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REMOVAL OF CHROMIUM (VI) FROM AQUEOUS SOLUTION USING LOW COST ADSORBENT: TECTONA GRANDIS LEAVES POWDER

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Abstract:-In this study Tectona grandis leaves were used in removal of Cr(VI) from aqueous solution conducting batch equilibrium adsorption. The various parameters such as effect of pH contact time, initial concentration and adsorbent dosage on the adsorption of Cr(VI) were studied. The maximum percentage removal efficiency of Cr(VI) was 75.83% for 1mg/ml of Tectona grandis leaves with pH 5 at contact time 180 min. The initial concentration of Cr(VI) was 1mg /ml by using Tectona grandis leaves as on agro based origin. The results indicate the adsorbent, used in this work proved to be effective high potential adsorption and technically feasible and locally available materials for the treatment of Cr bearing aqueous solution.

Keywords: Chromium (VI). Tectona grandis. leaves. adsorption .

INTRODUCTION

The presence of heavy metals in drinking water sources and in edible agricultural crops can be harmful to human. It is well known that heavy metals can be vital eg. they damage nerves, liver and bones also block functional groups of vital enzymes (Gholami F.et.al. 2006) 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 (Olayinka K.O.et.al.2007). The chromium contamined wastewater can originate from dyes and pigment manufacturing, wood preserving, electroplating and leather tanning industries.

The chromium exists in Cr (III) and Cr(VI) oxidation state as all other oxidation state are not stable in aqueous solutions. Both valences of chromium are potentially harmful (Dakiky.M. et.al.2002) The hexavalent chromium which is primarily present in the form of chromate (CrO42-) and dichromate (CrO72-) poses significantly higher levels of toxicity than the other valency state (Sharma D.C. and Forster C.F.1995). The conventional methods for removing Cr(VI) ions from industrial waste water include reduction (Kim S.D.et.al.2002) reduction followed by chemical precipitation (Ozer A.et.al.1997) membrane filtration and adsorption (Khan Naism Ahmad et.al.2003). Most of these which involve high capital cost, study on treatment of effluents bearing heavy metals have revealed adsorption to be highly effective cheap of an easy method among the physicochemical treatment process (Wong P.K.et.al.1993)

Many researchers have identified the low cost adsorbent like saw dust (Prasad M.N.V.et.al.2000) Rice husk (Srinivasan K.et.al.1998) coir pith (Suksabye Parinda et.al.) coconut shell. Waste tea powder coconut husk (.Kehinde O. et.al.2009) sugar cane bagasse (Khan N.A.et.al 2003) etc even though the industrial are not keen to adopt these adsorbents. All industries are adopting chemical processes only due to difficulty in disposing of adsorbent materials after use.

Therefore it is an important to indentify low cost adsorbent material like fly ash rice husk carbon (Nhapi I.et.al.2011) coconut leaves (Gowda Rudre et.al.2011) coffee husk (Ahalya N.et.al.) for removal of toxic metals from industrial effluents which are having advantage of removal of pollutants from effluents effectively and which do not have much adverse impact an environment when disposed after treatment.

Literature survey indicates that the low cost adsorbent Tectona grandis leaves have not been used as an adsorbent. The objective of the present study is to explore the feasibility of using Tectona grandis leaves to remove hexavalent chromium from aqueous solutions. The effect of pH, contact time, initial concentration and adsorbent dosages, adsorption equilibrium were investigated.

MATERIALS AND METHODS:

