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Use of Phytoremediation for the Treatment of Kitchen Wastewater

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Abstract: ***The wastewater is contaminated with many impurities therefore it is necessary to treat the wastewater. The wastewater is generated from canteen; restaurant and household kitchen are also potential pollutant. The water pollution in India is a major problem as 70% of surface water and ground water are contaminated by chemicals, organic and inorganic, biological and toxic contaminants. The aim of this project is to study the efficiency of phytoremediation in treatment of kitchen wastewater. It is a more effective and sustainable alternative for conventional waste water treatment technologies. In this paper we are analyze the performance of Phytoremediation for removal of pollutants such as Total suspended solid (TSS), Chemical oxygen demand (COD), Biological oxygen demand (BOD), Total dissolved solid (TDS) of kitchen wastewater at 1day Hydraulic retention time from the kitchen wastewater as plants play a great role in the removal of pollutants. This study will give the eco-friendly method and less cost of Maintence and operation. It reveals that proper treatment of kitchen wastewater can lead to higher profitability for restaurant and save environmental pollution***

Keywords: kitchen, Wastewater, pollutants, Phytoremediation, BOD, COD, TSS, TDS, Removal efficiency, HRT

1. Introduction

Kitchen waste is a left-over food from the restaurants, hotels and households. Large amount of kitchen waste is generated in highly populated areas and directly discharged in to the environment which is one of the major concerns of the water pollution. Kitchen waste contains high levels of carbohydrates, fats, proteins, and other organic molecules. Kitchen waste is usually acidic due Fermentation bacteria such as lactic acid bacteria.The kitchen consists of solid and liquid wastes with high BOD, COD, and high density organic matter, suspended solids, oil, grease and many hazardous contaminants which can pollute the water body and environment is mixed in huge amounts in the restaurant wastewater. It contain an organic load from food processing, washing in the kitchen, soap and detergents, with the main contaminants being detergents,oil,grease and other dissolved and suspended compounds. It is usually acidic due to the action of acid Fermentation bacteria such as lactic acid bacteria .Phytoremediation method is developed to treat wastewater. Liquid waste include wash water liquids used for cleaning, cooking oil, fats, or grease, and waste detergents. Kitchen wastewater was treated using phytoremediation and it was found effective to treat the waste water up to disposal quality.

Conventional waste water treatment technology has been proved effective technology. It consists physical chemical and biological processes. Physical process includes sedimentation and filtration. Most common chemicals process includes ozonation and neutralization.In biological treatment process, micro-organisms such as bacteria are used to biochemically decompose the wastewater and stabilize the end product. Phytoremediation is the biological treatment technologies to improve the water quality that have been used worldwide. Phytoremediation is the passive wastewater treatment methods and using plants-based systems and microbiological processes to eliminate contaminants in nature. It is the use of plant to remove contaminants from water. Phytoremediation is based on the physiochemical properties of the plants and associated microorganisms, such as photosynthesis, metabolism and mineral nutrition .It is a plant based on bioremediation technology. The aquatic plants are used to remove the contaminants from wastewater. The pollutant removal depends upon hydraulic retention time, hydraulic loading and efficiency Water depth plant species, plant density, influent concentration. Phytoremediation technology has been widely applied for waste water treatment, pollution control and environmental improvement. The phytoremediation technique has various advantages over any other biological treatment methods used to treat waste water. The biological wastewater treatment methods are economically suitable in the developing countries which have low operation and maintenance cost with better efficiency than any other treatment methods.

The aim of this project to reduce the pollutant load of wastewater. The performance of Phytoremediation for removal percentage of pollutants such as Chemical oxygen demand (COD), Biochemical oxygen demand (BOD), Total suspended solids (TSS), Total dissolved solids (TSS), at 1 day Hydraulic retention time for better efficiency from the kitchen wastewater. Calculate the removal efficiencies of pollution.

2. Material and Methods

2.1 Materials Used For phytoremediation SetupMaterials

Various materials used for the phytoremediation system were as follows
1) Plastic collection tank
2) Plastic can
3) Drainage pipe
4) Beaker

The experimental setup has been built in the open air which consist horizontal subsurface flow systemThe raw wastewater from Kitchen was collected in to the influent tank. The raw wastewater characteristics likeTSS, TDS, COD, and BOD were determined using the procedure mentioned in the standard methods.

