

TREATMENT OF DOMESTIC WASTEWATER BY BIOFILTRATION - ARTIFICIAL WETLAND

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Abstract

Water is the basic necessity of every human being. But, water scarcity is a major issue that is rising very rapidly in modern-day India. In addition, Water is one of the most misused commodities that we still waste. According to a survey conducted in India 30 litres and 10 litres of water was used in a house for Toilet Flushing and Washing Utensils. The main objective of the study is reusing the wastewater from the household (except toilet) after the treatment of wastewater. Also it is a low cost wastewater treatment with effective results. A small change can make a big difference. Reusing the wastewater from households for washing Utensils, flushing and gardening etc., can reduce the daily domestic consumption of water.

Keywords: *constructed wetland, epipremnum auerum plant, bio filter, hydrocarbons*

Introduction

Domestic Consumption of Water

In India on an average, the domestic consumption of water under normal condition is about 135 litres/day/capita as per IS: 1172. In developed countries figure may be as high as 350 litres/day/capita.

The details of the domestic consumption in India are as follows:

| | | |
|------------------|---|------------------------------|
| Drinking | - | 5 litres |
| Cooking | - | 35 litres |
| Bathing | - | 55 litres |
| Clothes Washing | - | 20 litres |
| Utensils Washing | - | 10 litres |
| House Washing | - | 10 litres |
| TOTAL | - | 135 litres/day/capita |

Domestic Wastewater

Wastewater produced due to human activities in households is called domestic wastewater. Domestic wastewater is usually characterized by a grey color, musty odor. It contains various microorganisms like bacteria, fungi, protozoa and algae. It contains million of bacteria per milliliter which may cause cholera, dysentery and typhoid fever. Domestic waste water is also a major source of plant nutrients. It mainly contains nitrates and phosphates. It promotes the growth of algae. It is classed as domestic water or sanitary sewage.

Classifications of Domestic Wastewater

- a) Grey wastewater (kitchen, bath, laundry)
- b) Black wastewater (urine, faeces)

Bio Filtration

Bio filtration is the process of utilizing natural biological oxidation for the destruction and removal of VOCs, odors and hydrocarbons. Any type of filter with attached biomass on the filter media can be defined as bio filter. The filtration process in which the pollutants are removed due to biological degradation rather than physical straining as is the case in normal filter is called Bio filtration.

Wetland

Wetland is a distinct ecosystem that is flooded by water either permanently or seasonally where oxygen free processes prevail. The primary factor that distinguishes wetland from other land forms or water bodies is the characteristic vegetation of aquatic plants. Wetlands play a number of functions including water purification.

Constructed Wetland

A Constructed Wetland is an artificial wetland to treat municipal or industrial wastewater, grey water or storm water runoff. Constructed wetlands are engineered systems that use natural functions vegetation, soil, and organisms to treat wastewater. Depending on the type of wastewater the design of the constructed wetland has to be adjusted accordingly.

Constructed Wetland Types

These are the fundamental forms of constructed wetland which differ in the direction of effluent flow.

- a) Free Water surface Flow
- b) Horizontal Subsurface Flow
- c) Vertical Flow

Objectives

- Objective of the project is to reuse the domestic wastewater for other purposes like Gardening, Washing Utensils, etc.,
- As per the details of the domestic consumption in India for Utensils Washing and House Washing 20 liters/day and For street washing 1.0 to 1.5 l/m²/day. was consumed.
- Using the treated water we can save water for our future uses during water scarcity.
- To reduce the bio wastes while treatment of water.
- Low cost and simple way to treat wastewater

Methods and Materials

Collection of Sources

The wastewater which going to be treated was collected from my household kitchen sink and shower. The total quantity of collected wastewater from my household was 30 litres per day. It was grey in color and musty odour.

Experimental Setup

A small Prototype of bio filter was setup with filter media for screening and bio degradation. The bio filter contains layer of soil bed big and small gravels, fine sand. The first layer of the filter is sand bed of grain size 0.2 to 0.3 mm. The height of the sand to be filled for 3CM. Gravel size should be 70mm. Aeration in the process of adding air into the wastewater to allow aerobic biodegradation of the organic materials. Aeration brings water and air in close contact in order to remove dissolved gases and oxidizes dissolved metals. An artificial wetland was constructed with *Epipremnum auerum* plant. The plant is able to remove indoor pollutants such as formaldehyde, trichloroethene, toluene, xylene, and benzene in controlled circumstances. The plant is sometimes used in aquariums placed on top of the water. This is beneficial to the plant and it absorbs many nitrates and uses them for growth.

