basic parameter values before treating and its after treatment by using plants (Bioremediation) method gives the reduction in the parameters. The reduction in pH values, turbidity, TDS and Total hardness after 10days of treatment process. The water which the industry is using for its processing is however having the same values to that of waste water. After plants treatment it has reduced to permissible limit which can be used for other purposes like gardening and so on.

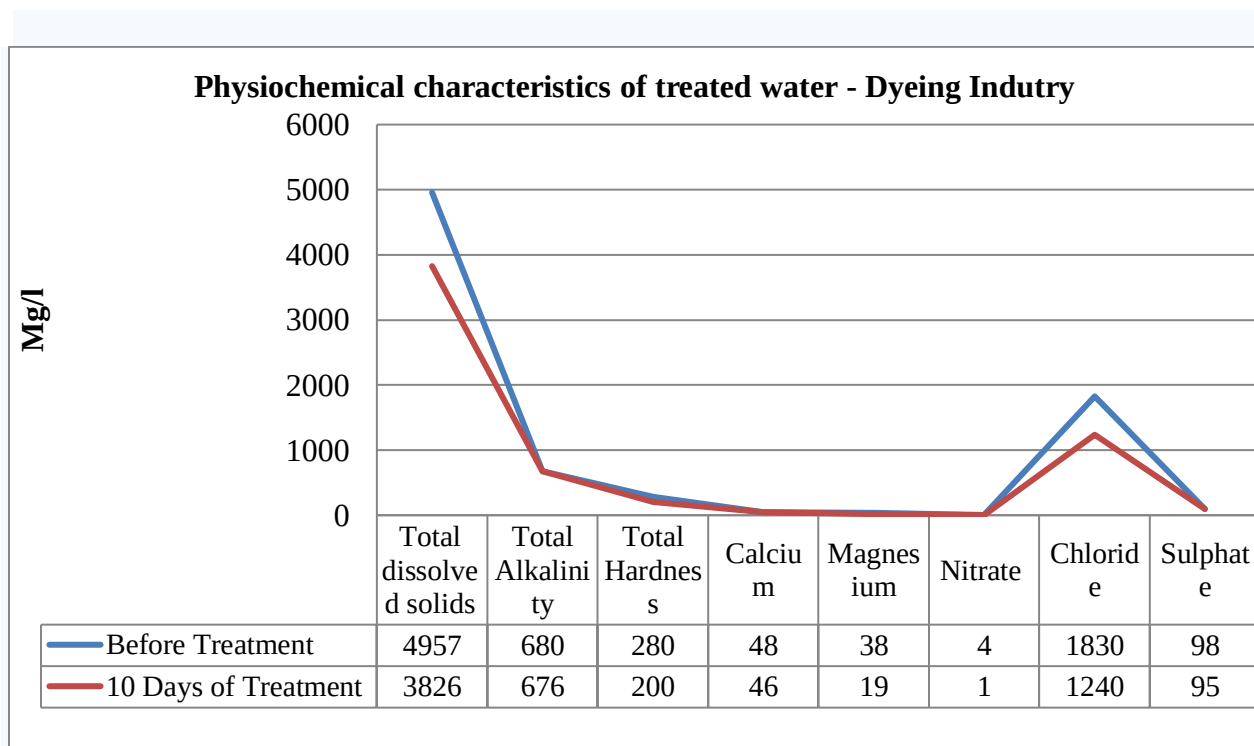


Figure 5.4- 10days of Treatment

The graph below shows that the basic parameter values before treating and its after treatment by using plants(bioremediation) method not gives high reduction in the parameters .The reduction in pH values, turbidity, Total hardness, Calcium, magnesium and nitrate after 20days of treatment process. After plants treatment by bioremediation it has been found that after optimum treatment of 10days we are able to find a better results in decontaminating pollutants.

