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Adsorption Studies Of An Activated Carbon (Prosopis Juliflora) To Remove Dye

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ABSTRACT
This study explored the effect of activated carbon preparation conditions on their adsorption performance. Activated carbon prepared from Wood chips of Prosopis juliflora has been utilized as the adsorbent for the removal of Eriochrome Black T from an aqueous solution. Prosopis juliflora was used as source material to prepare activated carbon by pyrolysis process using H_3PO_4 activation. The adsorption properties were evaluated by IDOINE NUMBER. The effects of various H_3PO_4 impregnation ratios, temperature and time on physical characteristics of the activated carbon were investigated. The Characterization of produced activated carbon will be determined by SEM analysis. The best activated carbons were obtained at a temperature of 300◦C with the impregnation ratio 1:2, In which the value of Iodine number is 917.12 mg/g which infers that it has high Micro Pores when compared to others ratios. Prosopis juliflora based activated carbon could be employed as a low cost alternative to commercial activated carbon in the removal of Eriochrome Black T dye from wastewater.
Keywords: Chemical Activation, Adsorbent, Color Removal.

1.INTRODUCTION

Dyes are broadly used in industrial sectors such as textile manufacturing, leather tanning, cosmetics, paper, food processing, and pharmaceutical industries. Textile effluent that contains organic materials which is carcinogenic that causes severe environmental threat to all living organisms. There are enormous research works going on to identify the suitable method to removal of dyes. Presence of colour in water reduce photosynthetic activity and aesthetic quality of water. The dyes which are left out will cause threat to aquatic life. Since many organic dyes are harmful to human beings, the removal of colour from process or waste effluent becomes environmentally important Efficient technique for the removal of highly toxic compounds from water has drawn significant interest. To remove these colours a more number of methods used such as coagulation, filtration, precipitation, ozonation, adsorption, RO and ion exchange process from the polluted water .These methods have been found to be limited, since they often involve highly capital and operational costs. Among the possible technique for water treatments, the adsorption process by solid adsorbents shows potential as one of the most efficient methods for treatment and removal of organic contaminants in wastewater treatment. Adsorption has an advantage over the other by the initial cost and land required.

1.1.BIOMASS SOURCE

Biomass is the total mass of living or recently-dead organic matter in an ecosystem, and Prosopis juliflora, commonly known as mesquite or mesquite tree, is a species of tree that is often associated with biomass production. One of the main advantages of using Prosopis juliflora for biomass production is its fast growth rate. This tree species is known for its ability to grow in arid and semi-arid regions, making it a suitable choice for biomass production in areas with limited water resources. Prosopis juliflora has a high biomass yield, which means that it can produce a large amount of organic matter that can be used for various purposes, such as bioenergy production, animal feed, and soil improvement. Additionally, This can have positive effects on soil health and agricultural productivity

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in regions where nutrient-depleted soils are a concern. Furthermore, Prosopis juliflora has the ability to tolerate harsh environmental conditions and is resistant to pests and diseases, which makes it a relatively low-maintenance option for biomass production. However, it's worth noting that Prosopis juliflora can also be invasive and have negative impacts on local ecosystems and biodiversity if not managed properly, so careful monitoring and management practices should be in place when cultivating this tree species for biomass production. Overall, Prosopis juliflora has the potential to be a valuable source of biomass due to its fast growth, high biomass yield, nitrogen-fixing ability, and adaptability to harsh environments, but it also requires responsible management to prevent potential negative impacts on the environment.

1.2. ACTIVATED CARBON

Among several wastes from agricultural wastes into activated carbon, wood chips had a better pore size of 0.1-0.3 m2 /g and increased surface area m2/g . The purpose of this work was to prepare activated carbon from wood chips and to find out the possibility of using this activated carbon as low-cost adsorbent for the removal of brilliant yellow dye from aqueous solution. The physical characteristics of biomass are determined by proximate analysis whichgives an estimate of moisture, volatile matter, ash, fixed carbon, the morphology of the biochar is determined by Scanning Electron Microscope (SEM) study.

Activated carbon is known as the most effective and useful adsorbent for the removal of contaminants in various processes, this is due to the properties of activated carbon which have a large active surface area that can provide high adsorption capacity, well developed porous structure and good mechanical properties. In addition, AC is the most widely used since its chemical (surface group) and physical properties (surface area and pore size distribution) can be adjusted according to the required application. Activated carbon of the wood chips is considered superior among all because of its superior adsorption capacity, hardness and high strength in which these desired properties are mainly due to their high lignin and high carbon content.

