Construction of vertical wetlands to Treat the Wastewater

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***Abstract* - For the purpose of irrigation, the source of water that is valued highly is water. In this manuscript, an effort is made for evaluated the effluent quality from the industry. This region is located near Nandyal, Kurnool district, Andhra Pradesh. In this research, the samples have been gathered and in order to reduce the very high costs of industrial disposal throughout worldwide, more decentralized purification system need to be established. To attain higher surface water quality, and thereby the acceptance of such system by governmental authorities, good removal rates for organic substances and also for nutrients (N, P) are necessary. This study compares the purification performance of vertical constructed wetland (VCW) using charcoal in two different container remediate sites contaminated with organic and inorganic pollutants. The studies aim at developing and assessing sewage treatment efficiency through a VCW pilot scale plant for treatment of sewage to test its pollutant sorption capacity. The samples were analyzed at treatment in the VCW as bedding media with charcoal. We need to notice that how the pollutants using Colocasia esculenta plant with charcoal bed has performed the treatment efficiency and need to notice that how Colocasia esculenta with charcoal is capable for the treatment to industrial wastewater treatment.**

***Index Terms* - charcoal, colocasia esculent, industrial wastewater, vertical constructed wetlands.**

I.INTRODUCTION

Today, water availability is a problem all over the world in terms of both quantity and quality. This problem is getting worsened as the world population and industrialization is increasing and climate change is affecting water resources, mainly in water stressed developing countries. Wastewater discharges are causing eutrophication and water borne diseases. The situation is getting worse with rapid urbanization where adequate sanitation and wastewater treatment facilities are lacking. The treatment of wastewater using Constructed Wetland (CW) is one of the suitable treatment systems, used in many parts of the world. This system seems to have the potential to be one of the sustainable solutions in treating and then discharging the huge quantity of wastewater and getting access to safe drinking water. Constructed wetlands (CWS) are treatment systems have been designed to accomplish natural processes with wetland substrates, vegetation and the associated microbial assemblages to help in treating wastewaters and take advantage of the processes that occur in natural wetlands within the more controlled environment

Constructed wetlands (CW) are the artificially created man made systems in which wastewater treatment take place by utilizing natural processes by involving soil, vegetation, and microbial communities. They resemble to the natural wetlands in treatment processes, but processes are carried out in a controlled environment (Vymazal, 2010) the concept of constructed wetlands was given by Kathe Seidel in early 1950s. She studied CW sys- tem for treatment of different types of wastewaters at Max Planck Institute. The early systems developed by Seidel comprised series of beds composed of sand and gravel with emergent vegetation (Typha, Scirpus, and Phragmites) and were named as hydro botani- cal systems. Seidel used vertical flow in most of her experiments and excellent removal of BOD5, TSS, N and P was claimed. In early 1960s attempts were made to grow macro-phytes in wastewater and sludge to improve the efficiency of septic tank or ponds and thus performance of wastewater treatment. (Vyamazal, 2005). FWS CW was firstly developed in Hungary in 1968 for the treatment of town wastewater by preserving water quality of Lake Balaton. The North

America also used free water surface constructed wetlands (FWSCW) for treatment of wastewater of natural wetlands using ecological engineering. This technology was utilized by North America for treatment of all types of wastewaters along with municipal wastewater (Kadlec and Wallace, 2008). Subsurface ow technology gained popularity later than FWS CW in North America but at present are in operation in high number. In 1970s and 1980s the use of constructed wetlands was done merely for treatment of municipal and domestic wastewater. In 1975 Amoco Oil Company's Mandan Refinery in North Dakota used CW for treatment of process water and industrial storm water. In early 1980s use of FWS CW for treatment of urban wastewater started in California. First full scale constructed wetland for treatment of municipal sewage was developed in Oth-fresen, Germany (Kickuth, 1977). Kickuth proposed the application of cohesive soils as filter medium with horizontal flow and Phragmites plants as vegetation. Theory behind his experiments was to open up flow channels in the unified soil due to plants root/rhizomes growth which increased the conductivity of soil. Due to increased conductivity efficient removal of BOD5, TSS, N, P and other organics was observed. In 1985 many reed bed systems including gravel as bed media with sloping bottom and a at surface were built in Great Britain based on Kickuth's concept soil (Boon, 1985). The purpose of using gravel instead of cohesive soil was to increase soil hydraulic conductivity while sloping bottom provided enough hydraulic gradients to make sure subsurface Blow in the bed. By 1990, about 500 of these 'reed bed' or 'root zone' systems were established in different parts of Europe. Since 1990s the constructed wetlands have been extensively built and operated for treatment of all kind of wastewater such as dairy farm (Sharma et al., 2013;Kato et al., 2013), landfill leachate, runoff, food processing, industrial, agricultural farms, mine drainage and sludge dewatering (Farooqi et al., 2008).

II. EXPERIMENTAL INVESTIGATION

A. Water sample

The water sample is collected from the Agro Industries and Nandi Milk dairy from nearby of our location, panyam, Nandyal, Kurnool District, in the state of Andhra Pradesh, India. The gathered water sample has tested in the laboratory and after that based on the concentrations we have gone for charcoal method to decrease the concentrations.

Figure 1: Water Samples collection

B. Properties of materials

Gravel is an extremely effective fillter media because of its ability to hold back precipitates containing impurities. Filter sand size, angularity and hardness are the important filter sand characteristics to ensure proper filtering.

