International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

Latex Industrial Wastewater Treatment by Root Zone Technology

Aswathy Johnson, M.A Chinnamma, Anitha k
1,Student,Malabar College of Engineering and Technology Desamangalam,Thrissur.
2Proof,MalabarCollege of Engineering and Technology Desamangalam,Thrissur.
3Assi.Proof,MalabarCollege of Engineering and Technology Desamangalam,Thrissur.

Submitted: 01-07-2021 Revised: 10-07-2021 Accepted: 13-07-2021

ABSTRACT: Increasing urbanization and human activities exploits and affect the quality and quantity of the water resources. This has resulted in pollution of fresh water bodies due to increased generation of domestic waste, sewage, industrial waste etc. This paper reviews the Root Zone Treatment System (RZTS) which are planted filter-beds consisting of soil. This Technology uses a natural way to effectively treat domestic and industrial effluents. Phytoremediation for fifteen days by constructed wetland technology reduced the cheracteristics effluents like,chemical oxygen demand, biochemical oxygen demand, pH, TN,TSS,TDS etc. of the effluent considerably.

KEYWORDS: Root Zone Technology, natural rubber waste water, chemical oxygen demand,constructedwetland technology,Colacassia and Vetiver plants.

I. INTRODUCTION

Industries are major sources of pollution in all environments. Rubber industry is an economically and socially significant industry. It consumes large volumes of water, uses many chemicals and produces enormous amount of effluent. It is later discharged into the water ways and causes pollution that affects human health. The rubber industry produces environmental pollutants, which are highly objectionable, from natural rubber processing. The high concentrations of nitrogen and organic and inorganic loading in rubber wastewater pose serious threats to the environment.

Various methods for treating this type of waste exist in the world, the most important of which are biological, aerobic, anaerobic, and physicochemical methods, and root zone technology. Wastewater collected from rubber processing industry was characterized for their pollution characteristics. Results of the analysis showed that the total dissolved solids (TDS), total suspended solids (TSS), total solids (TS), ammonia and phosphate, biochemical oxygen demand (BOD) and chemical oxygen demand (COD)compared to effluent discharge standard for industrial wastewater. respectively, which showed that the wastewater was high in pollution potentials and need to be treated before discharged to the environment. 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 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.

II. OBJECTIVES

The main objectives of this project are follows:
(i) Analyze and characterize the waste water from latex industry.
(ii) Investigate the feasibility of applying a constructed wetland system to treat the latex

III. LITERATURE REVIEW

3.1 HISTORY OF ROOT ZONE TECHNOLOGY

Root Zone technology originated from research conducted in Europe by Seidel and Kickuth at the Max Planck Institute in Plan, Germany starting in 1952 (Bastion and Hammer, 1992). Increasing urbanization and human activities exploits and affect the quality and quantity of the water resources. This has resulted in pollution of fresh water bodies due to increased generation of domestic waste, sewage, industrial waste etc. This paper reviews the Root Zone Treatment System (RZTS) which are planted filter- beds consisting of soil. This Technology uses a natural way to

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

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.

3.2 SIGNIFICANCE OF THE STUDY AREA

The wastewater from Malankara Latex Ltd. (HLL), Kerala, India were used for the root zone technology research purpose. Wastewater in this factory originates from washing of the centrifuge at the end of each operation, from coagulation milling sections and spill over from tanks and floor washings.

Fig. 3.1 Study Area

W.Chen(2007), In this workA wastewater culture system was designed to study the root growth of eight species of wetland plants with two different root types. The system included a plastic barrel for holding the wastewater and a foam plate for holding the plant. The results indicated that the root growth of the plants with fibril roots was faster than that of the plants with rhizomatic roots.

Wagh K.K(2014),In this paper the Large quantity of sewage is generated in urban and semi urban areas. Due to the lack of cost effective treatment methods, the world is facing problem of sewage treatment and disposal.Much advancement has taken place in the treatment technology both in aerobic and anaerobicmethods. However, huge capital investment is required for providing treatment facilities, also disposal of the treated effluents is a major problem. The operation and maintenance cost in case of conventional sewage treatment plant is estimated to about Rs 12 per 1000 litres. As treatment cost is high, sewage is directly discharged into the rivers or nearby water bodies and polluting the major sources of water available to the society.

