IMPACT OF SPIRODELA POLYRHIZA ON PHYSICOCHEMICAL PROPERTIES OF INDUSTRIAL WASTEWATER

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ABSTRACT

Industrial wastewater treatment can be done by using Spirodela polyrhiza in different retention time. This study investigates the use of Spirodela polyrhiza improves the quality of industrial wastewater parameters like negative log of hydrogen ion concentration (P^H), Electrical Conductivity(EC), Chemical oxygen demand (COD), Total hardness, sulphates, Total dissolve solids (T.D.S.). The reduced concentration of Chromium (VI) after introducing macrophyte was 0.0233mg/l) signifies that Spirodela polyrhiza can used for accumulation of toxic metal.

Keywords- Industrial wastewater; physicochemical properties; toxic metals and accumulation

I. INTRODUCTION

Water is a resource that is becoming increasingly scarce and needs to be sustained, globally and locally. Availability of fresh water due to water pollution becomes one of the most serious problems faced by billions of people today**.** These problems primarily occur due to generation of wastewater from metropolitan cities and industries having most of the organic and inorganic pollutants, nutrients & heavy metal, which are legally or illegally discharged into environment. The increased environmental burden of Cr (VI) may come from various industrial sources like those from electroplating, leather tanning, textiles and metal finishing industries **[1].** Wastewater contamination can be improved by adopting physicochemical paremeters methods of wastewater treatment [2]. Biosorption can be helpful in removal of toxic metals [3]. Phytoremediation is an emerging technology that utilizes plants and then the associated rhizosphere microorganisms to remove, transform, or contain toxic chemicals located in soils, sediments, ground water, surface water, and even the atmosphere [4]. Duckweeds are aquatic plants which often form dense floating mats in eutrophic ditches and ponds. It is a floating aquatic macrophyte belonging to the family Lemnaceae.

II. MATERIAL AND METHODS

A. Selection of water sample collection area

The selected area for sample collection was Naini Industrial Area, near Bharat Pump and Compressors Limited Naini, Allahabad Uttar Pradesh. Allahabad has a humid subtropical climate common to cities in plains of North India.

B. Collection of plant sample and Experimental set-up

Duckweed Spirodela polyrrhiza were obtained from a natural pond near, Dhanuha, Allahabad. The plant stocks were cleaned by tap water to eliminate remains of pond sediments and were placed in eight plastic tubes in laboratory condition in the treatment system with growing duckweed in eight tubes of 10-12 L was constructed in laboratory set up. Approximately 60g of fresh wet Spirodela polyrrhiza plants were stocked into each of the eight tubes. Each of the eight tubes was filled with 5 L same industrial wastewater. Retention time of duckweed was 15 days in the first two reactors, 30 days in the second and 45 days in the third and 60 days in fourth.

C. Method of investigation

The parameters selected for study were Colour, Odour, pH, EC, COD, Total Hardness, Sulphates, TDS, Chloride, Copper and Chromium. Analysis was carried out according to standard method of examination of water and wastewater **[5]**.
Collected water samples was digested at first in lab by taking 10 ml of water sample, then heated it up to 100 ^{0}C by addition of 3 ml concentrated sulphuric acid followed by perchloric acid in 3:1.
Plant material was wrapped in paper towels and dried in an oven at 70 ±2°C to a Constant weight. Dried plant was digested with concentrated nitric acid followed by perchloric acid in 3:1. Trace metal chromium and Copper concentrations level were carried out with Perkin-Elmer model 2380 atomic absorption spectrophotometer [6]. Industrial wastewater with macrophyte Spirodela polyrrhiza at different day interval are as following
D_0-Industrial wastewater without Spirodela polyrrhiza at the time of sampling**.**
D_{15}- Industrial wastewater with Spirodela polyrrhiza after 15 days.

D_{30}- Industrial wastewater with Spirodela polyrrhiza 30 days.
D_{45}- Industrial wastewater with Spirodela polyrrhiza after 45 days.

III. RESULTS AND DISCUSSIONS

Industrial wastewater treatment was carried out at different time interval by use of macrophyte spirodela polyrrhiza. The results obtained are presented and discussed with respect to data are given below:

Given Table I, the results obtained of physicochemical properties after collection of wastewater and content of heavy metal chromium and copper present in plant sample.