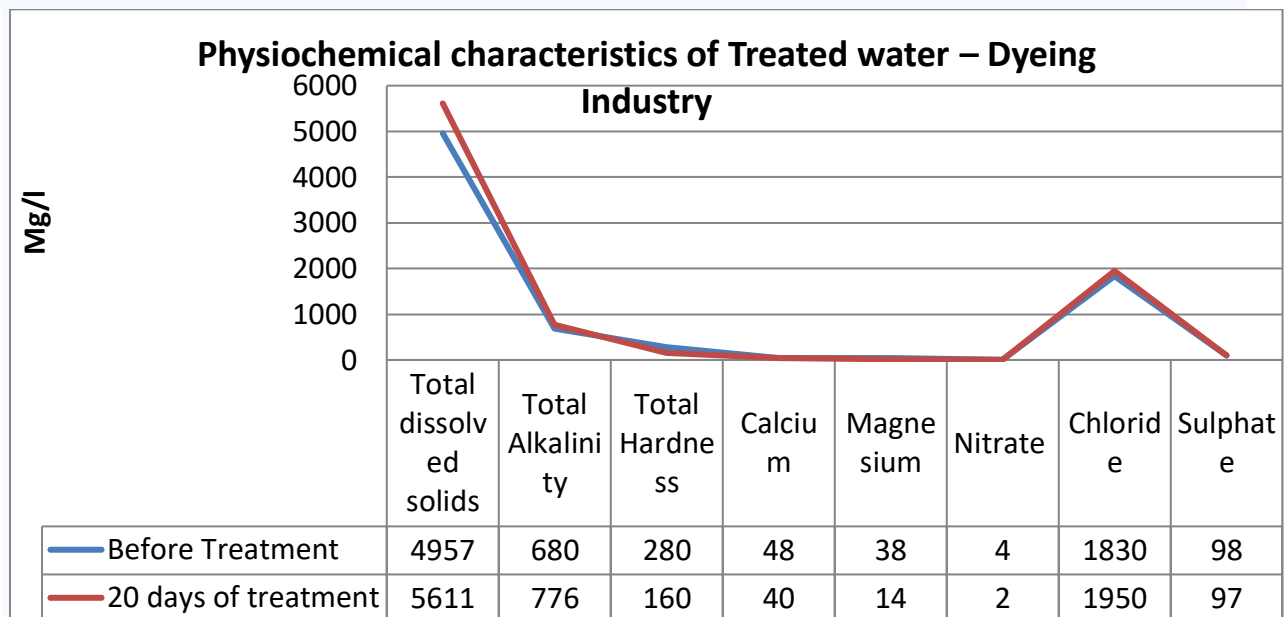


Figure 5.5- 20days of Treatment

The pond for treating the industrial waste water is developed and waste water is poured into it afterwards plants were placed in it for treatment.



Figure 5.6- Setup for plantation at industry



Figure 5.7- Plantation at setup site

TABLE 5.2: Results of Untreated and Treated Water- L2

Physical and Chemical Parameters	Before Treatment	10 Days of Treatment	15 Days of Treatment	After addition of water again
Appearance	Slightly Turbid	Slightly Turbid	Slightly turbid	Turbid
Colour	Black	Pale Yellow	Light yellowish	Yellow
Odour	Punget odour	Nill	Nill	None
Turbidity	15	9	7	10
Electrical Conductivity	1522	1433	1407	1735
Fecal Coliform	150	140	135	250
PH	7.52	7.1	6.9	7.03
Total dissolved solids	1065	1003	990	290
Total Alkalinity	400	190	156	500
Total Hardness	360	520	450	1
Iron	0.3	2	2	1.5
Fluoride	1.5	1.5	1.5	35
Nitrate	12	11	11	310
Chloride	240	220	200	187
Sulphate	148	119	99	1214

The graph below shows that the basic parameter values before treating and its after treatment by using plants (Bioremediation) method gives the reduction in the parameters. The reduction in pH values, turbidity, TDS and Total hardness after 10days of treatment process. The water which the industry is using for its processing is however having the same values to that of waste water. After plants treatment it has reduced to permissible limit which can be used for other purposes like gardening and so on.

