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Wastewater Treatment Potential through Constructed Wetland System

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ABSTRACT

Wastewater discharge is one of the most serious threats to the ecosystem. The most immediate impact of wastewater discharge on the environment is that contamination and devastation of natural habitats and the wildlife that live in those home ground which leads the entire food chain to ruin. A large number of technologies have been applied for wastewater treatment but most of them are expensive to erect and run. An alternate to conventional ways of wastewater treatment by utilizing natural process is, constructed wetland system. Construction of wetland system is a self-regulating mechanism to purify wastewater. This system involves an interaction between the bacterial metabolism, plant uptake, soil matrix and accumulation for pollutant removal. Vegetation such as Alternanthera sessilis and Canna indica are the dominant feature in this system and act as an important biotic factor in treatment process. They remove nitrogenous compounds, phosphorous, heavy metals and decrease the amount of BOD and COD. The resultant clean water is used for gardening, fencing, etc… based on their characteristic values. The characteristics of wastewater are recorded, analyzed and compared with their standards and has concluded by saying which plant treats more amount of wastewater.

Keywords:-*Wastewater, alternanthera sessilis, canna indica, clean water.*

INTRODUCTION

Water is a precious gift of nature presented for the sustainability of ecological system and human beings. It is known that the amount of fresh water available on earth is only 2.5% from a larger amount that exists. Human utilize fresh water and divert them as wastewater into the environment that largely devastates the ecological life.

Wastewater can be interpreted as combination of more than one of domestic effluent (black water and grey water), agricultural effluent, water from commercial buildings, educational institutions and manufacturing industries. Their effect on environment and human are largely negative. The developing countries suffer the most when people need to face the sanitation constraints and health risks due to the consumption of polluted water.

Today's emerging technologies coupled with proper management, wastewater can be redefined as beneficial sources, a conventional method of wastewater treatment in a greener way is construction of wetland system. Constructed wetlands are areas that supports natural vegetation adapted for living in saturated soil condition where the treatment of wastewater takes place in a soil volume which is penetrated by the roots of plants. This is a self-moving system being more economical and ecologically acceptable solution to water pollution management problems.

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MATERIALS

Alternanthera Sessilis

Alternanthera sessilis is a multipurpose plant commonly known as ponnanganni in Tamil Nadu, India. It is a common amphibious plant cultivated for its food, herbal medicines, as an ornamental plant, trade of aquatic museum and as a poultry food. In certain regions of southeast asia the plant own leaves and young shoots are used up as vegetables. They remove Biochemical Oxygen Demand (BOD), level of phosphorous, total suspended solids, nitrogen content of ammonium ion in this system.

Canna Indica

Canna indica is a perennial rhizomatous ornamental plant. They are low maintenance and easy to grow and both their flowers and foliage offer long lasting color in the garden. It removes Biochemical oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of wastewater. They also remove nitrogen and phosphorous. They translocate heavy metals like chromium, nickel and lead from effluents.

Others

The system consists of a basin having inlet an open end pipe which releases water into the wetland and an outlet for the treated water. The basin is filled with different layers of beds of sand and gravel. The soil is in saturated condition.

METHODOLOGY

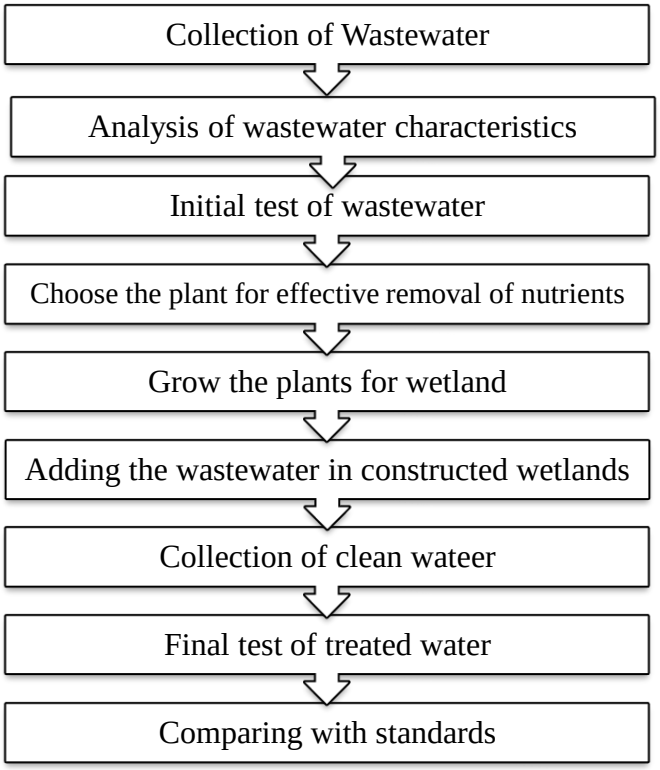


Fig.1:-*Overall plan of the methodology.*

Wetland system is constructed with different layouts that depends on the type of water, vegetation and soil shown in Figure 2. The vegetation is planted in a saturated soil contained in each basin having inlet and outlet appurtenances. The basin is also filled with layers containing sand and gravel shown in Figure 3. The wastewater taken as sample for the experiment is domestic effluents. They are