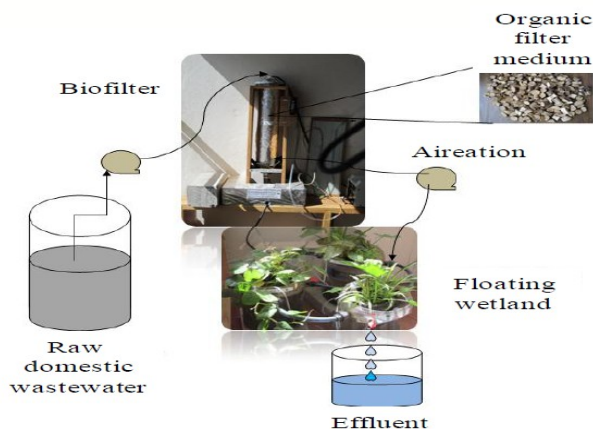


Figure 1 Experimental setup

Experimental Procedure

The collected domestic wastewater was stored in a bottle. The sample of water was taken for Ph level test. BOD and COD tests are done for the collected domestic wastewater sample. The value of COD and BOD are noted. Then the water passed through the bio filter for pre treatment process. The next chamber artificial wetland with the *Epipremem auerum* palnt. Then the effluent collected and again pH, COD and BOD Tests are done to find the percentage of removal of COD and BOD are calculated to find the reusing condition of the domestic wastewater.

Parameter Test before Treatment

Table 1 Physical parameter before treatment

| Physical Parameters | Before Treatment |
|---------------------|------------------|
| Appearance | Grey color |
| Odour | Present |
| Turbidity | 23.5 |

Chemical Parameters

Table 2 Chemical parameter before treatment

| Chemical Parameter | Before Treatment (mg/l) |
|--------------------|-------------------------|
| pH | 7.86 |

Biochemical Oxygen Demand

Table 3 Biological parameter before treatment

| Biological Parameter | Before Treatment (mg/l) |
|----------------------|-------------------------|
| BOD | 310.5 |

Chemical Oxygen Demand

Table 4 Biological Parameter before Treatment

| Biological Parameter | Before Treatment (mg/l) |
|----------------------|-------------------------|
| COD | 400 |

Testing of Materials

Physio - Chemical Parameters

After collecting the sample the physical and chemical parameters of the sample should be analyzed. For example Ph value of the sample should be find out by the pH meter.

PH

PH is a measure of how acidic/basic water is .the range goes from 0 to 14 with 7 being neutral. PHs of less than 7 indicates acidity, whereas a pH of greater than 7 indicates base.

For the collected sample the pH level 7.86



Figure 2 PH value

Biochemical Oxygen Demand

Biochemical oxygen demand (BOD) is the amount of oxygen consumed by microorganism to breakdown the organic content of a wastewater sample.

Chemical Oxygen Demand

Chemical oxygen demand is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water.

Parameter Test after Treatment

Table 5 PH level readings

| pH Level | |
|-------------------------|------|
| pH Before Treatment | 7.86 |
| pH After Bio filtration | 7.34 |
| pH After Treatment | 6.46 |

Table 6 BOD readings

| BOD | |
|-------------------------|------------|
| BOD Before Treatment | 310.5 mg/l |
| BOD After Biofiltration | 251 mg/l |
| BOD After Treatment | 159 mg/l |

Table 7 BOD readings

| COD | |
|-------------------------|----------|
| COD Before Treatment | 400 mg/l |
| COD After Biofiltration | 292 mg/l |
| COD After Treatment | 172 mg/l |

Table 8 T.S, S.S, D.S Readings

| Total Solids (T.S) Suspended Solids (S.S) Dissolved Solids (D.S) | |
|---|------------|
| T.S Before Treatment | 21.4 mg/l |
| T.S After Bio filtration | 19.18 mg/l |
| T.S After Treatment | 16.21 mg/l |
| D.S Before Treatment | 12.47 mg/l |
| D.S After Bio filtration | 11.07 mg/l |
| D.S After Treatment | 9.3 mg/l |
| S.S Before Treatment | 2.6 mg/l |
| S.S After Bio filtration | 2.3 mg/l |
| S.S After Treatment | 1.9 mg/l |

