International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 6, Issue 5, pp 150-161, May-2022
https://doi.org/10.47001/IRJIET/2022.605019

Wastewater Treatment by Root Zone Technology Using Decorative Plants

[1]Prof. Vrinda Bhalerao, [2]Poonam S. Thorat, [3]Rutuja G. Thormote, [4]Prashant R. Bhasakar, [5]Ranjan J. Palvi

[1]Assistant Professor, Department of Civil Engineering, GGS College of Engineering and Research Center, Nashik, India
[2,3,4,5]B.E., Scholar, Department of Civil Engineering, GGS College of Engineering and Research Center, Nashik, India
Author E-mail: thoratpoonam794@gmail.com

***Abstract* - The rapid urbanization has resulted in pollution of fresh water bodies due to increase generation of domestic waste, sewage, industrial waste etc. This RZT project should be expanded for side business such as Aquaponic and organic farming, because lot of clean water available in RZT plant. So this RZT plant clean water in aquaponic tank for fish production. Further this excreta contents water use for organic farming. The raw waste water and treated waste water were collected and tested for quality the raw waste water and treated waste water were collected periodically and tested for quality. It is seen that this pilot unit is reducing the concentrations of TSS, TDS, TN, TP, BOD, and COD. Flow rate and Detention time are the two factors on which channels are to be designed. Therefore, I am changing the flow rate and finding out the change in parameter with respect to detection time, Planting Colacassia and Canna plant. Both plants will get nearly same result but we can use planting as per requirement. The optimization is when we get better results with maximum flow. I have got satisfactory results for the detention time of Three days, Seven days and Fifteen day. With the help of this data I have designed the root zone bed system for the domestic wastewater. Coat of root zone technology is small as compared to conventional system.**

Keywords: Wastewater, Root Zone, COD, BOD, TSS, TDS, Cost Analysis etc.

I. INTRODUCTION

Environment pollution is one of the serious problems that the world is facing in this era. In India, major problems leading to environment pollution are increasing population, industrialization and urbanization. Solving this environment issue should be our top most priority. Central Pollution Control Board (2007) study found that discharge of untreated sewage single most important cause for pollution of surface and ground water in India. There is a large gap between generation and treatment of domestic wastewater in India. The problem is due to improper design or poor maintenance or lack of reliable electricity supply to operate the plants, together with absentee employees and poor management. The wastewater generated in these areas normally percolates in the soil or evaporates. Out of all the total water on earth, salt water in oceans, seas and saline groundwater makes up about 97% of it. Only 2.5–2.75% is fresh water, including 1.75–2% frozen in glaciers, ice and snow, 0.7–0.8% as fresh groundwater and soil moisture, and less than 0.01% of it as surface water in lakes, swamps and rivers. Freshwater lakes contain about 87% of this fresh surface water.

As the Earth completes world's Population, Pollution, urbanization and Industrialization ultimately demand of water will increase. In 1989, in world total amount of available fresh water was about 9,200 m^3 percapita per year. By 2001, this amount dropped to around 7500 m3 per capita. In 2031, the amount of water per capita is expected to fall up to 5,000, If the current situation persist, by 2031 the demand for fresh water is expected to rise to 55% more than currently available amount of fresh water.

Root zone treatment is one of the natural and attractive methods of treating domestic, industrial and agricultural wastes. It is an engineered method of purifying wastewater as it passes through an artificially constructed wetland area. It is considered as an effective and reliable secondary and tertiary treatment method. The root zone treatment is a natural maintenance free system where the sewage wastewater is purified by the roots of wetland plants. The root zone process functions according to the law of nature, to effectively purify domestic and industrial effluents.

The process incorporates the self-regulating dynamics of an ecosystem. Application of root zone technology is finding wider acceptability in developing and developed countries, as it appears to offer more economical and ecologically acceptable solution to water pollution management problem Root zone systems, whether natural or constructed, constitute an interface between the aquifer system and terrestrial system that is the source of the pollutants. These are reported to be most suitable for schools, hospitals, hotels and for smaller communities.

ISSN (online): 2581-3048
Volume 6, Issue 5, pp 150-161, May-2022
https://doi.org/10.47001/IRJIET/2022.605019

II. LITERATURE REVIEW

Sahu Omprakash (2014) has studied Reduction of Heavy Metals from Waste Water by Wetland. The Constructed wetlands are artificial wastewater treatment systems consisting of shallow ponds or channels which have been planted with aquatic plants, and which rely upon natural microbial, biological, physical and chemical processes to treat wastewater. They typically have impervious clay or synthetic liners, and engineered structures to control the flow direction, liquid detention time and water level. Depending on the type of system, they may or may not contain an inert porous media such as rock, gravel or sand. Constructed wetlands have been used to treat a variety of wastewaters including urban runoff; municipal, industrial, agricultural and acid mine drainage. In this regard's an attempted has been made to reduce the heavy metal present in waste water. Water reclamation and reuse as a sustainable strategy in water management has been attractive to communities in the intermountain waste.

Pawaskar S.R. (2012) has studied application of modified root zone treatment system for waste water treatment within nallah area. The rapid urbanization has resulted in putting excess pressure on infrastructure facilities resulting in low level of services provided by local authorities. The sewage flowing through nallahs joins rivers in untreated condition and creates heavy risk of river pollution. The city sewage treatment plants also do not produce treated sewage of expected quality standards and is similar to nallahs waste water. This study investigated the effectiveness and techno economical feasibility for RZTS (Root zone treatment system) along with its modification. Other objective of the study was to work out with BOD, COD and TSS removal efficiency of modified RZTS and trickling bed model.

N. P. Jajoo et.al (2018) Dairy Waste Water Treatment by Using Root Zone Technology System as Tertiary Treatment India tops in production of milk and involved in processing and manufacturing of various types of milk products. Typical by-products obtained include buttermilk, whey, and their derivatives. Dairy industries have shown tremendous growth in size and number in most countries of the world. Dairy industries discharge wastewater which is characterized by high COD, BOD, TDS, TS, and organic wastes such wastewaters become dangerous when released into water bodies. The dairy industry wastewaters are primarily generated from the cleaning and washing operations in the milk processing plants. 2 % of the total milk processed is wasted into drainage systems while washing. The study undertaken involved the characterization of wastewater and the dairy waste is selected for this purpose. By which the pH, suspended solids, TDS, and the significant reduction in the parameters were observed and hence found more useful.

