International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON FOOD INDUSTRY WASTEWATER TREATMENT BY REED BED TECHNOLOGY USING CYPERUS ROTUNDUS AND PENNISETUM PERPUREIUM PLANTS

Swathy M R[1], Habeeba V[2]

[1]*M.Tech scholar, Dept. of Civil Engineering, Malabar College of Engineering & Technology, Kerala, India*
[2]*Assistant Professor, Dept. of Civil Engineering, Malabar College of Engineering, & Technology, Kerala, India*

Abstract – *Food industry produces large quantities of wastewater from processing, making and cleaning processes. Improper treatment and disposal of wastewater cause many environmental issues. In this study a cost effective method for treatment of food industry wastewater using locally available plants was used. The plants used for this study was cyperus rotundus and pennisetum perpureim which is known as nut grass and Napier grass respectively. Two reed beds and one reed less bed were prepared and wastewater was allowed to pass through it. The effectiveness of these plants in pollutant removal from wastewater was analyzed by varying hydraulic retention time 1,2,3,4,5,6 days. The characteristics of water samples before and after treatment were compared and discussed.*

Key Words: Food industry wastewater, reed bed, cyperus rotundus, pennisetum perpureim, hydraulic retention time.

1. INTRODUCTION

The amount of wastewater generating is increasing day by day. Treating wastewater before disposal will decrease the effect of pollution in the environment. Conventional treatment of wastewater is costly, requirement of power and skilled personals are also essential. Reed bed is one of the natural and cheap methods of treating domestic, industrial and agricultural liquid wastes. Reed bed is considered as an effective and reliable secondary and tertiary treatment method where land area is not a major constraint [5]. Reed bed is a biological wastewater treatment technology designed to processes found in natural wetland ecosystems [3]. These systems use wetland plants, soils and their associated microorganisms to remove contaminants from wastewater [3]. Plants provide an environment for microbes to live, they oxygenate the wastewater, providing nutrients for the microbes to survive, they stabilize the soil and they also partake in the reduction of nutrients [10].

1.1 Cyperus rotundus

Cyperus rotundus commonly known as coco-grass, purple nut sedge, red nut sedge, etc., is a species of sedge belongs to Cyperaceae, native to Africa, southern and central Europe and southern Asia [13]. The root system of a young plant initially forms white, fleshy rhizomes. Some rhizomes grow upward in the soil, and then form a bulb-like structure from which new shoots and roots grow, and from the new roots, new rhizomes grow [13].

1.2 Pennisetum purpureum

Pennisetum purpureum belongs to the Kingdom–plantae and Family-Poaceae. The plant produce short, creeping rhizomes 15 to 25 cm long with fine roots at the nodes and culms that are from 2 to 8 m in height, up to 2.5 cm in diameter at the base, and have a solid center[14].

1.3 Food industry wastewater

Major volume of food industry wastewater comes from cleaning and washing process. Variation due to the amount of water usage, type of vegetable and fruits used, type of product and different additives like salt, sugar, gelatin, colors, oil and preservatives added also leads to the pollution load in the wastewater but this wastewater is nontoxic in nature because it comprises less hazardous compounds [15].

2. MATERIALS AND METHODS

Wastewater sample was collected from the food industries situated in the industrial estate kalamassery. Reed bed plants were planted in a plastic container having dimensions 60cm length, 40cm width and 30cm height. Plastic buckets having 35 liters capacity were used as wastewater holding tank. Flexible pipe was connected from holding bucket to the distribution pipe. Distribution pipe was provided with holes at suitable intervals for the smooth distribution of wastewater. A collection pipe was placed at the bottom of the plant bed for the collection of water after treatment. Collection pipe was connected with manual operating pipe at outside. The plant bed was prepared with 3 layers of filter media. The bottom most layer having 10 cm height consist of aggregates having 20 to 30 mm size. Second layer of 5cm consist of aggregates having 10 to 20 mm size. Final 5 cm layer was placed with washed sand. Three units were prepared like this and one unit was planted with Cyperus rotundus other with pennisetum purpureum and last one was kept as reed less bed.

Fig -1: Experimental setup

3. RESULTS AND DISCUSSION

Table -1: characteristics of wastewater

initial characteristics of wastewater	
pH	5.3
BOD	450 mg/l
COD	1980 mg/l
TSS	240 mg/l
TDS	320 mg/l
Nitrate	60 mg/l

The characteristics of wastewater taken from the food industry is described in the table 1. The various tests on the wastewater were conducted as per procedure laid down in standard methods.

