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Effectiveness of Vetiver System for the Treatment of Wastewater from an Institutional Kitchen

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Abstract

This paper investigates the potential of using Vetiver System (VS) for the treatment of wastewater generated from an Institutional kitchen. Vetiver grass is a perennial grass with deep root and has high biomass system. Researchers proved that Vetiver grass have extraordinary ability to with stand extreme environmental conditions such as elevated levels of salt, acidity, alkalinity, sodicity as well as whole range of heavy metals, nitrogen (N), and phosphorous (P). There are around 800 inmates in this institutional hostel; as a result large amount of wastewater have been produced everyday in campus kitchen wastewater outlet. A pilot experimental setup was made for the treatment of wastewater produced from the wastewater outlet and the capability of using VS for the treatment was studied. Experimental setup includes 5 drums of 130 liters capacity and is filled with soil, the Vetiver grass is planted in them and was connected in series using different pipe fittings. Each tank has outlet at the bottom of the tank and inlet provided at top with sufficient free board. The wastewater was supplied through the inlet of the 1st tank and was allowed to pass through the 2nd, 3rd, 4th and 5th tanks and the treated water was collected at the outlet of the 5th tank. The water quality parameters of wastewater and treated water were analysed and the effectiveness of using VS for the treatment was assessed. The various water quality parameters like pH, turbidity, acidity, alkalinity, BOD, COD, DO, Ecoli were analysed for the wastewater and treated water. It is observed that the wastewater treatment using VS has significant potential to reclaim the wastewater. The VS is able to remove 80 to 85 % of BOD, 85 to 90 % of COD, and 85 % of total Coliform. Most of the water quality parameters are within permissible limits as per IS 10550, 2012 and IS 2292, 1992.

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2. Introduction

There are many methods for wastewater treatment; more than half of the world population will be suffering from severe fresh water shortages. The water is the most important factor in food production and agriculture. The limited availability of water for agricultural production is increasing day to day and can be resorted by using treated wastewater for agricultural and domestic uses and the fresh water could be limited for drinking and emergent domestic needs such as cooking and washing.

Vetiver grass, a perennial grass with deep root system and has high biomass production and has unique morphological characteristics. It has the ability to resist adverse environmental condition, absorb and tolerate extreme levels of nutrients [1, 2, 5] and has been used effectively for wastewater treatment [1, 2]. The Vetiver grass also has unique characteristics suitable for environmental protection purposes [3, 4].

Vetiver grass is highly tolerant to adverse edaphic conditions such as high soil acidity and alkalinity, saline, sodic, magnesian, Aluminum and Manganese toxicities [6], and to elevated levels of all heavy metals [7]. The Vetiver grass is capable of withstanding extremely high N supply [5,6] and also it can absorb large amount of water [8, 9]. Vetiver was also effectively used as vegetative buffer or wetland plant species due to its extraordinary morphological and physiological features [10]. Wastewater which contains high concentrations of organic and inorganic pollutants, which is produced from the oil refinery of the Maoming Petro-Chemical Company, China, treated using different plant species, and observed that the performance of the VS is low at beginning and became stable as the plant is grown.

The floating platform techniques were performed [11, 12] to treat domestic wastewater with different Vetiver species and two wastewater strengths – high and low concentration wastewater. The results indicated that the treatment efficiencies of different concentrations of wastewater were significantly different and observed the ability of Vetiver to uptake heavy metals from industrial wastewater. From the literature it was observed that Vetiver grass has extraordinary ability to withstand highly adverse environmental conditions and consume large quantity of water during growth. The main objective of this paper is to study the effectiveness of using VS for treating wastewater which is generated in our campus wastewater outlet.

3. Materials and methodology

The wastewater for the experimental studies was collected from institutional hostel wastewater outlet in Amal Jyothi College of Engineering, Kanjirapally, Kottayam (latitude: 9° 31' 54.42" and Longitude: 76° 49' 12.5"), Kerala which is situated in southern part of India. There are around 800 inmates in the hostel; as a result large amount of wastewater is produced everyday in our campus wastewater outlet.

3.1 Experimental Setup

A pilot experimental setup was constructed to assess the potential of VS for treating wastewater generated in campus wastewater outlet. The experimental setup is shown in Fig. 1. Fig. 1a shows the setup immediately after the construction and Fig. 1b shows the Experimental setup 400 days after the Vetiver is planted. The setup includes 5 drums each contains 130 liters capacity and those are connected in series. The drums were filled with soil and Vetiver is planted in them. These drums are connected using PVC pipes with controlling valves and various pipe fittings. The heights of the drums are 85 cm and they are connected to each other using 1 inch diameter hose. Each tank has outlet and inlet. The inlet of 1st tank is 30 cm below from top and the outlet is

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