Deepu Sukumaran(2013),The present study is an attempt to have a comparative assessment of the efficiency of aquatic weeds like Typha latifolia, Eichhornia crassipes, Pistia stratiotes to treat the effluents from latex factory, in constructed wetlands. Ammonification of field latex, acid coagulation of skim latex and various chemical treatments during the production process of various products were found to be responsible for the high concentration of pollutants in this factory effluent. Phytoremediation for fifteen days by constructed wetland technology reduced the chemical oxygen demand, biochemical oxygen demand, pH, total solids of the effluent considerably.

IV. METHODOLOGY

4.1 WASTEWATER COLLECTION FROM MALANKARA LATEX INDUSTRIAL OUTLET

The wastewater from Malankara Latex Ltd. (MLL) out let, Kerala, India were used for the Root zone research water samples from the respective treatment sets were collected periodically for analyzing the changes in its physico-chemical characteristics. Water and plant samples were taken initially and subsequently with an interval of 5 days up to 15 days. Thus the analyses of water samples were carried out at four stages of treatment.

\
Fig. 4.1 Wastewater Collected From Malankara Latex Industrial outlet

Fig. 4.2 Collected Sample

4.2 CONSTRUCTION PROCEDURE OF ROOT ZONE TECHNOLOGY

Construction Wetland: In my work I designed and constructed wetland of size 35c.m x 55 c.m x 45c.m for both Colacassia and vetiver plant. Consider length of reactor 55c.m, height 35c.m and thickness 45c.m. In above figure shows section and plan of constructed reactor. At lower level consider 10c.m thick with aggregate 10mm size. Middle layer 10c.m thick with natural sand and top layer of 5c.m thick with black cotton soil. The aggregate cleaned by water before keeping in reactor similarly cleaned sand by water before keeping in reactor. Filled all layers simultaneously in reactor and keep it for one day or two day. Prepare two system parallel for vetiver plants and Colocassia plants.To prevent entry of soil into under drain pipe and washing out of soil a graded filter is provided at the blower portion of the reactor. The filter consist of crushed stone of gradation 40mm at bottom near to under drain pipe to 5mm at 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.

Fig. 3.3 Experimental Setup

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

(a)

(b)

(c)

Fig. 4.3 (a) Sample Before and Aafter Treatmemt. (b) Smple Before and After Treatment of Colocassia Plants(5d,10d,15d).(c) Sample Before and After Treatment of Vetiver Plants(5d,10d,15d).

V. RESULT AND DISCUSSIONS

5.1 BASIC DESCRIPTION

Test samples before and after treatment were analyzed in the vertical root zone technology by the two type of plants colocassia and vetiver plants used for the treatment characteristics fluids like pH, TSS, TDS, TN, COD, BOD,Turbidity, Colour and using Root zone technology. Finally, wastewater reduction efficiency and treatment efficiency of the test plants were calculated. The results of the chemical characteristics of Latex industrial waste waters are given.

5.2 SAMPLE CHARACTERISTICS

The below table shows the initial sample value of the latex industrial wastewater and its limits.Such as pH,TDS,TSS,TN,BOD,COD,Turbidity and Colour.

Table 5.1 Sample Characteristic and Desirable Limts

CHARACTERISTICS	OBSERVED VALUE (Initial value of Sample)	DESIRABLE LIMIT (as per CPCB)
pH	4	6-8
TDS(mg/l)	2250	2100
TSS(mg/l)	2180	100
TN(mg/l)	97	50
BOD(mg/l)	4978	30-100
COD(mg/l)	8579	250
TURBIDITY(NTU)	32.2	1-5
COLOUR	Slightiy whitesh yellow	

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

5.3 COMPARISON OF COLOCASSIA AND VETIVER PLANTS IN ROOT ZONE TECHNOLOGY

The following table shows the comparison between Colocassia and Vetiver plants. From the table it is clear that the rootzone technology is most suitable method for treating latex industrial waste water.

Table 5.2 Comparison of Colocassia and Vetiver plants

Parameters analysed	Detention time in days	Colocassia plants	Vetiver plants	DESIRABLE LIMIT(as per CPCB)
pH	5 day	4.6	4.8	6-8
	10 day	5.5	5.9	
	15 day	6.2	6.5	
TDS(mg/l)	5 day	1750	1748	2100
	10 day	955	945	
	15 day	613	605	
TSS(mg/l)	5 day	1050	1038	100
	10 day	840	827	
	15 day	756	745	
TN(mg/l)	5 day	76	73	50
	10 day	43	38	
	15 day	32	29	
BOD(mg/l)	5 day	3100	3047	30-100
	10 day	1975	1968	
	15 day	975	965	
COD(mg/l)	5 day	7115	7109	250
	10 day	4565	4549	
	15 day	2755	2748	
TURBIDITY(NTU)	5 day	25.5	23	1-5
	10 day	18	17.8	
	15 day	13.2	10.8	