Figure 2.Water Sample

Figure 3. 10 mm Coarse aggregate

Figure 4.Sand Passing through 2.36 mm

Figure 5. Charcoal passing through2.36 mm

C. Treatment plant details

Colocasiaesculenta is a tropical plant, whose many names such as Taro and Eddoe (figure Taro is closely related to Xanthosoma and Caladium, plants commonly grown as ornamentals, and like them it is sometimes loosely called elephant ear. Taro Was probably first native to the lowland wetlands of Malaysia (taloes). Estimates are that taro was in cultivation in wet tropical India before 5000 BC, presumably coming from Malaysia, and from India further transported westward to ancient Egypt, where it was described by Greek and Roman historians as an important crop. In India, it is known as "arbi" or "arvi". The selected plant Colocasiaesculenta belongs to Kingdomplantae, Order Alismatales, Family Araceae, Subfamily- Aroideae, Tribe- Colocasiodeae, Genus Colocasia and species- C. esculenta as per (L) Schott. This plant is locally known as, Alu in the state of Maharashtra. Rhizomes are of plant having different sizes and shapes. Leaves grows up to 4024.8 cm, sprouts from rhizome, dark green above and light green beneath, triangular-ovate, sub-rounded and mucronate at apex, tip of the basal lobes rounded or subrounded. Petiole is of 0.8-1.2 m in hight. Spathe is up to 25 cm long. Spadix is about 3/5 as long as the spathe, flowering parts up to 8 mm in diameter. Female portion at the fertile ovaries intermixed with sterile white ones.

Figure 6. Colocasia esculenta plant

III. METHODOLOGY

Experimental procedures followed in present investigation with Colocasiaesculenta are one of the prominent adaptive marshy plants which were used for treatment of wastewater. It was transplanted in the designed wetland system in the vertical Flow process of constructed wetland. Three sets of cylindrical circular drums were used in each experimental set up. Plastic cans were used for the collection of treated water after flowing out from the root zone bed through the outlets. Treated water samples were collected and analyzed in laboratory. The vertical constructed wetland set was prepared as follows:

Five layers were prepared with coarse aggregate, materials (charcoal in three different drums), sand and Garden soil. The big size coarse aggregate(25mm) making bottom layer of 20 cm height followed by sharp, medium sized coarse aggregate(10) were added to form a second layer of 201 height in three drums with same materials above. Sieved charcoal (passing through 2.36mm sieve) forming third layer of 6cm height in three different drums with different material. Sieved sand (2.36mm) forming fourth layer of 6cm height, soil forming five layer of 6cm height and

Colocasia esculenta plant were used for construction of bed.

Test samples before and after treatment were analyzed in sets (Charcoal for selective parameters like Ph, Turbidity, Electrical conductivity, Acidity, Alkalinity, BOD, COD and NO3 using standard method.

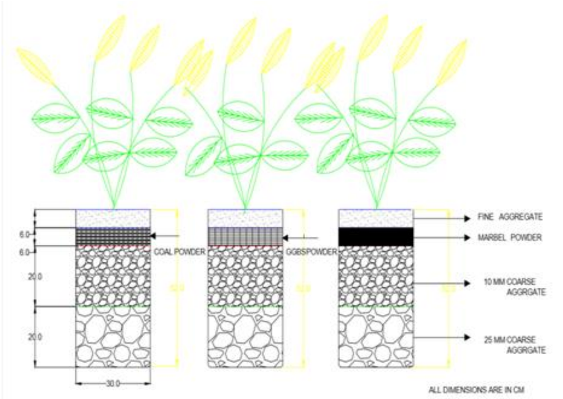

Figure 7. Auto cad design of VCW

Figure 8. Experimental vertical constructed wetland

IV.RESULTS AND DISCUSSION

Below are the results (Ph, Turbidity, Electrical conductivity, Acidity, Alkalinity, BOD, COD and NO3) showing for the test samples before and after treatment process.

Table No.1. Test Results for the Samples

S.NO	Water quality parameters	AGRO INDUSTRIES		NANDI MILK PRODUCTS (Dairy form)		Acceptable limits for Irrigation
		Before Treatment	After Treatment	Before Treatment	After Treatment	
1.	PH	7.8	6.82	10.2	8.25	6-9
2.	Electrical conductivity	1.952ms/cm	1.161ms/cm	2.853ms/cm	1.382ms/cm	4
3.	Alkalinity	260mg/l	34 mg/l	650mg/l	176mg/l	300
4.	Acidity	45 mg/l	10 mg/l	76 mg/l	38 mg/l	50
5.	BOD	360mg/l	193mg/l	850mg/l	252mg/l	300
6.	Nitrates	11 mg/l	7 mg/l	40 mg/l	10 mg/l	5-10

V. CONCLUSION

- From the Vertical flow constructed wetlands that we have constructed artificially with different filter media, we have observed different concentration values.
- In this process the maximum BOD was reduced by 70% & NO3 was reduced by 92% in Charcoal material. The BOD removal is believed to occur

rapidly through settling and entrapment of particulate organic matter in the void spaces of the substrate.

- The substrate is the main supporting material for plants and microbial growth. Fine gravel promotes higher growth of plants and therefore increases the quantity of contaminant removal.
- The microorganisms attached to the root zone of the plants play a very important role in the degradation of organic matter.
- They play crucial role in the conversion of organic carbon to carbon dioxide.
- In this process, the oxygen is supplied by the roots of the plants. Soluble organic matter may also be removed by number of separation processes including absorption and adsorption.
- These pollutants were reduced due to root bed of Colocasiaesculenta. Some wetland plants also take up pollutants directly through the root transport system and transfer them to the atmosphere via their transpiration system.
- The difference in the efficiency of each parameter has reduced by using VCWs. and it indicates that the use of charcoal is helpful for better treatment of Industrial wastewater.

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