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Original Research Paper

Microbiology

BIOREMEDIATION OF SUGARCANE BIOREFINERY WASTEWATER EFFLUENT USING DEVELOPED NANO- COMPOSITES

Mrs. M. Meenakshi

ABSTRACT Heavy metal pollution is as a serious threat to environment because it is toxic to living organisms, including humans, and not biodegradable. The wastewater treatment, nanotechnology is applicable in detection and removal of various pollutants. Herbal-Metal Nanocomposite (HMNC) was developed in the present research using *Hemigraphiscolorata* and copper nanoparticles with the aim of treating waste-water effluent collected from a sugarcane processing industry. The Nanocomposite formulation treated wastewater showed distinct reduction in the tested parameters like turbidity and chemical oxygen demand. The plant growth potential was tested. The plant growth promoting abilities in the presence nanocomposite treated water was compared with and normal water and untreated waste-water.

KEYWORDS : Nano-composites, waste water effluents, Chemical oxygen demand, Heavy metal pollution.

INTRODUCTION

In many developing countries, especially in Asia and South America, sugar cane industry is one of the most important agricultural industries. As a consequence, sugar cane industry has significant wastewater production. Due to the lack of knowledge and financial support, most of sugar cane industries in developing countries discharge their wastewater without adequate treatment

Bagasse can be used in boilers during combustion, while stillage is mainly disposed to field crops, incorporating a risk for aquatic pollution. Surface water pollution potential is mainly due to the high contents of organic matters in stillage. Organic matters cause oxygen depletion by heterotrophic biodegradation when enter in surface water. Stillage also contains high concentration of potassium which can accumulate at toxic levels in the soil.

The main final products of sugar cane industry are crystalline sugar and bio-ethanol. The latter is obtained from the fermentation and distillation of sugar cane juice and molasses. Quantitatively, the most significant by-product is bagasse, the solid residue from sugar cane after juice extraction and stillage (also called vinnasse or dunder), the liquid waste effluent after the distillation process of sugar cane juice

Metal oxide (Natural or Engineered) nanoparticles include Titanium dioxide (TiO2); zinc oxide (ZnO); cerium oxide (CeO2). They have high reactivity and photolytic properties [Klaine et al., 2008]. They are considered good adsorbent for water purification because they have large surface area and their affinity can be increased by using various functionalized groups. Effectiveness of MgO nanoparticles and magnesium (Mg) nanoparticles as biocides against Gram-positive and Gram- negative bacteria (*Escherichia coli* and *Bacillus megaterium*) and bacterial spores (*Bacillus subtillus*) was demonstrated.Nano TiO2 and Cu2O electrodes were used for electrocatalytic oxidation of organic components and COD removal was observed to be high

Fig. 1.1: *Hemigraphiscolorata*, (Moorikooti) leaves

Table-1: pH analysis of waste water treated with Herbal-Metal Nanocomposite (HM_{NC})

Duration of Treatment		0 day	5 day	10 day	15 day	20 day	25 day
pH	Control	5.6	4.9	4.7	4.6	4.7	4.8
	Nanocomposite treated	5.5	4.3	4.3	4.5	4.9	4.4

Effect Of Herbal-metal Nanocomposite On Chemical Oxygen Demand (cod) Of Treated Effluents

The COD value of the raw wastewater effluent collected from the sugar cane processing industry was 1000mg/l as an average. By addition of Herbal-Metal Nanocomposite, the BOD decreased dramatically throughout the time of study. The experiment showed that the inoculation of nanocomposite to the wastewater tend to decrease the BOD during the 25 days of treatment from 1000 to 350 mg/l (about 65 % reduction. Before and after titration, the change in colour for the samples tested on 0^{th} day, 10^{th} day and 25^{th} day. From the obtained values, it was evident that the values of BOD was decreased due to the action of Herbal-Metal Nanocomposite in the degradation of the organic compounds present in the effluent water.

Case Study

Fig3.1 Ludwigiaovalis grown in the pot poured with Nanocomposite treated water

In the present study, the plant growth potential of treated effluents was evaluated using pot studies of an aquatic plant called *Luwdigiaovalis*. Small leaflet plant with two leaves and a stem was placed in a garden soil filled in plastic disposable glasses. Normal water was added to the plantlets daily and recorded as Control (positive control). Similar set up was made and the soil was poured with treated effluents. In the third set of experimental cups, untreated effluent was added to the plantlets. To calculate average mean, standard deviation values, three plants for each experiment was performed. Parameters like number of leaves per plant, average shoot length, average root length and overall growth was selected for evaluation.

CONCLUSIONS

In the present study the effect of herbal-metal nanocomposite on the growth of leaves, shoots and roots of *Ludwigiaovalis* was analysed by growing the plants under green-house conditions. The developed nanocomposite were found to be very efficient in removing the color from 55% to 93% during the period of studies. For untreated control samples, colour reduction was not evident; in contrast the nanocomposite treated effluents showed colour removal significantly from 0^{th} day to 25^{th} day with reduction of 93%. The effect of herbal-metal nanocomposite on the removal of effluent colour was well accomplished.

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