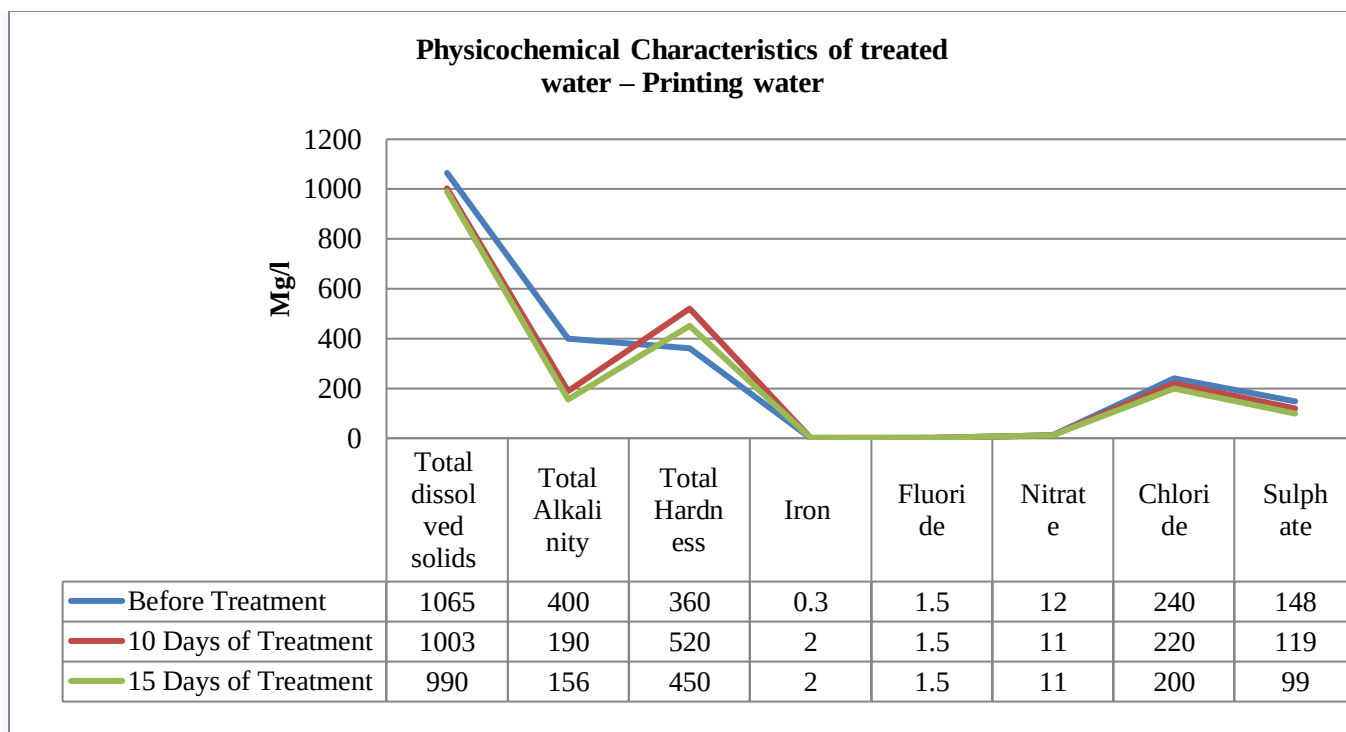


Figure 5.8 – 10days of Treatment

The graph below shows that the basic parameter values before treating and its after treatment by using plants(bioremediation) method not gives high reduction in the parameters .The reduction in some parameters but still after 20days of treatment process there is very minimal reduction in pollutants. After plants treatment by bioremediation it has been found that after optimum treatment of 10days we are able to find a better results in decontaminating pollutants. Only after the 10days of treatment appreciable results can be achieved.

