JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ADSORPTION STUDIES OF METAL REMOVAL (LEAD, COPPER,CHROMIUM AND NICKEL) ON ACTIVATED CARBON DERIVED FROM DELONIX REGIA (GULMOHAR FRUIT SHELL)

[1]Shubham Chandgude, [2]Sahil Meshram, [3]Mahi Gajbhiye [4] Rupesh Desai [5]Shivam Barge [6]Kanchan Humnapure

1Assistant professor , Department of civil engineering, Dr. D.Y. Patil Institute of Engineering, Management and Research, Akurdi, , Savitribai Phule Pune University, Pune, Maharashtra, India

Abstract : ***An efficient, cost effective, rapid and convenient method has been developed for preparation of activated carbon from sun-dried Gulmohar (Delonix Regia) Fruit shells as precursors. The industries are water based and a considerable volume of wastewater originated from these is generally discharged into water sources either untreated or inadequately treated resulting in water pollution. Activation of the precursors was brought about by phosphoric acid as it is non-toxic and toxic heavy metals and suitable for treating potable water .The various parameters such as concentration, Activation time and the heavy metals (chromium is such metal which is to be found in aqueous system as ionic form) is to be used. Adsorption has been advocated as most promising among the currently known methods for wastewater treatment, especially for removal of metals like copper, lead, chromium and nickel. The adsorption process can be carried out using abundantly available low-cost adsorbent. The method was found to be superior than many other existing method in terms of its cost, efficiency and ease of preparation.***

I. INTRODUCTION

Activated carbon (Charcoal) has great demand in modern times. It is used for various purposes and is on ingredient of many industrial products, Recently, it has become a popular option in water purification due to its adsorption quality and low availability Activated carbon also find applications in medica end pharmaceutical industries, body come product, food industries, electrical and electronic industries and nano materials. Their persistent native, non - biodegradability toxicity and ability to bioaccumulate in the environment have made heavy metals priority pollutants. various health effects one caused by anthropogenic pollutants chich are mainly comprised of heavy metal such as mercury, nickel lead, cadmium copper, zine and cobalt. Water of high quality is vital for human existence and agricultural, industrial, domestic and business use and most of these sports also are liable for polluting the water. Majority of the industries are water primarily based and a extensive volume of wastewater originated from these is commonly discharged into water sources both untreated or inadequately treated resulting in water pollution. The infection of water because of poisonous heavy metals via the discharge of business wastewater is a global environmental problem. The heavy metals reach the water our bodies through many business activities. From the heavy metals chromium is such metallic that is to be discovered in aqueous gadget as both ionic bureaucracies i.e., Trivalent and Hexavalent chromium. These days a great deal significance has been given on removal techniques and trends of latest technique for heavy removal from wastewater. There is massive quantity of industries which discharge chromium containing waste, specifically tanning, electroplating, fabric cement and asbestos, refractories, cooling towers of thermal electricity stations and many other industries. Adsorption has been endorsed as most promising most of the presently regarded techniques for wastewater treatment,

mainly for elimination of heavy metals. The adsorption technique may be executed using abundantly to be had low price adsorbent. In the present study ***Delonix regia*** pods (Gulmohar) are decided on for coaching of activated carbon for removal of Cr (VI) from wastewater.

II. NEED OF STUDY

Presently, environmental pollution has come to be one of the most critical problems confronted by means of humans. It has elevated rapidly inside the past few years and reached to alarming levels in phases of its poisonous outcomes on dwelling beings. Although pollution due to tanneries in India dates returned to 100 years, it acquired much attention only inside the current beyond. Toxic heavy metals are considered as one of the strong pollutants which have direct impact on people and animals. Industrial wastewater containing lead, copper, cadmium, chromium etc. can contaminate groundwater assets and thus lead to extreme floor water pollutants issues. Cr (VI) compounds are robust oxidizing sellers and are enormously corrosive. Strong publicity of Cr (VI) reasons most cancers in digestive system and may purpose epigastric ache, nausea, and vomiting, severe diarrhoea. Hence, it's far required to examine the elimination of Cr (VI) from wastewater to avoid the risky effect.

