Root zone treatment system using Canna indica plants

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Abstract—Water resources are the sources of water that are potentially useful for everyday activities. And now a day this resource is steadily decreasing and getting polluted. Household sewage is directly led into river without any primary treatment. In Residential areas domestic sewage water started playing its major role due to the increasing population. In this experimental investigation, instead of allowing this daily used domestic sewage water into the drainage as waste, it can be recycled naturally by using the roots of the Canna Indica plants and soil bacteria for domestic re-usage such as for Gardening, Flushing of toilets. The main aim of this study is treatment of untreated wastewater from DPCOE campus. The sewage water sample is collected from DPCOE campus (Canteen) and is analyzed for various parameters such as DO, pH, Turbidity, Electrical Conductivity. Then the collected domestic sewage water is allowed for its treatment by flowing it over the Canna Indica plant bed.

Keywords-DO(dissolved oxygen), pH, turbidity, canna indica,

1. INTRODUCTION

Root treatment system can be defined as "the efficient use of plants to remove, detoxify or immobilize environmental contaminants in a growth matrix (soil, water or sediments) through the natural biological, chemical or physical activities and processes of the plants". Plants are unique organisms equipped with remarkable metabolic and absorption capabilities, as well as transport systems that can take up nutrients or contaminants selectively from the growth matrix, soil or water. The term 'Root Zone' encompasses the life interactions of various species of bacteria, the roots of reed plants, soil, sun and water

They are also known as constructed wetlands or subsurface flow systems. In this system, these plants conduct oxygen through their stems into their root systems and create favorable conditions for the growth of bacteria .The wastewater flow through the root zone in a horizontal or vertical way, where the organic pollutants are decomposed biochemically by the bacteria present in the rhizosphere of root plants. The filter media are selected carefully to provide favorable conditions for both plants and bacterial growth and to avoid clogging. Organic pollutants are removed drastically from wastewater and are reduced to their elemental forms. It also has the potential to accumulate heavy metals in the root zone.

Out of about 61948 million liter per day of sewage generated treatment capacity exists for only about 23277 million liter per day. Thus, there is a large gap between generation and treatment of wastewater in India. Even the treatment capacity existing is also not effectively utilized due to operation and maintenance problem. Operation and maintenance of existing plants and sewage pumping stations is not satisfactory, as nearly 39% plants are not conforming to the general standards prescribed under the Environmental (Protection) Rules for discharge into streams as per the CPCB's survey report.

Objective of the research

1. To analyze the characteristics of inlet and outlet wastewater in the root zone treatment system
2. To investigate the feasibility of applying a constructed root zone treatment system to treat the domestic sewage waste water.
3. To study the reduction of pollutants present in wastewater after treatment by using root zone treatment system
4. To treat the wastewater naturally by using canna indica plants.

2. METHODOLOGY

Construction of treatment unit

1. The unit consist of a basin i.e a rectangular tray with inlet pipe at top and outlet pipe at the bottom of the tray
2. The basin is filled with layers of gravel and sand, planted with aquatic plant named Canna Indica and by three layers of sand, the bottom layer filled with coarse sand (small stones), the intermediate layer filled with fine-grained oval gravel, after that is a layer of charcoal and the top layer filled with sandy loam.
3. The canna indica plants are allowed to grow to maturity. While the growth of plants till maturity fresh water is supplied. After the growth of canna indica plants sewage waste water is fed through the inlet and allowed to infiltrate.

Fig. Treatment Unit

Experimental procedure

1. After reactor is stabilized in about 30 days with tap water, doses of sewage applied with increasing percentage of sewage. Each dose is continued for two watering that is 6 days then next higher dose was applied. Gradual increase in sewage dose is done so that the plants adapt the quality of water.
2. Water samples are taken once from inlet chamber and outlet chamber of the root zone treatment unit. The samples are collected by putting a clean beaker below the inlet and outlet pipe of constructed wetland.
3. The samples are analyzed for pH, DO and turbidiy according to Standard Methods for Waste and Waste water Examination.

3. RESULTS

Parameters	**Observed Results Inlet**	**Observed Results Outlet**	**Standard Range**
pH	5.26	6.8	6.5-8.5
Turbidity	244 NTU	74 NTU	50-150 NTU
Dissolved Oxygen (DO)	4.6 mg/l	5 mg/l	5 mgl/l and above 5mg/l

4. POLLUTANT REMOVAL MECHANISM

1. The presence of plant biomass and substrate media will physically retard the pathways of wastewater enhancing the sedimentation of suspended solids.
2. The breakdown of organic matter and destruction of pathogens can occur in the exposure of the sunlight and atmospheric gases.
3. The oxygen released by the hairs of the plant's root will provide the water with oxygen and this presence of oxygen will help the growth of aerobic bacteria which will breakdown organic matter and provide nutrients to the plants
4. By the nitrification process done by nitrosomonas and nitrobacter the ammonia present in the water will be converted to nitrates. These nitrates in the presence of denitrifying bacteria will be reduced to atmospheric nitrogen.

5. ADVANTAGES

1. Ecofriendly method for treating waste water using Canna Indica plants.
2. Low cost setup as compared to large sewage treatment plants.
3. It requires negligible attendance for operation and monitoring.
4. It enhances the landscape and gives the site a green appeal. If done on large scale it will create a natural habitat for birds

6. CONCLUSION

1. During supplying waste it was observed that sewage is very good for plants as during the sewage treatment process plants are seen to be grown very well.
2. There was considerable decrease in turbidity of water in outlet as compared to turbidity of inlet water . The Dissolved Oxygen (DO) was seen to be increased.
3. Therefore, from the result we came to the conclusion that this method is effective for reducing turbidity, increasing dissolved oxygen, and bringing pH near to that of neutral water.

7. REFERENCES

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