3.1 pH

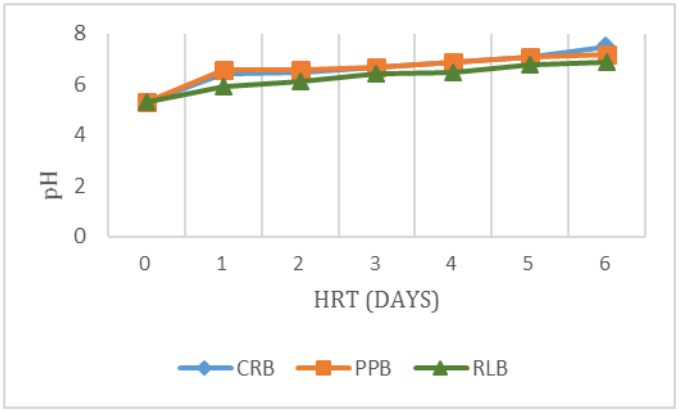

Chart -1: Variation in pH

The mean pH of the untreated sample was 5.3 and it was acidic in nature. The pH values was increasing throughout the period of treatment in all treatment beds. The pH changes to 7.2, 7.5, and 6.9 after treatment in cyperus rotundus, pennisetum perpereium and control bed respectively. In 4 th day of treatment cyperus rotundus and pennisetum perpereium get nearly neutral pH.

3.2 Biochemical Oxygen Demand

The results show that the BOD content of the waste waters was higher before the treatment in reed bed system. But after the treatment it was reduced by 93.5%, 94% and 44.22% in the cyperus rotundus, pennisetum perpereium and reed less bed respectively. BOD reduction in reed bed is achieved by aerobic bacteria attached to the media and to the plant roots [4].

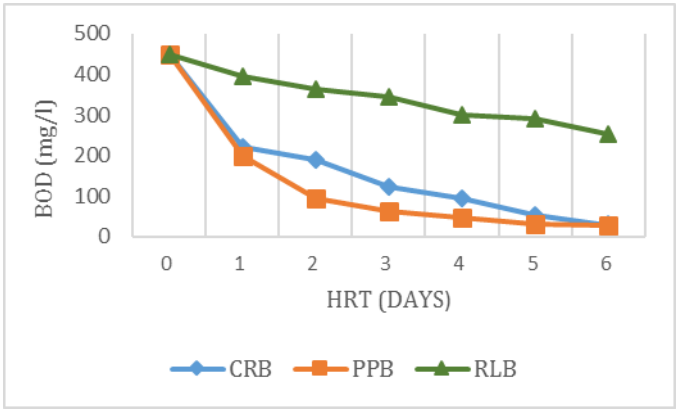

Chart -2: Variation in BOD

3.3 Chemical Oxygen Demand

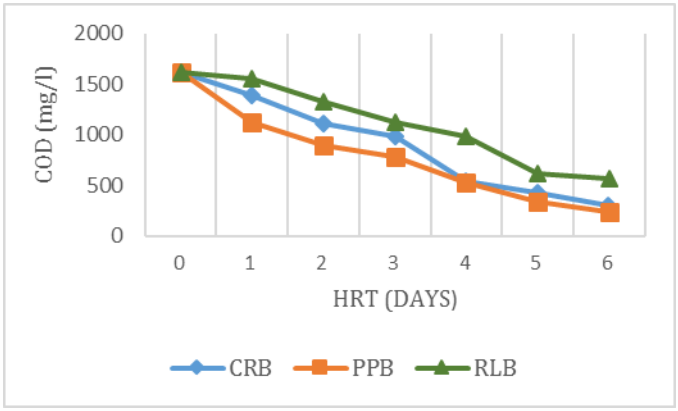

Chart -3: Variation in COD

High COD indicates that high degree of pollution load in water [4]. From the results it is observed that, reed bed technology using cyperus rotundus and pennisetum perpereium is a very effective method of treating waste waters containing more COD. Because after the treatment period, the COD of the waste waters was reduced considerably. The percentage reduction was recorded as

81.6%, 85.5 % and 65.18% for cyperus rotundus, pennisetum perpereium and reed less bed respectively.