collected from households of an area located at Madurai, Tamil Nadu, India. Grits and floating materials are removed from the raw effluent. Characteristics of wastewater has to be known. Initial Test such as pH, Chloride, Hardness, Suspended solids, Volatile & Fixed solids, BOD and COD for the sample is conducted.

Sample of 2 litre is made to pass through the inlet of the basin of each plant. In the mean-time the plant has to grow and need to expand its root system. They create attachment sites for microorganisms and release oxygen. The water from the inlet of the basin passes through different layers of sand and gravel to get filtered. The filtered water makes its way through the roots. As the filtered water passes through the root system of the plants, they themselves take up certain amount of nutrients from wastewater. The microorganisms at the attachment sites of the roots aerobically oxidize the organic effluents. The filtering action of different layers, action of bacteria through the attachment sites and certain chemical actions finally helps in obtaining treated water. The absorbed nutrients help the plant in their growth and providing food & aesthetic view to the human resource.

After 3 days the treated water is collected through each outlet in a separate beaker. Tests which are performed initially are again conducted in treated water as final test. The procedure is repeated again with another sample of domestic effluents and the treated water is collected after 6 days from the outlets. The incurred initial and final test results are recorded, analyzed and compared with the standards.

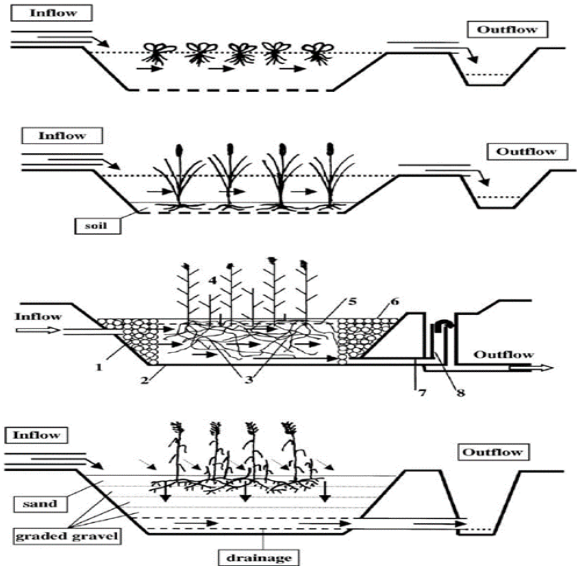


Fig.2:-*Different layouts of wetland system*

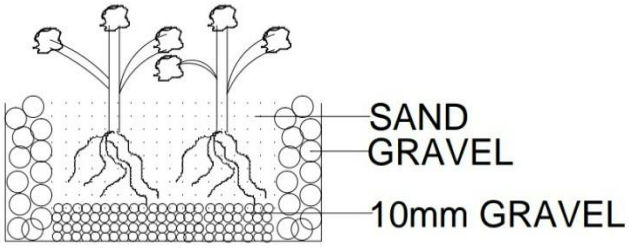


Fig.3:-*Apparatus setup of the wetland constructed*

Table 1:-*Initial and standard test values*

S.no	Parameters	Initial value	Standard value
1	pH	8.25	6 – 8
2	BOD mg/l	805	500
3	COD mg/l	300	250
4	Hardness mg/l	900	600
5	Chloride mg/l	1663	1000
6	TSS mg/l	1465	100
7	Volatile & fixed solids mg/l	3112	2100

RESULT AND DISCUSSION

The sample collected from the households are analyzed by the characteristic's tests of water. The water is made to pass through the root system of the vegetations that are planted. Finally, the treated water is also analyzed for their characteristics

Table 2:-*Final test values of Alternanthera sessilis and Canna indica.*

S.no	Parameters	Alternanthera sessilis	Canna indica
1	pH	7.5	7.8
2	BOD mg/l	385	408
3	COD mg/l	120	180
4	Hardness mg/l	384	485
5	Chloride mg/l	950	975
6	TSS mg/l	90	82
7	Volatile & fixed solids mg/l	1300	1600

The graph depicts the analyzed parameters of water collected from households. It shows various test values that are analyzed from the experiment. Initial test, standard values and final test values are displayed. The final test value includes both Alternanthera sessilis and Canna indica plants.

