INVESTIGATION OF MULTICOMPONENT HEAVY METALS ADSORPTION CAPABILITY USING RAW COIR DUST AND PROCESSED COIR PITH

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ABSTRACT

Water is the most vital natural resource that sustains all living organisms on the earth and access to safe and clean water has become a crisis due to intense water pollution by anthropogenic activities, over-pumping of groundwater for irrigation purposes, limited water availability due to climate changes, regional conflicts over common water resources, etc. Wastewaters that contain various heavy metals, such as arsenic, chromium, manganese, nickel, lead, cadmium, zinc, and copper are being discharged into natural water bodies annually by many industries. Industrial processes that generate wastewater with significantly high levels of heavy metals use various techniques, such as chemical coagulation, chemical precipitation, membrane separation, extraction, electrodeposition, ion-exchange, and electrochemical techniques in order to remove the heavy metal contents. Nevertheless, most of these techniques use expensive chemicals and require considerable time, and some of them are proven to be less effective and less efficient, especially in removing trace amounts of metals. Besides above methods, adsorption technique is one of the most widely used technique to remove heavy metals from water and studies have revealed that it is much effective in removing heavy metals with high solute loading and even at minute concentrations. In the past decade, significant number of studies have been conducted worldwide on the removal of heavy metals from aqueous solutions by non-living and biologically inactive biomass. This approach of wastewater treatment is known as biosorption, and the non-living biomass used there is defined as bio sorbent. Use of bio sorbents to remove heavy metals from wastewater is a novel and developing technology in the water treatment field. Coir pith is a waste-derived material that can be utilized as a biosorbent for heavy metals removal from wastewater. In this study, directly obtained raw coir dust from coconut husks and processed coir pith were tested for their removal efficiencies of 8 heavy metals, i.e., As, Cd, Cu, Cr, Mn, Ni, Pb, and Zn. Standard heavy metal solutions were prepared for each metal and heavy metal content of standard solutions, coir pith, and coir dust were first measured using the Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES) method. A multicomponent batch adsorption experimental procedure was conducted to determine the removal efficiencies of each metal by both coir dust and coir pith. In experimental procedures, respectively, 1g, 2g, 3g, 4g, and 5g of coir pith and coir dust were added to equal volumes of each metal solution and allow adsorption for 2 hours. Then filtered samples were tested for the heavy metal concentrations using

the ICP-OES method. Multicomponent heavy metal removal efficiencies of coir pith were tested by varying the adsorption temperatures and the contact time between the heavy metal solution and the coir pith sample. Analytical results show that both raw coir dust and coir pith act as suitable bio sorbents for removal of As, Cd, Cr, Ni, and Pb, and the optimum solid/liquid ratio is 0.1 g/ml at room temperature for 2 hours if contact time for all these five heavy metals. According to the results comparison between the of raw coir dust and processed coir pith, raw coir dust shows higher heavy metals removal capacities Coir pith is the most suitable biosorbent for Cu removal while coir dust is most suitable biosorbent for Mn removal. For raw coir dust metals and bio sorbents 0.08g/ml at room temperature for 2 hours contact period is the optimum solid/liquid ratio. For processed coir pith metals and bio sorbents 0.1g/ml at room temperature for 2 hours contact period is the optimum solid/liquid ratio Anyway both coir pith and coir dust are not suitable for Zn removal from aqueous solutions. For all metals except Zn, contact period of 30 minutes and temperature of 30 °C are the optimum operating conditions.

In this experimental we have used multi component heavy metal sample as a result of it both materials adsorption and desorption are happening in the same sample. When we consider heavy metal adsorption with the temperature from 30-70 °C heavy metals adsorption capacity has decreased the reason for this with the increasing of temperature kinetic energy of the metal has increased then desorption is happened inside the sample. As a result of it with increasing of temperature heavy metals adsorption capacity will decrease.

When we consider contact time of the heavy metals sample with the absorbent, For Cr, Cu and Pb show similar results. From 30 min to 2 hr material adsorption efficiency has decreased but 2 hr to 4 hr adsorption efficiency has increased the reason is for this, from 30 min to 2 hr desorption appeared in the sample but with the increasing of the contact time from 2 hr to 4 hr again heavy metals adsorption is happened in the sample. But all other heavy metals are showing decreasing trend of heavy metals adsorption capacity with the increasing of contact time.

Keywords: Coir pith, coir dust, heavy metals, adsorption, biosorption, biosorbent

DEDICATION

Dedicated with gratitude to everybody who supported me to make this a success.

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