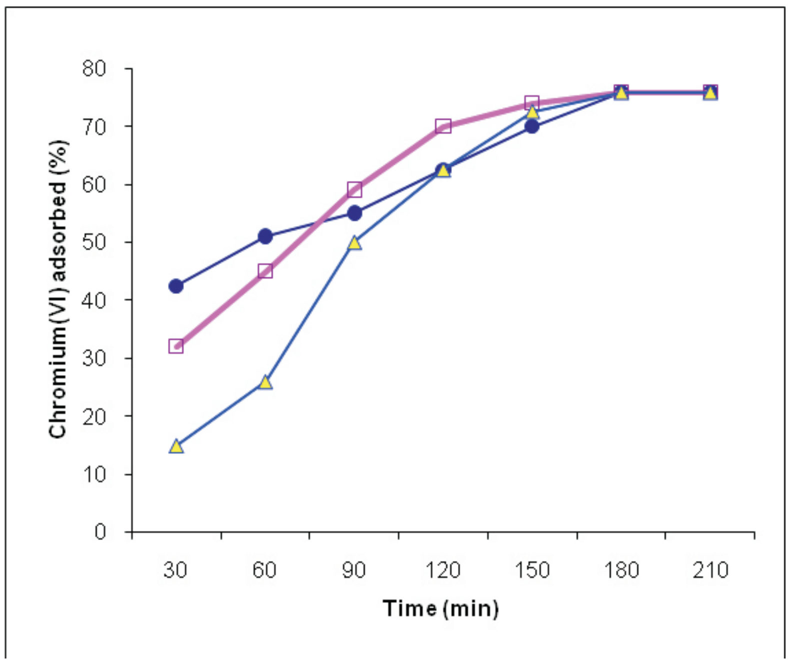
The Tectona grandis dry leaves collected from local area and washed with distilled water, Then dried at 600 C temperature crushed and sieved to small particle size of range 50-60 mesh for use of adsorbent. It was grounded and treated with H2SO4 and formaldehyde was heated at 50oc temperature for six hours stirred occasionally in an oven (Digital oven –TC303) A stock solution containing 1000 mg/l of Cr(VI) was prepared using potassium dichromate in distilled water All these chemicals used were analytical grade. The Batch mode experiments were conducted by agitating 50 ml of chromium solution at desired concentration at pH 5. The adsorbent was separated using Whatman No.1filter paper and the supernatant was analyzed Colorometrically (Digital Coloimeter EQ- 650) using.1.5 diphenylcarbazide (APHA, 985). To study the effect of pH (Digital pH meter EQ- 610) It was varied between 2 to 8 at different initial metal ion concentration. The pH was adjusted using 0.1N NaOH and 0.1 N HCl. The effect of adsorbent dosage was studied by varying the adsorbent from 0.5 gm to 3.5gm at various initial metal concentration at pH 5. The effect of contact time was studied by varying the contact time from 30 min to 180 min. at various initial metal concentration at pH 5.

RESULTS AND DISCUSSIONS:

1) Effect of contact time on Cr(VI) removal using Tectona grandis leaves

The effect of contact time for various initial concentrations was studied (figure) The percentage adsorption Cr(VI) increased with increase in agitation time the time required to attain equilibrium for 10 mg/l, 50 mg/l and 120 mg/l Cr(VI) attained equilibrium at 180 minutes the maximum percentage adsorption was 75.83%, for initial Cr(VI) concentration of 10 mg/l, 50mg/l and 120 mg/l

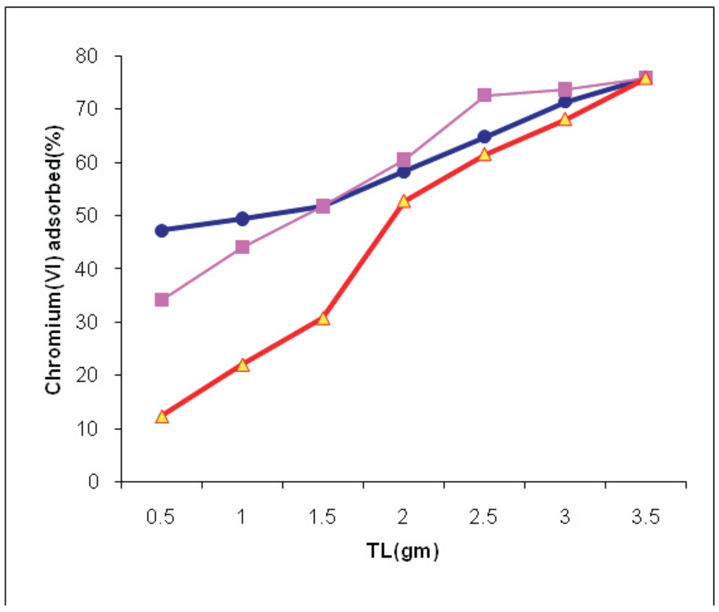
Fig. 1 Effect of agitation time on Cr(VI) adsorption at ▲ 10 mg/l, ■ 50 mg/l and ● 120 mg/l, 3.5gm/50ml at pH 5.0