.

III) Objectives of Research:

1) To reach on the low value adsorbent for elimination of heavy steel i.e., Hexavalent chromium.
2) To observe the physical and chemical residences of the prepared activated carbon.
3) To determine the performance of the organized activated carbon.
4) Budget friendly way to get rid of heavy metals from commercial wastewater.

IV) Scope

1) Seeds of Gulmohar ***(Royal Poinancios)*** can also be used for chemically activation to prepare chemically activated carbon.
2) Test can also be carried out with adsorbent of various particle size which will pick out the exceptional sized adsorbent.
3) Test may also be conducted to realize the effect of initial concentration various Cr (VI).
4) Seeds of Gulmohar ***(Royal Poinancios)*** also can be used to do away with different toxic metals like lead, cadmium and nickel and so on.
5) Experiment may also be carried out to get activated carbon by various the temperature for locating the elimination performance of adsorbent.
6) Adsorption studies can be further continued on various other heavy metals like chromium, lead, zinc etc.
7) Experiment can also be conducted by varying temperature.
8) Experiment may also be conducted to know the effect of various arsenic concentrations on removal efficiency of adsorbents.
9) Regeneration and reuse after adsorption can be carried out.

V)Literature Review.

1) P. Venkateswar, M. Venkata Ratnam, D. Subba Rao, M. Venkateswara Rao, studied removal of chromium from an Aqueous solution the usage of ***Azedarach indica*** (neem) leaf powder as an adsorbent. ***Azedarach indica*** (neem) leaf powder is used as an adsorbent for the elimination of chromium from aqueous answers. The equilibrium studies are systematically done in a batch system, covering various manner parameters that consist of agitation time, adsorbent size and dosage, initial chromium attention, volume of aqueous answer and pH of the aqueous solution. Adsorption conduct is determined to follow Freundlich and Langmuir isotherms. The adsorption mechanism is defined with the aid of a pseudo 2nd order kinetics. The result suggests that Leaves of ***Azedarach indica*** could be used as an opportunity, cost effective and powerful fabric to take away excessive amount of Cr (VI) ion from wastewater.

2) Renuga Devi N, Manjusha and Lalitha P studied elimination of Hexavalent Chromium from aqueous answer the usage of an eco-friendly activated carbon adsorbent, was tested for its ability to cast off poisonous hexavalent chromium from aqueous solution. The existing have a look at is targeted on elimination of hexavalent chromium from aqueous solution the usage of a eco-friendly adsorbent, activated carbon prepared from the pods of ***Delonix regia.*** The effect of best dosage, pH and preliminary concentration of adsorbate on the powerful elimination of hexavalent chromium has been studied. The results of the look at show the adsorption of Cr(VI) to be concentration and pH based. The maximum removal of Cr(VI) became determined at pH 2.Elimination of Cr(VI) expanded from 70.58% to 100% with increasing adsorbent dosage from 50 to 200 mg. The adsorption procedure became determined to obey Langmuir adsorption isotherm and Freundlich adsorption isotherm. Hence using the low fee carbon prepared is of practical significance and is anticipated to be low-cost.

3) Shashikant.R.Mise, Sugunashree.S.M studied elimination of chromium by way of activated carbon derived from *Mangifera indica* .The Elimination of chromium (VI) from synthetic sample through adsorption on activated carbon organized from ***Mangifera Indica*** (mango) Seed shell had been carried out at room temperature. The removal of chromium (VI) from synthetic sample by means of adsorption on Chemical activation (Zinc chloride). It's far found that as dosage will increase the adsorption expanded alongside the growth in Impregnation ratio. It turned into additionally noted that as I.R. Increases the floor region of ***Mangifera Indica*** shell carbon extended.

MATERIALS AND METHODS

A}Selection of Material

To assess a feasible and comparatively cheap low value treatment. To put off the heavy steel Cr (VI) present in synthetic pattern by way of using Abundant seeds of Gulmohar. By means of making ready activated carbon from this Gulmohar seeds ***(Delonix regia)*** as an adsorbent.

