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ANALYSIS OF ADSORPTION CAPACITY OF SULPHONATED RICE BRAN FOR REMOVAL OF SOME HEAVY METAL IONS

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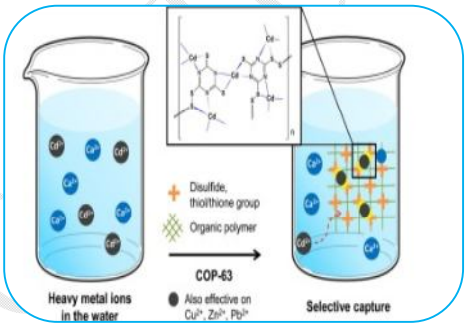
ABSTRACT:

The importance of removal of heavy metal from drinking water has received significant attention of researchers and decision makers across the globe. Bio- adsorbents have emerged as potential remediation materials for the removal of heavy metals and metalloids from both groundwater and surface water. Plants, algae, fungi are some of the biomass derived adsorbents which are capable of removing heavy metals and metalloids from aqueous solution by adsorption In present work Rice husk (RH) has used for removal of various heavy metals (such as Pb, Co, Ni and Zn) from water. The adsorption efficiency of rice husk evaluated by considering the parameters like contact time, adsorbent dose (rice husk), initial concentration of heavy metals, pH and temperature. The objective of the present study is to comparative analysis of absorption capacity of rice bran and activated charcoal for removal of heavy metal ions.



KEYWORDS: *Adsorption efficiency, Heavy metals, Metalloids, Rice husk.*

INTRODUCTION

The presence of heavy metals in groundwater and surface water has become one of the major environmental worries. Heavy metals such as Pb, Co, Zn, Ni, and metalloids in drinking water have adverse impacts on human health such as allergies, hyper pigmentation, skin lesions, skin cancer, neurological effect, hypertension, cardiovascular disease and pulmonary disease[1]. The above-mentioned heavy metals and metalloids target the liver, kidneys, lungs, brain and bones once absorbed through various path ways[2]. For removal of heavy metals and metalloids, many conventional techniques such as chemical precipitation, membrane filtration, ion exchange, carbon adsorption and co-precipitation have been used. But they are not suitable for high concentration of metals and also not cost effective [3]. Use of bioadsorbent is one of the potential alternatives for removal of heavy metals and metalloids. Rice husk (RH) is a low cost bioadsorbent which can be used for the removal of various heavy metals ions (such as Pb, Co, Zn, and Ni) from both groundwater and surface water[4]. .

MATERIAL AND METHODOLOGY

The adsorbent material was collected from local area and cut into small pieces of size 5 mm. The adsorbent particles were washed with tap water followed by deionized water, then filtered and finally dried at 65 ºC for 24 hours[5]. The dried material Was crushed, powdered and then soaked in AR conc. Sulphuric acid for 2 hours.[6] The biomass was then

heated on a water bath till the fumes ceased then washed thoroughly with distilled water till the black mass was acid free. It was then dried at 110 0C in the oven for 3 hours and passed through 0.63 mm mesh to get particles of uniform size sorbent and stored in vacuum desiccators.

Standard solution of metal ions containing (Pb^{2+}, Zn^{2+}, Ni^{2+} and Co^{2+}) which concentration was equal to 10 mg/L, was prepared. Different quantity of(0.2, 0.4 and 0.6gm) of the Rice bran have taken in an Erlenmeyer flask, and 25 mL of the multi-element standard solution poured in each flak the mixtures were shaken using a rotary shaker at about 200 rpm for different time interval . After that, the mixtures were filtered using a Whatman no. 1 filter paper. The filtrate was analyzed using an atomic absorption spectrophotometer. Each experiment was carried out at room temperature.

A systronic flame atomic absorption spectrophotometer (air/acetylene flame) was used for metal ions determinations. A Systronic (model 317) digital pH meter equipped with a combined glass electrode was used for the pH adjustments..

Estimation of Removal Percentage of Metal Ions by Materials Amount of removed material through series of batch investigations will be determined by the following equation[7]:

$$\text{Removal } \% = [(Co - Cf)/ Co] \times 100,$$

where Co and Cf are the initial and equilibrium concentration (ppm) of metal ions in solution, respectively.

RESULTS AND DISCUSSION

Effect of weight of RH on the Removal of the Heavy Metal Ions

The effect of weight of sorbent (RH) on the percent removal of heavy metal ions is shown graphically in Figure 1. Maximum percent removal was obtained for Co^{2+} and Ni^{2+} ions, The order of maximum percent removal of metal ions with weight of Rice bran used as sorbent lies in the order $Ni^{2+} > Co^{2+} > Pb^{2+} > Zn^{2+}$.

