COMPARITATIVE STUDY OF ADSORPTION OF Cr(VI) FROM WASTE WATER USING TAPIOCA PEEL AND BANYAN TREE ROOT

Shabina A R and Anu N

Abstract- One of the most important and toxic heavy metals in wastewater is chromium. Cr (VI) is released from different industrial operations, including metallurgy, leather tanning, paint, textile industries, chemical manufacturing, pulp production, ore and petroleum refining, metal corrosion, electroplating products etc. Hexavalent chromium is toxic, carcinogenic, probably mutagenic and highly soluble. The harmful effects of chromium include lung and throat cancer. Since chromium is an important heavy metal used in various industrial processes, it finds its way into the industrial effluents causing lethal environmental hazards. The impacts of chromium on human health and the environment is matter of concern.The untreated metal containing effluents into water bodies is the most important pollution problems. Adsorption is one of the effective techniques for removal of chromium (VI) from wastewater. In the present study, low, batch adsorption is conducted using natural low cost adsorbents like Tapioca Peel (*Manihot Esculanta*) and Banyan Tree (*Ficus Benghalensis*) for the removal of chromium (VI) from wastewater. Experiment is conducted with increase in adsorption dosage. Adsorption efficiency of material will be found using UV spectrophotometer at a wavelength of 560nm.

Key words—Adsorption, Batch adsorption, Chromium, *Manihot esculanta*, UV spectrophotometer.

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1. INTRODUCTION

Water is the most important element among the natural resources, and is needed for the survival of all living organisms. Due to increasing urbanization and industrialization have negative implications for water quality[5]. The pollution from industrial and urban waste effluents and from agrochemicals in some water bodies and rivers has reached alarming levels. The presence of toxic heavy metals such as chromium (VI) contaminants in aqueous streams, arising from the discharge of untreated metal containing effluents into water bodies, is one of the most important environmental problems. Adsorption is one of the effective techniques for chromium (VI) removal from wastewater. Different physical, chemical and biological methods have been adopted for its removal, but all those methods were found to be expensive [7]. In the present study, adsorbent was prepared from low cost adsorbents and studies were carried out for chromium (VI) removal. Chromium is one of the water pollutants which is actually a micro nutrient required by our body in minute quantity.

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This form of chromium is the safe trivalent or 'Chromium-3'. Chromium also exists in another very rare form known as 'Hexavalent chromium' or 'Chromium-6'. Hexavalent chromium-6 is usually introduced into ground water when chemical industries using chromium, discharge their water without proper treatment. Hexavalent chromium-6 is poisonous and should be guarded against people using well water [5]. It is recommended that a daily intake of 50 to 120 µg (for adults) is helpful for human beings whereas, Cr (VI) is highly toxic in nature. It causes cancer, anuria, nephritis, gastrointestinal ulceration, perforation in partition of nose [4]. It penetrates cell membrane and badly affects central nervous system, causes respiratory trouble, and lung tumors when inhaled. Trace amount of Cr III is essential for normal glucose, protein and fat metabolism and hence it is an essential trace element in diet. 5].The Ministry of Environment and Forest has set the permissible limit of Cr (VI) in industrial effluents to 0.05mg/L [8].

2. OBJECTIVES

The main objective of the study was to estimate the adsorption of the chromium using alternative adsorbent.

- To conduct the adsorption study of two adsorbents with different dosages.
- To compare the adsorption efficiency of powdered Tapioca peel and Banyan tree root ash for the removal of Cr (VI) from waste water using UV spectrophotometer (wavelength-560nm).

3. MATERIALS AND METHODS

3.1 Materials

Potassium dichromate has been used for the preparation of stock solution. DPC, acetone, acetic acid and HCl has also been used, for the analysis of chromium. The analysis was carried out using a UV spectrophotometer.

3.2 Preparation of adsorbent

Tapioca peel (*Manihot esculanta*) and Banyan Tree Root (*Ficus benghalensis*) were taken as adsorbent for conducting batch study. Tapioca Peel and Banyan Tree Root were collected and washed with distilled water several times to remove dirt particle. Tapioca Peel was dried in oven for 8hrs at a temperature of 60°C and grinded into fine particles. Banyan Tree Root was made into carbon by heating in muffle furnace for 2hrs at a temperature of 500°C. Both particles were sieved in sizes 70µ, 150µ and 300µ. The particles retained in sieve sized 150µ is used for the analysis. Particles were stored in air tight containers. No chemical modifications were given to the material.

3.3 Preparation of standard solution

Stock solution is prepared by dissolving 141.4mg of potassium dichromate in distilled water and diluting it to 100mL (concentration of solution is 500mg/L). Standard solution is obtained by diluting 1 mL of stock solution to 100mL.

3.4 Preparation of calibration curve

Diphenylcarbazide method has been used in this study for the analysis of Cr (VI). Chromium solutions of different concentrations were prepared by taking different volumes of standard solution (2ml, 4ml, 6ml, 8ml and 10ml) and diluting it to 100ml. 2ml of DPC solution and 2ml of HCl (diluted in 1:1 proportion) were added. DPC solution was prepared by adding 1g of DPC to 100ml acetone and acidifying the same with acetic acid. The solutions are then analysed in UV spectrophotometer and the calibration curve was plotted.

