

Bio-sorption of Zinc Ions by Green Algae *Spirogyra*

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Abstract: Heavy metals are among the major concerns in waste water treatment. Heavy metals are often derived from heavy industry, such as electroplating and battery factories. The treatment of this type of waste water involves high cost techniques such as ion exchange, evaporation, precipitation, membrane separation etc. The removal of toxic heavy metal ions from waste water is of great importance from an environmental view point. Bio-sorption is an effective technology, using non-living biomass to remove heavy metals from aqueous solutions. In this paper, the bio-sorption of copper ions onto the dead biomass of *Spirogyra*, a green algae, was investigated in batch mode. The results indicated that the biomass of *Spirogyra* sp. is an efficient bio-sorbent for the removal of zinc ions from aqueous solutions and bio-sorbent dose dependent. The maximum removal rate was achieved at a solution of bio-sorbent dose of 0.6 gram.

Keywords: Heavy metal, Bio-sorption. Green algae

1. Introduction

Continuous discharge of industrial, domestic and agricultural wastes in rivers and lakes causes deposit of pollutants in sediments. Such pollutants include heavy metals, which endanger public health after being incorporated in food chain. Heavy metals cannot be destroyed through biological degradation, as is the case with most organic pollutants. Incidence of heavy metal accumulation in fish, oysters, mussels, sediments and other components of aquatic ecosystems have been reported from all over the world. Excessive amounts of some heavy metals can be toxic through direct action of the metal or through their inorganic salts or via organic compounds from which the metal can become easily detached or introduced into the cell. Exposure to different metals may occur in common circumstances, particularly in industrial setting. Accidents in some environments can result in acute, high level exposure. Some of the heavy metals are toxic to aquatic organisms even at low concentration. The problem of heavy metal pollution in water and aquatic organisms including fish, needs continuous monitoring and surveillance as these elements do not degrade and tend to biomagnified in man through food chain. Hence there is a need to remove the heavy metals from then aquatic ecosystems. Research and development, therefore focuses on sector-specific methods and technologies to remove colour and heavy metals from different kinds of waste streams. In view of the above toxicological effects of heavy metals on environment, animals and human beings, it becomes imperative to treat these toxic compounds in wastewater effluents before they are discharged into freshwater bodies (Wasewar, 2010).

Bio-sorption is a term that describes the removal of heavy metal, by the passive binding to non-living biomass from an aqueous solutions. Bio-sorption uses inexpensive dry biomass to extract industrial effluents of toxic heavy metals. The bio-sorption is a process in which solids of natural

origin are employed for binding heavy metals. The biomass can be composed of algae, mosses, fungi, bacteria and various, plant species. It is a promising alternative method to treat industrial effluents, mainly because of its low cost and high metal binding capacity. The algae can be collected and/or cultivated in many parts of the world, factor that has encouraged the development of new bio-sorbent materials using biomass. The toxic effects of copper on microorganisms are well documented and many report exists of copper uptake by microorganisms (Romera *et al.*, 2008; Holan and Volesky 1994). Zinc, like the majority of heavy metals, is toxic but it has been widely used in metallurgical and tanning industries. Therefore, this work was developed with the objective of evaluated the zinc bio-sorption process by means of the dead green algae biomass. The objective of the present study was investigate the use of green algae biomass as a bio-sorbent for the removal of zinc ions from aqueous solution and also the effect of bio-sorbent dose on it.

2. Materials and method Bio-sorbent

Algal biomass, *Spirogyra* was washed thoroughly in running tap water 4-5 times and distilled water to remove alkalinity. Later it was dried in a hot air oven at 60 °C for 24 hours. The dried biomass was then ground well and passed through a 100-200 mesh sieve to obtain a powder form. Finally the contents were stored in a desiccator at room temperature to be used as a powdered bio-sorbent.

Preparation of synthetic solution- Dissolve 0.100g zinc metal in 20 ml, 1+1 HCl and dilute to 1000ml with water.

Batch Bio-sorption studies-Batch mode adsorption studies were carried out to investigate the effect of different parameters such as contact time and pH on the rate of adsorption of zinc by biomass. The amount of adsorbed metal ions per gram of dead algae was obtained using the following equation:

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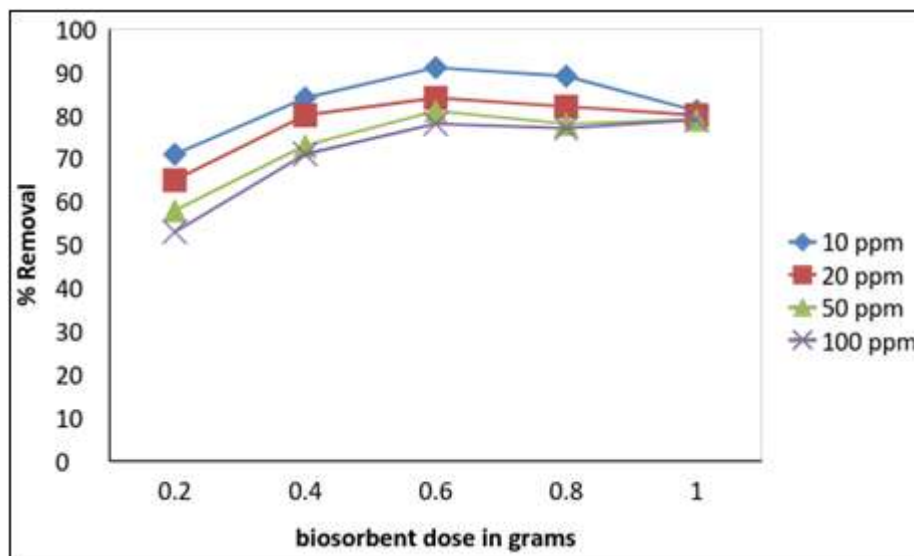
$$q = [(C_i - C_e) V] / M$$

where q is the metal uptake (mg/g), C_i is the initial metal concentration (mg/l), C_e is the initial metal concentration (mg/l), V is the volume of metal solution and M is the mass of bio-sorbent used in the reaction mixture (Hashim and Chu, 2004).

3. Results and Discussion

It was observed that with the increase in bio-sorbent dose the removal percent of metal first increases but after sometime it started to decrease. Therefore 0.6gm of adsorbent comparatively shows the highest removal percentage. The

biomass concentration is an important variable during metal uptake. It has been suggested that electrostatic interaction between cells can be significant factor in the relationship between biomass concentration and metal sorption. In this regard, at a given metal concentration in suspension, the higher will be the metal / bio-sorbent ratio and the metal retained by a sorbent unit, unless the biomass reaches saturation, suggesting that biomass concentrations can exert a shell effect protecting the active sites from being occupied by the metal. In the present study it was noted that the amount of adsorbent significantly influenced the extent of zinc ions.



Effect of bio-sorbent dose on zinc bio-sorption using dead biomass of green algae *Spirogyra* (contact time 120 mins, temperature =25°C).

4. Conclusion

The study indicated that the dried biomass of green algae *Spirogyra* could be used as an efficient bio-sorbent material for the removal of copper ions from aqueous solutions. The dried algal biomass, was found to be very efficient in removing zinc ions from aqueous solution and the maximum removal rate was achieved at a solution of bio-sorbent dose of 6.0 gm. It has been concluded that this adsorbent has a great potential for removing zinc from aqueous solutions as an eco-friendly process.

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