Table I
Experimental Analysis

Parameters	Initial result	Final result
Colour	Brownish	Light brownish
P^H	8.29	7.87
Chloride	214.93 (mg/l)	173.70
Total Dissolved Solids	510 (ppm)	1066.00
Total Hardness	1603 (mg/l)	968
Chemical Oxygen Demand	202.66 (mg/l)	64.00
Sulphates	17.92 (mg/l)	12.69
Chromium(VI) (Water sample)	0.0401 (mg/l)	0.023
Copper(II) (Water sample)	0.054 (mg/l)	0.010
Chromium (VI) (Plant sample)	4.92 (mg/l)	7.05
Copper (II (Plant sample)	24.22 (mg/l)	27.18

From above table it has been observed that the reduced level of pH at D_{60} was recorded as 7.85. Minimum EC at D_0 was 1.13 mmhos/cm however the maximum EC at D_{60} was 3.2 mmhos/cm. Minimum TDS at D_0 was 510 ppm however the maximum TDS at D_{60} was 1259 ppm. Minimum Chloride content at D_{60} was found as 173.70 mg/l. The minimum Chloride content at D_{60} was found as 173.70 mg/l. Maximum hardness at D_{60} was 1603 mg/l however the minimum hardness at D_{60} was 968mg/l. Maximum COD at D_0 was 202.66 mg/l however the minimum COD at D_{60} was found as 64mg/l. MaximumChromium (VI) at D0 was 0.0401 mg/l however the minimum Chromium (VI) at D60 was 0.0233mg/l. The maximum Copper (II) at D0 was 0.05406 mg/l however the minimum Copper (II) at D60 was 0.0098 mg/l. Minimum chromium (VI) content in plant at D_0 was 4.92 mg/l however the maximum chromium (VI) content in plant at D60 was 7.05 mg/l. Minimum copper (II) content in plant at D_0 was 24.22 mg/l however the maximum copper (II) content in plant at D_{60} was 27.81 mg/l.

Decreasing value shows that the plant species under investigation try to grow and maintain the pH towards the neutral due to their root secretion and addition of organic acids in water sample. The similar change was also reported in ref. [7]**.** After introducing Spirodela in wastewater it may also results to root loss in wastewater results to high electrolyte content which may cause to increase in value of EC from increasing the time interval. Root growth continues to recover.TDS of sample increased highly in different retention time within the contact of Spirodela polyrhiza. This may be cause due to the secretions from roots of plants and addition plant content and residues of roots dissolve in water after retention time. The ion associated with the roots of Spirodela help in absorption of chloride from wastewater by exchange takes place between anions of chloride also cations present in water. Therefore the reduction of chloride in water sample takes place by increasing the time interval. Total Hardness of sample decreased in different retention time within the contact of Spirodela polyrhiza.

In industrial wastewater sample the content of calcium and magnesium salts was found be high which can govern the total hardness. Decline in COD was due to the consumption of organic substances by the plant which have capability to purify the sample, thus reducing its COD. The cause of reduction may be due to plant ability to absorb different types of pollutants and accumulated in their tissues**.**The presence of carboxyl groups at the roots system induces a significant cation exchange through cell membrane and this might be the mechanism of moving heavy metal in the roots system where active absorption takes place. The metal ions removal rates from aqueous solution by biosorption are generally faster.

Concentration of copper present in sample decreased in different retention due to absorption of heavy metal Cu (II) by S.polyrhiza, because the roots absorb water together with the contaminants in water.

It results that the chromium content of spirodela increased in different retention time due to accumulation of heavy metal chromium present in wastewater. Plant showed the capacity to reduce the concentration of copper in wastewater and accumulation of Cr in their tissues in 60 days interval also observed the same result, studied the phytoextraction capacity of copper by Spirodela [8].

IV. CONCLUSIONS

Due reduction in concentration of most of water parameter and toxic metal by use of this macrophyte, it is concluded that Spirodela is very much appropriate for the treatment of wastewater and can be used for removal of toxic metals as chromium and copper.

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