B} Properties of Gulmohar ***(Delonix Regia)***

1) Botanical classification

COMMON NAME:	GULMOHUR
KINGDOM:	PLANTAE
DIVISION:	PHANEROGAMS
CLASS:	DICOTYLAEDONEAE
SUBCLASS:	POLYPETALAE
SERIES:	CALYCIFLORAE
ORDER:	ROSALES
FAMILY:	LEGUMINOSAE
SUB-FAMILY:	CAESALPINEACEAE
GENUS:	DELONIX
SPECIES:	REGIA

2) Botanical Name: ***Delonix regia***

3) Synonyms

Delonix regia var. flavida Stehle

Delonix regia var. genuine Stehle
Delonixregia var. genuine Stehlé
Poinciana regia Hook.
Poinciana regia Bojer

4)Common Names

Hindi:Waykaran, Samrsro, Sandeshra
Sanskrit: Siddheshwara
English: Peacock flower, Pride of Barbados
Telugu: Chinnaserribeseri, Chittikeshwaramu
Tamil: Perungondrai, Wadanarayanan
Malayalam: Kempukengiga, Niraangi
Marathi: Sankasura, Sanchaila

5) Botanical Description

The flora of ***Delonix regia*** are massive, with four spreading scarlet or orange-crimson petals up to 8 cm long, and a 5th upright petal Referred to as the usual, that is slightly large

Botanical Description of *Delonix regia*

Plant type		Medium- sized , evergreen , perennial and deciduous trees Height – 35-40 ft
Growing requirements		Soil tolerance: - clay; loam; sandy; slightly alkaline; acidic; well – drained.
(a)	Leaf	have a feathery appearance and are a characteristic light, bright green and are doubly pinnate each leaf is 30–50 cm long
(b)	Flower	scarlet or orange-red petals up to 8 cm long
(c)	Pods	They can be up to 60 cm long and 5 cm wide
(d)	Seed	are small, weighing around 0.4 g on average

and spotted with yellow and white. They appear in corymbs alongside and on the ends of Branches. The obviously happening range) has yellow plant life.The pods are green and flaccid whilst young and flip darkish-brown and Woody. They can be up to 60 cm long and five cm extensive. The seeds are small, weighing around 0.4 g on common. The compound leaves Have a feathery appearance and are a function mild, bright inexperienced and are doubly pinnate. Each leaf is 30–50 cm lengthy with 20 to 40 pairs of primary leaflets or pinnae, every divided into 10–20 pairs of secondary leaflets or pinnules. All the description Characteristics of this plant are indexed in table below :

6) Characteristics of Gulmohar:

Some claim that the Gulmohar tree is the most colourful tree in the world when it is in full bloom. It is covered in flamboyant clusters of 4-5-inch-wide flame-red flowers for several weeks in the spring and summer. They feature four spoon-shaped spreading crimson or orange-red petals that are about 3 in long, and one erect somewhat bigger petal (the standard) that is marked with yellow and white. Even up close, the individual flowers are remarkable. The minuscule, individual leaflets that make up the fragile, fern-like leaves fold up as dusk approaches. The graceful, widely spreading canopy of Gulmohar, which can reach a height of 30 to 40 feet, can be wider than the tree itself.

7) Figures of ***Delonix Regia***

C} Methods of Preparation Of Activated Carbon :

For removal of hexavalent chromium from aqueous solution adsorption technique wa employed using activated carbon prepared from locally available Seeds of Gulmohar ***(Royal Poinancios).*** There are two methods to prepare activated carbon namely :

1.Physical Activation

2. Chemical Activation.

In the present study both physical and chemical activation are employed to prepare active carbon powdered Seeds of Gulmohar ***(Royal Poinanc)***

(3.5)

RESULTS & DISCUSSION

The chapter deals with the study efficiency of prepared carbon for removing hexavalent chromium for,

A. Effect of contact time

B. Effect of carbon dosage

C. Effect of pH

1) Effect Of Particles Size On Adsorption: Adsorption is a surface phenomenon; as such the extent of adsorption is proportional to specific surface area. Hence the amount of adsorption per unit weight of solid adsorbent is greater in the more finely divided and more porous material. Rate of adsorption depends mainly on particle size. Finer the particle, higher the rate adsorption and wise-versa. However, there is a limitation for particle size, If particle size is less than 175 µ, Each particle having small surface area, act as an individual entity for the removal of adsorb ate from aqueous solution. Hence in the present study experiments were carried out using effective particle size of 300µ for removal of chromium (VI).