1.3. APPLICATION OF ACTIVATED CARBON

The large specific surface area, porous structure, surface functional groups of biochar which are useful for the removal efficiency. Mostly bio char is used for the removal of heavy metals from the pollutants. According to the available literatures about biochar application in water treatment, nearly 46% of the studies concerned the removal ability of biochar for heavy metals, 39% for organic pollutants, wherein the NP is about 10-13% and 2 % other pollutants.

1.4. PROPERTIES OF BIOCHAR

Thus as we said before that the pyrolytic temperature and feed stock residence time has a major effect of properties of biochar. Correspondingly, it is obvious that these factors may have conspicuous influence on the adsorption efficiency toward various pollutants. Of which, temperature is presumably a key parameter. It was found that the pyrolytic temperature had more influence on structural characteristics and isotherms shape of the biochar than the biomass feedstock’s. Chen et al. (2008) assessed the combined adsorption and partition effects of biochar produced by pyrolysis of pine needles at different temperatures (100–700◦C). The results turned out that the pyrolytic temperature significantly altered the structures of biochar, and played an important role in the adsorption of various organic contaminants. The contribution of adsorption increased in the order of increasing temperature, which is consistent with their specific surfaces. Chen et al. (2012b) stated that the pyrolytic temperature of a biomass affected the rate of uptake of a compound by a biochar because the temperature affected the degree of carbonization of a biochar. At higher temperature, the organic matters of the biomass were completely carbonized, the surface area was greatly increased, and more nanopores were developed, resulting in the sharply enhanced adsorption rate of Naphthalene (NAP).. Ahmad et al. (2013 a) found that the presence of more carbonized matters in the biochar produced at high pyrolytic temperatures caused greater adsorption of trichloroethylene (TCE). By the conclusion from referred journals that when the pyrolysis process temperature plays an important role in adsorption process. In essence, the pyrolytic temperature was also reported have effects on the adsorption of heavy metals. Kim et al. (2013) reported that the pyrolytic temperature

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significantly influenced the structural, elemental and morphological properties of biochar. As a result, pH and surface area of biochar increased greatly at pyrolytic temperatures > 500˚C, resulting in the increase of Cd adsorption capacity with increasing pyrolytic temperature.

1.4.1 SOLUTION PH

The influence of pH on adsorption was dependent on types of biochar and the target contaminants. It affects not only the adsorbent surface charge, but also the degree of ionization and speciation of the adsorbate. Thus most of studies involved in contaminants adsorption onto biochar took the pH effect into account. The main properties of biochar contains surface functional groups (oxygen groups, carboxylate, ACOOH and hydroxyl groups).The behaviour of these functional groups changes with the increase of the solution pH. At the range of low pH The functional groups are in positively charges form. For pH <pH_{pzc} (point of zero charge), the biochar surface is positively charged, favouring adsorption of the anions. In addition, the presence of a large number of H+ and H_3O+ in the aqueous solution may compete with the cation for adsorption sites available on biochar. Thus, electrostatic repulsion will occur between cation contaminants and positively charged biochar surface thus a lower adsorption was observed at low pH in most of the studies. More binding sites are released due to deprotonation of functional group with increase in pHvalue, The surface of biochar is negatively charged when pH >pH. Therefore, in the higher pH range, the cations can be easily captured by biochar surface. Further various researchers have studied the effect of pH on organic contaminants and other inorganic contaminants adsorption by biochar. The results showed that the adsorption of these contaminants on biochar was also highly pH-dependent due to the change of biochar surface charge and contaminants properties with the change of solution pH

1.4.2 DOSAGE OF ADSORBENT

The adsorbent dosage also has a significant influence in their efficiency. Applying an optimum dosage of biochar to contaminants removal is crucial for its cost-effective application. Chen et al. (2011) reported that the increase of the concentration of biochar decreased the adsorption efficiencies. The highest observed metal sorption efficiencies for both hardwood and corn straw derived biochar were at 1 g/L. While, increasing the adsorbent concentration did result in an increased removal efficiency of the total heavy metals due to the increase in total amount of active sites. Similar results were found by Tsai and Chen (2013). They stated that the number of adsorption sites increased in line with the increase of adsorbent dosage (i.e., 0.10–0.30 g/L). However, the adsorption efficiency of the swine-manure-derived biochar decreased as its mass increased. In another study, the researchers reported that the removal efficiency of methylene blue dye increased with increasing biochar dose from 2 to 8 g/L at a constant methylene blue dye concentration, which can be attributed to the increase in available adsorption surface and the availability of more adsorption sites (Sun et al., 2013b).