2) Effect of adsorbent dose on adsorption

The percentage adscription of Cr(VI) was studied by increasing adsorbent dose from 0.5 to 3.5 gm for 50 ml of Cr(VI) concentration of 10 mg/l , 50mg/l and 120 mg/l (Figure 2) The result indicated that the percentage of Cr(VI) adsorbed increased with an increase in adsorbent dosage for all Cr(VI) concentration at pH 5.0

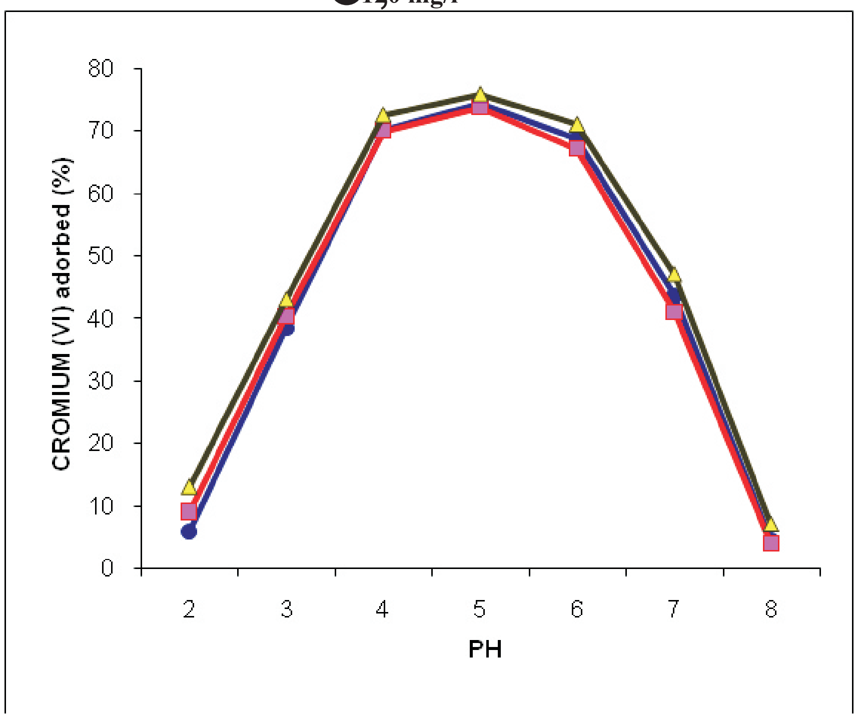
Fig. 2 Effect of adsorbent dose on Cr(VI) adsorption at ▲ 10 mg/l, ■ 50 mg/l and ● 120 mg/l agitation time 180 minutes initial pH 5.0



3) Effect at pH

The pH of the solution is an important factor that controls the uptake of Cr(VI). The experimental results showed that the percentage adsorption increased as the pH was increased from 2 to 5 and decreased after 5.Though the Literature survey revealed that the maximum uptake of chromium at pH 2.Here we obtained the maximum uptake at pH 5. At pH 5 maximum adsorption occurs due to the surface of the adsorbent becomes attracts Chromate ions. As the pH is increased above the zeta potential of the adsorbent there is a reduction in the electrostatic attraction between the chromate ions and the adsorbent surface with the consequent decrease in percentage adsorption.

Fig. 3 Effect of pH on Cr(VI) adsorption at different initial Cr(VI) concentration ▲ 10mg/l, ■ 50mg/l and ● 120 mg/l



CONCLUSION :

The experimental result show that Tectona grandis leaves are an excellent alternative for the removal of Cr(VI) from aqueous solutions adsorption of Cr(VI) was dependent on pH, contact time, adsorbent dosage and initial metal ion concentration. The present adsorbent can be used at an industrial scale to remove chromium ion from the effluents before discharging into the environment the Tectona grandis leaves can replace the expensive activated carbon in the adsorption process most of the electroplating effluents contain chromium as one of the major contaminant which can be removed in a cost effective and efficient manner by Tectona grandis leaves.

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