2) Effect of Contact Time: Contact time has great influence in the adsorption process. The effect of contact time on the removal of chromium (VI) for synthetic sample at pH 2±0.02 using physically carbon of Seeds of Gulmohar(Royal Poinancios)in figure4.1and model values are shown in the table 4.1 from the table it is observed that contact time differs for different carbons i.e. for physically activated carbons. It is further authenticated by studying pore diffusion of carbons. As the time passes, pore diffusion increases, Hence adsorption also increases. 3) Effect of Adsorbent Dosage: Adsorption is a process in which there is a continuous transfer of solute from solution to adsorbent until residual concentration of solution maintains an equilibrium with that adsorbed by the surface of adsorbent at

constant contact time. Effect of adsorbent dosage is studied and graph of percentage of chromium removal versus dosage is plotted as shown in figure no 4.2. From the graph it is observed that, as the doses of carbon increases, amount of residual chromium (VI) decreases sharply and attains minimum. The point where maximum removal is attained is taken as optimum dosage. After this not much change in adsorption is observed even after increasing the amount of carbon. The optimum dosage for all prepared carbon are listed in table 4.2. 4) Effect ofpH On Hexavalent Chromium Removal: The pH of a solution has influence on the extent of adsorption removal efficiency of chromium (VI) by prepared activated carbon at different pH values are shown in table 4.3 and figure 4.3. From the shown figure it is observed that chromium (VI) is removed more effectively in acidic range. As pH increases, the removal efficiency decreases appreciably. This is due to possibility of precipitation of carbon surface by nucleation. $2H^+ + 2HCrO_4^- \leftrightarrow 2H_2CrO_4 \leftrightarrow 2H_2O + Cr_2O^{-2} + 2H^+ \leftrightarrow 2CrO_3 + H_2O$ The H_2CrO_4 and CrO_3probably exist as polynuclear species, along with their anhydrous from at high chromium concentration and at low pH. Thus high degree of adsorption of Cr(VI) is due to the ability of chromium to stabilize itself , forming dissociate polynuclear species as well as CrO_3 crystallization is proton consuming process and requires constant source of protons. This indicates that crystallization of chromium anhydride is the final form 0f chromium when it is adsorbed on activated carbon. The other mole of chromium adsorption is also due to the formation of more $HCrO_4$ species in aqueous solution of chromium the following equillibria holds good. $Cr_2O_7^{-2} + H_2O \leftrightarrow 2H_2CrO_4$
$Cr_2O^{-2} + 2H^+ \leftrightarrow Cr_2O_7^{-2}$ $Cr_2O^{-4} + H_2O \leftrightarrow H_2CrO_4 + CH_2$ With decreases in pH more $Cr_2O_7^{-2}$ is formed equation. Which in turn changes to $2H_2CrO_4$ as equation H_2CrO_4..Species adsorbed on the surface of carbon as pH is less $Cr_2O_7^{-2}$ is more, formation HCr_4 is more and adsorption is more. Hence we have used optimum pH 2±0.02 for chromium (VI) adsorption.