Nanda Sahil (2017) has studied on Root Zone waste water Treatment for domestic sewage the wastewater is collected from the septic tank when that overflows are transferred to the plant. At the plant, a bit of essential dimension is made. The clarified sewage from the septic tank is made to pass through the Root Zone pit. The length and breadth of the pit depend on the volume of the wastewater to be treated per day. The pit is lined by sealing with low Density Polypropylene sheets or rolls. If necessary, other types of civil structure can be made in the treatment tank. The pit is filled layer by layer with layered made of adequate porosity.

Mane Mahesh et. al. (2017) has studied in Introduction to Waste Water Treatment by Root Zone Technique. In This study Increasing urbanization and human activities exploit and affect the quality and quantity of the water resources. This has resulted in pollution of freshwater bodies due to increased generation of domestic waste, sewage, industrial waste etc. This paper reviews the Root Zone Treatment System, which is planted filter beds consisting of soil gravel, sand and fine aggregate. This Technique uses a natural way to effectively treat domestic and industrial effluents. RZTS are well known in temperate climates and are easy to operate having less installation, low maintenance, and operational costs and incorporates the self-regulating dynamics of an artificial soil eco-system.

Parmar Jigar et. al. (2016) has studied on Experimental study on post treatment of dairy wastewater is using hybrid reed bed technology in this Study give knowledge about dairy waste and the dairy waste and their effective treatment. He had used the hybrid reed plant for treatment of Dairy waste. It give from this study confirmed that the Hybrid reed bed system was highly effective in removing BOD up to 14 mg/L and COD at up to 110 mg /L at 36 hours detention time with a removal efficiency of BOD is 97%, and COD is 92% of dairy wastewater. Reductions in TDS and TSS were not significant. Initially the pH of Dairy waste sample was more alkaline, but due to the techniques implemented the pH was brought up much near to the neutral axis.

Irfan Naseemul et. al. (2015) has studied in Holistic Household Waste Management at Source- An Experimental Study. He has discussed related gray water and kitchen, solid waste management. Simple sand filter bed method of treatment and the sand filter with reed plant are experimented and compared to Wastewater management. It also suggests the method of using PVC pipes for making compost from the kitchen waste. Phragmites Australis (locally known Canna) and canna Indica (locally known as cannas) were used as reed plants for wastewater treatment. This paper presents the method of construction of reed bed and the effectiveness of removal of various contaminants using root zone treatment

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

process. The quality parameters of raw water and treated water samples were compared and discussed.

Shitole Dhiraj (2014) has studied on Feasibility Study of Low Cost Treatment for Non Point Sources He had explained about non point source and their treatment. In present scenario the river water has become wastewater due to disposal of city waste through which it flows.

Due to improper and ill-planned infrastructure development, the sewerage network & treatment facility are inadequate. At any places, this leads to the development of illegal sewage, resulting into Non-Point sources. Most of the existing wastewater treatment plants are getting over The Root Zone Bed System is one of the lowest cost methods to treat wastewater. With the help of this system we can treat the Non-Point sources with the best results.

III. MATERIAL AND METHODOLOGY

1. Constructed Wetland: I have designed constructed wetland of size 1.5m x 0.5m x 0.3 m for both Cola cassia and canna plant.

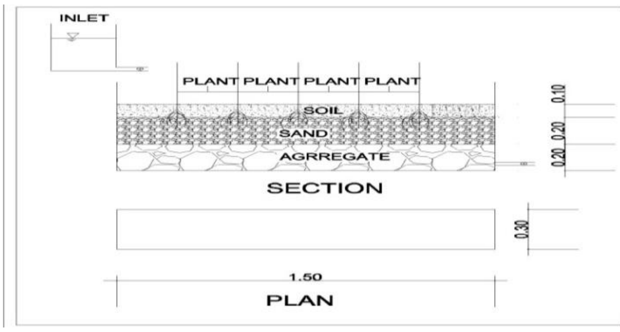
Consider the length of reactor 1.5m, height 0.5m and thickness 0.3m. In above figure shows section and plan of constructing reactor. At lower level, consider 200mm thick with aggregate 20mm size. Middle layer 200mm thick with natural sand and top layer of 100mm thick with black cotton soil.

The aggregate cleaned with water before keeping in reactor similarly cleaned sand with water before keeping in the reactor. Filled all layers simultaneously in the reactor and keep it for one day. Prepare two systems parallel for cane plants and Colacassia plants.

Selecting Various Decorative Plants used for Root Zone Treatment,

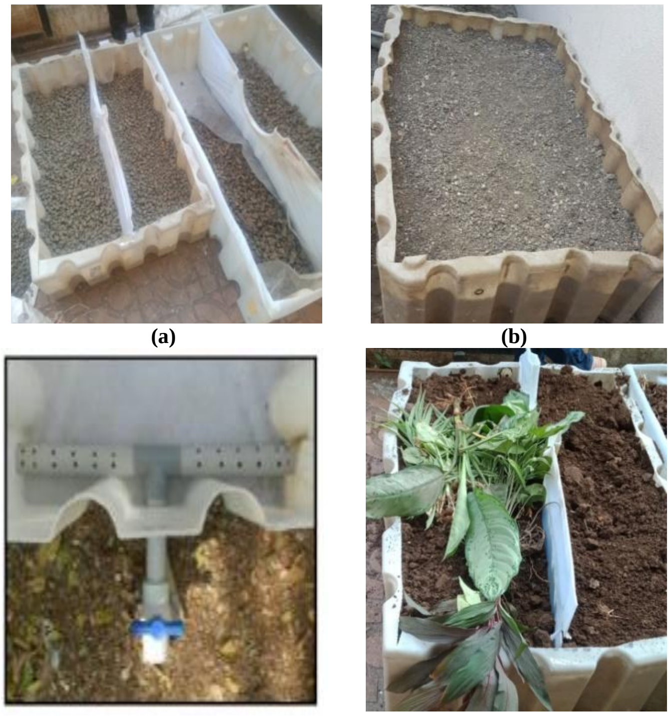
1) Canna plant with green leaf and red leaf
2) Colacassia (alu) plant
3) Babies' spider plant
4) Red leaf cordyline fructicosa plant

2. Arrangement of Reactor: The rectangular tub with plant bed was provided with 100 slope with slight elevation at the bottom of the backside of the tub and kept in the slanting position. Inlet and outlet flow rates were adjusted by using a bucket and timer. Inlet flow and outlet flow of wastewater were adjusted to maintain Hydraulic Retention Time (HRT) of 3days, 7days and 15days.



