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TREATMENT OF GREY WATER USING CONSTRUCTED WETLAND SYSTEM

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Abstract:

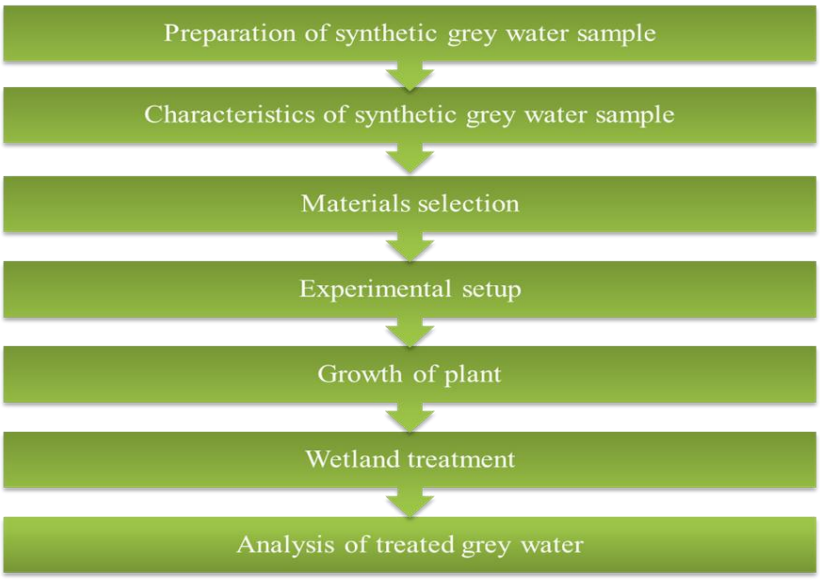
The grey water is the waste water that is generated in the households or office buildings from streams without fecal contamination. Sources of grey water include water from sinks, showers, baths, washing machine or dish washers. As grey water contains fewer pathogens than domestic waste, it is generally safer to handle and easier to treat and reuse onsite for toilet flushing, landscape or crop irrigation. The removal of toxic content in grey water in this era is one of the most needed process by now. A constructed wetland (CW) is an artificial wetland created for the purpose of treating anthropogenic discharge such as domestic, industrial wastewater and storm water runoff. The treatment of grey water for the removal of toxic content using constructed wetland along with plant species is the most simple and widely accepted eco-friendly method for the better treatment of grey water. This paper addresses the treatment of grey water using constructed wetland with Canna Indica plant and reduces the toxic content in grey water. Grey water and treated water is tested for pH, Total dissolved solids, Turbidity, Chemical oxygen demand, Total hardness, Biochemical oxygen demand, Electronic conductivity and the removal efficiency is discussed with the results.

Key Words: Grey Water, Physic-Chemical Characteristics, Constructed Wetland, Canna Indica & Pollutants.

1. Introduction:

The environment is the surrounding in which we will live in, that follows an ecological cycle but due to the pollution in the modern era the whole ecological cycle has collapsed. More research work, volunteers and NGO's are needed for bringing back the ecological cycle. One of the problem in ecological cycle is depletion of water. Water is a transparent and nearly colorless chemical substance that is the main constituent of Earth's streams, lakes, oceans, and the fluids of most living organisms. Water covers about 71% of the Earth's surface so it is vital for all known forms of life. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation. Only 2.5% of this water is freshwater and 98.8% of that water is in ice (excepting ice in clouds) and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere. The grey water is the waste water that is generated in the households or office buildings from streams without fecal contamination i.e., all streams except for the waste water from toilets, source of grey water include e.g., sinks, showers, baths, washing machine or dish washers. As grey water contains fewer pathogens than domestic waste, it is generally safer to handle and easier to treat and reuse onsite for toilet flushing, landscape or crop irrigation. The grey water cannot be used for drinking purpose. More than 70% of the fresh water goes as grey water. Hence it can be reused after the treatment process, so that the usage of fresh water can be reduced.

2. Methodology:



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3. Experimental setup:

The experimental setup consists of a unit of constructed wetland systems. The pilot scale model of vertical surface flow constructed wetland has a tub of size is 0.52m x 0.30m x 0.30m and inverted water-can was used to hold the grey water. The capacity of each vertical water-can is 25 liters. The total volume of root zone bed was 0.0468m3 with suitable outlets. The pilot units were "filled from bottom to top". The wetland is constructed by laying a layer of gravel in the tub. Then a layer of sand is laid after which a layer of charcoal is added and there is a layer of the soil above which the canna indica is planted. Gravel size is 20mm and the bed thickness is 5cm. Grain size of sand is 4.75µ and the bed thickness is 2cm. the charcoal is dropped up to 4cm thickness. The soil is placed to a thickness of 15cm and the constructed wetland unit was planted with five Canna Indica plant. Grey water sample is allowed to flow through the above setups made. Water trickling through the filter bed is cleaned by microorganisms living on the root system. The bed utilizes the sewage for growth of bacteria which results in a clean effluent

4. Test Conducted:

pH: pH (potential of hydrogen) is a numeric scale used to specify the acidity or basicity of an aqueous solution. It is approximately the negative of the base 10 logarithm of the molar concentration, measured in units of moles per liter, of hydrogen ions. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic.

