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Research Article

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Removal of heavy metal from industrial effluent using bio adsorbents (*Camellia sinensis*)

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ABSTRACT

The presence of metal ions in final industrial effluent 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, but their extensive usage and increasing levels in the environment are serious concerns. various techniques have been employed for the treatment of metal bearing industrial effluents, which usually include precipitation, adsorption, ion exchange, membrane and electrochemical technologies. But these techniques are expensive,not environment friendly and usually dependent on the concentration of the waste which are in effective in very diluted solutions. Therefore, the search for efficient ,eco-friendly and cost effective remedies for waste water treatment has been initiated. Biosorption can be an effective technique for the treatment of heavy metal bearing waste water resulting from human and industrial activities. biosorption can be effective technique for the treatment of heavy metal bearing waste water resulting from human and industrial activities. several bioadsorbents have the ability to remove the heavy metals and thereby making water contaminant free. It has been reported that the spent tea leaves adsorbed the lead was more than the cadmium. in the present study the biosorption of heavy metals using the tea 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 75% of biosorpyion of lead and 69% of cadmium was observed. The time taken for maximum sorption of lead was 3 hrs. The optimum mesh size was 150 and rpm was found to be 200.

Key words: Lead acetate, *Camellia sinensis*, pH, biosorbent.

INTRODUCTION

Rapid growth of industrial activities in recent years led to increase of industrial wastes such as heavy metal and dyes 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 to aquatic ecosystems has become a matter of concern in India over the past few decades. These pollutants are introduces in to the aquatic systems significantly as a result of various industrial operations. Industrialization in India gained a momentum with initiation of five year developmental plan in the early 50's. The pollutant of lead, chromium, mercury, uranium, selenium, zinc, arsenic, cadmium, gold, silver, copper and nickel. These toxic materials may be derived from 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. The level of lead in the worlds environment has increased since industrialization. this has been added to the difficulty in knowing exactly how much the original amount of lead in the environment has been. in 2001 the UNEP governing council called on governments that had not eliminated the use of lead in their gasoline to do so. In 2002 East African governments joined together to make a decision to phase out leaded fuel by the year 2005. Tea leaf (*Camellia sinensis*) and contains important compounds that protect human health. Tea is the natural source of the amino acid thiamine and poly phenolic anti oxidant catechins.

Biosorption is a property of certain types of inactive, dead microbial biomass to bind and concentrate pollutants from every aqueous solutions. biosorption is defined as the accumulation and concentration of organic and inorganic pollutants including metals, dyes and odour causing substances from aqueous solutions by the use of biological materials. these material are typically ;ive or dead microbial biomass, agricultural by-products and industrial wastes.

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 tea leaves were purchased from tea estate Ooty. 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 until the dye will remove. the washed samples were kept in hot air oven for over night at 60 ^{0}C.Then the sample 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 concentration were prepared by dissolving lead nitrate and cadmium in double distilled water to get different metal concentration 6 gm of Dithiozone was added as a complexing agent to 1000 ml. The metal solution was prepared in sterilized glassware obtained from borosil, India. prior to experiment all the glass 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 the samples were taken in to the different time interval. Then 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.

$$\%\ of\ biosorption = \frac{(\text{initial}-\text{final metal concentration})}{(\text{initial metal concentration}}\ \text{x}100$$

Biosorption studies were done using tea 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 out so far, the waste spent tea leaves were used for the biosorption of lead. The parameters affecting the biosorption of lead using tea 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 spent tea 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,47% of lead was removed by 0.5 g spent tea leaves adsorbent and 55.2% lead was removed by the 2g of same adsorbent. 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.

S.No	Time (min)	Absorbance at 400 nm
1.	30	0.436
2.	60	0.471
3.	90	0.613
4.	120	0.649
5.	150	0.697
6.	180	0.768
7.	210	0.700

The below table shows the effect of mesh size. the percentage of removed lead increased with the increase in spent tea leaves adsorbent size. it is also observed that the maximum absorption percentage with the increase of mesh size up to 150.

S.No.	Mesh size	Absorbance at 400 nm
1.	52	0.208
2.	72	0.298
3.	100	0.350
4.	150	0.743
5.	200	0.696
6.	240	0.660

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 200 rpm.

S.No.	Rpm	Absorbance at 400 nm
1.	100	1.215
2.	150	1.420
3.	200	1.920
4.	250	1.906
5.	300	1.726
6.	350	1.680

Effect of Dosage:

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

S.No	Dosage (g)	Absorbance at 400 nm
1.	0.5	0.725
2.	1	0.790
3.	1.5	0.845
4.	2	0.994
5.	2.5	1.206
6.	3	1.547
7.	3.5	1.460

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