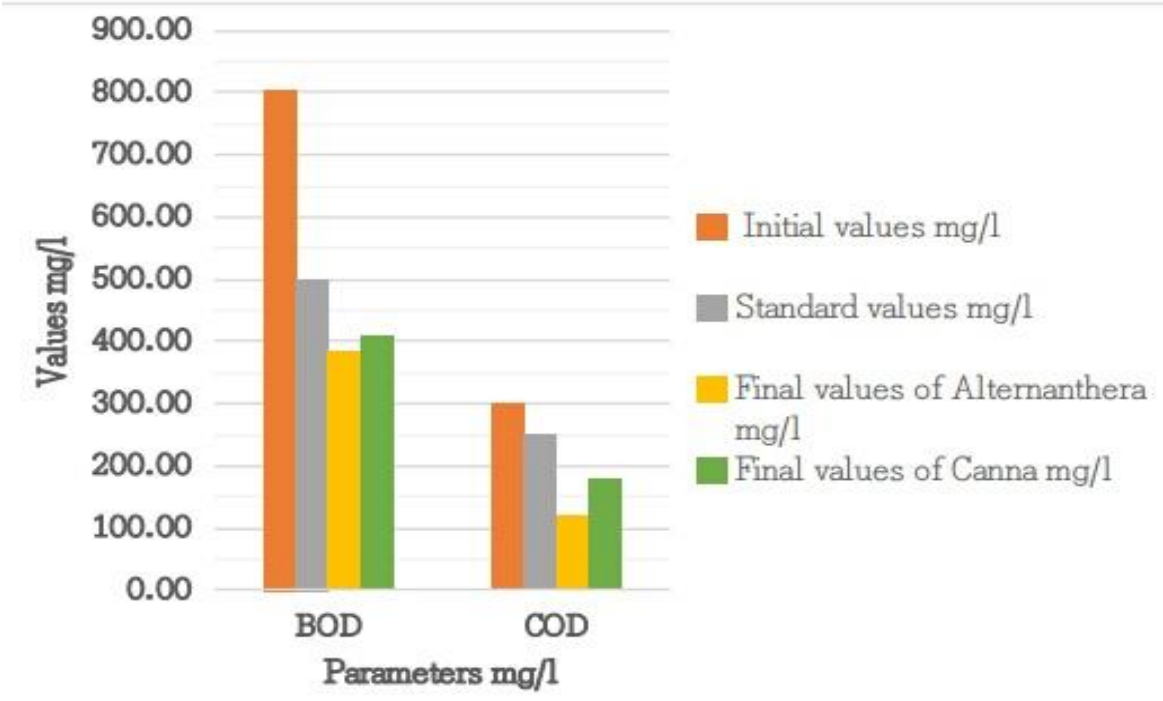


Fig.4:-*Test values for BOD and COD*

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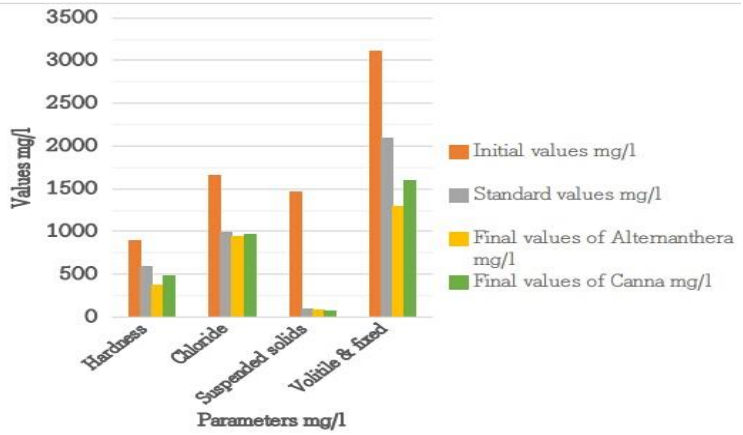


Fig.5:-*Test values for hardness, chloride, suspended solids, volatile and fixed solids*



Fig.6:-*Experimental setup*



Fig.7:-*Treated and untreated water*

CONCLUSION

Thus, the project has been done successfully. From the incurred results, among Alternanthera sessilis and Canna indica it is obvious that Alternanthera sessilis effectively removes more amount of pollutants from the collected effluents.

The treated water is used in the field of irrigation, aquifer recharge, industrial mixing of water, cooling towers etc. Also, the shoot system of Alternanthera sessilis is an edible part, human use it for their healthy life and Canna indica gives aesthetic view.

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