1.4.3 TEMPERATURE

Most previous studies have reported that the adsorption of contaminants by biochar appeared to be an endothermic process and the adsorption capacity increased with increasing temperature. Meng et al. (2014) studied the effect of temperature on Cu (II) adsorption onto biochar derived from swine manure, and the thermodynamic parameters were calculated. The positive values of ΔG_0 indicated that the reaction was endothermic. In another study of textile dyes adsorption onto food waste biochar at 20, 30, and 40◦C, the negative values of ΔG_0 and the positive values of ΔG_0 indicated that adsorption of dyes onto biochar was spontaneous and endothermic. The value of ΔG_0 increases when the temperature increases which suggest that the adsoption is favoured at high temperature. Liu and Zhang (2009) reported that higher temperature favoured lead ions adsorption onto pinewood and wood chips derived biochar. The enhanced temperature provided sufficient energy for lead ions to be captured onto the interior structure of biochar. Sun et al. (2013b) investigated the effect of temperature on adsorption capacity for cationic methylene blue dye (MB) onto biochar at 30, 40 and 50◦C. The results demonstrated that the effect of temperature on the adsorption performance of MB was significantly enhanced for eucalyptus biochar with the temperature increasing to 50◦C. This result probably occurred because of the increase in diffusion rate of MB with increasing temperature.

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1.5. ADSORPTION PHENOMENA

Adsorption is a surface phenomenon with common mechanism for organic and inorganic pollutants removal. Adsorption has an advantage over the other by the initial cost and land required. The adsorption processes is widely used for treatment of industrial wastewater from organic and inorganic pollutants and meet the great attention from recent years because of its performance and ease of its operation. When a solution containing absorbable solute contact with a highly porous surface structure, liquid-solid intermolecular forces of attraction cause some of the solute molecules from solution to be concentrated or deposited at the solid surface. The solute retained in adsorption process is called as adsorbate, whereas the solid on which it is retained is called as an adsorbent. This creation of an adsorbed phase having a composition different from that of bulk fluid phase forms the basis of separation by adsorption technology. In a bulk material, all the bonding requirements of the constitutional atoms of material are filled by other atoms in the material. s. The exact nature of bonding depends on the details of the species involved but the adsorption process is generally classified as Physisorption (characteristics of weak Van –Der Waals forces) or chemisorption (characteristics of covalent bonding. It may also occur due to the electrostatic attraction.

MATERIALS & METHODOLOGY

2.1. MATERIAL

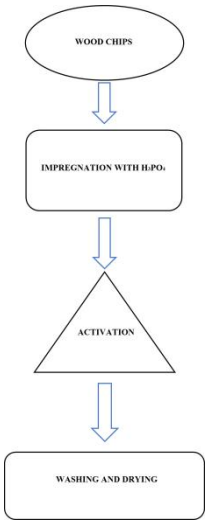
The wood chips were collected from surroundings and separately washed with water to remove dust like impurities and dried in sun. Then the wood chips are chopped into small pieces.

2.2 ADSORBENT PREPARATION

The activated carbon (AC) from biomass was prepared by chemical activation method using orthophosphoric acid as activating agent with an impregnation ratio of 1:2. The biomass was soaked for 24 hours in orthophosphoric acid.

The mixture was dried at 110 °C for 2 hours and then transferred to a sealed ceramic container. The mixture was then placed in a muffle furnace at 300 °C for 1 hour in the muffle furnace.

The produced activated carbon was repeatedly washed with distilled water to remove the



residual acid content until the neutral pH is attained and kept in drier until the moisture is removed. The activated carbon thus obtained was named as mesquite it is sieved and stored in a air tight container.