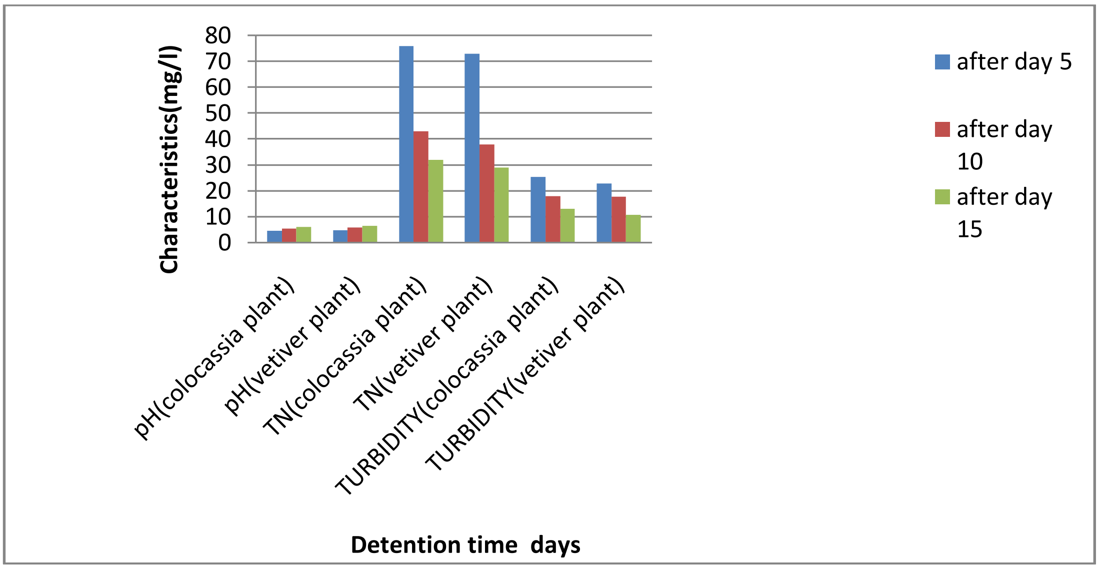

Fig.5.1 Comparison of Colocassia and Vetiver plants

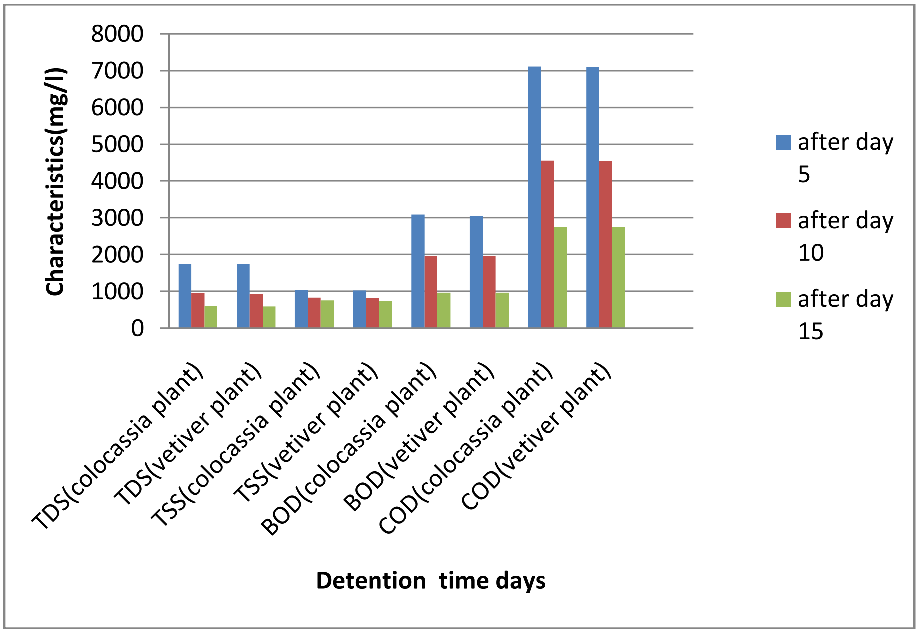

Fig. 5.2 Comparison of Colocassia and Vetiver plants

The comparison of vetiver and colocassia plants in root zone technology, comparison of pH after 15 days are 6.2 in colocassia plant and 6.5 in vetiver plants. comparison of TDS after 15 days are 613 in colocassia plant and 605 in vetiver plants.The vetiver plants more remove in TDS.The comparison of TSS after 15 days are 756 in colocassia plant and 745 in vetiver plants.The vetiver plants more remove in TSS. The comparison of TN after 15 days are 32 in colocassia plant and 29 in vetiver plants.The comparison of two plants vetiver plants is more remove in TN. The comparison of BOD after 15 days are 975 in colocassia plant and 965 in vetiver plants.The comparison of two plants vetiver plants is more remove in BOD. The comparison of COD after 15 days are 2755 in colocassia plant and 2748 in vetiver plants.The comparison of two plants vetiver plants is more remove in COD. The comparison of Turbidity after 15 days are 13.2 in colocassia plant and 10.8 in vetiver plants.The comparison of two plants vetiver plants is more remove in Turbidity. The pH,TDS and TN are attaining desirable limits. Removal of parameters is

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

higher for vetiver plants as compared to colacassia plants in root zone technology.Costs of both processes are nearly equal.Root zone technology is a promising technology for applications in wastewater treatment.

5.4 TREATMENT EFFICIENCY OF COLOCASSIA AND VETIVER PLANTS IN ROOT ZONE TECHNOLOGY

The following table shows the Treatment Efficiency between Colocassia and Vetiver plants. From the table it is clear that the rootzone technology is most suitable method for treating latex industrial waste water.

Table 5.3 Comparison of Treatment Efficiency

Parameters analysed	Detention time in days	Colocassia plants (%)	Vetiver plants (%)
pH	5 day	15%	20%
	10 day	37.5%	47.5%
	15 day	55%	62.5%
TDS(mg/l)	5 day	22%	22%
	10 day	57.5%	58%
	15 day	73%	74%
TSS(mg/l)	5 day	52%	53%
	10 day	61.5%	62%
	15 day	65%	66%
TN(mg/l)	5 day	22%	25%
	10 day	56%	61%
	15 day	67%	70%
BOD(mg/l)	5 day	38%	39%
	10 day	60%	61%
	15 day	80.5%	81%
COD(mg/l)	5 day	17%	17%
	10 day	47%	47%
	15 day	68%	68%
TURBIDITY(NTU)	5 day	21%	29%
	10 day	44%	45%
	15 day	59%	66.5%

