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BIOSORPTION STUDIES FOR THE REMOVAL OF ZINC FROM AQUEOUS SOLUTION BY USING *Tabebuia aurea*

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ABSTRACT
Zinc is a heavy metal which is commonly used in many industries such as chemical, metallurgical and electroplating industries. The discharge of effluents from these industries constitutes one of the major causes of land and water pollution and degradation. Therefore, Biosorption is a potential technique generally used for the removal of heavy metals from the solutions and recovery of precious metals. In the present study, Biosorption studies was conducted at different conditions such as varying pH (3, 5, 7, 9, 11), Biosorption dosage (0.5, 1.0, 1.5, 2, 2.5 g), rpm (75, 150, 200) and concentration (50, 75, 150 mg/L) for the Biosorption of zinc by Tabebuia aurea Leaves. From the experiments it was found that the Biosorption dosage efficiency increases zinc adsorption concentration.

KEYWORDS: *Tabebuia aurea* leaves, Biosorption, Zinc sulphate, Metal uptake, Correlation.

INTRODUCTION
Water pollution is a major problem in the global context. Several industrial wastewater streams may contain heavy metals such as Cr, Cu, Pb, Zn, Ni, etc. including the waste liquids generated by metal finishing or the mineral processing industries.(Abasi *et al*., 2011) An important source of zinc pollution is the burning of coal, petroleum and its products. Incineration of municipal solid waste can introduce about 75% zinc to urban air. Also, municipal wastewater generally contains significant amounts of zinc. The use of municipal and industrial waste in agriculture results in the accumulation of zinc in the surface layers of soil. The degree of toxicity of zinc is not big, but it depends on the ionic form, and changes under the influence of water hardness and pH. The daily average download of zinc by an adult is estimated at about 10-50 mg /day. (2) Fuel and power industries generate 2.4 million tons of As, Cd, Cr, Cu, Hg, Ni, Pb, Se, V, and Zn annually The metal industry adds 0.39 million tons/yr of the same metals to the environment, while agriculture contributes 1.4 million tons/yr, manufacturing contributes 0.24 million tons/yr and waste disposal adds 0.72 million tons/yr. (Anne Chao *et al*., 2006) Water is a vital resource for agriculture, manufacturing and other human activities. . Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. (Animesh Agarwal *et al*., 2012)
heavy metals in wastewater are not biodegradable and their existence in receiving lakes and streams causes bioaccumulation in living organisms, which leads to several health problems in animals, plants and human beings such as cancer, kidney failure, metabolic acidosis, oral ulcer, renal failure and damage in for stomach of the rodent (Mehmet E.A *et al*., 2006) Exposure of Zn in large amounts is extremely toxic to living organisms. In humans, it can cause a range of serious ailments including anemia, damage to pancreas, lungs, metal fume fever, decreased immune functions, ranging from impaired neuropsychological functions, growth retardation and stunting, impaired reproduction, immune disorders, dermatitis, impaired wound healing, lethargy, loss of appetite and loss of hair. There are two options to control the pollution- Prevention or control methods. Prevention or control of wastes at the source is cheaper than the purification of contaminated water. Treatment processes for heavy metal removal from wastewater include precipitation, membrane filtration, ion exchange, adsorption and co precipitation adsorption. (Shri Chand, et al., 1994). But these methods are either expensive or inefficient for the removal when the metals are at high concentration. The search for new technologies involving the removal of toxic metals from wastewaters has attracted attention to biosorption method. (Forstner *et al*., 1981). Biosorption can be defined as the ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated or physico-chemical pathways of uptake (Fourest and Roux, 1992). Algae, bacteria and fungi and yeasts have proved to be potential metal biosorbents (Volesky, 1986). The major advantages of biosorption over conventional treatment methods include (Kratochvil and Volesky, 1998a). The choice of the suitable methods is based not only on the concentration of heavy metals in surface water but on economical factors, too. bioSorption belongs to effective and economically acceptable methods to remove heavy metals(Petrilakova and Balintova, 2011).

MAERIALS AND METHODS
Selection of the plant
Tabebuia aurea leaf was selected as biosorbent for removal of zinc ion in this study. The leaves were obtained from a *Tabebuia aurea* tree located at Adhiyamaan College of Engineering (Autonomous), Hosur.

Preparation of leaf adsorbent

Mature *Tabebuia aurea* leaves were collected and it was washed thoroughly under running water to remove impurities and any adhering particles. The leaves were then dried under sunlight for a few days until it became crisp. The dried leaves were crushed and blended to powder form using a blender. It was stored in an airtight plastic for further use to avoid contact with moisture in atmosphere.