3.4 Total suspended solids

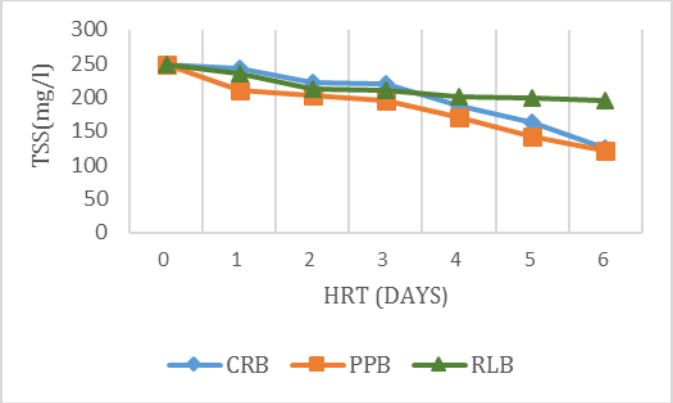

Chart -4: Variation in TSS

There was a good reduction of total suspended solids in both the cyperus rotundus and pennisetum perpereium reed beds. Total suspended solids were decreased by 50%, 51.2%, 20.96% in cyperus rotundus, pennisetum perpereium and reed less bed respectively.

3.5 Total dissolved solids

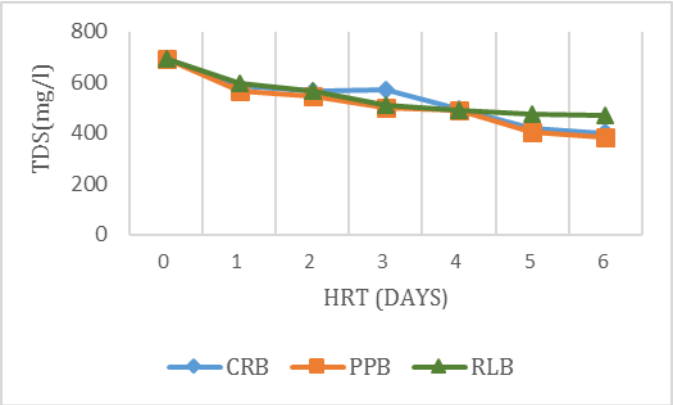

Chart -5: Variation in TDS

The percentage reduction in TDS content were recorded as 42.36 %, 44.5% and 32.27% in cyperus rotundus, pennisetum perpereium and reed less bed respectively. The solids present in the effluents are removed by the wetland system by processes like straining, sedimentation, impaction and interception [4].

3.6 Nitrate

The results showed a removal efficiency of 56.67%, 65% and 11.67% in cyperus rotundus, pennisetum perpereium and reed less bed respectively. Nitrogen undergoes several transformations in wetlands, including ammonification, nitrification, denitrification, volatilization, adsorption and plant and bacteria uptakes and these mechanisms are considered as the key process for nitrogen removal from wetlands [4].

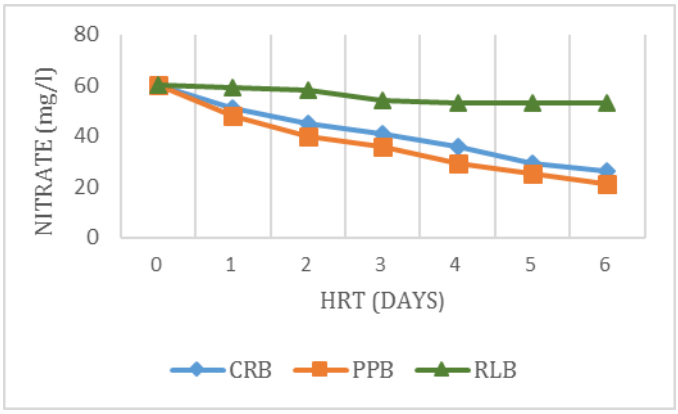

Chart -6: Variation in nitrate

4. CONCLUSIONS

From the study conducted, it is observed that the pollutants such as BOD, COD, TSS, TDS and nitrate were removed remarkably from the food industry wastewater by using cyperus rotundus and pennisetum perpereium reed beds. The pollutant removal efficiency of reed less bed is much less than when compared to the reed beds. Here found the significance of reeds in wastewater treatment. Pennisetum perpereium bed removed the considered pollutants more efficiently than cyperus rotundus bed. After treatment BOD, COD, TSS, TDS and nitrate were decreased by 94%, 85.56%, 51.21%, 44.52% and 65% respectively. The pH of wastewater increased from acidic to slightly alkaline. The color and odor were removed and treated water were become very clear and odorless. The treated effluent can be suggested for the cleaning purpose in the industry as well as for further irrigation purposes and for growing aquatic animals. Reed bed treatment system was found more cost effective when compared to the conventional treatment plants in the industries. It can be suggested to the industries for treating their wastewater where land area is not a constraint.

