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Application of Wetland Ecosystem for Treatment of Industrial Wastewater

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ABSTRACT: As a natural alternative to artificial methods of wastewater treatment Constructed Wetlands are used favorably. Detailed knowledge on minute, minor and important complex processes of micro-organisms, plants, soil matrix and the components of wastewater and how they interact among themselves is rather incomplete.The objective here is to compare parameters of industrial wastewater sample which is treated by wetland ecosystem and other not treated by wetland ecosystem. Specific Plants which are efficient to use in a Wetland project are known. Wetland treatments are advocated by regulatory agencies and has been determined as the technology of choice by municipalities and industries required to meet stringent discharge regulations. Use of this technology in treating wastewater is still in its infant stage, though it will grow rapidly. It is concluded that constructed wetlands are optimum for removal of pollutants from wastewater.

KEYWORDS: industrial wastewater, characteristics of wastewater, constructed wetland, wetland ecosystem.

I.INTRODUCTION

The toxins and contaminants released in water bodies from Industries cause an adverse effect on the Health of Humans and damage the Environment. This Wastewater contains heavy metal elements, from industries such as metal plating industry, mining operations and tanneries. When this wastewater is not treated properly, it leads to contamination of fresh water which is used by humans. Even at low concentrations the Heavy metals are toxic and poisonous, they also have relatively high density due to their chemical composition. The thing about Natural wetlands is that they are very different from other ecosystems, the have functions like controlling floods, they also provide special habitat for some species of plants and animals, natural wetlands also recycle water and treat the contaminants included in it. Constructed Wetlands are not naturally occurring but human made ecosystems that imitate natural wetlands and its functions. The good part about Constructed Wetlands is that they can be customized for efficiency and for optimized and desired results. At present time, Conventional wastewater treatment plants cost a lot, the Constructed Wetlands is cheaper alternative for that. In past, Egyptians and Chinese used Natural Wetlands for Water Purification. First instance of Constructed wetlands was done in Australia in (1904). Basic application of an Constructed Wetland (CW) is management of river flow, very little documentation can be found for Constructed Wetlands used for treatment of Wastewater. Nowadays, the main purpose of Constructed Wetlands is treating anthropogenic discharge from Domestic and Industrial Sources. For use at Refineries, for land reclamation after mining or other ecological disturbances Constructed Wetlands are used. The Constructed Wetland needs to be adjust according to type of treatments, like pre-treatment or post treatment. Other functions of Constructed Wetlands are acting as bio filters which is similar to Natural Wetlands.

Two types of Wetland can be found, subsurface flow and surface flow. The species or types of plants planted in Constructed Wetlands play an important role in removal of contaminants, the bed has a combination of sand, gravel and soil which is equally important. The organic matter in the waste water is to be broken down by micro organisms, these microorganisms are found in plant roots, stems and leaves. They are known as periphytons. Combining periphytons with natural chemical processes remove approximately 90% pollutants and organic waste. Remaining removal is caused by plants. Mechanism of Constructed Wetlands include sedimentations, chemical precipitation, filtration and adsorption, microbial interactions, these mechanisms help in removal of pollutants like heavy metals.

Treatment of water is done by vegetation in wetland which uses nutrients in wastewater for growth. The conditions provided by a wetland are different and give a habitat to the micro-organisms for removing the pollutants. The active and passive circulation of elements provide a way to the Vegetation in CWs to play an important role in the biogeochemistry. The benefits of wetland plants are that it can absorb pollutants in their tissue and provide an environment for the micro-organisms to grow.

II.RELATED WORK

1. Observations were made that various wetland plant species have different abilities to separate and collect metal elements. Removal of metal can be optimized by selecting appropriate plants. The functions of those various plant species were studied in five Wetland units.
2. Constructed wetland came out as a very big contender to replace conventional methods of wastewater treatment because of lower construction and operating costs, more flexibility, less requirement for trained personnel. Wetland treatment is now promoted by regulatory agencies and has been determined as the technology of choice.
3. It was found that rapid industrialization has led to increased disposal of heavy metals into environment. Removal of these components if achieved by physiochemical process where microorganism are to be affected by discharges of heavy metals into the environment. Physiochemical process is used for heavy metal removal from wastewater includes precipitation, coagulation and reduction process.
4. At the present stage, the use of Wetland ecosystem is very less but it is predicted to get wide and expand continuously, given the increasing trend in usage of wetlands worldwide. As the range for wetland application increases so will the requirement for methods to deal with complex mixtures of pollutants under availability of site.
5. Appropriate plants can convert the contaminated water parameters at its lowest level experiments are done on aquatic macrophytes and improved the water quality using species such as Common bulrush, this species is capable for removing organic and inorganic substances from wastewater and also improves soil quality by removing heavy metals and hydrocarbons from water.