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

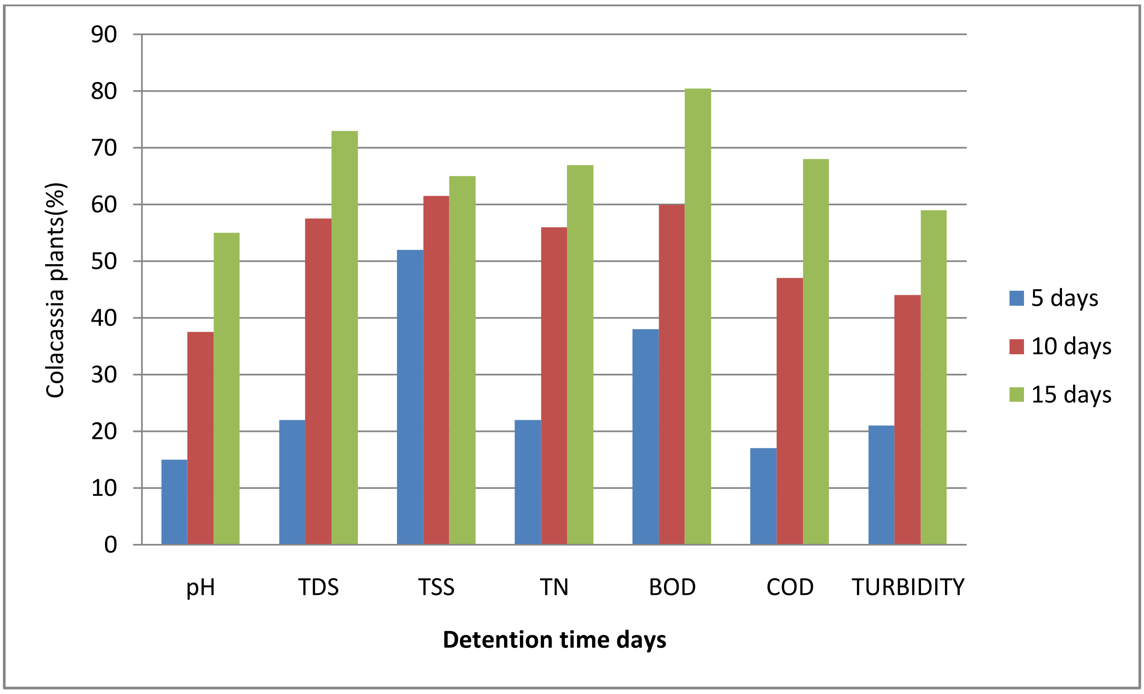

Fig. 5.3 Treatment Efficiency of Colocassia Plants.

Fig 5.3 shows the treatment efficiency of colocassia plants in rootzone technology.This process can minimize most of the disadvantages of conventional processes.Percentage removal of pH after 5days,10days and15days are 15%,37.5% and 55% respectively.TDS decreasing by rootzone Technology in colocassia plant after 5days,10days and15days are 22%,57.5%,73% respectively.TSS decreasing by rootzone Technology in colocassia plant after 5days,10days and15days are 52%,61.5%,65% respectively.TN decreasing by rootzone Technology in colacassia plant after 5days,10days and15days are 22%,56%,67% respectively.BOD decreasing by rootzone Technology in colocassia plant after 5days,10days and15days are 38%,60%,80.5% respectively. COD decreasing by rootzone Technology in colocassia plant after 5days,10days and15days are 17%,47%,68% respectively. Turbidity decreasing by rootzone Technology in colocassia plant after 5days,10days and15days are 21%,44%,59% respectively. Costs of both processes are nearly equal.Root zone technology is a promising technology for applications in wastewater treatment.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