All dimensions are in meters

Figure 1: Plan and Section of root zone system



(a) **(b)**

(c) (d)

Figure 2 (a) & (b) 200mm depth of bottom layer with aggregate (c) Experimental setup (d) under drainage pipe at bottom

3. Planting Arrangement: Reeds can be planted as rhizomes, seedlings are planted clumps. The clumps can be planted during all seasons at 2 Nos / m2. Rhizomes grow best when planted in Pre-monsoon and t 4 – 6 rhizomes can be planted per m2. Seedlings should be planted in Pre-monsoon with 3 – 5 seedlings per m2. Planting should be done from supporting boards to avoid compaction of the filter media. Initially the plants should be kept well watered, but not flooded. With well-developed shoots, the growth of weeds can be suppressed by periodical flooding. During the first growth period a sufficient supply of nutrients is required. If wastewater is used for initial watering precautions like avoidance of stagnation have to be taken to inhibit the formation of H2S within the filter bed.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

Figure 3: Planting of Colacassia and Canna plant, Babies Spider plant Red leaf cordyline fructicosa plant

To prevent entry of soil into under drain pipe and washing out of the soil a graded filter is provided on the blower portion of the reactor. The filter consists of crushed stone of gradation 40mm at the bottom near to under drain pipe to 5mm at the top just below the soil layer. A fertile soil layer of 20 cm thickness is provided above the filter. Over this 1-2cm thick layer of organic compost is laid over the soil layer. Plantation is done after these layers are laid and plants are watered. Different species of plants were considered for plantation in RZT system. Considering local availability, ability to consume the organic and inorganic matter from waste, and revenue by selling the plant, Elephants Ear or Arum was considered as the plant species in the RZTS.

4. Types of plant used system

Colacassia plant (Alu): Colacassia esculenta is a tropical plant grown primarily for its edible corms, the root vegetables most commonly known as taro. It is believed to be one of the earliest cultivated plants. Linnaeus originally described two species which are now known as Colacassia esculenta and Colacassia antiquorum of the cultivated plants that are known by many names including eddoes, dasheen, taro and madumbi, but many later botanists consider them all to be members of a single, very variable species, the correct name for which is Colacassia esculenta.

Figure 4: Colacassia plant

Uses of Colacassia plant

Taro's primary use is the consumption of its edible corm and leaves. In its raw form, the plant is toxic due to the presence of calcium oxalate, and the presence of needle-shaped raphides in the plant cells. However, the toxin can be minimized and the tuber rendered palatable by cooking or by steeping in cold water overnight.

Corms of the small round variety are peeled and boiled, sold either frozen, bagged in its own liquids, or canned. The leaves are rich in vitamins and minerals. It is also sold as an ornamental aquatic plant. It is also used for Anthocyanin study experiments especially with reference to biaxial anthocyanic concentration.

Canna plant: Canna (or canna lily, although not a true lily) is a genus of 10 species of flowering plants. The APG II system of 2003 assigns it to the clad comeliness, in the monocots. Plants have large foliage and horticulturists have turned it into a large-flowered garden plant. It is also used in agriculture as a rich source of starch for human and animal consumption. Although a plant of the tropics, most cultivars have been developed in temperate climates and are easy to grow in most countries of the world as long as they receive at least 6–8 hours average sunlight during the summer, and are moved to a warm location for the winter. See the Canna cultivar gallery for photographs of Canna cultivars.

Figure 5: Canna plant

Uses of Canna plant

Some species and many cultivars are widely grown in the garden in temperate and subtropical regions. Sometimes, they are also grown as potted plants. A large number of ornamental

ISSN (online): 2581-3048
Volume 6, Issue 5, pp 150-161, May-2022
https://doi.org/10.47001/IRJIET/2022.605019

cultivars have been developed. They can be used in herbaceous borders, tropical plantings, and as a patio or decking plant.

1. Internationally, cannas are one of the most popular garden plants and a large horticultural industry depends on the plant.
2. The rhizomes of cannas are rich in starch, and it has many uses in agriculture. All of the plant has commercial value, rhizomes for starch (consumption by humans and livestock), stems and foliage for animal fodder, young shoots as a vegetable, and young seeds as an addition to tortillas.
3. The seeds are used as beads in jewelry. The seeds are used as the mobile elements of the kayamb, a musical instrument from Réunion, as well as the hosho, a gourd rattle from Zimbabwe, where the seeds are known as hota seeds.
4. In more remote regions of India, cannas are fermented to produce alcohol.

Babies Spider plant

Spider plants produce a rosette of long, thin, arched foliage that is solid green or variegated with white. These easy-to-grow houseplants look especially nice in a hanging basket and were a favorite in Victorian-era households. Here's how to grow spider plants in your home! During the summer, spider plants may produce tiny white flowers on long stems, as well as baby spider plants (offsets) called "pups." The pups look like tiny spiders, hence the plant's name.

Figure 6: Babies Spider plant

Red leaf cordyline fructicosa plant

Figure 7: Red leaf cordyline fructicosa plant

USES

Simply called Ti (tee) Cordyline fruticosa spent most of its history with humans as a food, a source of alcohol, or a medicine. Now it's foliage is in demand with many showy cultivars. Ti is probably native to Southeast Asia and Papua New Guinea. It was carried throughout much of the Pacific by Polynesians who used the starchy rhizomes for food. An outdoor ornamental in warmer areas of the Earth today Ti is found naturalized in eastern Australia and many of the larger tropical Pacific islands including the Hawaii. It's a common potted plant in cooler climates. The point is you should be able to find it nearly everywhere, often with other people taking care of it for you. And if you are so inclined you can even make a Hula skirt out of it.

Boiled roots taste like molasses and were used to make a beer that was reported to cure scurvy (but modern references to its nutrition are scarce.) Some say the Hawaiians learned to distill Ti beer into a stronger brew from convicts in Botany Bay, Australia. Young leaves are used as a potherb. Older leaves are used to wrap food, make clothes, rain capes and for thatch. Ti leaves are to wrap foods for grilling, steaming or baking. Dried leaves should be soaked to soften before using.

IV. WORKING OF ROOT ZONE TECHNOLOGY

Sampling Methodology: I have taken sample at Nasardi River near Bombay Naka Nashik.

This river polluted due to it fowling through city area and slum area of city. Sample has taken in sample botle. Sample bottles: One litre or 2 ½ litre new PVC bottles to be used for all samples taken except samples taken for bacteriological, oil based or solvent analysis.

Sampling hand-pump with extension tube – to be used for depth sampling at low flow. Otherwise a sampling beaker (250ml, 500ml or 1000ml) with screw-in extension rods to be used for depth sampling with sufficient flow.