III.MATERIALS AND METHODS

A. Identification of industrial wastewater source:

Heavy metals discharging industries was found out. One industry was selected for sample collection from GondaVillage near Nashik. One industry was from Aluminium products and electroplating and another was from anodizing, both of them manufacturing process were related with heavy metals. Electroplating and anodizing industries are discharged large quantity of heavy metals in their wastewater stream. Grab sampling was done through collection chamber where all influent streams of industry were collected.10 liters cans were used for sample collection which tightly capped after collection and brought to laboratory.

B. Experimental set up:

By considering all parameters set up of constructed wetland is done. Set up consists of different vegetation and support media. Vertical Flow CW was chosen to accomplish maximum time of contact and time support media. PVC (Poly vinyl chloride) drum was used to manufacture experimental setup. Support media consist of charcoal flakes at bottom and saw dust with each of 35cm of depth. One unit is planted with emergent vegetation and second unit is left with only support media. Perforated pipe used for distribution of uniform flow.

Multi type vegetation and different type of media used CW consist of strange container, flow control valve, charcoal chips, saw dust as support media.

C. Support media:

Selection of support media was done by using treatises. Literature shows that saw dust, charcoal chips have good affinity toward heavy metals and saw dust have good absorption capacities to dissolved heavy metals (Villaescusa et al, 2000; Yasemin et al.2007; Hancifiah et al. 2008; Syring et al 2009; Nagham 2010). Based on these treatises saw dust from saw mill and charcoal chips are collected. Preparation used alteration of support media is essential

D. Vegetation:

Wetland species differ greatly in their abilities to accumulate and translocate metals it is given in literature review. By using appropriate plant species we can remove metals (Calheiros et al. 2007). To treat different heavy metals multi species. Vegetation was adopted in CW to get maximum benefits of a plant uptake mechanism. Two short of each species were planted. There are different phases to treat the wastewater in the Initial Phase the experimentation were planned, with groundwater with added sewage as feed water. After the required depth the growth of vegetation they were used to treat for heavy metal removal.

There are two phases of Experiment

1) Initial 2) Established

Initial Phase- The initial phase includes the period when the vegetation grew to a certain height and root developed. This Initial phase is for the growth of vegetation. Groundwater was used as feed water. When vegetation had grown to a sufficient height so that it could sustain and treat the wastewater. This phase is known as Established Phase of the experiment. In the established phase of the experiment, the treatment system was evaluated. For its performance in treating the raw wastewater. Wastewater was collected from an electroplating industry which has its

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own plant for water treatment. The performance was assessed in terms of organic matter. Biochemical Oxygen demand (BOD). The organic loading was calculated for each of the unit separately. The experiments were planned for organic loading in the range 20–110 kg/had and HRT between 1 and 3 pH was determined to detect the effect within the system. The procedures to analyse these parameters were according to Standard Methods (APHA) pH and turbiditywere determined by electrometric and nephelometric methods respectively.

IV.RESULTS AND DISCUSSIONS

Initial phase- The initial phase of experimentation covered the growth of vegetation (Canna Indica, lemon grass), development of roots and maturation of the system. The freshwater was fed to the system and the growth of plants was observed. The average height of the plants was 40 cm at the end of initial phase. Four weeks was required for adequate growth of the vegetation.

Established phase- In the established phase, the treatment system was fed with varied organic loadings and the system was operated at various HRTs. The performance evaluation of each of the treatment units and system as a whole is described below. Sand-gravel filter the performance of SGF was evaluated for the removal ofturbidity and organic matter. Turbidity The turbidity of feed (settled wastewater) was in the range 20–50 NTU. The turbidity of effluent from the SGF was observed to be less than 1 NTU for HRT of 1, 2 and 3 d. No clogging and ponding effects were observed during the period of study. The turbidity removal mechanism involved was basically mechanical straining.

