International Journal of Advanced Research in Engineering and Applied Sciences
ISSN: 2278-6252
Impact Factor: 4.817

HEAVY METALS REMOVAL FROM FOOD WASTE WATER OF RAIPUR AREA USING BIOADSORBENTS

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Abstract: *A simple cost effective and eco-friendly method for the remediation of heavy metals from food wastewater has been investigated. A novel biomaterial, Oscimum Sanctum Linn (Tulsi) a medicinal plant, was used for the removal of heavy metals from food wastewater and the method was also applied for real sample analysis. The presence of metal ions in food wastewater is extremely undesirable, as they are toxic to both lower and higher organisms. Under certain environmental conditions, metals may accumulate to toxic levels and cause ecological damage of the important metals, mercury, lead, cadmium, Arsenic, and chromium (VI), regarded as toxic to certain extent, but their extensive usage and increasing levels in the environment are serious concerns. Several bioadsorbents have the ability to remove the heavy metals and thereby making water contaminant free. Therefore, the search for efficient, eco-friendly and cost effective remedies for waste water treatment has been initiated. Recently efforts have been made to use cheap and available agricultural wastes such as coconut shell, orange peel, rice husk, peanut husk and sawdust as adsorbents to remove heavy metals from wastewater. Biosorption can be effective technique for the treatment of heavy metal bearing waste water resulting from human and industrial activities. In the present study the biosorption of heavy metals using the tulsi leaves and parameters affecting the biosorption of heavy metals; such as time, pH, Dosage, rpm, mesh size have been investigated. The present study shows that 80% of biosorption of lead and 60% of cadmium was observed.*

Key words: *Bioadsorbent, Lead acetate, Ocimum Sanctum Linn, pH.*

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INTRODUCTION

Rapid growth of food industries, hotels and restaurants in recent years led to increase of pollutants through food wastes such as heavy metals and contaminants in the environment, mainly in the aquatic systems. Heavy metals are considered as hazardous pollutant because of their toxicity even at low concentrations. Removal of these toxic heavy metal ions from waste water is important for environmental pollution control. The discharge of heavy metals in aquatic ecosystems through drains has become a matter of concern in India over the past few decades. These pollutants are introduced in to the aquatic systems significantly as a result of various food wastes and other sources. The pollutants of lead, chromium, mercury, uranium, selenium, zinc, arsenic, cadmium, gold, silver, copper and nickel are highly poisonous when excreted beyond the limits. These toxic materials may be derived from fertilizers, mining operations, refining ores, sludge disposal, fly ash from incinerators, the processing of radioactive materials, metal plating, or the manufacture of electrical equipment, paints, alloys, batteries, pesticides and preservatives. Tulsi leaf (*Oscimum Sanctum Linn*) a major medicinal plant contains important compounds that protect human health.

Biosorption is a property of certain types of inactive, dead microbial biomass to bind and concentrate pollutants from every aqueous solution. Biosorption is defined as the accumulation and concentration of organic and inorganic pollutants including metals, dyes and odor causing substances from aqueous solutions by the use of biological materials. These materials are typically, active or dead microbial biomass, agricultural by-products and industrial wastes. The biosorbent terms refers to material derived from microbial biomass, seaweed or plants that exhibit adsorptive properties. The biosorption process involves a solid phase (sorbent or biosorbent: biological material) and liquid phase (solvent, normally water) containing a dissolved species to be sorbed (sorbate, metal ions).Due to higher affinity of the sorbent for the sorbate species, the latter is attracted and bound there by different mechanisms. The process continues till equilibrium is established between the amount of solid- bound sorbate species and its portion remaining in the solution. The degree of sorbent affinity for the sorbate determines its distribution between the solid and liquid phases.

EXPERIMENTAL SECTION

Bioadsorbent:

The Tulsi leaves were purchased from farm house in Raipur. The collected leaves were washed with distilled water, then the washed samples drenched in 3M NaOH solution for 24 hrs. After 24 hours the drenched samples were washed with distilled water and the washed samples were kept in hot air oven for overnight at 60° C. Then the samples are crushed with ball mill. The crushed samples were separated the different mesh size 52, 72, 100, 150, 200, 240 respectively using the sieve shaker.

Stock solution preparation:

Different metal concentrations were prepared by dissolving lead nitrate and cadmium in double distilled water to get different metal concentrations. 6 gm of dithiozone was added as a complexing agent to 1000 ml distilled water. The metal solution was prepared in sterilized glassware obtained from borosil, India. Prior to experiment all the glasswares were treated with 0.1 M HCl before and after the biosorption experiments to avoid binding of metals to it.

Experimental procedure:

50 ml of heavy metal solution were taken in to the 250 ml conical flask and add the adsorbents in to the conical flask (0.5g, 1 g, 1.5g, 2g, 2.5g and 3g). Keep it in the shaker for 3 hours then samples were taken in to the different time interval. The samples were filtered with the whatman no.4 filter paper. The collected samples were centrifuged with 4000 rpm at 10 minutes. The centrifuged solutions were collected for the analysis of absorbance.