GLASSWARE AND APPARATUS USED

All glass wares (Conical flasks, Measuring cylinders, Beakers, Petri plates and Test tubes etc.) used are of Borosil/Rankem. The instruments and apparatus used throughout the experiment are listed below:

Instruments	Make	Function
Electronic weight balance	Sartorius	To measure weight

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PH meter	EuTech Instruments	Measurement of pH
Spectrophotometer(UV/Vis)	Jasco(V-530)	absorbance
shaker	EnvironmentalOrbital Shaker	To stir the content

2.3 CHARACTERISATION OF ACTIVATED CARBON

2.3.1 PROXIMATE ANALYSIS

Proximate analysis of the samples in terms of volatile matter, ash content, and moisture content was conducted according to ASTM standards methods, ASTM D 3175-11, ASTM D 3174-12, and ASTM D 7582-15, respectively

2.3.1.1 MOISTURE CONTENT

A small quantity of the sample was put in crucible, covered with a lid & weighed using a weighing balance. The crucible was placed in the hot air oven at 105ºC with its lid 16 removed & dried for 1 hour. The crucible was taken out, immediately covered with the lid, cooled in a desiccator or room temperature & weighed.

$$M=100\ (B - F) / (B – G)$$

Weight of crucible = G
Weight of crucible + AC sample before heating = B
Weight of crucible + moisture free sample after heating = F

2.3.1.2 ASH CONTENT

The inorganic residue remaining after the combustion. The crucible was ignited in the muffle furnace at 750 ± 25ºC for 1.5 hours. The crucible was placed in the desiccator, cooled to room temperature & weighed. A known amount of the sample which was dried in the hot air oven at 150ºC for 1 hour was put in the crucible and the crucible was placed back in the muffle furnace at 750±25ºC for 30 min. The crucible was taken out of the furnace, placed in the desiccator, cooled to room temperature & weighed.

$$\text{Ash \%} =100\ (F - G) / (B - G)$$

Weight of empty silica crucible = G
Weight of crucible + AC sample before heating = B
Weight of empty crucible + ash after heating = F

2.3.1.3 VOLATILE MATTER CONTENT

Volatile matter consisting of gases and vapours driven off during pyrolysis. A known amount of sample was put in the crucible. The crucible was placed in a muffle 17 furnace at 920 ± 10ºC, covered with lid, & placed for exactly 7 minutes. The crucible was taken out, allowed to cool & weighed.

$$\text{Volatile Matter} = 100\ [100\ (B - F) – M\ (B-G)] / [\ (B – G)\ (100 – M)\ ]$$

Weight of empty crucible with lid = G
Weight of empty crucible + sample before heating = B
Weight of empty crucible + sample after heating = F
Moisture content in % = M

2.3.1.4 FIXED CARBON

Percentage of fixed carbon = 100 - (M + A + VM)

M - Moisture content
A – Ash content
VM- Volatile matter content

2.3.1.5 YIELD

Activated carbon yield was calculated by

$$X\ (\%) = M/Mo \times 100$$

X is char or activated carbon yield (%)
M is the char or activated carbon mass (g)
Mo is the raw sample mass (g)

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2.3.2 IODINE NUMBER

Iodine number is the milligrams of iodine adsorbed by one gram of activated carbon. Iodine number is a measure of micro-pore content of the activated carbon. A higher iodine number indicates higher micro- porosity of the sample. Iodine number may be used as an approximation of surface area for some types of activated carbon. The high microporous carbons would make adsorption of larger molecules. This large molecule would have difficulty entering and navigating through the micropores with the possibility that the micropores could become clogged, thereby effectively stopping further adsorption.

ASTM D4607-94(2006) gives the standard procedure for the determination of the iodine number of the activated carbon. 0.5 to 2 grams of dried activated carbon was mixed with 10 ml of 5% HCL and 100ml of H2SO4& swirled in a conical flask until the activated carbon was wetted. The flask was shaken vigorously for 30 seconds. The contents were filtered through a filter paper. Initial 20-50 ml of the filtrate water collected in a clean beaker. 50 ml of this filtrate was titrated against 0.1 N sodium thio-sulphate solution until yellow colour just disappeared. 1 ml of starch solution was added & titration was carried out till blue colour was disappeared.