Preparation of zinc stock solution

Stock solution of zinc of 1000 mg/L was prepared by dissolving 0.44 g of zinc sulphate it gives 100mg/l concentration. The working solution was prepared by diluting the stock solution. Zinc concentration was analysed by using AAS. 0.1N NaOH and 0.1N Hcl solutions were used to adjust and to maintain the pH of the metal solutions

BIOSORPTION STUDIES

Effect of shaking velocity

10gm *Tabebuia aurea* of leaf powder was added in 250 ml conical flask containing 50 mg/L of zinc solution. Flasks were maintained at different shaking velocity such as 75,150,200 rpm in an orbital shaker. Zinc concentration was analysed by using AAS. (Table: 1).

TABLE: 1 Effect of shaking velocity

Synthetic effluent: Concentration :50mg/L , pH : 6, Biosorbent dosage : 10g/L Plant : *Tabebuia aurea*			
	rpm=75	rpm=150	rpm=200
TIME	OD	OD	OD
0	0.205	0.531	0.498
1	0.482	0.268	1.288
2	0.345	0.673	0.77
3	0.519	0.72	1.384
4	0.376	1.104	0.973
5	0.986	1.356	1.746

TABLE 2: Effect of pH

Synthetic effluent: Concentration :50mg/L, rpm: 200, Biosorbent dosage : 10g/L					
	P^H:3	P^H:5	P^H:7	P^H:9	P^H:11
TIME	OD	OD	OD	OD	OD
0	0.432	0.673	0.603	0..282	0.279
1	0.569	0.839	0.738	0.534	0.299
2	0.738	1.246	0.839	0.643	0.301
3	0.812	1.509	0.985	0.89	0.444
4	1.395	1.93	1.459	0.929	0.678
5	1.553	2.344	2.209	1.065	0.713

Effect of pH

10gm of *Tabebuia aurea* leaf powder was added in 250 ml conical flask containing 50 mg/L of zinc solution. Flasks were maintained at different pH such as 3, 5, 7, 9 and 11 in an orbital shaker at a speed of 200 rpm. Zinc concentration was analysed by using AAS. (Table: 2)

Effect of concentration

10gm of *Tabebuia aurea* leaf powder was added in a 250ml conical flask containing different Zinc concentrations such as 150mg/L, 75mg/L, and 50mg/L in an orbital shaker at a speed of 200 rpm. All experiments were conducted in duplicate. Zinc concentration was analysed by using AAS. (Table: 3)

Effect of biosorbent dosage

0.5gm, 1gm, 1.5gm, 2gm and 2.5gm of *Tabebuia aurea* leaf powder was added to each conical flask containing 50mg/L of Zinc and kept in an orbital shaker at a speed of 200 rpm. Zinc concentration was analysed by using AAS. (Table: 4)

TABLE 3: Effect of Concentration

Synthetic effluent: rpm: 200, Biosorbent dosage : 10g/L, pH : 3			
	Conc.(mg/l):50	Conc.(mg/l):75	Conc.(mg/l):150
TIME	OD	OD	OD
0	1.15	0.984	0.244
1	0.752	2.218	0.904
2	1.037	1.284	1.014
3	1.32	1.063	0.855
4	0.927	1.187	1.054
5	1.125	1.416	0.406

TABLE 4: Effect of biosorbent dosage

Synthetic effluent: Concentration :50mg/L, rpm: 200, pH : 3					
	Dosage: 5g/l	Dosage: 10g/l	Dosage: 15g/l	Dosage: 20g/l	Dosage: 25g/I
TIME	OD	OD	OD	OD	OD
0	0.346	0.419	0.4561	0.57	0.613
1	0.246	0.563	0.545	0.643	0.875
2	0.654	0.598	0.846	0.811	1.378
3	1.065	0.746	0.928	1.141	1.569
4	1.278	1.137	1.308	1.647	2.64
5	1.569	1.458	1.738	2.017	3.017

RESULTS & DISCUSSION

Effect of shaking velocity

As the Biosorption study was carried out by varying the shaking velocity of adsorption from 1 to 6 hour. The absorbance value obtained by using UV spectrophotometer analysis and their respective concentration calculated are shown in Figure 1. It was observed that with an increase in the rpm, removal of zinc also increases rapidly at 200 rpm.

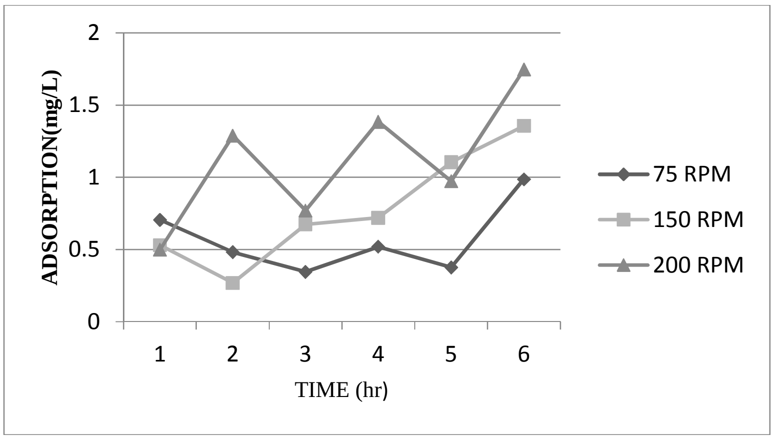

FIGURE 1: Effect of shaking velocity

Effect of pH

As the Biosorption studies was carried out by varying the pH of adsorption from 1 to 6 hour. The absorbance value obtained by analysis and their respective calculated Concentration was shown in Table 4 given in Figure 2. It was observed that with an increase in the pH, Biosorption of zinc also increases rapidly at pH11.