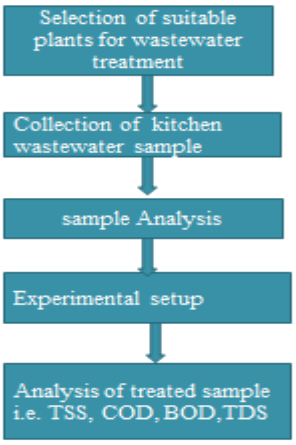

Figure 2.1: Methodologyof phytoremediation system

2.2 Selections of Plants in phytoremediation system

Selection of the plant is based on the pollutant tolerance potential, oxygen carrying capacity, root system, climatic tolerance, and removal efficiency. Plants play an important role as plants takes the contaminant and stored as bio mass.

2.3 Experimental set up

The experimental set-up was used to treat the kitchen wastewater. The treatment process consists of the primary treatment which was used to remove the suspended solids and organic matter from the kitchen wastewater which may become the barrier while biological treatment of kitchen wastewater. The experiment model of phytoremediation system has constructed in open experimental site. Waste water sample was collected in plastic circular tank from kitchen. Pass this waste water through the bed with the help of peristaltic pump. The phytoremediation bed is installed with suitable inlet and outlet drainage pipe. The bed is regular rectangular size. Gravels are used in this experiment. The gravels are used as filter media. Suspended solids are removed by filtration gravels. Outlet sample was collected in beaker. In phytoremediation plants role is to purify water. In the departmental laboratory these collected at 1 day hydraulic retention time treated samples sample were analysed. In this experiment plants play an important role in clean up processes. In this experiment setup flow rate was kept in desired HRTof 1 day. The pH was ranging between 6 and 8.

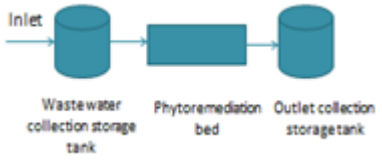

Figure 2.2: Flow diagram of phytoremediation experiment set up

2.4 Analysis of Kitchen Wastewater

Analyse the pre and post sample parameters likeBOD, COD, TDS, and TSS for understanding the pollution removal efficiency. The standardised method and procedure followed for the analysis of these parameters.

2.5 Methods used for treatment of kitchen wastewater

Total Suspended Solids- Gravimetric Method
Total Dissolved Solids- Gravimetric Method
Chemical Oxygen Demand-Volumetric Method
Biological Oxygen Demand-Volumetric Method

3. Result and Discussion

The study focused on the performance of phytoremediation for the treatment of kitchen wastewater. The various parameters analysed are Total suspended solids (TSS), Biological oxygen demand (BOD), and Chemical oxygen demand (COD), Total Dissolved Solids (TDS)

3.1 BOD Reduction from kitchen Wastewater

BOD is the amount of oxygen required by microorganisms during the biological reaction of oxygen with organic material. Reduce level of oxygen leads to decrease the removal efficiency.The average removal efficiency of 1 day HRT is 86.74 %.The above bar graph of BOD removal rate of phytoremediation is obtained, as shown in Figure 3.1

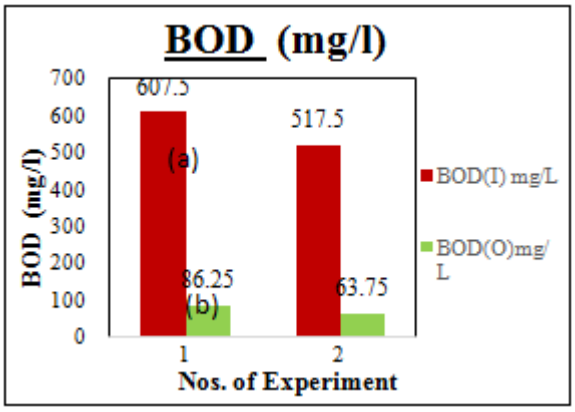

Figure 3.1: A BOD reductions at 1 day HRT for phytoremediation systems

3.2 COD Reduction from kitchen Wastewater

In phytoremediation removal of COD is mainly depend on microbiological degradation of the matter attached to and the plant roots. The degradation of organic and the inorganic matter depend on the atmospheric oxygen. The average removal efficiency of 1day HRT is 92.88% the above bar graph of COD removal rate of phytoremediation are obtained, as shown in Figure 3.2