Effect of Contact Time on the Removal of the Heavy Metal Ions

It is shown in figure 2, the plot revealed that the rate of percent metal ions removal is higher at the beginning. This was probably due to larger surface area of the plants being available at beginning for the adsorption of metal ions. As the surface adsorption sites become exhausted, the uptake rate was controlled by the rate at which the adsorbate is transported from the exterior to the interior sites of the adsorbent particles. Maximum percent removal was attained after about 60 min of shaking time..

Effect of pH on the Removal of the Heavy Metal Ions:

The adsorption of metal ions were found to be strongly dependent on the pH of the solution and analyzed using atomic absorption spectrophotometer. It was demonstrated that the optimum pH for the adsorption metal ions were about 5 which were rather acidic. At low pH (below 3), there was excessive protonation of the active sites at Rice bran powder surface and this often refuses the formation of links between metal ions and the active site. At moderate pH values (5 to 6), linked H+ is released from the active sites and adsorbed amount of metal ions is generally found to increase. Moreover, at higher pH values (above 6), the precipitation was dominant or both ion exchange and aqueous metal hydroxide formation may become significant mechanisms in the metal removal process.

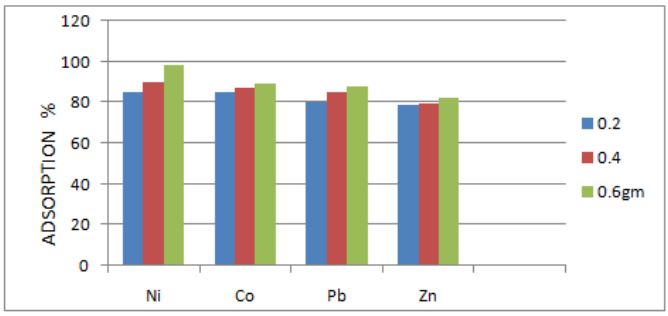


Figure: 1 Effect of weight of rice bran the removal of heavy metal ions.

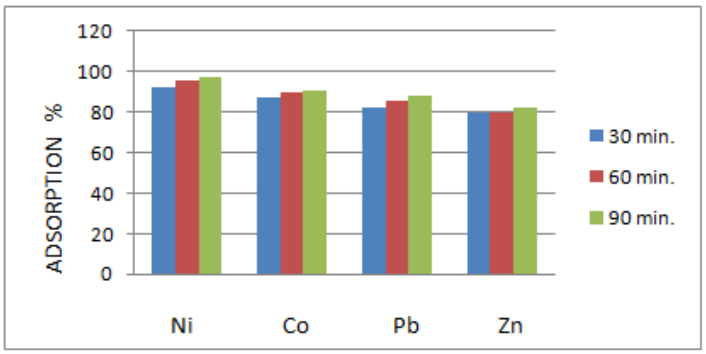


Figure: 2 Effect of contact time on the removal of heavy metal ions.

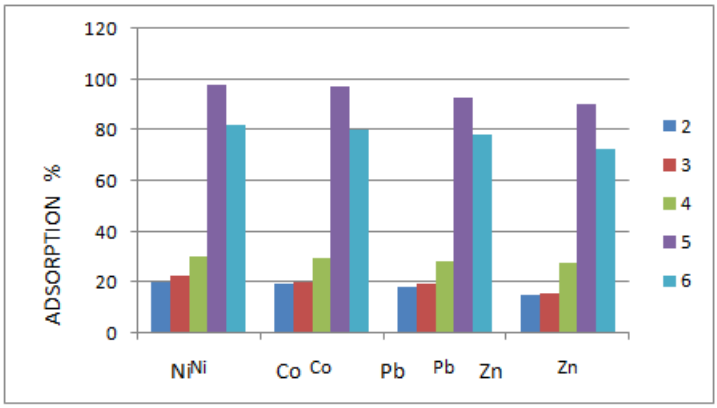


Figure: 3 Effect of pH on removal of Heavy Metal ions.

CONCLUSION

Based on the present investigation, it could be concluded that some low cost materials like Rice bran can be used efficiently in the removal of heavy metal ions (Pb2+, Zn2+,Ni2+ and Co2+) from aqueous solutions. The removal of heavy metal ions was pH dependent as the adsorption capacity increases with increasing the pH value of the solution. Experimental results showed that the best pH for adsorption was 5 and time was 60 min. The metal ions showed different behaviors towards adsorption on Rice bran by increasing the initial concentration of the metal ions. This investigation also showed absorbent prepared from Rice bran to be suitable adsorbent for removing the heavy metal ions.

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