Figure 6: Sample before and after treatment & sample point at Nasaradi river Nashik

International Research Journal of Innovations in Engineering and Technology (IRJIET)

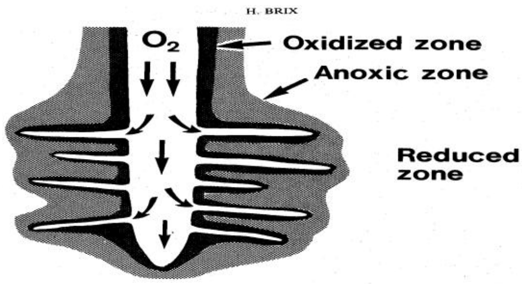
ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

Root Zone Mechanism

Experimental procedures followed in present investigation were similar to those described elsewhere Colocasia esculenta and Canna is one of the prominent adaptive marshy plants in the India region which was used for treatment of wastewater. It was transplanted in the designed wetland system in the Angular Horizontal Subsurface Flow process of constructed wetland.



1. In Constructed system filled with washed aggregate first up to 200mm thick at bottom. And then filled with washed sand up to 200mm at middle layer of reactor. At top filled soil up to 100mm.
2. Initially, plants in bed were acclimatized for two weeks with suitable dilutions each time. As the time passed, the concentrations were increased such as 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% of sewage through plant treatment. These samples were treated using Colocasiaesculenta and Cannaby Phytoremediation technique and other set as control (without plant) also analyzed after their pre-treatment characterization
3. Two sets of buckets with different sizes and dimensions were used in each experimental set up. The vertical buckets as holding tank (Inlet) were used to hold the wastewater. The water storing capacity of tank was 50 liters each.
4. The rectangular tub with test plant bed was used as experimental test setup in each set for preparing root zone bed of size 1.5m length and height 0.5m having suitable outlet. The vertical pipe was placed above the tub in an inverted 'T' shape for equal distribution of wastewater which was connected with the rubber pipe to the inlet of holding tank in each set. The length of plastic pipe was 40 cm and the holes were provided at the interval of 5 cm and equal flow was adjusted manually through them.
5. Plastic cans were used for the collection of treated water after flowing out from the root zone bed through the outlets. Inlet, Root zone tub and outlet were connected to each other with taps by tubes and plastic water pipes. Treated water samples were collected and analyzed in laboratories.

Selection Parameters

Test samples before and after treatment were analyzed in both sets (Plant bed and control bed) for selective parameters like pH, TSS, TDS, TN, COD, BOD, PO4, DO and using standard methods. Soils used in before and after treatment in both beds of CWs were analyzed. Finally, pollution reduction efficiency and treatment efficiency of the test plant were calculated.

V. RESULT AND DISCUSSION

Table no. 1 P^H value of Colacassia and Canna plants

Sr	Description	Colacassia plant	Canna plant
1	Before treatment	6.8	6.8
2	After 3days	6.9	7.0
3	After 7days	7.1	7.2
4	After 15days	7.2	7.2

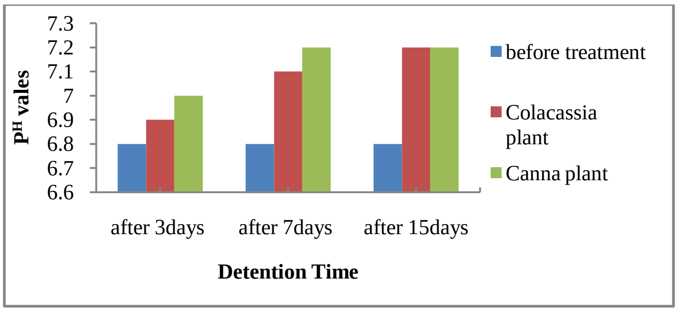
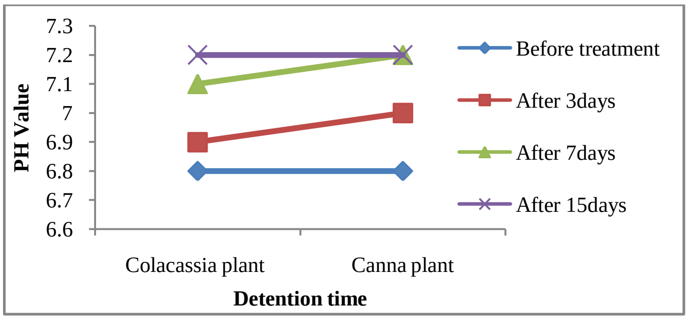


Chart no. 1 P^H value of Colacassia and Canna plants



Graph no. 1 P^H value of Colacassia and Canna plants

Table no. 1 P^H value of Babies Spider plant and Red leaf cordyline fructicosa plant

Sr	Description	Babies Spider plant	Red leaf cordyline fructicosa plant
1	Before treatment	6.8	6.8
2	After 3days	6.7	7.0
3	After 7days	6.9	6.8
4	After 15days	7.1	7.1

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

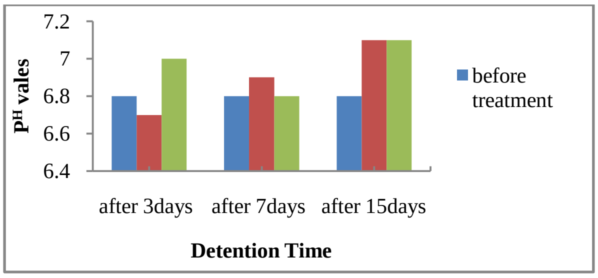
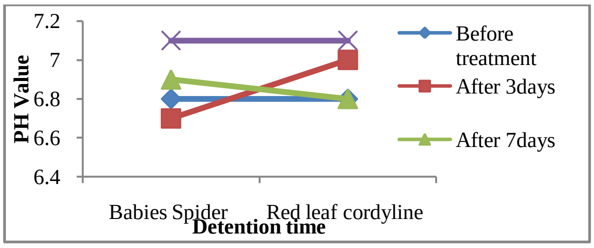


Chart no. 1 P^H value of Babies Spider plant and Red leaf cordyline fructicosa plant



Graph no. 1 P^H value of Babies Spider plant and Red leaf cordyline fructicosa plant

Table no. 2 BOD value of Colacassia and Canna plants

Sr. No.	Description	Colacassia plant	Canna plant
1	Before treatment	340.5	340.5
2	After 3days	170.8	173.5
3	After 7days	89.5	85.5
4	After 15days	70.5	69.2

