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Evaluation of chromium(VI) Removal Efficiency by Recycling and Reuse of Magnifera Indica Fruit Seed Shell, Peltophorum Pterocarpum and Saw Dust Activated Carbon

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Abstract In this study, the removal of Chromium (VI) from a synthetic sample that has been created is evaluated. Recycled Magnifera Indica fruit seed shell, Saw dust, Peltophorum Pterocarpum activated carbons are used as adsorbents. Following recycling and reuse, Magnifera Indica fruit seed shell activated carbon shows removals of Cr (VI) of 68%, Peltophorum Pterocarpum activated carbon shows removals of Cr (VI) of 54% and Saw dust activated carbon shows removals of Cr (VI) of 55% respectively. When all three adsorbents are washed with 1N HCL, more Cr (VI) is removed than with 1N NaOH or distilled water.

Keywords *— Chromium (VI), Recycle, Reuse, Magnifera Indica fruit seed shell, Peltophorum Pterocarpum, Saw dust and Adsorption*

I. INTRODUCTION

God gave us a beautiful and pristine planet as a gift. However, degradation of the environment has come from the rapid rise of industrialization, urbanization, and population increase all over the world. Heavy metals, a consequence of numerous industries, have greatly contaminated the environment, including the air, water, and food we ingest. Mines, plating plants, and basic non-ferrous metal foundries all generate trash as byproducts of their activities. The discharge of various types of industrial wastewater often results in the introduction of "Chromium (VI)" to freshwater sources. It is employed in the tanning of hides and skins, in the production of alloys, in electroplating processes related to refraction and catalysis of chromic oxides and chromic salts. The plating industry relies on chromic oxide for the production of chromic acid. Paints and laboratory cleaning solutions containing chromic salts are common uses for this substance. The World Health Organization (W.H.O.) sets the safe upper limit for chromium in drinking water at 2.0 mg/L. The principal drinking water criterion set by the US EPA (United States Environmental Protection Agency) is 5 mg/L [1]

ADSORPTION

Effective removal of heavy metals from wastewater can be achieved using adsorption. However, common adsorbents such as silica gel and the like can be quite pricey. Consequently, inexpensive adsorbents such as Magnifera Indica fruit seed shell, Saw dust, Peltophorum Pterocarpum activated carbons can be used as a viable alternative. Adsorption is a method of separation in which molecules from a fluid phase (such as a gas or liquid) are transferred to a solid surface. So, the system is heterogeneous because it contains two or more fluid phases in addition to the solid adsorbent. Adsorbed molecules are called adsorbate, whereas the solid surface onto which they are adsorbed is called the substrate or adsorbent. Adsorption occurs at the interface, the border between the phases.

OBJECTIVE OF THE STUDY

Using Magnifera Indica fruit seed shell, Saw dust, Peltophorum Pterocarpum activated carbons, which are prepared as adsorbents, to test how well they perform as a low-cost and effective treatment for heavy metals included in synthetic samples.

The current investigation adhered to the following protocols.

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1) The purpose of this study was to compare the effectiveness of Chromium (VI) removal using recycled Magnifera Indica fruit seed shell, Saw dust, Peltophorum Pterocarpum activated carbons.

II. MATERIALS AND METHODOLOGY

MANGIFERA INDICA (MANGO):

The common mango, botanically known as the Mangifera indica (Mango), is reported to have originated as alloploid and its native home is suggested as Eastern India, Assam to Burma or possibly further in the Malay region.The mango trees belong to the sumac family. In fact, there are hundreds of assortments of mangos, and they can range from the size of plums to that of apples, frequently weighing a pound or more. The familiar color of the mango is orange, although the color of the fruit may vary from green, yellow or red.

Fig 1: Magnifera Indica Fruit

Fig 2: Carbon Form

Peltophorum pterocarpum (commonly known as copper pod) is a species of *Peltophorum*, native to tropical southeastern Asia and a popular ornamental tree grown around the world. It is a deciduous tree growing to 15–25 m (rarely up to 50 m) tall, with a trunk diameter of up to 1 m belonging to Family Leguminosae and sub-family Caesalpiniaceaea. The leaves are bipinnate, 30–60 cm long, with 16–20 pinnae, each pinna with 20–40 oval leaflets 8–25 mm long and 4–10 mm broad. The flowers are yellow, 2.5–4 cm diameter, produced in large compound raceme up to 20 cm long. Pollens are approximately 50 microns in size. The fruit is a pod 5–10 cm long and 2.5 cm broad, red at first, ripening black, and containing one to four seeds. Trees begin to flower after about four years.