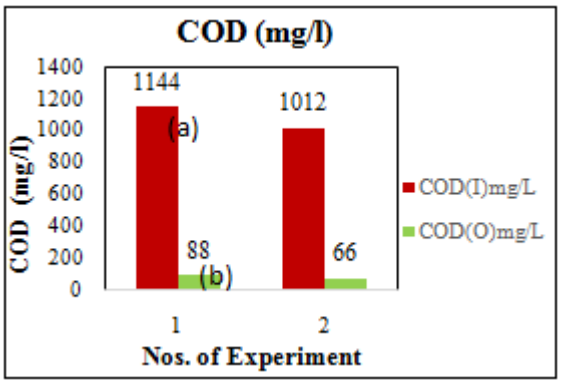

Figure 3.1: COD reductions at 1 day HRT for phytoremediation systems

3.3 TSS Reduction from kitchen Wastewater

Sediment suspension not only releases pollutants from the sediments, but also increases the turbidity and reduces light penetration. The reduction in TSS is found to be 74.55 % in different1 day HRT. TSS mainly removed by physical process of sedimentation. The above bar graph of TSS removal rate of phytoremediation is obtained, as shown in Figure 3.3

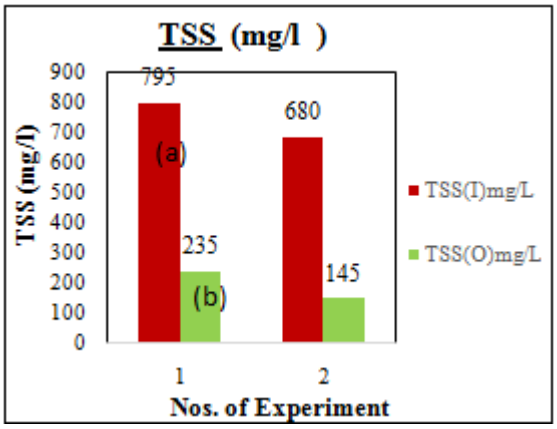

Figure 3.3 TSS reductions at 1 day HRT for phytoremediation systems

3.4 TDS Reduction from Kitchen Wastewater

In phytoremediation removal of TDS is mainly depend on the dissolved organic and inorganic ions. The average removal efficiency of 1day HRT is 71.44 % the above bar graph of TDS removal rate of phytoremediation are obtained, as shown in Figure 3.4

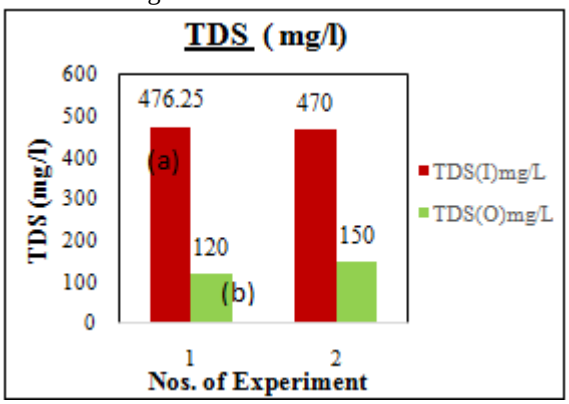

Figure 3.4: TDS reductions at 1 day HRT for phytoremediation systems

4. Conclusion

In this paper, the study on phytoremediation technology for the treatment of kitchen waste water has been conducted. After pre and post treatment process, parameters like TSS, TDS, BOD, and COD it concluded that phytoremediation is a sustainable process to treat kitchen wastewater. In this study Phytoremediation process performed in 1 day HRT. The removals efficiency were obtained in those beds when the hydraulic retention time (HRT) reaches 1 days the removal efficiencies are 86.74 % reduction in BOD , 92.88 % reduction in COD , 74.55 % reduction in TSS and 71.44 % reduction in TDS. Further studies will focus on removal of nutrients, and utilization of plats treat waste water naturally this process does not require high energy inputs, maintenance cost. This is a solar-driven process as light and carbon sources are utilizes to derive the microbial and plant processes. Phytoremediation required lesser energy, are easily operated, have no sludge disposal problems and can be maintained by untrained personnel. It is an eco-friendly and simple to construct. Phytoremediation are less expensive than other clean-up technologies as construction and maintenance cost is very low, need not required costly, electromechanical equipment. They can be aesthetically pleasing and they also provide habitat for wildlife and human enjoyment. Reuse of treated wastewater for irrigation, washing, plantationand other purposes. They provide effective and reliable cleaning under fluctuating hydraulic and contaminant loading rates. It is seen that the better removal efficiencies are obtained through 1 day HRT. Ithelpto reduce the operation as well as maintenance cost.

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