3.5 Batch studies

The present study is done mainly to compare the adsorption efficiency of two adsorbents by conducting the adsorption study for different adsorbent dosage. 100mL of adsorbate solution of known concentration was taken in a conical flask. Dosages of both adsorbents of 0.1g, 0.2g, 0.3g, 0.4g, 0.5g was added to the conical flasks and the contents are mixed properly by using a shaker for 30min at 180rpm. After giving an adsorption period of 20 minutes, the solution is filtered through a filter paper.50 ml of filtered water was taken and 1ml of DPC & 1ml of HCl was added. This gives a pink colour to the solution. The concentration of chromium in the filtered water was then found out using UV spectrophotometer.

Adsorption percentage = { (Co – Ce)/Co}* 100
Co – initial concentration of Cr in mg/L
Ce – final concentration of Cr after adsorption in mg/L

4. RESULTS AND DISCUSSION

4.1 Effect of adsorbent dosage:

Chromium solution analyzed has an initial concentration of 2.5mg/l. the adsorption study of two adsorbents has been conducted with different adsorbent dosages like 0.1g, 0.2g, 0.3g, 0.4g, 0.5g. In case of Tapioca Peel, Fig [1] and Table [1] showed that the adsorption efficiency increases with increase in adsorbent dosage. This is due to increase in sorption surface area [5]. In fig 2and table [2], it showed that the adsorption efficiency remain constant with increase adsorbent dosage, it reveals that there is no significant adsorption capacity for Banyan Tree Root ash.

Table 1: Effect of Tapioca Peel on adsorption efficiency.

Adsorbent dosages(g)	Initial Cr conc. (mg/L)	Final Cr conc. (mg/L)	Absorbance	Adsorption efficiency %
0.1	2.5	1.84	0.234	26.4
0.2	2.5	1.76	0.224	29.6
0.3	2.5	1.42	0.184	43.2
0.4	2.5	1.24	0.163	50.4
0.5	2.5	1.21	0.159	51.6

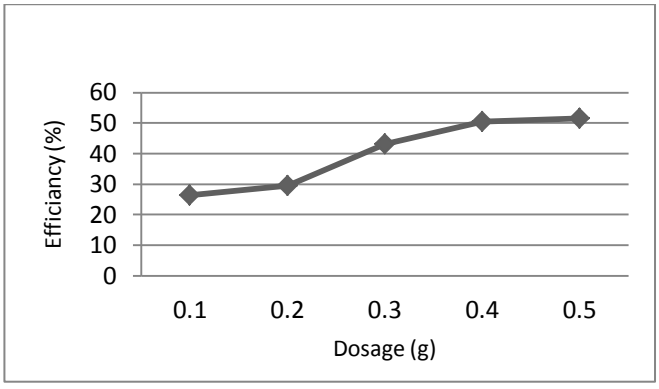

Fig.1: Adsorption efficiency of Tapioca Peel

Table 2: Adsorption efficiency of banyan tree root

Adsorbent dosages(g)	Initial Cr conc. (mg/L)	Final Cr conc. (mg/L)	Absorbance	Adsorption efficiency %

0.1	2.5	0.48	0.073	80.8
0.2	2.5	0.49	0.074	80.4
0.3	2.5	0.49	0.074	80.4
0.4	2.5	0.49	0.074	80.4
0.5	2.5	0.49	0.074	80.4

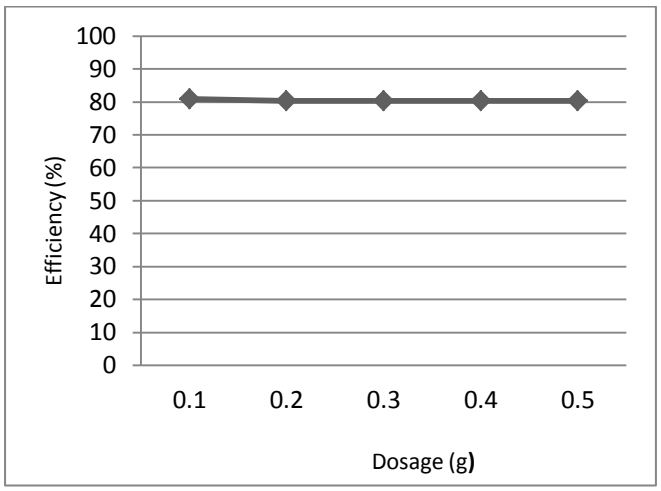

Fig 2: Adsorption efficiency of Banyan tree root ash

5. CONCLUSION

The present work aimed to compare the adsorption efficiencies of Tapioca Peel and Banyan Tree Root for the removal of Cr (VI) from wastewater. Batch studies were done for this purpose**.** Batch study was conducted for both adsorbents with different adsorbent dosages. The adsorption efficiency of Tapioca Peel was found to be 26.4%, 29.6%, 43.2%, 50.4%, 51.6% for adsorbent dosages 0.1g, 0.2g, 0.3g, 0.4g, 0.5g respectively. It was found out that the removal efficiency of Cr (VI) increased with increase in adsorbent dosage. But the adsorption efficiency of Banyan Tree Root remains constant with increase in adsorbent dosage. So it has no adsorption capacity, this is due to in availability of adsorption site and lack of chemical treatment. It can be concluded that Tapioca Peel is more effective in adsorbing hexavalent Chromium from wastewater than Banyan Tree Root.

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