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Relavant Approach to Assess the Performance of Dry-Biomass of *Eichhornia Crassipes* for Adsorption of Heavy Metal Ions from Aqueous Solutions

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Abstract

Heavy metals are the major sources of pollution which are added regularly to our water sources. present paper is an attempt to evaluate the adsorption of heavy metals like Cadmium (Cd), chromium (Cr), zinc (Zn), and lead (Pb) by the dry biomass of aquatic plants Eichhornia crassipes commonly called water hyacinth. Living water hyacinth plants have the capacity to absorb heavy metals from waste water. The present experimental study was conducted to assess the adsorption capacity of dry biomass of Eichhornia crassipes to compare and identify their potential to improve the water Quality by removing the impurities. The paper critically evaluates the water – purifying capacity of dry – biomass of free- floating macrophyte (*E. crassipes*). Manuscript will be helpful in showing the water purifying capacity of dry biomass of free floating macrophyte (*E.crassipes*) and also will evaluate the best results of adsorption shown in varied time period.

Keywords - Plants, Dry biomass, *E. crassipes*, Heavy metals, adsorption, isotherm.

Introduction

Waste water is generated from residential and industrial day today activities but it must be treated before it is released into surface water bodies or to environment. So that it does not cause further pollution of water sources. Natural sources of water are depleting fast and are polluted due to industrialization and urbanization in a haphazard manner. The Potential toxic metal elements such as cadmium, chromium, lead, Copper, Zinc etc. are identified to cause health hazards in animals [1], [2] these heavy metals are reported to be toxic and found associated with the occurrence of several health effects. Heavy metals even at low concentrations can cause toxicity to humans and other forms of life, its adverse effects on human health are quite evident. Techniques presently in existence for removal of heavy metals from contaminated waters include: reverse osmosis, electro dialysis, ultra filtration, ion-exchange, chemical precipitation, phytoremediation, etc. However, all these methods have disadvantages like incomplete metal removal, high reagent and energy requirements, generation of toxic sludge or other waste products that require careful disposal. With increasing environmental awareness and legal constraints being imposed on the discharge of effluents, a need for cost–effective alternative technologies are essential. In this endeavor plant biomass can emerged as an option for developing economic and eco-friendly wastewater treatment through a process called biosorption.

Materials and methods

The present study was mainly concentrated upon adsorption of four heavy metals viz. chromium, Cadmium, lead and zinc by dry biomass E.crassipes for which the experiments are conducted. The plants of E.crassipes were taken from sahapura lake drainage basin. Macrophytes were washed with Milli-Q water to eliminate the remains of lake sediments and particulate matter, and then the plants are cut into pieces and sun dried. After being completely dried / dehydrated they are grinded into powder. The powder was grounded to pass through 2 mm sieve. The samples for analyzing various parameters were prepared by standard method

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(APHA, 1999) of 10, 50 and 100 mg/l concentration. In 100 ml of each of the samples of Heavy metal i.e. chromium, Cadmium, lead and zinc,1gm of the E.crassipes powder was added and then put into shaker at 65 rpm and at temperature of 28^0C, for varied time periods viz. 15 to 120 min and a control sample for all the test was also taken. And then the samples were filtered with whatmann no. 40 filter paper after attaining their reaction period. All the experiments were set up in duplicate for all parameters a control set was also studied and there was no powder (dry biomass) added. All the parameter were analyzed by the method as mentioned in APHA [3] i.e. Heavy metals with atomic absorption spectrophotometer.

Results and discussion

Results presented indicate the effect of adsorption of selected heavy metals on dry biomass (powdered E.crassipes) at different contact duration's on equilibrium concentration, reaction rate constant and percent removal of Cd. Cr, Zn and Pb ions content in aqueous solution. Figure-1 a-d represents adsorption of Cd, Cr, Pb, and Zn ion on dry biomass of E.crassipes at various contact time from 15 to 120 minutes.