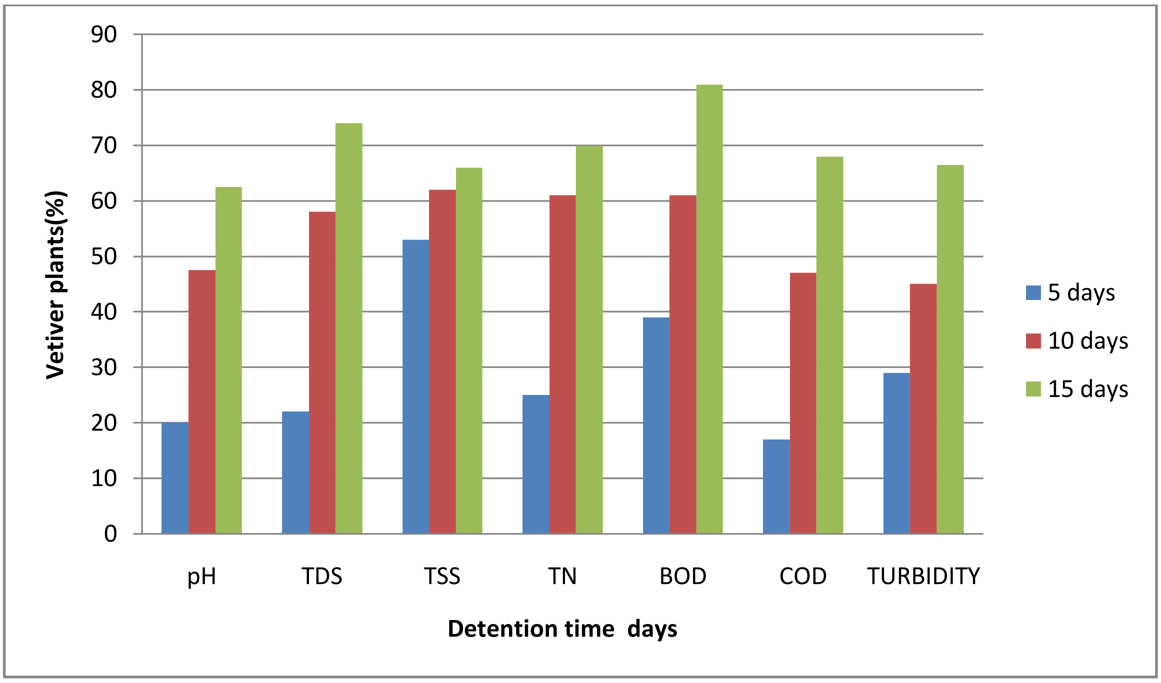

Fig. 5.4 Treatment Efficiency of Vetiver Plants

Fig 5.4 shows the treatment efficiency of Vetiver plants in rootzone technology.This process can minimize most of the disadvantages of conventional processes.Percentage removal of pH after 5days,10days and15days are 20%,47.5% and 62.5% respectively.TDS decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 22%,58% and 74% respectively.TSS decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 53%,62%,66% respectively.TN decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 25%,61%,70% respectively.BOD decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 39%,61%,81% respectively. COD decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 17%,47%,68% respectively. Turbidity decreasing by rootzone Technology in vetiver plant after 5days,10days and15days are 29%,45%,66.5% respectively.The treatment efficiency is higher for vetiver plants as compared to colacassia plants in root zone technology.Costs of both processes are nearly equal.Root zone technology is a promising technology for applications in wastewater treatment.

VI. CONCLUSIONS

Latex industry is an economically and socially significant industry. It consumes large volumes of water, uses many chemicals and produces enormous amount of effluent. It is later discharged into the water ways and causes pollution that affects human health.Various conventional methods for waste water treatment are present from ancient times, but most of them are complex and lengthy in nature.Root zone technology can minimize most of the disadvantages of conventional processes. From this study, the emergent plants colocassia and vetiver based constructed wetland has proved as a promising technology for removing pollutants from latex industry effluents. Its rooted nature has favored increased rhizosphere activity, thereby enhancing nutrient and pollutant removal.Colocassia and Vetiver plants reduce considerably.

It is concluded from my project that the method of root zone technology is capable to reduce pollutant level in the latex industrial wastewater.The pollution was effectively remove 60% to 70% of characteristics effluent in the wastewatertreatment up to my work.Efficiency is higher for vetiver plants as compared to colocassia plants in root zone technology.Costs of both processes are nearly equal.Root zone technology is a promising technology for applications in Latex industrial wastewater treatment.The Any treatment system should be able to reduce or eliminate pollutant level in the latex industrial wastewater. In the present study, it was observed that the the wastewater efficiency of the rootzone system was significant within 15 days of its operation. The adjustable outflow helped in maintaining the water level below the surface in the root zone system .