Fig.3: Peltophorum pterocarpum

Fig 4: Carbon form

Sawdust (or wood dust) is a by-product or waste product of woodworking operations such as sawing, sanding, milling, planning, and routing. it is composed of small chippings of wood. these operations can be performed by woodworking machinery, portable power tools or by use of hand tools. a major use of sawdust is for particleboard; coarse sawdust may be used for wood pulp. sawdust has a variety of other practical uses, including serving as a mulch as an alternative to clay cat litter, or as a fuel. until the advent of refrigeration, it was often used in icehouses to keep ice frozen during the summer. it has been used in artistic displays, and as scatter in miniature railroad and other models. it is also sometimes used to soak up liquid spills, allowing the spill to be easily collected or swept aside. as such, it was formerly common on barroom floors. it is used to make cutler's resin. mixed with water and frozen, it forms pykrete, a slow-melting, much stronger form of ice.

Fig 5: Saw Dust

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Fig 6: Carbon form

III. Results

Recycle and Reuse

Adsorbents that have served their purpose can be recycled by washing them in a series of three solutions: 1N hydrochloric acid, 1N sodium hydroxide, and distilled water. Used adsorbent is gathered by sifting it through paper and then adding it to the appropriate solutions after 30 minutes of stirring. It is then filtered and utilized again in the adsorption process after being subjected to the stirring procedure. Adsorbent recycling involved some vigorous churning on a magnetic stirrer. The results demonstrate that 1N HCL was the most effective in removing Cr (VI) from all three adsorbents, followed by 1N NaOH and distilled water. percent of Cr(VI) that has been removed following recycling and reuse, Table 1, Table 2 and Table 3 reveal that 68% of Cr (VI) are removed from Magnifera indica fruit seed shell activated carbon, 54% of Cr (VI) are removed from Peltophorum Pterocarpum activated carbon, and 55% of Cr (VI) are removed from saw dust activated carbon, respectively.

I. Table: 1 Results of Recycled and Reused Adsorbents on Chromium (VI) Removal using Magnifera Indica Fruit Seed Shell Activated Carbon

Adsorbent	Solution used for recycling	%removal of Chromium(VI) before recycling of adsorbent	%removal of Chromium (VI) After recycling of adsorbent
Magnifera Indica $MgCl_2$ (I.R – 0.75)	1N HCl	78	68
	1N NaOH	78	63
	Distilled Water	78	58

I. Table: 2 Results of Recycled and Reused Adsorbents on Chromium (VI) Removal using Peltophorum Pterocarpum Activated Carbon

Adsorbent	Solution used for recycling	% removal of Chromium (VI) before recycling of adsorbent	%removal of Chromium (VI) after recycling of adsorbent
Peltophorum Pterocarpum $MgCl_2$ (I.R – 0.75)	1N HCl	72	54
	1N NaOH	72	51
	Distilled Water	72	49

Table: 3 Results of Recycled and Reused Adsorbents on Chromium (VI) Removal using Saw Dust Activated Carbon

Adsorbent	Solution used for recycling	% removal of Chromium(VI) before recycling of adsorbent	% removal of Chromium(VI) after recycling of adsorbent
Saw Dust $MgCl_2$ I.R – 0.75	1N HCl	72	55
	1N NaOH	72	51
	Distilled Water	72	42

IV. Conclusions

The following inferences can be made from this experimental study:

- As for Cr (VI) removal, 1N HCL washed adsorbents show the highest percentage removal compared to 1N NaOH and distilled water.
- Magnifera Indica Fruit Seed shell activated carbon removes 68% of Cr (VI) after recycling and reuse, Peltophorum Pterocarpum activated carbon removes 54% of Cr (VI) and Saw dust activated carbon removes 55% of Cr (VI).

References

[1] Vandana Sreedharan[1]; K. V. Krithishna[2]; and P. V. Nidheesh[3] (2017) Removal of Chromium and Iron from Real Textile Wastewater by Sorption on Soils American Society of Civil Engineers.

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