The effluent can be recycled and re-used for nonpotable purposes within a household. The hybrid natural system is useful for the treatment of domestic wastewater at household level. It provides a low-cost, efficient, easily operable/maintainable and least mechanized option for wastewater treatment in a decentralized system.

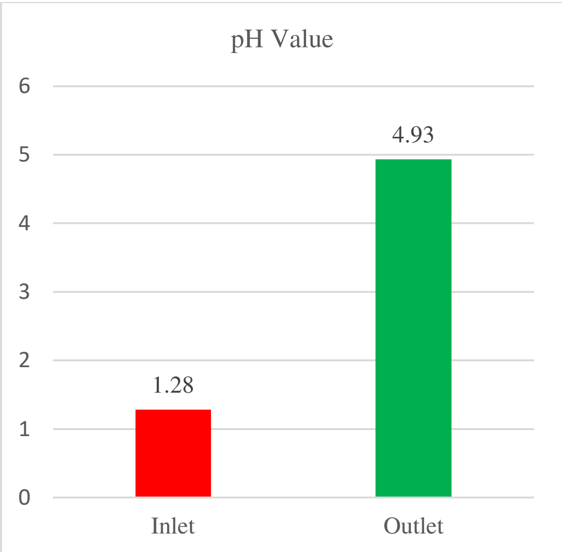

Chart A

Chart Ashows the changes in pH Value of the sample before treatment and after treatment. In this chart we observe the pH value has increased from 1.28 to 4.93, as pH is acidic below 7 and alkaline above 7. In this experiment the result obtained shows that the acidic nature of the sample has been decreased and the wastewater has become more alkaline due to wetland treatment.

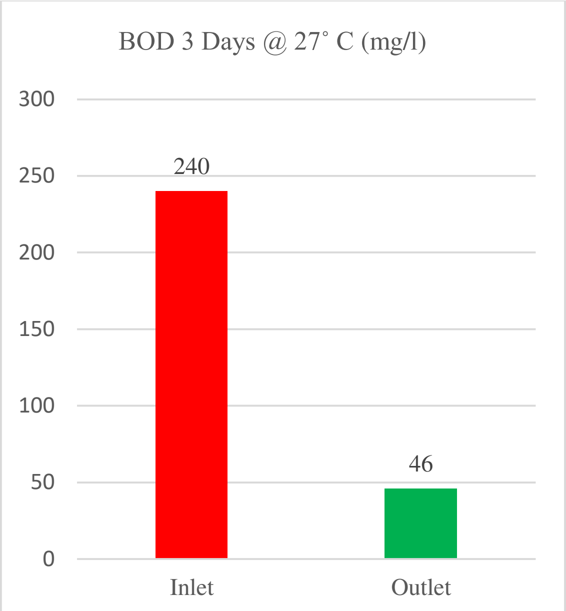

Chart B

Chart B shows the changes in BOD value of the sample before treatment and after treatment. We observe that changes in the value of Biochemical Oxygen Demand (BOD). It is clear from the chart that the BOD has decreased after the treatment.

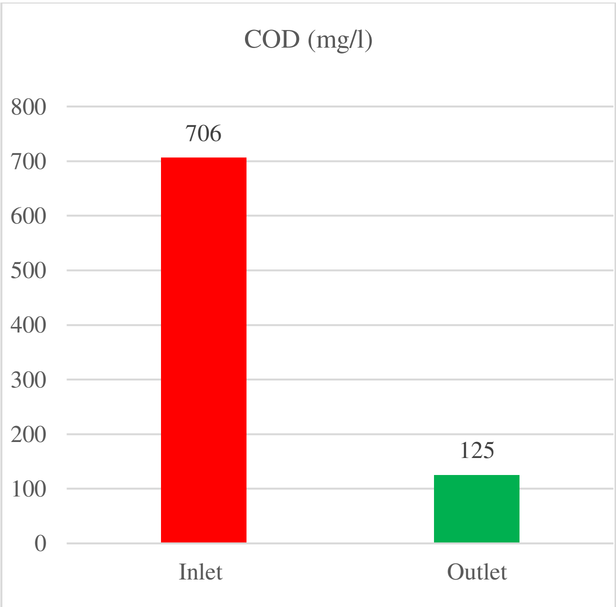

Chart C

Chart C shows the values of Chemical Oxygen Demand in the wastewater.It can be clearly seen that COD has significantly decreased from the wastewater after treatment.

