International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-6 Issue-4, April 2017

Industrial Waste Water Management by Implementing Wetland Ecosystem

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Abstract: ***Constructed wetlands are natural alternative to technical methods of wastewater treatment, however our understanding of the complex processes caused by the plants, micro organisms, soil matrix and the substances in the wastewater, and how they all interact with each other, is still rather incomplete. The main objective of this project is to compare the parameters of industrial waste water sample which is treated by wetland ecosystem with another industrial waste water samples without applying wetland ecosystem. The Principle of this is to perform a preliminary comparative study between some coagulants on the removal of suspended solids organic matter and testing the Chemical and Biochemical Oxygen Demand from the industrial waste water. For implementation of wetland ecosystem, we are going to study specific plants which can be used for wetland ecosystem.***

Keywords: ***industrial wastewater, characteristics of wastewater, constructed wetland, wetland ecosystem.***

I. INTRODUCTION

There is adverse effect on the health of people and severe damage to the environment due to the Industrial wastewater. Industrial waste water contains heavy metal elements, which are discharged by industries such as metal plating industries, mining operations and tanneries. This leads to contamination of fresh water if not treated properly. Heavy metals are chemical elements with relatively high density and are toxic or poisonous at low concentrations. Natural Wetlands are very different from other ecosystems, their functions are controlling and buffering floods, providing special habitats, recycling nutrients and treating pollutants in water. Constructed Wetlands are manmade ecosystems that simulate the functions of natural wetlands, they can be manipulated for efficiency or achieving desired results. Nowadays, the Wastewater treatment plants in Industries cost a lot, the Constructed Wetlands are cheaper alternative to those treatment plants.

Manuscript published on 30 April 2017.
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In past, Egyptians and Chinese used Natural Wetlands for Water Purification. The first example of use of artificial wetland was in Australia (1904). Most common application of CWs is flow management of rivers, there has been little documentation of using CWs for treatment of polluted river water. Nowadays, CWs are being used for the purpose of treating anthropogenic discharge like municipal or industrial waste water. CWs may also be created for refineries, Land reclamation after mining or other ecological disturbance. The Constructed Wetland ecosystem has to be adjusted according to the type of treatments, eg. Pre-treatment, post treatment. CWs can emulate the main features of natural wetland, such as acting as a bio filter or removing pollutants such as heavy metals from waste water. There are two main types of constructed wetlands, subsurface flow and surface flow. The plants and vegetation planted in the CWs play an important role in removal of contaminant, but the filter bed has combination of sand, gravel and soil which is important too. To break the organic materials in polluted waste water microorganisms are required, they grow on the substrate (roots, stems and leaves) provided by vegetation in Wetlands. This type of microorganisms are known as periphyton. The periphyton combined with natural chemical processes remove approximately 90 percent of pollutants and breakdown of organic waste. The remaining removal is caused by plants, also acting as a source of carbon for the microbes. Various mechanisms of a Constructed Wetland such as sedimentation, filtration, chemical precipitations and adsorption, microbial interactions, help in the removal of pollutants such are heavy metals. The water is treated by the vegetation in the wetland that uses the nutrients in the wastewater for their growth. The microorganisms that have their natural habitat in the conditions provided by a wetland are part in the removal of the pollutants. Natural materials or waste products from certain industries with a high adsorption capacity for heavy metals can be obtained, employed, and disposed off with little cost. Various vegetation in CW has been shown to play important roles in wetland biogeochemistry through their active and passive circulation of elements. The benefits of wetland plants are that it can absorb pollutants in their tissue and provide a surface and an environment for microorganism for their growth.

II. LITERATURE REVIEW

[2.1] Babatunde and Zhao et.al., Sludge is an inevitable by-product of water treatments, its disposal is more important economic and environmental issue.

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The authors reviewed past available literature and listed more than 10 ways in which sludge can be reused. Emphasis was given on reuse of sludge as a multi-pronged approach offering economic and environmental sustainability.

[2.2] Calheiros, Rangel and Castro et al., Observations were made that different wetland plant species have different abilities to separate and collect metal elements. Removal of metal can be significantly increased by selecting of appropriate plants. He created different models of constructed wetland according to plant species and.

investigated them receiving wastewater from tannery. The functioning of those various plant species was studied under subsurface horizontal flow. There were five constructed wetland units, each having species of Stenotaphrumsecundatum, Iris pseudacorus, Phragmites australis, Canna India, Typha latifolia. An additional sixth unit of constructed wetland was left unvegetated.