$$\mathbf{X/M} = (A - DF \times B \times S)/M$$

Where,
X/M = Adsorbed per gram of Activated Carbon (mg/g)
S = volume of sodium thio-sulphate (ml)
M = Amount of AC used (g)
A = N1× 12693 N1 = Normality of Iodine
B = N2×126.93 N2 = Normality of Sodium thio-sulphate
DF = Dilution Factor = (I+ H) /F
I= Volume of Iodine (ml) 19
H = 5%of HCL used (ml)
F = Filtrate (ml)

2.3.3 METHYL VIOLET NUMBER

Methyl violet number is defined as the milligrams of methyl violet dye adsorbed by 1g of dried activated carbon. It is a measure of the macro pore content of the activated carbon. Some carbon has macro pore structure which adsorbs medium size (>20 nm) molecule. To determine the methyl violet take known weight of activated carbon in 250ml conical flask. A few ml of Methyl violet solution was added and the conical flask shaken for 5mins. Methyl violet solution was further added to decolorize the solution in the flask. When there is no colour change is observed to stop the titration. Methyl violet was calculated by using

$$\textbf{Methyl violet (mg/g)} = (\mathbf{C}\times \mathbf{V}) \div \mathbf{M}$$

V = volume of Methyl violet used (ml)
C = Concentration of methyl violet (1000ppm)
M = Mass of adsorbent (g)

2.3.4 METHYLENE BLUE NUMBER:

Methylene blue number is defined as the milligrams of methylene blue dyeadsorbed by 1g of dried activated carbon. It is a measure of the mesopore content of the activated carbon. Some carbon has meso pore structure which adsorbs medium size (2 -50 nm) molecule. Methylene blue was chosen in this study because of its known strong adsorption onto solids and its recognized usefulness in characterizing adsorptive material. Methylene 20 blue has molecular weight of 373.9 x 10-3 kg mol-1.To determine the methylene blue number take known wt of activated carbon in 250ml conical flask. A few ml of Methylene blue solution was added and the flask shaken for 5 mins. Methylene blue solution is further added to the decolorized the solution in the flask. When there is no colour change to stop the titration. Methylene Blue number was calculated by using

$$\textbf{Methylene Blue Number (mg/g)} = (\mathbf{C}\times \mathbf{V}) \div \mathbf{M}$$

V = volume of Methylene Blue used(ml)
C = Concentration of methylene Blue (1000ppm)

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M = Mass of adsorbent (g)

3. BATCH ADSORPTION EXPERIMENTS

Batch studies were conducted in a series of 500 ml capacity flasks containing 100 ml of adsorbate solution of known concentration and fixed adsorbent dosage of 0.1g and agitated in a temperature controlled shaker .The agitation speed of shaker was fixed at 150 rpm and temperature 20 ±10°C for all batch experiments. The sample at different intervals (0-360min) were taken and centrifuged at min 1500 rpm for 10 min. The concentration of the samples at different intervals was analysed in a UV-Vis spectrophotometer at a wavelength of 370 nm. The initial dye concentration and dosage of carbon varied to investigate their effects on adsorption kinetics. The pH of the dye solution adjusted by using NaOH and HCl. The sorption studies were carried out in different temperature like 20°C, 30°C , 40°C . The amount of sorption time t, qe can be calculated by using the following equation

$$qe = (Co - Ct)VM$$

Where V is the volume and M is the weight of the adsorbent

Co is the initial concentration and Ct is Concentration at given time t. \

The percentage adsorption is defined as the ratio of difference in before and after adsorption to the initial dye concentration removal can be calculated by using following equation

$$\% \text{ Removal} = (Ci - Cf)\ Ci \times 100$$

Co, Ct are the initial and final concentration of dye before and after of adsorption process

RESULT AND DISCUSSION

CHARACTERIZATION OF ADSORBENTS

4.1.1 Proximate Analysis results

The values of iodine number, methylene blue number, and methyl violet number are important because it indicates surface area of activated carbon and it is predicted for 1:1, 1:2, and 1:3 impregnation ratio for various time duration such as 1 hr, 2 hr, 3 hrs and compared their results to optimize which is better impregnation for the biochar production. These numbers are determined as per the ASTM D4607-94, ASTM C837-09, ASTM D1153-06 procedures. The results are given in table 4.2.

Higher iodine number shows higher micro porosity of the sample (adsorb pores larger than 10Å). Methyl violet number indicates macropore (>50nm) distribution of prepared carbon sample. Methylene blue number indicates mesopore (2-50 nm) content of prepared carbon.