Table-4.1 Effect of Contact Time on Removal ofCr (VI)

Initial concentration =10.0 mg/L Dosages of Adsorbent =100 mg

pH= 2±0.02 Temperature=32±1oCVolume of sample=1000 ml

Time in minutes	Cr(VI) Adsorbed on prepared activated carbon (mg/L)	Concentration of Cr(VI) remaining in solution (mg/L)	Removal of Cr(VI) %
03	2.4	7.6	24
05	3.0	7.0	30
07	4.0	6.0	40
10	4.5	5.5	45
13	4.8	5.2	48
15	5.0	5.0	50
20	5.1	4.9	51
25	5.2	4.8	52
30	5.5	4.5	55
35	6.0	4.0	60
40	6.1	3.9	61
45	6.4	3.6	64
50	6.5	3.5	65
55	6.5	3.5	65

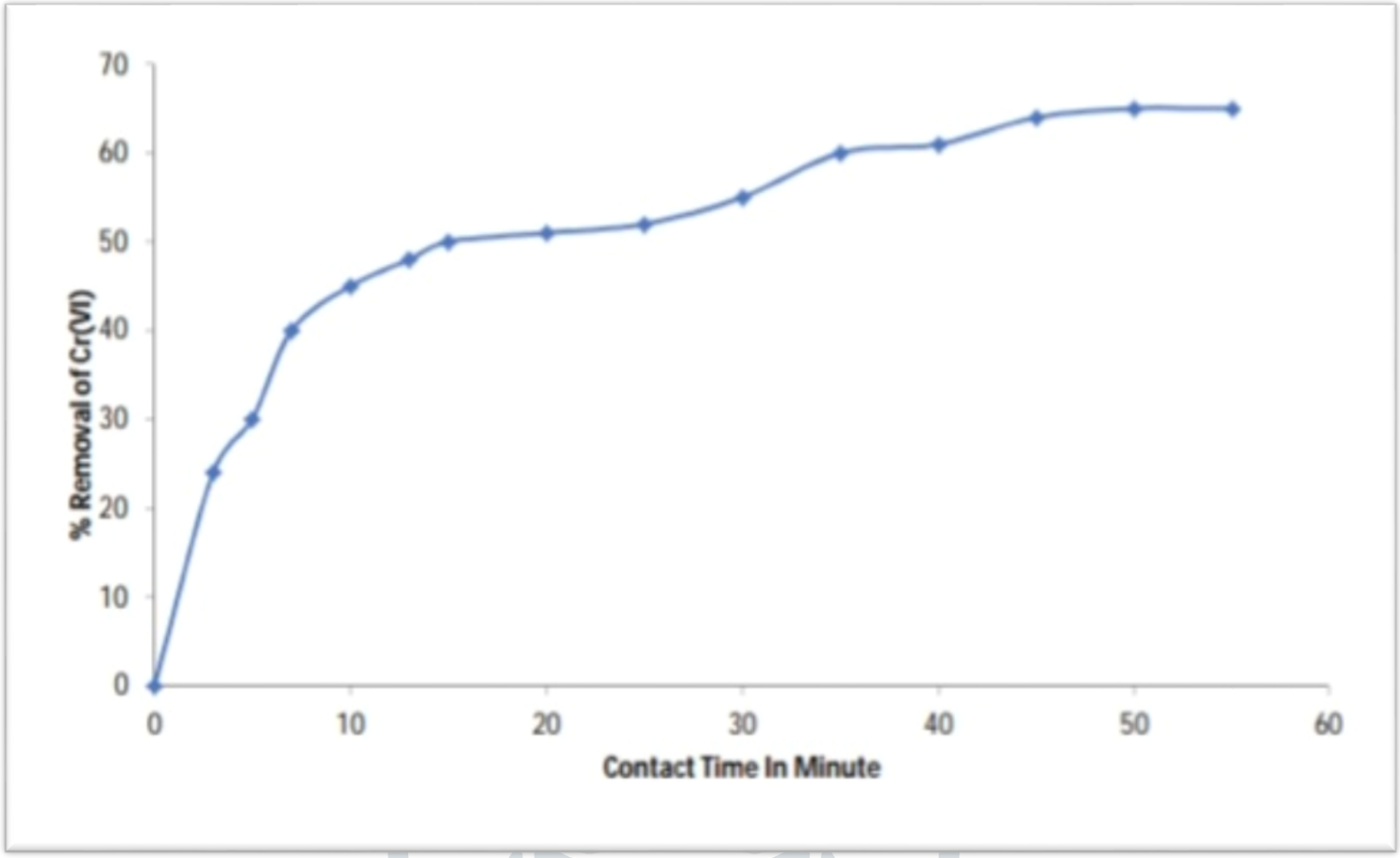

Fig. 4.1 Effect of Contact Time on Cr (VI) Removal

Table-4.2 Effect of Adsorbent Dosages on Activated Carbon

Initial concentration =10.0 mg/L pH= 2±0.02 Temperature=32±10 C

Adsorbent dosages in mg	Concentration of Cr(VI) remaining in solution (mg/L)	Cr(VI) Adsorbed on prepared activated carbon(mg/L)	Removal of Cr(VI) in %
20	9.5	0.5	5
40	9.0	1.0	10
60	7.9	2.1	21
80	6.6	4.4	44
100	3.45	6.55	65.5
120	3.5	6.5	65
140	3.5	6.5	65
160	3.5	6.5	65
180	3.5	6.5	65
200	3.5	6.5	65
220	3.5	6.5	65