GRAPH

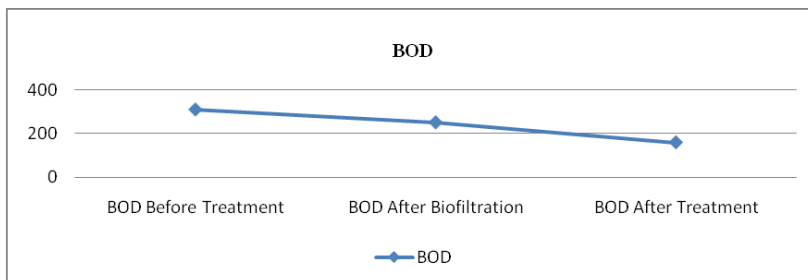


Figure 3 BOD graph

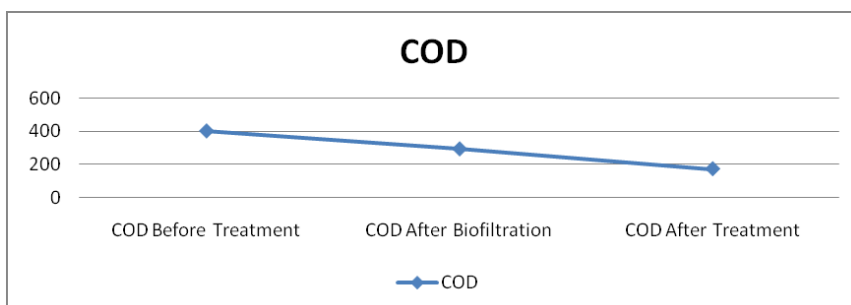


Figure 4 COD graph

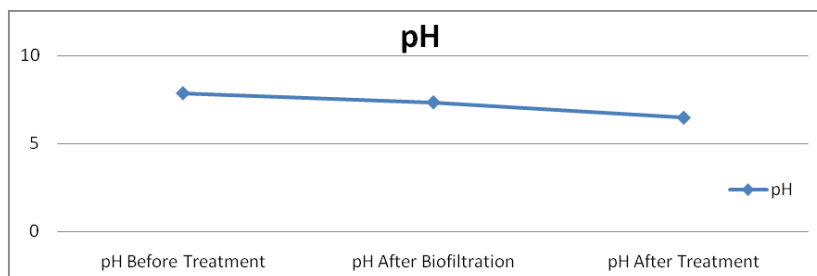


Figure 5 PH graph

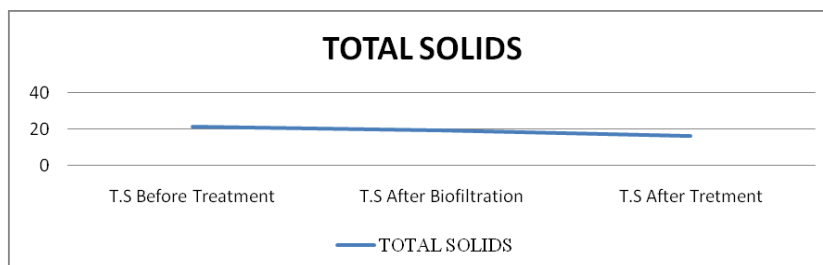


Figure 6 Total solids graph

Conclusion

This project clearly proves that the Artificial Wetlands have the capacity to treat Domestic wastewater. Especially the *Epipremnum auerum* plant absorbs the wastes in the water for its growth and treats the wastewater. Domestic wastewater is low contaminated water and can be treated effectively by the artificial wetland. In present work *Epipremnum auerum* plant was used in the wetland. In present work the domestic wastewater collected from my household was treated moderately with good percentage of removal. Percentage of BOD removal was 35% and Percentage of COD removal was 42%. The Graph shown that the values of Biological Oxygen Demand and Chemical Oxygen Demand are decreasing after the bio filtration and after the treatment. The inlet of wastewater was 30 liters and effluent collected after treatment was only 16.5 litres. Artificial wetland can effectively be used in an economical manner. It is Simplicity in Operation. This study reinforces that the Constructed wetlands have the ability for treating Domestic wastewater. Treated wastewater can be used in gardening, ground water harvesting, street washing etc., except drinking. This will save a major volume of fresh water.

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