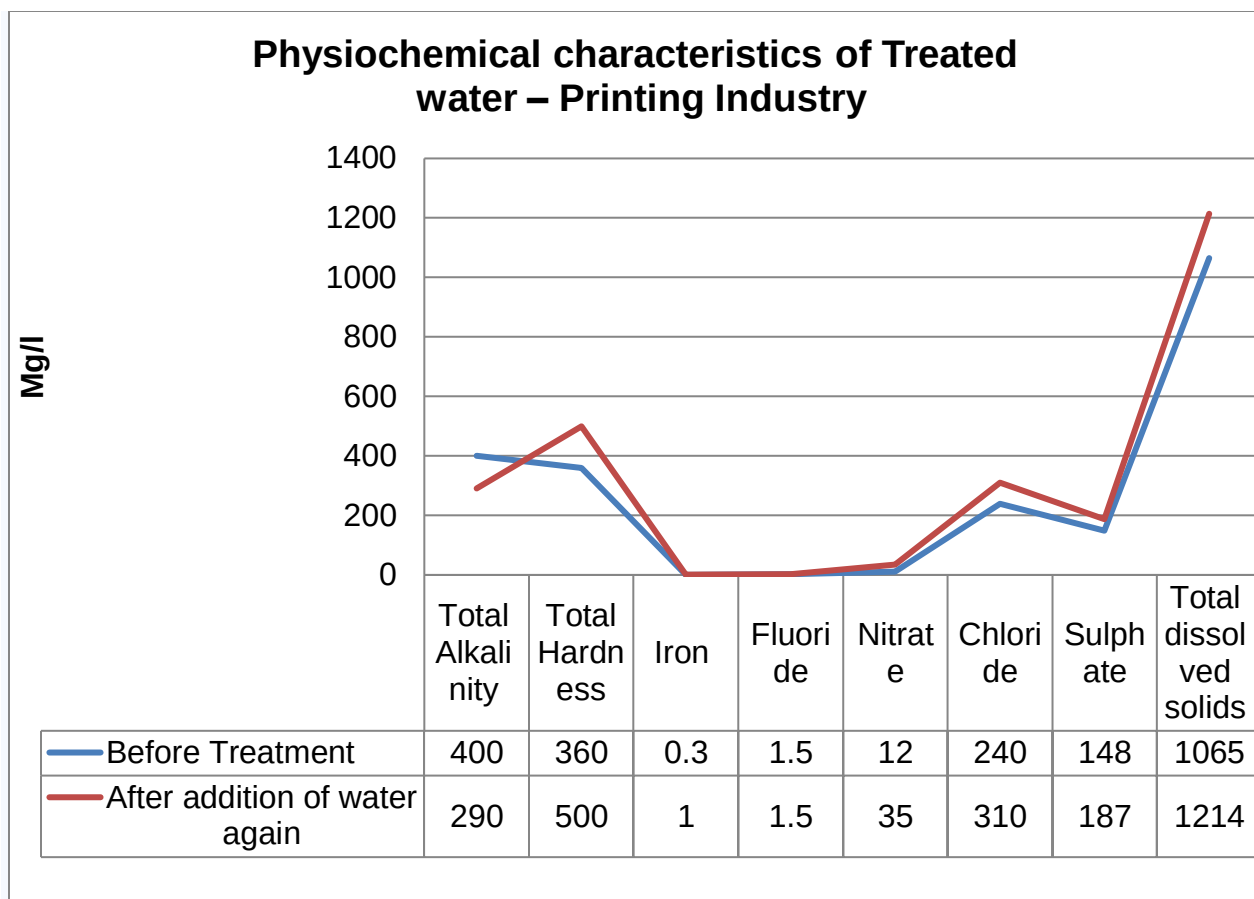


Figure 5.9 – After adding water into the treatment

5.2 DESIGN OF FLOATING RAFTER

This invention relates to buoyant(floating) rafter - sustainable technology for wastewater treatment, this invention pertains to environmental protection. Control of water pollution requires appropriate infrastructure and management plans. Nature based solutions are another approach to prevent water pollution. The design of pontoon rafters can be used in Industrial, agricultural and Sewage waste water to improve the water quality. Plant root plays a major role in the treatment processes of floating wetland systems by virtue of the fact that the water passes directly through the extensive (Rhizoadsorption) root system. The floating wetland process has been installed in the least turbulent part of any water treatment plants using waste but reusable materials like used plastic bottles, foam material to hold the aquatic plants which we are using and used PVC pipes. These system seem to predominantly rely on

