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Removal of heavy metals from wastewater using sugarcane leaf as adsorbent

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ABSTRACT

In the present study, the potential of sugarcane leaf powder as an adsorbent for the removal of heavy metals such as Lead, Cadmium and Chromium from aqueous was investigated. Highest adsorption capacity of the material Lead, Cadmium and Chromium was found to be in the range of 86, 64 and 62 percentage an initial metal ion concentration of 100ppm solution. Hence the present study reveals that the low cost adsorbent of sugarcane leaf may be used for removing the above said heavy metals effectively from wastewater.

Key words: Heavy metals, Sugarcane leaf, Adsorption, Contact time.

INTRODUCTION

Groundwater is a vital natural resource for the reliable and economic provision of potable water supply in both the urban and rural environment. Water contamination is a global problem that can result in illness and death. Lead is one of the potentially toxic heavy metals when adsorbed into the body [1]. The release of industrial effluents containing heavy metals to the river water causes several adverse effects [6]. Heavy metals are dangerous environment pollutants due to their toxicity and strong tendency to concentrate in environmental pollution and in food chains [7, 8]. Consumption of contaminated drinking water is particularly problematic in third world countries where inadequate purification processes, coupled with rapidly increasing population growth and industrialization pose serious health risks. One of the most common and deadly contaminants found in water are Lead, Chromium and Lead. Agricultural waste is one of the rich sources of low-cost adsorbents besides industrial by product and natural material. The presence of heavy metals in drinking water sources and in edible agricultural crops can be harmful to human. They damage nerves, liver and bones also block functional groups of vital enzymes [3]. Heavy metals are found in water air and soil. The major sources of heavy metals in water and soil are waste water streams from many industrial processes [4]. Heavy metal ion contamination of aqueous stream is becoming a serious threat to aquatic system, because of their high toxicity even at very low concentrations. Heavy metals ions released by number of industrial processes are the major pollutants in marine, ground water, industrial and even in treated waste waters [11]. Water is essential to all forms of life and makes up 50-96 % of the weight of all plants and animals. It is also a vital resource for agriculture, manufacturing and other human activities [12]. Industrial waste water are mostly loaded with heavy metals that are not biodegradable and leads to accumulate in to aquatic organism. In order to decrease the content of heavy metals in the environment [13]. Although great efforts made to protect environment but still majority of industries of the world are constantly releasing toxic metals into the environment [14]. Chromium has been considered as one of the toxic pollutants and because of its carcinogenic characteristics, it has

been become a serious health problem. Extensive use of chromium results in large quantities of chromium containing effluents which need sufficient treatments [15].

MATERIALS AND METHODS

The Sugarcane leaf was collected in the local market. The collected leaf was taken as an adsorbent for this experimental work. The leaf was washed with doubled distilled water till the adhering dirt removed. Then the leaf was dried in the air oven. The dried leaves were grinded to fine particles and sieved into 0.5 mm particles and were used as adsorbent for overall studies [9]. The sieved adsorbent was stored in an air-tight container. No other chemical modification was taken place. All reagents used were of analytical grade (Merck) without further purification [9].

Batch adsorption studies

The metal solutions used in this study were prepared as the stock solutions containing 1000mg/L of each metal. 100ml of adsorbate solution of known concentration was taken in the 250 ml conical flask, to that 1g of adsorbent sugarcane leaf powder was added and then reactant was stirred by magnetic stirrer without any pH modification at room temperature. For a wide range contact time 30-180 mins. After that the solution was filtered by whatmann 42 filter paper and concentration of the filtered solution was determined by atomic absorption spectrophotometer [2]. The percentage removal was determined by the following expression.

The amount of adsorption efficiency was calculated by,

$$\text{Adsorption percentage} = \frac{(Co - Ce)}{Co} \times 100$$

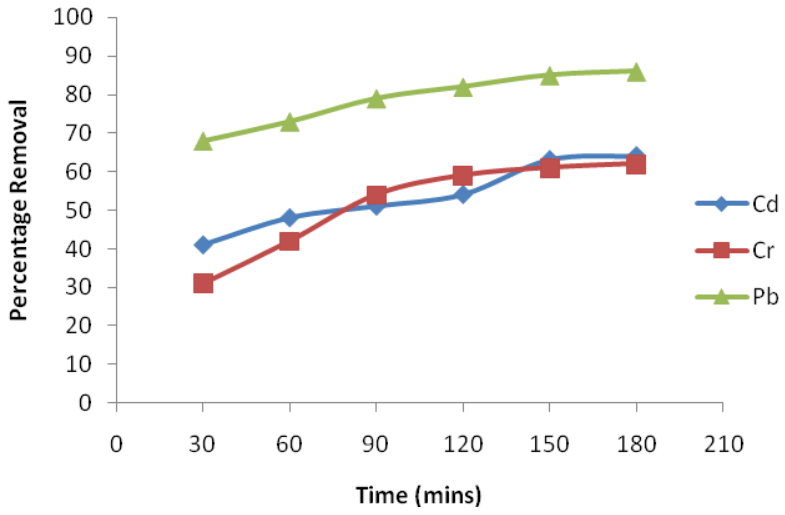
Where C_o is the initial concentration of sorbate solution in (mg/l) and the C_e is the concentration of the sorbate solution at equilibrium (mg/l).

RESULTS AND DISCUSSION

Effect of Contact Time on Adsorption of Heavy Metals

The relationship between contact time and the percentage removal of heavy metals from wastewater with sugarcane leaf powder is shown in figure-1. The effect of contact time was studied at a room temperature at intervals of 30mins for 3hrs. From the obtained result, it shows that the removal of metal ions increased as contact time increases [5].

Figure 1. Percentage Removal of Cd, Cr and Pb



The percentage of adsorption is found to increase continually with time till the equilibrium is attained with saturation at 180mins. The percentage reduction of cadmium is 41-64 for adsorbent of sugarcane leaf has slightly increased. This may be due to utilization of active sites is larger surface area. The percentage reduction of chromium is 31-62. The decreased adsorption efficiency is due to less adequate availability of active sites on the adsorbents [9]. The high percentage reduction of lead is found to be 68-86 is rapidly increased. The reduction efficiently is increased. This increase maybe due to the utilization of active sites availing the larger surface area [10]. Hence the present study reveals that the low cost adsorbent of sugarcane leaf may be used for removing 86, 64 and 62 % of Lead, Cadmium and Chromium effectively from wastewater.

CONCLUSION

From the obtained results, it shows that material produced from sugarcane leaf is a good adsorbent for removal of lead, Cadmium and Chromium ions in wastewater. Sugarcane leaf is inexpensive and readily available, thus this study provide a cost effective means for removing metal ions from contaminated water or effluents. This work showed that sugarcane leaf could be used as a good adsorbent material for Lead, Cadmium and Chromium for wastewater treatment. The present adsorbent can be used at an industrial scale to remove chromium, Lead and Cadmium from the effluents before discharging into the environment. Undoubtedly low-cost adsorbents offer a lot of promising benefits for commercial purpose in the future.

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