Instruments required:

UV-visible spectrophotometer, Hot air oven, ball mill, sieve shaker, orbital shaker.

$$\% \text{ of biosorption} = \frac{\text{Initial-final metal concentration}}{\text{Initial metal concentration}} \times 100$$

Biosorption studies were done using tulsi as a function of various parameters such as

a) Time

b) Dosage concentration

c) rpm

d) Size

e) pH

RESULTS AND DISCUSSION

In the present investigation carried so far, the medicinal tulsi leaves were used for the biosorption of lead. The parameters affecting the biosorption of lead using Tulsi leaves were studied. Biosorption was confirmed to be controlled by redox, ion exchange and coordination reaction, of which alcohol, carboxylamino and sulphonic groups play important role. Chemical modification by 0.2% formaldehyde could modify seaweed and lowered the organic leaching, resulting increase of metal biosorption. The amount of lead removal showed adsorbent dosage dependence. The percentage of lead removal increased with the increase of Tulsi leaves dosage. This attributes to the increased adsorbent surface area and availability of more adsorption sites resulting from the increase of the dosage. Under that experimental conditions, 55% of lead was removed by 0.5 g tulsi leaves adsorbent and 75% lead was removed by the 2g of same adsorbent.

The effect of pH for lead adsorption onto tulsi leaves was investigated with 0.5g of tulsi leaves in 100 ml water containing 10mg/L of lead and each sample were adjusted Biosorption mainly involves cell surface complexation, ion exchange or affinity and micro precipitation.

Table shows the effect of contact time. It was observed that sorption percentage increased with the increase of time up to 180 min.

The

SR. NO	TIME (MIN)	ABSORBANCE AT 510nm (Pb)	ABSORBANCE AT 520nm (Cd)	ABSORBANCE AT 457nm (Cu)	ABSORBANCE AT 620nm (Zn)	ABSORBANCE AT 470nm (Ni)
1	30	0.456	0.350	0.225	0.200	0.200
2	60	0.481	0.362	0.255	0.210	0.210
3	90	0.625	0.382	0.320	0.230	0.310
4	120	0.665	0.400	0.350	0.267	0.345
5	150	0.685	0.420	0.362	0.272	0.360
6	180	0.750	0.450	0.400	0.300	0.380
7	210	0.720	0.462	0.600	0.500	0.400

below table shows the effect of increasing mesh size with absorbance the percentage of removed lead increased with the increase in tulsi leaves adsorbent size. It is also observed that the maximum absorption percentage with the increase of mesh size up to 150.

SR.NO	MESH SIZE	ABSORBANCE 510nm(Pb)	ABSORBANCE 520nm (Cd)	ABSORBANCE AT 457nm (Cu)	ABSORBANCE AT 620nm (Zn)	ABSORBANCE AT 470nm (Ni)
1	52	0.310	0.150	0.600	0.500	0.550
2	72	0.300	0.162	0.590	0.480	0.570
3	100	0.450	0.182	0.560	0.457	0.565
4	150	0.840	0.200	0.700	0.440	0.540
5	200	0.900	0.180	0.680	0.437	0.510
6	240	0.890	0.150	0.350	0.420	0.500

Effect of agitation (rpm):

The effect agitation speed on removal efficiency of lead was studied by varying speed of agitation from 100 to 350 rpm. This also indicates that the a shaking rate in the range 100 to 200 rpm is sufficient to assure that all the surface binding sites are readily available lead uptake. The maximum sorption found in 350 rpm.

SR.NO	RPM	ABSORBANCE AT 510nm (Pb)	ABSORBANCE AT 520nm (Cd)	ABSORBANCE AT 457 (Cu)	ABSORBANCE AT 620nm (Zn)	ABSORBANCE AT 470nm (Ni)
1	100	2.225	0.100	0.300	0.700	0.325
2	150	2.450	0.125	0.350	0.620	0.310
3	200	2.970	0.160	0.420	0.620	0.280
4	250	2.986	0.190	0.450	0.600	0.340
5	300	3.225	0.195	0.480	0.680	0.360
6	350	3.650	0.200	0.510	0.880	0.380

Effect of Dosage:

This table shows the concentration of 3 g was sufficient for maximum biosorption.

SR.NO	DOSAGE (g)	ABSORBANCE AT 510nm (Pb)	ABSORBANCE AT 520nm (Cd)	ABSORBANCE AT 457nm (Cu)	ABSORBANCE AT 620nm (Zn)	ABSORBANCE AT 470nm (Ni)
1	0.5	0.835	0.555	0.225	0.520	0.210
2	1	0.750	0.600	0.350	0.532	0.200
3	1.5	0.870	0.725	0.365	0.545	0.270
4	2	0.885	0.800	0.380	0.600	0.280
5	2.5	2.565	0.850	0.400	0.645	0.310
6	3	3.550	0.900	0.480	0.650	0.320

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