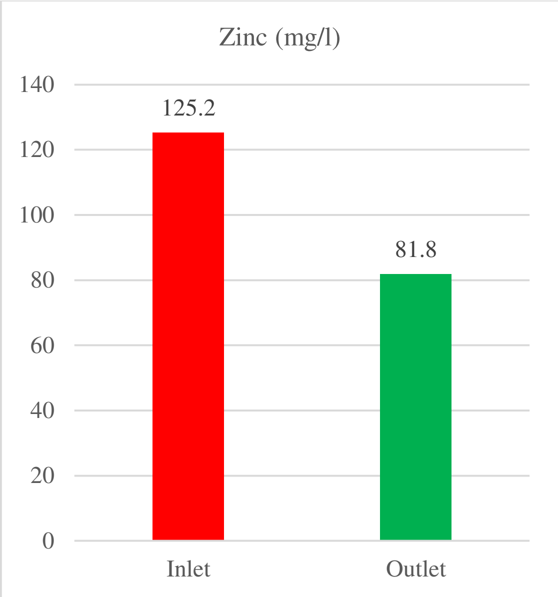

Chart D

Chart D shows the values of Zinc content in the wastewater.It can be clearly seen that Zinc Content has significantly decreased from the wastewater after treatment. This concludes that wetland system is effective and successful.

V.CONCLUSION

Based on the experimental results, the following conclusions are made.

1. This study demonstrated that the designed sub-surface horizontal flow constructed wetland system could be used for treatment of the campus waste water.
2. A constructed wetland system can be an effective treatment facility for campus waste water. Regarding the performance achieved, the sub-surface horizontal flow constructed wetland was able to reduce further the level of the main physicochemical pollution parameters.
3. The plants do play an important role in the treatment. The treatment level was affected by not only by the change of seasons, but also by the variation in influent quality and quantity.

The removal of water pollutants can take place through physical, chemical, and biological processes. Sewage treatment has used biological processes to purify water, full advantage of such processes has not been taken. Because the treatment of waste water through conventional treatment systems are expensive both in construction and in operation and taking into account that the pollutant removal rates are poor, alternative methods have been designed and constructed wetlands that are specifically designed and built systems for waste water treatment The potential for using biological processes to treat surface water, ground water, and different types of waste water rests with the ability to degrade organic material, remove nutrients, and potentially toxic elements such as heavy metals. A major advantage of including wetland treatment in such situations is the decreased load and reduction in odour that needs to be dealt with either in a water recycling or irrigation scenario. Constructed wetlands can provide an energy-efficient & cost-effective alternative to conventional waste water treatment technologies.

REFERENCES

[1] Babatunde, A.O.; Zhao, Y.Q. “Constructive approaches towards water treatment works sludge management: an international review of beneficial re-uses” (2007)

[2] Calheiros, C. S. C., Rangel, A. O. S. S., and Castro, P. M. L. “Constructed wetland systems vegetated with different plants applied to the treatment of tannery wastewater” Water Res., 41, 1790–1798,(2007)

[3] Hans G. Peterson. "Use of constructed wetlands to process agricultural wastewater" Canadian Journal of Plant Sci. 78: 199–210(1998)

[4] Kapoor, A., Viraraghavan, T. Fungal Biosorption-an alternative treatment option for heavy metal bearing wastewater: a review. Bioresource. Technol. 53: 195-206(1995)

[5] Kadlec, R. H. and S. D. Wallace “Treatment Wetlands, Second Editions" Florida, CRC Press.(2009)

[6] Mungur, A. S., Shutes, R. B., Revitt, D. M., and House, M. A.“An assessment of metal removal by a laboratory scale wetland.” Water Science. Technol., 35(5), 125–133(1997)

[7] Villaescusa, I., Martinex, M., and Miralles, N. “Heavy metal uptake from aqueous solution by cork and yohimbe bark wastes.” J. Chem. Technol.Biotechnol., 75, 812–816(2000.)

[8] Knight, R.L., and Kadlec, R. H. “Treatment wetlands”, Lewis,Boca Raton, Fla. (1996)

[9] Siedel K. Patent: System for purification of polluted water. Washington DC.(1973)

[10] Barker, D. J. and Stuckey, D. C. “A review of soluble microbial products (SMP) in wastewatertreatment systems.” Water Research, 33(14), 30633082(1999).