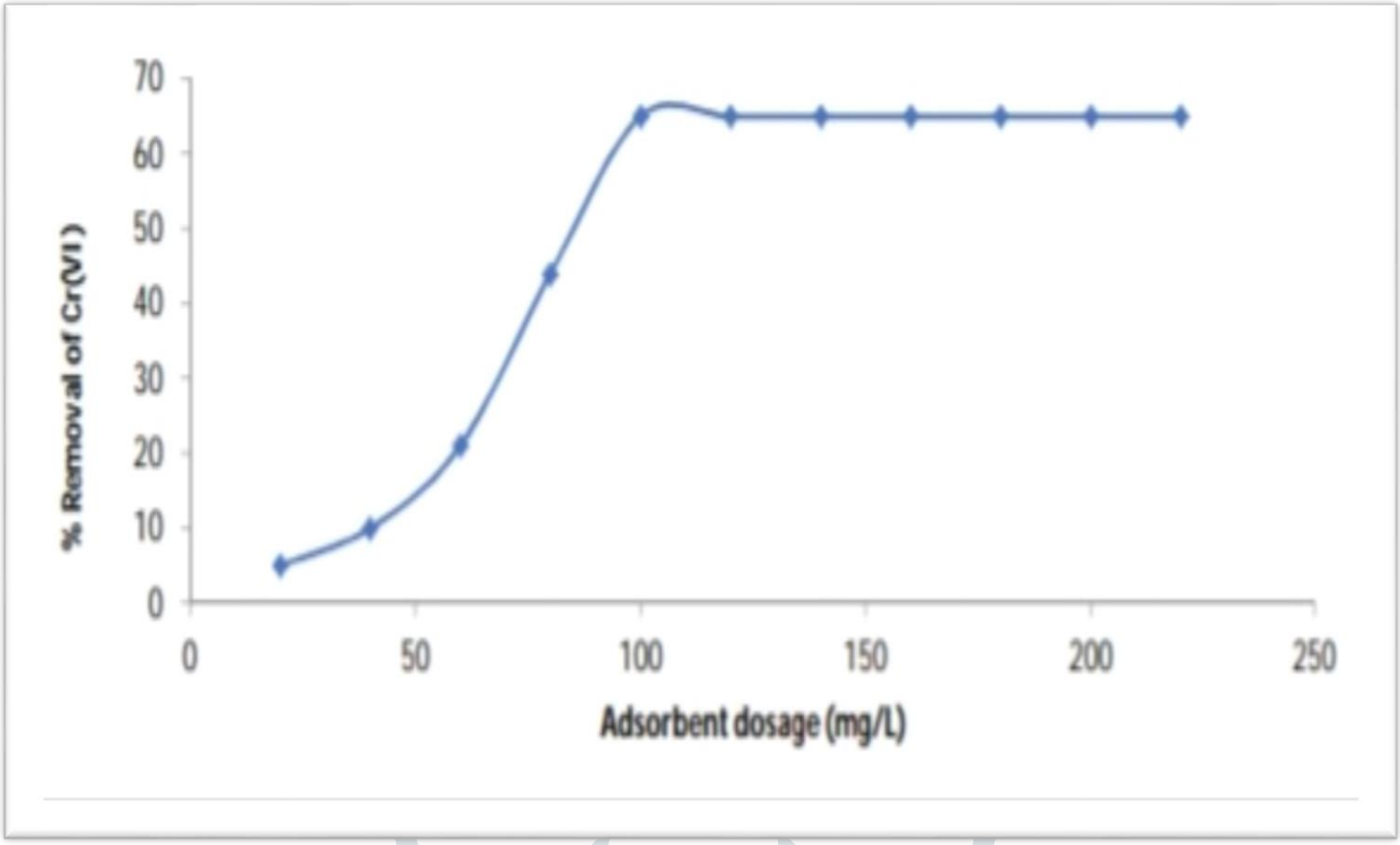

Fig. No- 4.2 Effect of Adsorbent dosage on Cr(VI) removal by prepared Activated Carbon

Table-4.3 Effect of pH on Cr (VI) Removal by Prepared Activated Carbon
Initial concentration =10.0 mg/L Dosages of Adsorbent =100 mg Temperature=32±10c

pH	Concentration of Cr(VI) remaining in solution (mg/L	Cr(VI) Adsorbed on prepared activated carbon (mg/L)	Removal of Cr(VI) in %
2.0	3.3	6.7	67
3.0	3.9	6.1	61
4.0	4.6	5.4	54
5.0	5.0	5.0	50
6.0	5.4	4.6	46
7.0	5.9	4.1	41
8.0	6.4	3.6	36
9.0	6.9	3.1	31
10.0	7.2	2.8	28