Turbidity: Turbidity is the amount of cloudiness in the water. This can vary from a river full of mud and silt where it would be impossible to see through the water (high turbidity), to a spring water which appears to be completely clear (low turbidity).Turbidity is usually measured in nephelometric turbidity units (NTU) or Jackson turbidity units (JTLJ), depending on the method used for measurement.

BOD: The amount oxygen required for the decomposition of organic matter consumed by the bacteria.

COD: The amount of oxygen required by the organic matter to react with carbondioxide and water.

Electrical Conductivity: Electrical Conductivity is the reciprocal of electrical resistivity and measures a materials ability to conduct an electrical current. Ions in water conduct electrical current, therefore electrical conductivity is fast, simple method of estimating the amount of total dissolved solids in water sample. Electrical conductivity is expressed in ds/m.

5. Test Results:

The samples of grey water and treated water are tested for the following physico-chemical characteristics such as pH, total dissolved solids, BOD, COD, turbidity and total hardness.

Table 5.1: Physico-chemical characteristics of grey water and treated water sample

S.No	Test	Unit	Water Sample	
			Grey Water	Treated Water
1.	pH	No unit	8.4	6.7
2.	Turbidity	NTU	13.6	10.6
3.	Total Hardness	mg/l	750	510
4.	COD	mg/l	1320	220
5.	Total Dissolved Solids	mg/l	6265	2093
6.	Electrical Conductivity	ds/m	8.95	2.99
7.	BOD	mg/l	165	54

Table 5.2: Removal Efficiency

Test	Removal Percentage
pH	20.35%
COD	83%
Total Dissolved Solids	66.59%
Total hardness	32%
Turbidity	22%
Electrical conductivity	66.59%
BOD	67.27%

6. Results and Discussions:

pH: pH or hydrogen ion concentration is an important quality parameter of natural and wastewaters. Though it has no direct effect on the human health all bio chemical reaction is sensitive to the variation of pH. The pH value for the grey water sample changed from 8.4 to 6.7 in the treated water of constructed wetland system. It comes under the standards of irrigation value so the treated water can be used for the irrigation purpose.

Turbidity: The turbidity value has been reduced in the constructed wetland treatment. Before the treatment the value was 13.6 NTU in the grey water sample. After the treatment the value was 10.6 NTU. The turbidity value of water used for irrigation purpose should be between 5 to 11 NTU. The treated sample falls under the limited range so it can be used for domestic purpose.

BOD: The BOD value has been reduced to a greater extent from the constructed wetland treatment method. Before the treatment the value was 165 mg/l in the grey water sample. After the treatment the value was 54 mg/l.

COD: The COD value has been reduced to a greater extent by constructed wetland treatment method. Before the treatment, the value was 1320 mg/l in the grey water sample. After the treatment the value was 220mg/l. The treated sample attained the limits for irrigation, so it can be used for it. The COD is removed with help of rhizomes in the plant system.

Electrical Conductivity: The electrical conductivity value has been reduced by constructed wetland treatment method. Before the treatment the value was 8.95 ds/m in the grey water sample. After the treatment the value was 2.99 ds/m.

Total Dissolved Solids: The TDS value has been reduced to a greater extent from the constructed wetland treatment method. Before the treatment the value was 6265 mg/l in the grey water sample. The TDS content are removed through the filter media. After the treatment the value was 2093 mg/l. The TDS value of water used for irrigation purpose should be 2100 mg/l. The treated sample falls under the limits, so it can be used for domestic purposes.

7. Conclusion:

The grey water taken for the treatment is successfully treated and pollutants in the grey water are reduced by constructed wetland method. The tests that were done to find out the physico-chemical characteristics are pH, Turbidity, COD, BOD, Total hardness, Total dissolved solids and Electrical conductivity. The treated water is used for domestic purpose like irrigation such as watering the plants and lawn. The effluent from constructed wetland was of good quality than the influent which was polluted. This experiment proved that the wetland is an effective and simple method of grey water treatment. Each technology has its unique opportunities, benefits and challenges. From the present experiment, it is found that, treatment of grey water sample by constructed wetland would be a better solution, where naturally available sources are used for the treatment. It is simple to execute and also can be used as the improvement of aesthetic as well as treatment process of contaminated water with lowest operation and maintenance cost. The waste water in the wetland system is treated without any electrical or any other artificial energy sources. It is one of the efficient, effective and economic methods of treatment.

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