Results after treating cadmium standard solution of 10 ppm concentration at different time are very encouraging. Adsorption % of 10 ppm 'Cd' solution in 15 – 120 min it was found in the range of 58 to 97 % (Fig1 a-d) it shows that the dry biomass adsorbed almost whole of the Cd metal ion. The adsorption concentration was found directly proportional to increasing time [4].

Cr is very much toxic [5],[6]. Dry biomass of E.crassipe efficiently adsorbed Cr from 10, 50, 100 mg/l concentration of Chromium solution at varied time period. The adsorption % increased with increasing time (Fig 1-b). The average percentage adsorption of chromium was found 87.52 %. The results show that initially the adsorption rate was high and after duration of 2 hr. it slowly got reduced. Cr is very much toxic and carcinogenic for living beings.

The lead metal showed reduction in it concentration by the dry biomass from the sample from 10 ppm to 1.5 ppm. There was the adsorption of about 86 % on an average. With the increasing time period the original concentration in the solution decreased with slow rate and this concentration increased with very slow rate with increasing time and remained stationary after 60 min attaining adsorption of 97 %. Lead is very much toxic and carcinogenic for living beings.

Results obtained by treating 10 mg/l of zinc soln. for varied time period showed marked decrease in its concentration (Fig 1-a-d). with the contact period of only 1/2 hr. and then the values remained stationary after 1 hr. The % adsorption of Zn metal ion of 10 mg/l concentration calculated for period of ½ hr., 1hr., and 2 hr., were 78 %, 85 % and 86 % respectively. As we know, zinc is not very much toxic up to permissible limit (30.0 ppb for aquatic life and 5.0 mg L-1 for drinking water as per WHO [7].

Increase in percent Cd. Cr, Zn and Pb removal with increase in concentration of adsorbent suggest more adsorption of Cd. Cr, Zn and Pb, which is supported by considerable increase in reaction rate. Considering the nature of curve, it can be concluded that adsorption isotherms are Langmurian type with the plateau region occurring at very high concentration above critical micelles concentration (cmc).

Results for Cd. Cr, Zn and Pb ions removal indicate that when contact period is increased from 30 to 60 min. lesser amount of adsorbent is required to attain equivalence concentration, while the same equivalence concentration is attained with more adsorbent at contact period of 30 minutes. This can be interpreted as more removal of Cd.

Cr, Zn and Pb contents with less amount of adsorbent, when longer contact period is permitted. In other words, increase in contact period which affects economics of the adsorption process and enhances the removal Cd. Cr, Zn and Pb contributing components of the waste water.

The regression analysis and experimental observations show that the experimental data fitted well in both the isotherms. However, the values of correlation coefficient 'R^2, were marginally higher for Freundlich isotherm than the values of' R^2, for Langmuir isotherm.

Two types of observations were collected after treating the water with the dry- biomass.