[2.3] Peterson H.G.et al.,Use of wetland to activate agricultural wastewater Can. J.PlantSci 78:199-210. Constructed wetland come out as serious provocation to conventional wastewater treatment because of lower construction and operating costs, more flexibility, less requirement for trained personnel. Water quality upgradation can be achieved by removal of plant nutrients, such as N & P, organic (natural and manmade) as well as inorganic contaminants. Wetland treatment is now promoted by regulatory agencies and has been determined as the technology of choice by municipalities and industries required to meet extreme discharge regulations. These same regulations have not usually been imposed on the agricultural community. [2.4] Kapoor and Viraghavan. et al.,Rapid industrialization has led to increased disposal of heavy metals and radio nuclides into the environment. Removal of heavy metals and radio nuclides from metal bearing wastewater is achieved by physiochemical process. Micro-organisms are the first to be affected by the discharges of heavy metals into the environment. Bacteria, cynobacteria and fungi alter the form of occurrence of metals through methylation, chelation, complexation, catalysis or absorption affecting their bio-availability and movement in the food chain. Physio-chemical process is use for heavy metal removal from wastewater includes precipitation, coagulation a reduction process, ion exchange membrane process. They used the model of various metals by fungi are reviewed in sections.[2.5] Kadlec and Wallace et al.,according to them the present stage of this technology a wide range of industrial applications exist and will expand continuously, given the increasing trend in using wetlands worldwide. Changing regulatory climate, low maintenance and costs, and efficiency in treatment are further incentives for using the wetland ecosystems. As the range for wetland application increases so will the requirement for methods to deal with complex mixtures of pollutants under availability of site. The evolution of this technology will occur at even more speed. [2.6] Mungur et.al. He studied the performance of laboratory-scale wetland system for removal of heavy metals by storm water runoff. The results were as the removal efficiencies and rates for metals monitored ranged from 75.8–95.3% and 30.8–387 mg/m2/day for Pb,81.7 to 91.8% and 36.6–372.7 mg/m2/day for Cu, and 82.8–90.4% and 33.6–362.1 mg/m2/day for Zn respectively. After the experiment, results for the storm water runoff simulation showed that the metal elements leaving the system remained very low with the wetland system retaining over 99% of the metal elements. This concluded that wetland receiving storm water can be an efficient sink for heavy [2.7] Villaescusa et al., studied that industrial wastewater treatability studies have demonstrated heavy metal uptake by wood, wood products and plant fiber-derived materials. Wood fiber sorption capacities for dissolved heavy metals were on the order of 5–10 mg/g. In this work the ability of cork and yohimbe bark wastes to remove Cu (II) and Ni (II) from aqueous solutions has been studied. When comparing both biomaterials, yohimbe bark waste was found to be the most efficient adsorbent for both metals studied. [2.8] Knight et al., collected operational data for many number of wetlands. The size of the wetlands ranges from less than 0.1ha to 500 ha. BOD input to the wetland ranged from a low of 1.5 to a high of 229mg/l. Outflow BOD rates were mere moderate. I.e. up to 0.5 to 50mg/l. The total suspended solids (TSS) also extend over a wide spectrum ranging from literally no solids (< 1 mg/l) to very high (232mg/l). It is found out that at the very low end of inputs the output TSS level is actually higher, but at the high end the wetland is able to greatly reduce the levels. The Ammonium levels again range from very low to strong organic wastes (60mg/l) and total phosphorous (TP) also extend wide range of inflow concentration with the higher levels being typical of strong organic wastes. Hence, it is concluded that wetland have been used to treat organic material of similar strength to that of any animal wastewater. [2.9] Kathe Seidal et al.,at Max Planck Institute in Plon West Germany has invented New Technology for treatment of wastewater by wetland ecosystem and got patented. Appropriate plants can convert the contaminated water parameters at its lowest level experiments are done on aquatic macrohpytes and improved the water quality using species such a Common bulrush, thisspecies is capable for removing organic and inorganic substance from wastewater and also improves oil quality. It removes Heavy metals and hydrocarbons from water. [2.10] Barker and Stuckey et al.,Even though there are difference between oxygenated and unoxygenated outflow, oxygenated treatment is commonly used for decomposing high metal content material compound and unoxygenated treatment choose for decomposing low metal content material compound compared to other types of treatments, unoxygenateddegradation is economical and simple process and has energy efficient and it can produce methane gas which is beneficial to site. Therefore anaerobic digestion of organic wastes from many industries becoming a more widely used practice with time.

III. METHODOLOGY

We use surface flow wetland system for this we collected 3 crates and collecting some soil type which have tendency to filter water and also we collecting saw dust and we laid layer of sand, gravels, saw dust, soil etc.

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Then we planted wetland plant species like Canna Indica, Umbrella Palm, Lemon grass etc. We planted such plants in the Crates with internal coating of polythen sheet. Inlet and outlet positions were fixed. Outlet hole was drilled is at the lower side of crate and PVC pipe was used as a outlet. Required Slope was given to crates. Multi species and dual media CW: experimental set-up of Multi species and dual media CW consists of PVC crate as CW reactor, charcoal and saw dust as support media.

Support media: Selection of support media was done by using literature review. Literature shows that wood chips, saw dust, bio-char have good affinity towards heavy metals and wood fiber have good sorption capacities for dissolved heavy metals.(Villaescusa et al., 2000; Yasemin et al., 2007;Hanafiah et al., 2008;Syring et al., 2009; Nagham 2010). Based on these literature review saw dust from timber industries and charcoal is selected. Preparation and modification of support media is essential for proposed study to achieve higher removal efficiency.

Vegetation: Literature review shows that wetland plant species differ greatly in their abilities to accumulate and translocate metals. Metal removal can be significantly enhanced by the selection of appropriate plant species (Calheiros et al., (2007). Multi species vegetation was adopted in CW to get maximum benefits of plant uptake mechanisms for different heavy metals. Canna Indica, Umbrella Palm and Lemon grass were selected for cultivation in CW. Two Shoots of each species were planted. In the initial phase the experimentation were planned with groundwater with added sewage as feed water. After growth of vegetation they were used to treat for heavy metal removal.

The experiments are planned, in two phases. In the initial phase experimentation is planned for establishment of vegetation and bio layer development on and CW and in second phase, evaluates CW with synthetic and industrial wastewater at various operational parameters. 24 h cycle (fill time: 0.5 hour, react time: 22hours, settle time: 1 hour, decant time: 0.5 hour.) will fixed for experimentation. Idle time is not provided for all cycles.

IV. SUMMARY

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.

V. FUTURE SCOPE

Constructed Wetlands provides an energy efficient and cost effective alternative to conventional wastewater treatment technologies. The application of one species with a medium to remove heavy metals. In order to explore the potential of various species and media, there is scope to develop a multi-species and multi-media constructed wetland to remove heavy metals and asses its performance. Recycling of wastewater of industries and reuse of wastewater by wetland ecosystem.

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