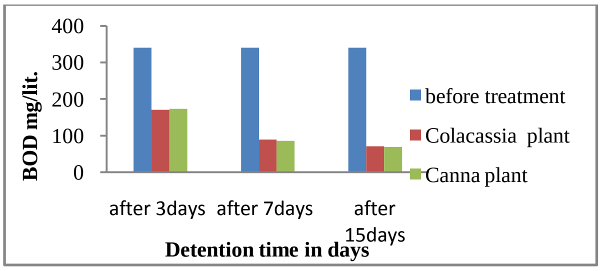
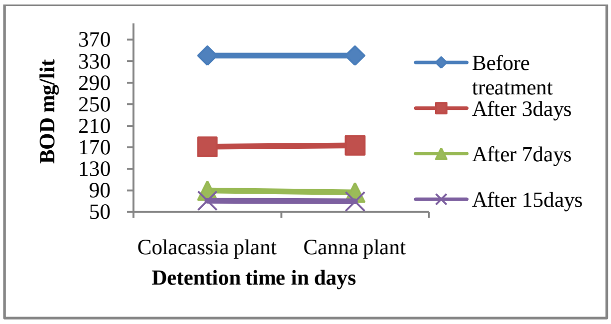


Chart no. 2 BOD value of Colacassia and and Canna plants



Graph no. 2 BOD value of Colacassia and Canna plants

Table no. 2. BOD value of Babies Spider plant and Red leaf cordyline fructicosa plant

Sr. No.	Description	Babies Spider plant	Red leaf cordyline fructicosa plant
1	Before treatment	340.5	340.5
2	After 3days	172.5	172.5
3	After 7days	85.5	84.5
4	After 15days	72.5	79.2

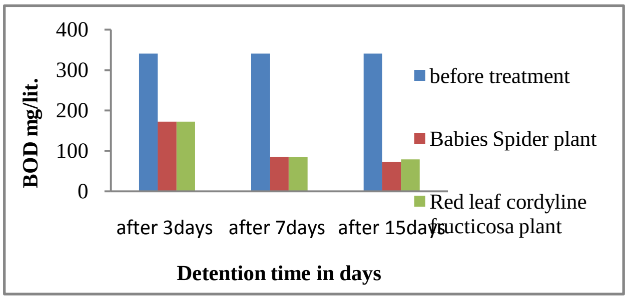
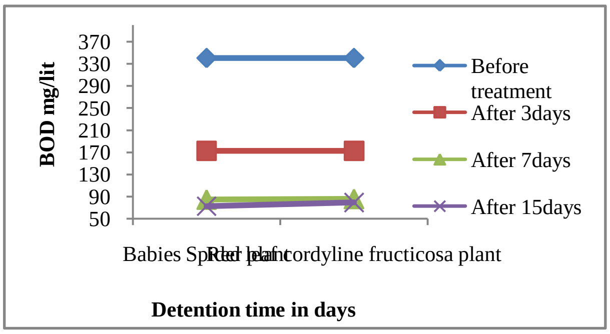


Chart no. 2 BOD value of Babies Spider plant and Red leaf cordyline fructicosa plant



Graph no. 2 BOD value of Babies Spider plant and Red leaf cordyline fructicosa plant

Table no. 3 COD value of Colacassia and Canna plants

Sr. No.	Description	Colacassia plant Mg/lit	Canna plant Mg/lit
1	Before treatment	443.5	443.5
2	After 3days	212.8	217.2
3	After 7days	91.2	94.8
4	After 15days	80.5	82.8

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

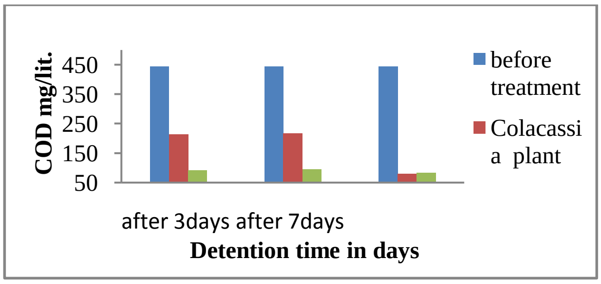
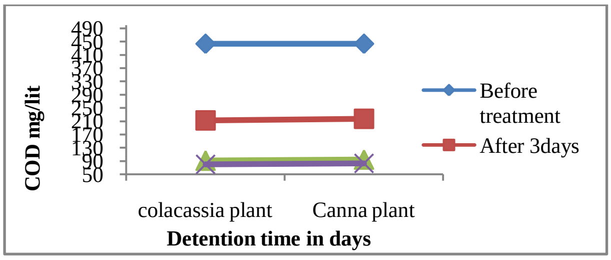


Chart no. 3 COD value of Colacassia and Canna plants



Graph no. 3 COD value of Colacassia and Canna plants

Table no. 3 COD value of Babies Spider plant and Red leaf cordyline fructicosa plant

Sr. No.	Description	Babies Spider plant	Red leaf cordyline fructicosa plant
1	Before treatment	443.5	443.5
2	After 3days	249.5	227.5
3	After 7days	91.2	90.8
4	After 15days	80.5	80.8

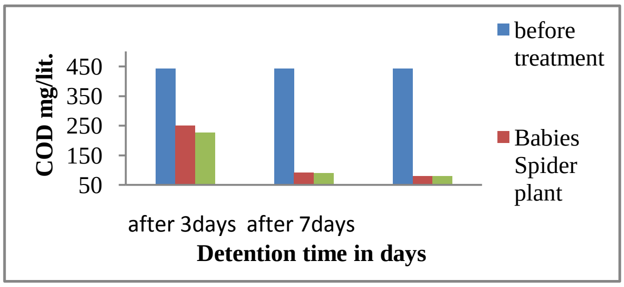
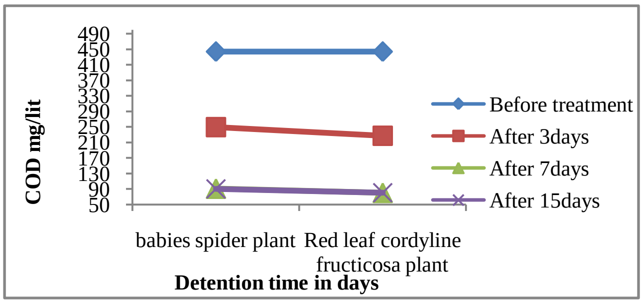


Chart no.3 COD value of Babies Spider plant and Red leaf cordyline fructicosa plant



Graph no.3 COD value of Babies Spider plant and Red leaf cordyline fructicosa plant

Table no. 4 TDS value of Colacassia and Canna plants

Sr. No.	Description	Colacassia plant Mg/lit	Canna plant Mg/lit
1	Before treatment	900.5	900.5
2	After 3days	604.5	600.2
3	After 7days	552.8	550
4	After 15days	480.2	485.8