1. Reduction concentration of heavy metals and other impurities from water sample.

2. Effect in the rate of adsorption with changing time.

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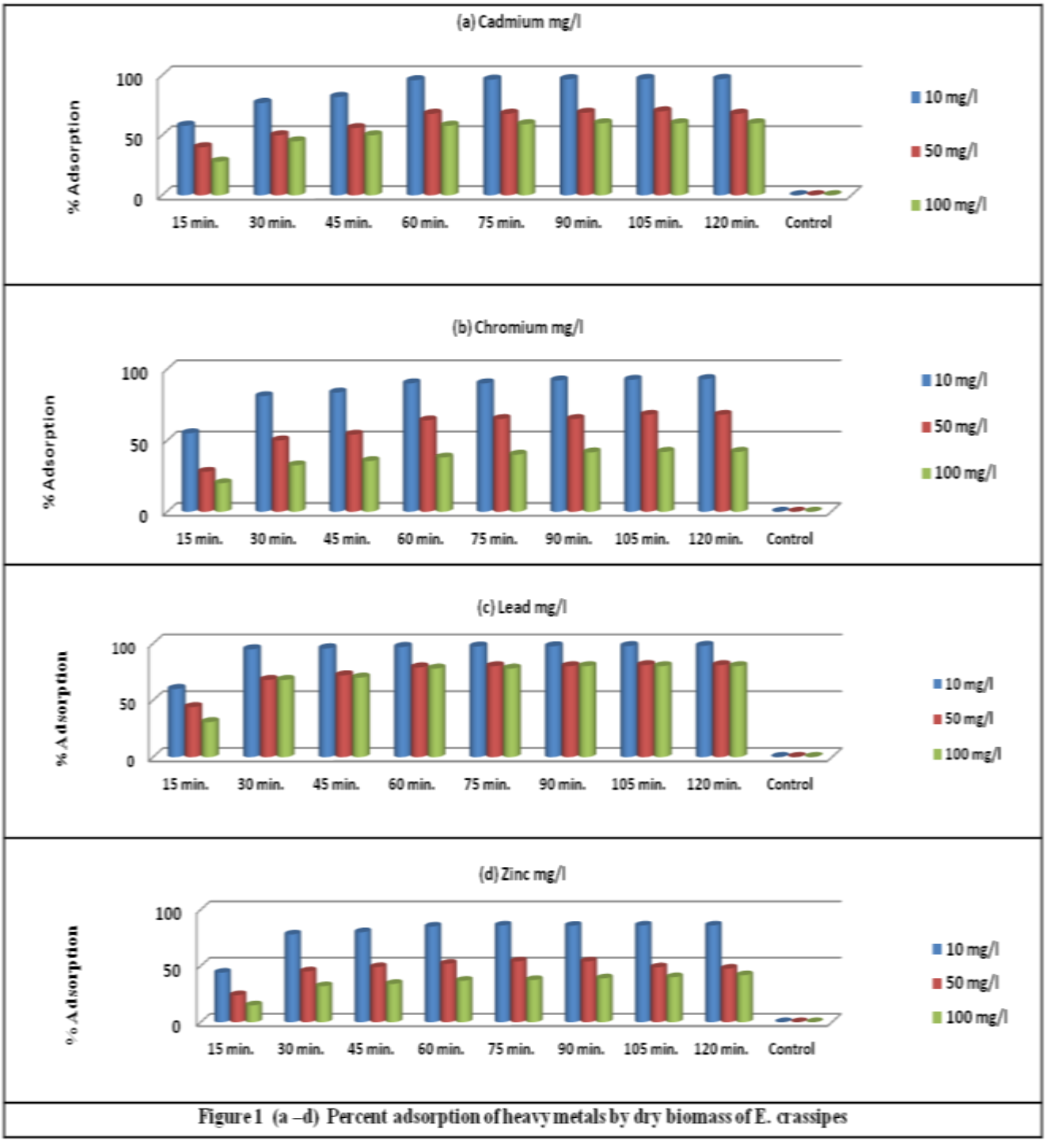

Figure 1 (a –d) Percent adsorption of heavy metals by dry biomass of E. crassipes

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Conclusion

Observations obtained from the above mentioned batch study concluded that not only living plants of E. crassipes but also dry biomass of the plant can also be used for reducing heavy metals present in waste water generated from industrial activities. The control samples merely showed any visible difference in the concentration to that of original concentration which signifies that the dry biomass of the plant has good potential for waste water treatment. It is well evaluated that the dry mass of the plant showed the required good results in case of heavy metals as it has shown great reduction from its original concentration for all the studied heavy metals. and the results obtained were comparatively better than that done with the living plants of E.crassipes [8]. It was also noticed that many of the studied heavy metals viz. Cadmium, Chromium, Zinc and Lead showed reduction in their concentration with increasing contact period but after 4 hr. they showed stability in reduction percentage. This concludes that the dry biomass powder of E.crassipes can be effectively utilized for reducing heavy metals and it gives the results in short span of time and so will prove to be a powerful tool among various waste water treatment technologies.

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