the relatively high nutrient and mental uptake rate of different grass species leads for water quality improvement. The main purpose for the floating wetland system are removal of contaminants and heavy metals from the waste water efficiently. The main objective for the design of a rafter, that combine to create an easily deployable and retrievable aquatic plant growing apparatus that can be used to reduce Pollutant in waste water. Another objective is to provide a floating wetland raft that is reusable from year-to-year till the end of its useful life also retains sufficient strength after being in water for up to one year Such that it can be removed, handled, and possibly replanted elsewhere without falling apart in the process. The design motto is to provide a floating wetland rafter designed from lightweight materials providing an appropriate degree of flexibility, resiliency, durability, and longevity. This pontoon rafter possesses a simple and Scalable design. It can be economically manufactured and to provide for widespread use and disposability. These are small artificial platforms that allow these aquatic emergent plants to grow in water. Their roots spread through the floating islands and down into the water creating dense columns of roots with lots of surface area, a major environmental crisis will be erased by using this apparatus which cleans and disintegrating the contaminants in polluted water.

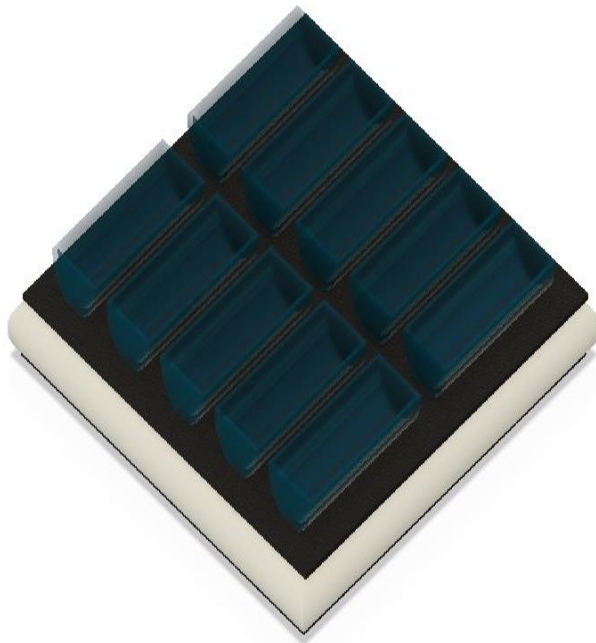


Figure 5.10 – Floating rafter

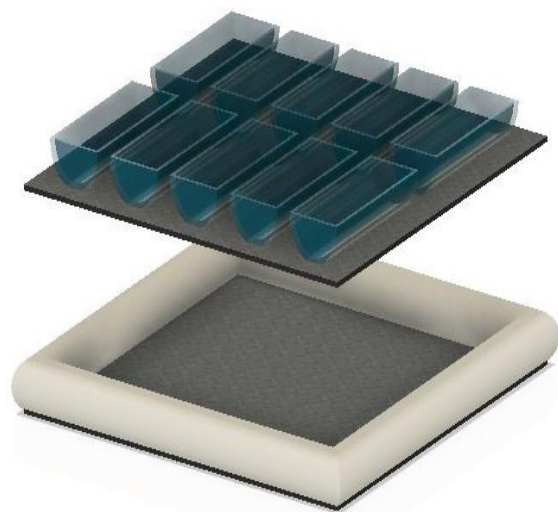


Figure 5.11 – Pererspective view of rafter

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Selected area in Erode district is one of the biggest exporting centres of printing and bleaching industry in Tamilnadu. The total number of industries located in and around Erode town are 240 and more. The collected two water from two locations the both water samples are tested as per parameters. The selected two plants like eichhornia they are collected from different locations of wetland. Then they kept for plantations into observation with fresh water for 15 day and then treated with our water sample for the analysis of 15 days and 20 days. There is a constant decrease in general parameters and pollutants. The post-treatment and pre-treatment of the plants by phytoremediation are analyzed and concluded.

6.2 CONCLUSION

- Results showed that in both industrial water the plant species remove color, Organic matter, Toxicity.
- Wetlands degrades the water pollutant and makes sludge to settle.
- Bacterial growth is good after a period 15-20 days.
- Plant growth and effluent degradation is appreciably good.
- After remediation, the textile effluent quality was improved and it can be released in the environment without any risk.
- By visual Interpretation treated water after 15-20days shows colorless water and significant sludge.
- By designing the sludge settlement provision the quality of water may be enhanced in the better ways.
- From the experimental study, optimum of 10 days will provide best results which will give a indication of lesser storage period than 20 are more days.

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