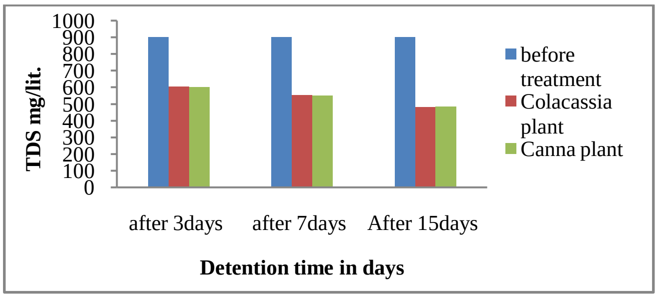
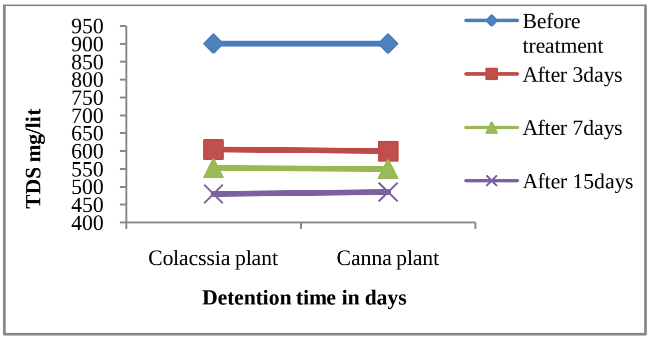


Chart no. 4 TDS value of Colacassia and Canna plants



Graph no. 4 TDS value of Colacassia and Canna plants

Table no. 4 TDS value of Babies Spider plant and Red leaf cordyline fructicosa plant

Sr. No.	Description	Babies Spider plant Mg/lit	Red leaf cordyline fructicosa plant Mg/lit
1	Before treatment	900.5	900.5
2	After 3days	590.5	580.2
3	After 7days	552.8	525
4	After 15days	450.25	425.5

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

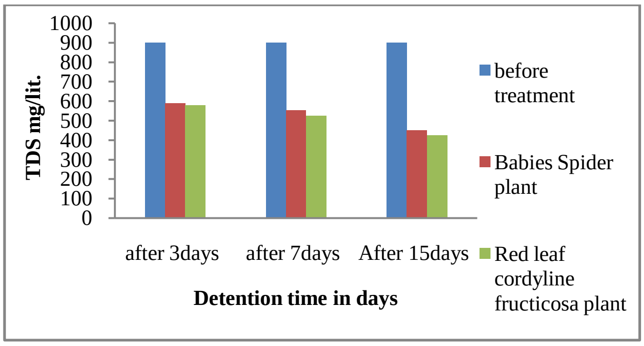
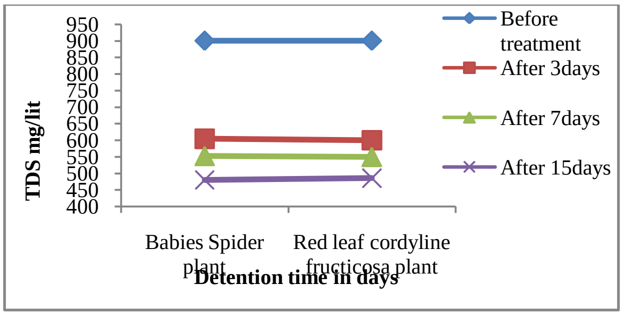


Chart no. 4 TDS value of Babies Spider plant and Red leaf cordyline fructicosa plant



Graph no. 4 TDS value of Babies Spider plant and Red leaf cordyline fructicosa plant

Table no. 5 TSS value of Colacassia and Canna plants

Sr. No.	Description	Colacassia plant	Canna plant
1	Before treatment	185.5	185.5
2	After 3days	132.4	125.6
3	After 7days	74.8	79.2
4	After 15days	64.2	63.8

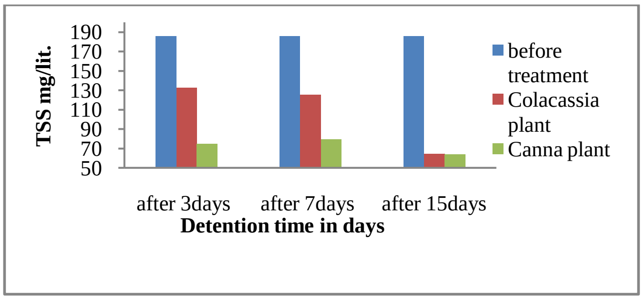
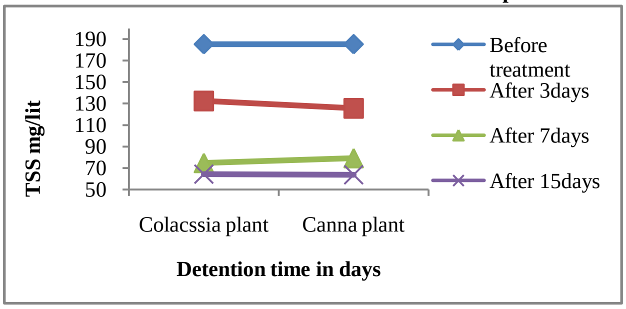


Chart no. 5 TSS value of Colacassia and Canna plants



Graph no. 5 TSS value of Colacassia and Canna plants

Table no. 6 Nitrogen value of Colacassia and Canna plants

Sr. No.	Description	Colacassia plant	Canna plant
1	Before treatment	60.5	60.5
2	After 3days	27.6	29.5
3	After 7days	13.8	15.5
4	After 15days	11.5	12.2

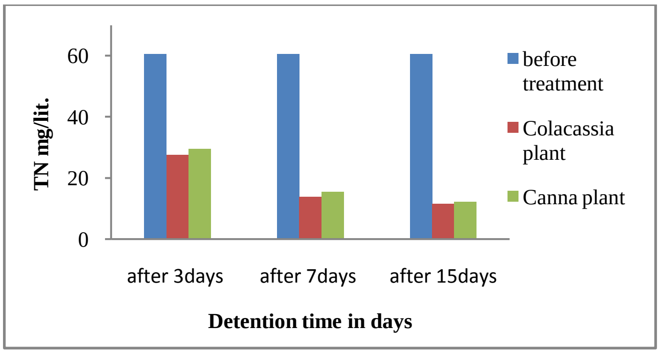
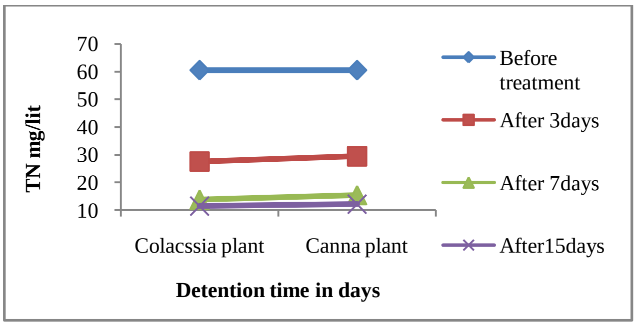