REFERENCES

[1] Amol B. Mankoskar, Prof. Sagar M. Gawande, Reed bed system an efficient treatment removal of sewage wastewater parameters, International Research Journal of Engineering and Technology, Volume 3 Issue: 1, Jan-2016

[2] Aparna Bhardwaj, C.P Kaushik, Anubha Kaushik, Batch treatment of low strength distillery wastewater in constructed wetland microcosms using Canna indica and Phragmites australis, International Journal of Advanced Scientific and Technical Research, Issue 5 volume 6, September-October 2015

[3] Bansari M. Ribadiya, Mehali J. Mehta, Treatment of municipal and industrial wastewater by reed bed

technology: A low cost treatment approach, *Int. Journal of Engineering Research and Applications*, Vol. 4, Issue 12(Part 3), 15-18, December 2014

[4] Dhanya, G and Jaya, D. S, Pollutant Removal in Wastewater by Vetiver Grass in Constructed Wetland System, International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 12, December – 2013

[5] Dr. Shalini Saxena, A Low Cost Treatment Approach of Treatment of Municipal Waste Water by Reed Bed Technology, International Journal of Theoretical & Applied Sciences, Special Issue-NCRTAST 8(1): 31-33, 2016

[6] Elena Castro et al., Effects of Wastewater Irrigation In Soil Properties And Horticultural Crop (Lactuca Sativa L.), Journal of Plant Nutrition, Vol. 36, Pages 1659–1677, 2013

[7] G. Baskar, V.T. Deeptha, Abdul A Rahman, Treatment of Wastewater from Kitchen in an Institution Hostel Mess using Constructed Wetland, International Journal of Recent Trends in Engineering, Vol. 1, No. 6, May 2009

[8] J.S.Sudarsan et al., Phyto-Remediation Of Dairy-Waste Water Using Constructed Wetland, Int J Pharm Bio Sci; 3(3): (B) 745 – 755, 2012 July

[9] Kavya S Kallimani, Arjun S Virupakshi, Comparison Study On Treatment Of Campus Wastewater By Constructed Wetlands Using Canna Indica & Phragmites Austrails Plants, International Research Journal of Engineering and Technology, Volume: 02, Issue: 09, Dec-2015

[10] Kiran D. Ladwani et al., Impact of Domestic Wastewater Irrigation on Soil Properties and Crop Yield, International Journal of Scientific and Research Publications, Volume 2, Issue 10, October 2012

[11] Muhammad Masud Aslam, Removal of Metals from the Refinery Wastewater through Vertical Flow Constructed Wetlands, Int. J. Agric. Biol., 12: 796–798, 2010

[12] Pachpute A. A, Kankal S. B , M.V Jadhav, Use of Artificial Wetland for Treatment of Dairy Industry Waste Water for Analysis of BOD and COD, International Journal of Scientific Engineering and Research (IJSER), Volume 2 Issue 6, June 2014

[13] Ramprasad. C, Experimental study on waste water treatment using lab scale reed bed system using Phragmitis australis, International Journal Of Environmental Sciences, Volume 3, No 1,2012

[14] Sangotola T. M. , Aribisala, J. O. and Awopetu, M. S., Industrial Wastewater Treatment using Reed bed Constructed Wetland, International Journal of Engineering Research & Technology, Vol. 4 Issue 08, August-2015

[15] Shruthi Dyamanagowdru, Lokeshappa, Comparative Assessment and Performance Evaluation of Horizontal Flow Constructed Wetland Using Vetiver and Canna species, International Journal of Engineering and Innovative Technology, Volume 4, Issue 10, April 2015

[16] Subhashini, V and A. V. V.S. Swamy, Phytoremediation Of Cadmium And Chromium Contaminated Soils By Cyperus Rotundus. L, American International Journal of Research in Science, 14-338, 2014

[17] V. P. Dhulap And S. S. Patil, Removal of Pollutants from Sewage through Constructed Wetland using Pennisetum purpureium, European Academic Research, Vol. II, Issue 1, April 2014

[18] Vanerkar A. P. , Sanjeev Satyanarayan, Shanta Satyanarayan, Treatment of Food Processing Industry Wastewater by a Coagulation/ Flocculation Process, International Journal of Chemical and Physical Sciences IJCPS, Vol. 2, Special Issue - March 2013