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 7 July 2021, pp: 1681-1690 www.ijaem.net ISSN: 2395-5252

6.1 Significance & Future Perspectives Of The Study

The experimental period of this study is not sufficient to develop microbial community in the root zone of macrophytes as well as on the growing media. Therefore,future studies should focus on long term experiments to develop and to interact microbial community with the macrophytes(colacassia,vetiver etc.) and growing media to enhance the removal potential of such water quality parameters to improve the efficiency of the constructed wetland systems.Best suitable for villages,small towns and cities.Locally available material can be used and required skilled labour for construction.

REFERENCES

[1]. **Mahesh Mane** (2017) Introduction to waste water treatment by root zone technique, International Journal of engineering and technology Vol.4, December 2013

[2]. **G.Baskar** (2009) Root zone technology for campus waste water treatment International Journal enviromental Research and developmentVol. 3, 439-451

[3]. **A Raval** (2015) Root zone Technology Reviewing its past and present, International Journal of Microbiology and applied Science, Vol.4

[4]. **Varne Ashok** (2016)Low cost Treatment of sewage using root zone technology Journal of enviromental Research and development Vol.9, October 2016

[5]. **B.L. Chavan** (2020) Design and testing of wastewater in constructed wet land using parameters karka,International journal of physical and social sciences ,Vol 5

[6]. **Gokil Ramanan,Vijayan N** (2015) Treatment of Waste Water from Natural Rubber Processing Plant,International Journal of Scientific Engineering and Research(IJSER) ISSN:2347-3878,Impact Factor(2015):3.791

[7]. **Dhanya G,Jaya D.S** (2013) Waste Water Treatment Efficiency of Vetiver Grass in Construted WetlandsnJournal of Aquatic Biology and Fisheries, Vol.2

[8]. **Dipu Sukumaran** (2013) Phytoremediation of Latex Effluent by Constructed Wetland Technology Applied Ecology and Environmental Sciences,vol.6 p.g 104-109

[9]. **Poonam Thorat,Sayyad Saniya** (2019) Domestic WasteWater Treatment by Root Zone Technology Option:Colacassia Plant International Journal of Engineering and Management Research, Vol.2

[10]. **Nimmy P.K, Anjali K Ullas** (2020) Coagulation Efficiency of Mangifera Indica Leaf Powder and Curcumin on Treatment of Rubber Effluent International Research Journal of Engineering and Technology,vol.7