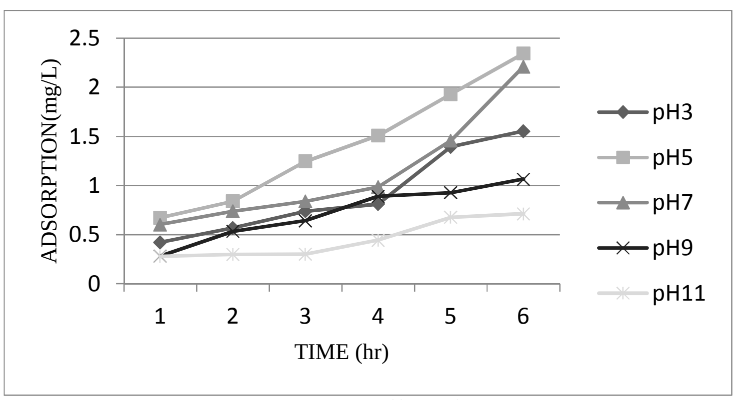

FIGURE: 2 Effect of pH

Effect of Concentration

Effect of concentration on the adsorption of zinc was also observed by varying the concentration. Biosorption of zinc concentration calculated values is given in Table 3 shown in Figure 3. It was observed that with increase in concentration, Biosorption concentration decreases. It was observed that with an increase in the concentration, Biosorption of zinc also increases rapidly at 150mg/L.

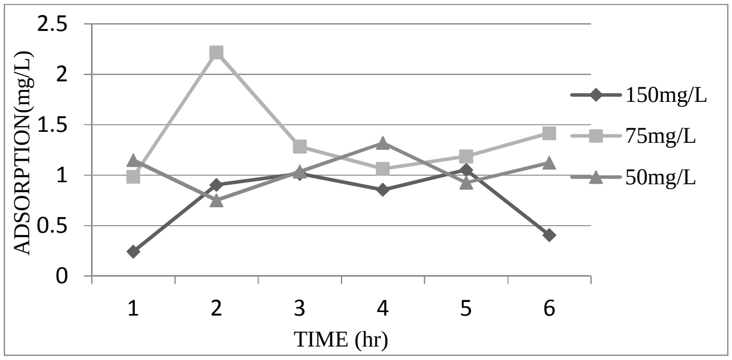

FIGURE 3: Effect of Concentration

Effect of biosorbent dosage

As the adsorption experiment was carried out by varying the biosorbent dosage of adsorption from 1 to 6 hour, the absorbance value obtained by analysis and their respective calculated concentration are shown in Table 4 given in Figure 4. It was observed that with an increase in the biosorbent dosage, Biosorption of zinc also increases rapidly at 25g/L.

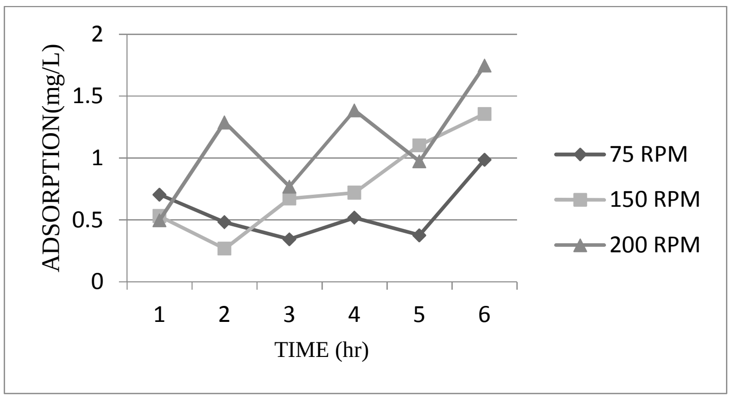

FIGURE 4: Effect of Biosorbent dosage

CONCLUSION

This study showed the possibility of the selected biosorbents tabebuia aurea utilization for Zn removal from model solutions. This plant was the most efficient for Zn removal. In general, the tabebuia aurea has better biosorption property. When increase in the pH of Biosorbent, sorption of zinc also increases. When increase in the concentration of the sample solution the Biosorption of the metal concentration Decreases. While increase in the shaking velocity of Biosorbent of zinc sorption increases. When increase in the biosorbent dosage of Biosorption of zinc increases. Maximum zinc Biosorption was obtained at biosorbent dosage concentration 150mg/L. The results of this study will be used for absorption of heavy metals from synthetic solutions with the aim of their real using for acid mine drainage treatment.

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