Chart no. 6 Nitrogen value of Colacassia and Canna plants



Graph no. 6 Nitrogen value of Colacassia and Canna plants

Table no. 7 Phosphate value of Colacassia and Canna plants

Sr. no.	Description	Colacassia plant	Canna plant
1	Before treatment	32.5	32.5

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 6, Issue 5, pp 150-161, May-2022

https://doi.org/10.47001/IRJIET/2022.605019

2	After 3days	22.6	23.8
3	After 7days	11.8	12.5
4	After 15days	9.5	9.4

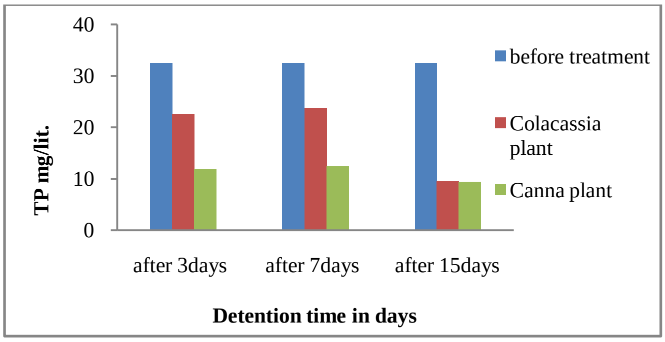
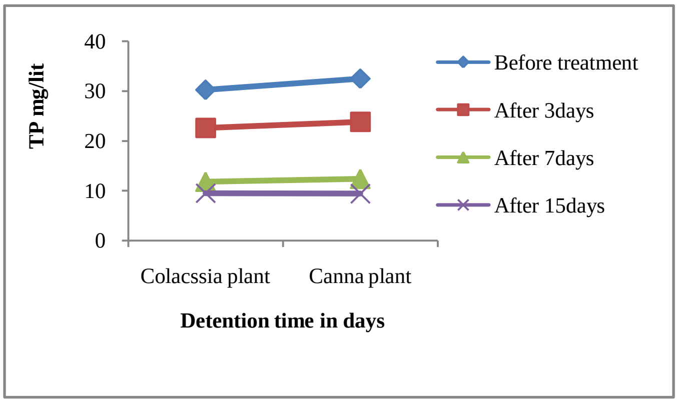


Chart no. 7 Phosphate value of Colacassia and Canna plants



Graph no. 7 Phosphate value of Colacassia and Canna plants

VI. COST ANALYSIS

6.1 Cost Analysis

Cost of conventional method of sewage treatment

Cost analysis of conventional treatment with Activated Sludge Process (ASP) including primary treatment, secondary treatment and chlorination is given below.

The construction cost of ASP plant= 90 lakh per MLD.
Land requirement / MLD plant = 1 acre.
Land cost/MLD = 30 lakh per acre.

Therefore, Capital Investment required for setting up 1MLD sewage treatment plant consisting activated Sludge process

= Cost of construction + Cost of land required
= 90, 00,000 + 30, 00,000
= Rs 1, 20, 00,000 /-

The operational and maintenance cost including interest on capital, electricity consumption, skilled and unskilled labor cost, repair and maintenance cost and depreciation of civil and mechanical works ,the revenue obtained is worked out to Rs12 per 1000 liters of sewage. Thus the operation and maintenance cost for operating conventional sewage treatment plant of 1 MLD is about Rs 43,80,000/year.

Cost analysis of Root Zone Technology treatment plant

For comparing the cost economics of root zone technology with conventional method, sewage treatment plant of 1MLDconsisting root zone technology is considered.

Land requirement/MLD = 3.5 acres.
Cost of land = 30 lakh per acre
= 30 x 3.5 acres=70 lakh.
Cost of excavation for construction of RZT reactor = 18 lakh.
Cost of filter media = 40 lakh.
Cost of polyethylene sheeting= 14 lakh.

Therefore, capital investment required for setting up the Root Zone Technology (RTZ) treatment plant, = Cost of construction + Cost of land = (18 lakhs + 40 lakhs + 14 lakhs) +105 lakhs = Rs 177 lakhs /- The operational and maintenance cost or treatment cost is determined considering following items,

i) Labor for watering, cutting and maintenance.
= 3 labors per acre x Rs 200 x 365 days x 3.5 acres.
= Rs 7, 67,000 /-
ii) Interest on investment at 8 % = Rs 1416000 /-
iii) Revenue generated from plants per year = Rs 6, 00,000 /-

Treatment cost =Labor cost+ Interest on investment at 8% - Revenue obtained by selling the plant. Treatment Cost = 7, 67,000 + 14,16,000 – 6,00,000= Rs 15,08,000 /- Total sewage treated per year = 365X 1 MLD=365 million liters=365 X 1000 X1000 liters. Therefore, treatment cost per m3 of sewage = (15,08,000) /(365X1,000) = Rs 4.13/- Therefore the treatment cost of sewage using Root Zone Technology is Rs 4.13 per 1000 liters or Rs 4.13 per m3 which is very less as compared to the treatment cost of Rs 12 per m3 for Conventional Sewage treatment

VII. CONCLUSION

Constructed Wetlands are being extensively used in developing countries to treat domestic, agricultural and industrial wastewater and urban and highway runoff for current status of application of the root zone system especially used for domestic’s wastewater.

It is concluded from the above project that the method of RZT is capable to reduce pollutant levels shown below.

ISSN (online): 2581-3048
Volume 6, Issue 5, pp 150-161, May-2022
https://doi.org/10.47001/IRJIET/2022.605019

1. The Initial PH of before treatment is 6.8 and after treatment by plant RZT s 7.2 And by a cane plant is 7.2
2. BOD is decreasing by root zone after 3days, 7days, 15days and are 50%, 74%, 79% respectively
3. COD decreasing by root zone after 3days, 7days, 15days are 52%, 78%, 82% respectively..
4. TDS decreasing by root zone after 3days, 7days, and 15days is 33%, 39%, 47% respectively.
5. TSS decreasing by root zone after 3days, 7days, and 15days is 29%, 60%, 65% respectively.
6. Nitrogen decreasing by root zone after 3days, 7days, and 15days is 54%, 77%, 81% respectively.
7. Phosphate decreasing by root zone after 3days, 7days, 15days is 30%, 64%, 70% respectively.
8. The overall study strongly recommends the use of CWs for treatment of domestic wastewater for pathogenic bacteria, besides pollutants.