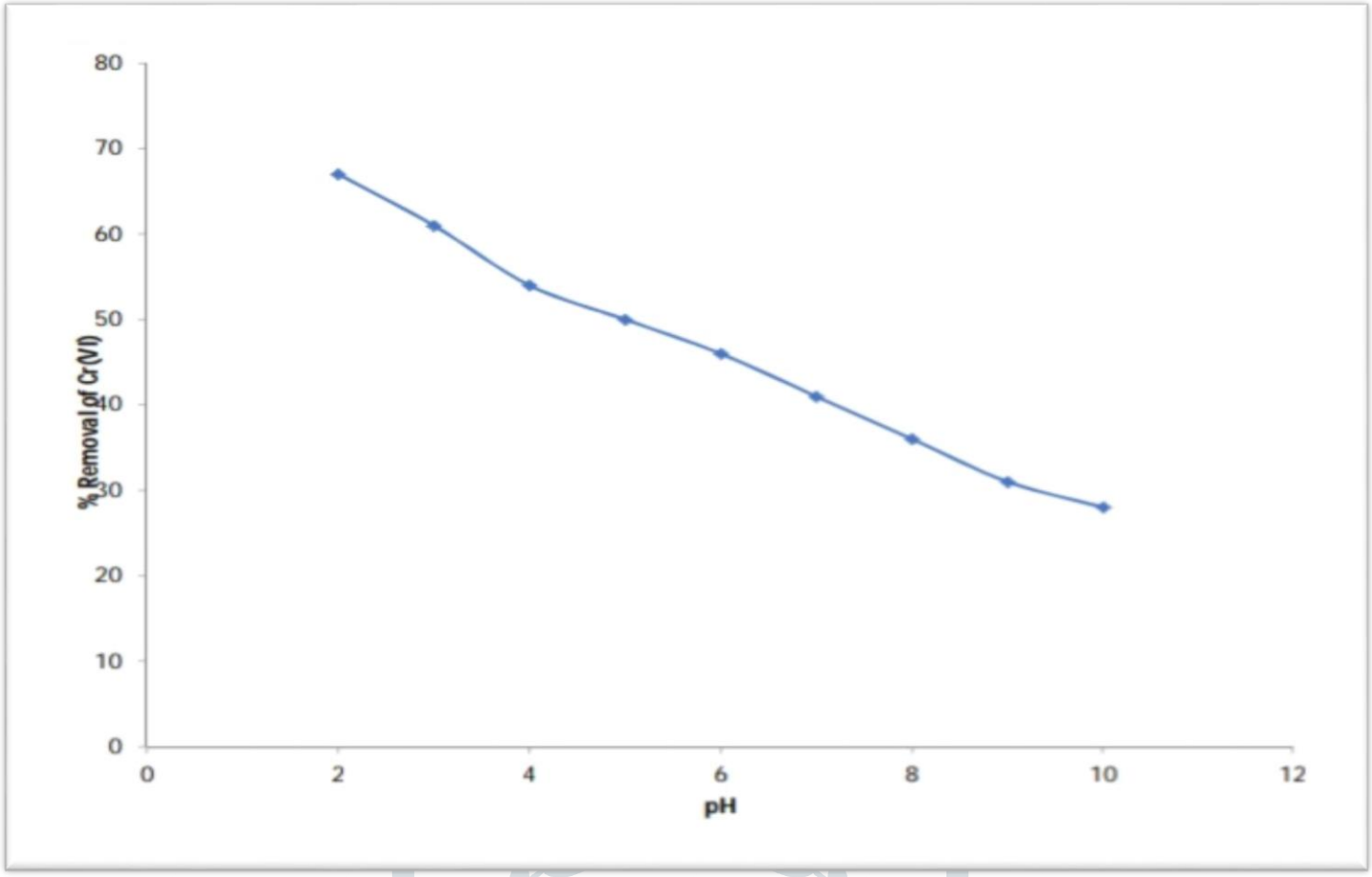

Fig. No-4.3 Effect of pH on Cr(VI) Removal By Activated Carbon

Table-4.4 Optimum Contact Time, Optimum Dosage and, OptimumH For Prepared Activated Carbon Initial concentration =10.0 mg/L Temperature=32±10 C

Type of Carbon	Optimum time in minute	Optimum Dosages in mg	Optimum pH
Activated Carbon	50	120	2.0

CONCLUSION

Seeds of Gulmohar(Royal Poinancios) can be effectively used for the preparation of activated carbon.The adsorption of Cr (VI) is pHdependent. The removal efficiency of adsorbent increased with decrease in pH value of solution. Maximum adsorption takes place at pH2. From the kinetic studies it is observed that, adsorption of Cr (VI) is very rapid up to 45 minutes and decreases while approaching equilibrium. At optimum time 50 minutes, optimum dosage of 100 mg and optimum pH =2 physically.Activated carbon made from Seeds of Gulmohar(Royal Poinancios) has shown good Cr(VI) removal efficiency of 65%. Seeds of Gulmohar(Royal Poinancios) is good source for preparation of low cost adsorbent. require less time and energy for production of highly porous nontoxic AC from Gulmohar fruit shells which is a throw-away waste thus converting it into a highly useful product.

REFERENCES

[1] P. Venkateswarlu, M. Venkata Ratnam, D. Subba Rao and M. Venkateswara Rao "Removal of chromium from an aqueous solution using Azadirachta indica (neem) leaf powder as an adsorbent" International Journal of Physical Sciences.

[2] Renuga Devi N, Manjusha.K and Lalitha P "Removal of Hexavalent Chromium from aqueous solution using an eco-friendly activated carbon adsorbent" Pelagia Research Library.

[3] Shashikant.r.mise, sugunashree.s.m "removal of chromium (vi) by activated carbon derived from mangifera indica" international journal of research in engineering and technology.

[4] Dr.U.SENTHILNATHAN "adsorption kinetics on removal of chromium from wastewater using acacia nilotica wood based activated carbon" International Journal of Advanced Research.

[5] Alexandro M.M. Vargas, Clarice A. Garcia, Edson M. Reis, Ervim Lenzi, Willian F. Costa and Vitor C. Almeida. NaOH – activated carbon from Flamboyant (Delonixregia) pods: Optimization of preparation conditions usingcentral composite rotatable design. Chemical Engineering Journal, vol. 162, pp. 43 – 50, 2010.