ACKNOWLEDGMENT

At the outset, I wish to express my deep sense of gratitude to my project guide **Prof. Vrinda S.Bhalerao** for his guidance and encouragement, without which it would have not been possible. I would like to thank **Dr. V.M.Natraj**, Head, civil Engineering Department for his encouragement, guidance and allowing us to use the all facilities in the department. I am also grateful to Principal **Dr. N. G.Nikam** who has been a constant source of my inspiration. At the last I also like to thank my family. I am also thankful to my friends who has helped me completion of this project report.

REFERENCES

[1] Bansari Ribadiya Mehali J. Mehatal (2014), “Treatment of municipal and industrial wastewater by reed bed technology”, Journal of Engg. Research and Application, Vol. 4, Issues 12 (Part 3) Page 15-18.

[2] Chavan B.L.Dhulap V.P (2013), “Developing a Pilot Scale Angular Horizontal Subsurface Flow, Constructed Wetland for Treatment of Sewage through Phytoremediation with Colocasia esculenta”, International Journal of Environmental Sciences, Vol.2 (2), page 6-14.

[3] Calheiros, Cristina S.C. Antonio O.S.S. Rangel, Paula M.L. Castro (2007), “Constructed wetland systems vegetated with different plants applied to the treatment of tannery wastewater”, Water Research 41 page-1790-1798.

[4] Desai Binita and Pratibha Desai (2014), “Root-zone technology as energy efficient and cost effective for sewage water treatment Biomed Research’’, International Journal of Pharmacy & Bioscience, IJPBS 14 04 Volume 01, Page 1-6.

[5] Dhulap V. P. And S. S. Patil (2014), “Removal of Pollutants from Sewage through Constructed Wetland using Pennisetum purpureium’’, Europian Academic Research, Vol. II, page 52-64.

[6] George Alex, Robin, Tiwari Gaurav, (2014), “Multi-Stage Organic Water Filter System’’, Global Humanitarian Technology Conference, page 458-461.

[7] Irfan Naseemul, M V Molykutty (2015), “Holistic Household Waste Management at Source- An Experimental Study’’, Volume IV, Page 12-16.

[8] Joshi, S. & S. S. Patil (2009),“Eco planning and eco technological n solutions for the wastewaters from point and Non-Point sources of modern urbanization in the Ujjani Reservoir Catchment’’, International Journal of Pharmacy & Bioscience , Volume, I, Page 45-68.

[9] Kumer Makvana & Manish K.Sharma (2013), “Assessment of Pathogen Removal Potential of Root Zone Technology from Domestic Wastewater’’, Universal Journal of Environmental Research and Technology, Volume 3. Page 401-406.

[10] Mane Mahesh, Bhupen Patil, Mohite Powar, Yatin Gohil,Akshaya Ghalimath (2017), “Introduction to Waste Water Treatment by Root Zone Technique’’, International Research Journal of Engineering and Technology, Volume 04, page 1691-1694.

[11] Mthembu M.S.Odinga CA, Swalaha FM. Bux F. (2013), “Constructed wetlands: A future alternative wastewater treatment technology’’, African Journal of Biotechnology, Vol 12 (29), pp.4542-4553.

[12] Nanda Sahil (2017), “Root Zone waste water Treatment of domestic sewage’’, African Journal of Biotechnology Volume 04, page 568-89.

[13] Parmar jigar, Dr. Dipak S. Vyas, & Dr. Robin A. Christian (2016), “Experimental study of post treatment of dairy wastewater is using hybrid reed bed technology’’ Journal of Ecology and Environmental Sciences, Issue – 3, Vol. 2, page 618-628.

[14] Pawaskar S.R. (2012), “application of modified root zone treatment system for waste water treatment within nallah area’’ Journal of Ecology and Environmental Sciences, Volume 3, page 46-49.

[15] Panchani Monika & Sawant S. (2013), “Identification and Quantification of Non-Point Sources of pollution of Sabarmati River, Ahmadabad’’ International Journal of Current Microbiology and Applied Sciences, Vol12 (29), 618-712.

[16] Ravala A.A. Desai P. B. (2015), “Root Zone Technology: Reviewing its past Present’’ International Journal of Current Microbiology and Applied Sciences, Volume 4, page 238-247.

[17] Shitole Dhiraj (2014), “Feasibility Study of Low Cost Treatment for Non Point Sources’’ International

ISSN (online): 2581-3048
Volume 6, Issue 5, pp 150-161, May-2022
https://doi.org/10.47001/IRJIET/2022.605019

Journal of Current Microbiology and Applied Sciences, Vol.2 (2). Page 781-792.

[18] Shinde Sagar, Suraj Phad, Prashant Mishra, Saurabh Gaikwad, Shubham Bharade (2017), "low cost sewage treatment by root zone technology'' International Journal of Current Microbiology and Applied Sciences, Page 44-51.

[19] Sahu Omprakash (2014), "Reduction of Heavy Metals from Waste Water by Wetland'' International Letters of Natural Sciences, Vol 12 page 35-45.

[20] Smith, E. & Robert R. (2012), "Economics of water Quality Protection from Non-Point Sources", Journal of Scientific & Industrial Research, Volume 3, Issue 1, page 33-42.

[21] Thakur Kalpana Kumari, Avinash Bajpai & Shailbala Singh Baghel (2014) , "Wastewater Treatment through Root Zone Technology with Special Reference to Shahpura Lake of Bhopal (M. P.), India'', Journal of Scientific & Industrial Research, volume 3, page 169-175.

[22] Vasudevan Padma, Paul Griffin, Alam Warren, Alka Thaliyap & Mamta Tandon (2011) , "Localized domestic wastewater treatment part I- constructed'' Journal of Scientific & Industrial Research, Vol. 70, page 583-594.

[23] Zafar Equbal,& Chamundeeswari (2012), "Wastewater Management by Root Zone Technology'', International Journal of Computer Organization Trends , Volume 2, Issue 2, page 41-46.

[24] Dr. H. Karibasappa, A.Akila, N.Dhanabal, R.Dharani, K.Dhinesh (2017), "An Experimental Investigation on Recycling of Grey Water Naturally by Using Canna Plants'', International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, Issue – 3, page 3737-3743.

Citation of this Article:

Prof. Vrinda Bhalerao, Poonam S. Thorat, Rutuja G. Thormote, Prashant R. Bhasakar, Ranjan J. Palvi, "Wastewater Treatment by Root Zone Technology Using Decorative Plants" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 6, Issue 5, pp 150-161, May 2022. Article DOI https://doi.org/10.47001/IRJIET/2022.605019

****