Proximate Analysis of Activated Carbon

Table 4.1 At Temperature 250 ˚ C

IMPREGNATION RATIO		METHYLENE BLUE (mg g-1)	IODINE NUMBER (mg g-1)	METHYLENE VIOLET (mg g-1)
1:1	1 hr	73.2	397.3	55.5
	2 hr	81.7	553.8	61.9
	3 hr	76	472.1	52.5
1:2	1 hr	71.6	415.8	65.1
	2 hr	73.8	591.3	68.3
	3 hr	69.7	438.6	60.9
1:3	1 hr	58.2	458.3	45.2
	2 hr	69.8	575.2	60.7
	3 hr	55.3	498.4	47.3

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Table 4.2 At Temperature 300 ˚ C

IMPREGNATION RATIO		METHYLENE BLUE (mg g-1)	IODINE NUMBER (mg g-1)	METHYLENE VIOLET (mg g-1)
1:1	1 hr	91.5	428	72
	2 hr	94.5	604.85	78
	3 hr	87	501.55	69
1:2	1 hr	91.5	442.92	76.5
	2 hr	87	671.71	79.5
	3 hr	85.5	515.3	67.5
1:3	1 hr	72	501.3	57
	2 hr	81	621.44	64.5
	3 hr	67.5	573.9	61.5

Table 4.3 At Temperature 350 ˚ C

IMPREGNATION RATIO		METHYLENE BLUE (mg g-1)	IODINE NUMBER (mg g-1)	METHYLENE VIOLET (mg g-1)
1:1	1 hr	93.3	432.8	69
	2 hr	95.6	609.65	75
	3 hr	89.5	511.76	69.3
1:2	1 hr	88.7	513.8	76.3
	2 hr	86.3	658.35	79.5
	3 hr	84.1	483.12	68.7
1:3	1 hr	91.3	538.7	65.5
	2 hr	93.7	619.2	73
	3 hr	88.6	502.5	69.3

INFERENCE:

The wood chips was activated at different temperatures with imprengantion ratio and pore size were calculated by ASTM D4607-94 procedures. From the above table, at temperature 300 ˚C with impregnation ratio 1: 2 the value of iodine number is 671.71(mg/g) which infers that it has high micropores when compared to other ratios and it is optimized for the adsorption studies

The characteristics of wood chips (moisture content, ash content, fixed carbon, volatile matter, and yield) were determined for impregnation ratio 1:2 as per ASTM procedure.

Table 4.4 Proximate analysis of wood chips

CHARACTERISTICS	VALUES
Moisture (%)	7.39
Ash (%)	27.91
Volatile (%)	57.52
Fixed Carbon (%)	7.18

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4.2 ADSORPTION STUDIES

4.2.1.EFFECT OF CONTACT TIME AND CONCENTRATION

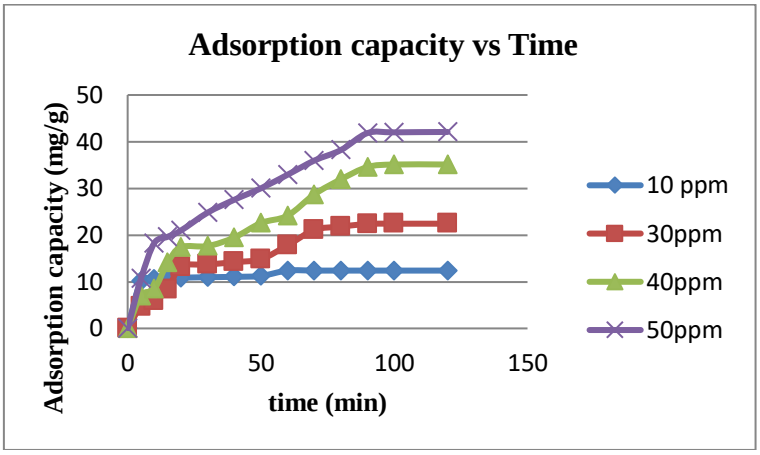

Fig.4.2.1 Effect of contact time and concentration on adsorption capacity and comparison between different concentrations10ppm, 30 ppm, 40 ppm,50 ppm and carbon dosage 0.1g for temperature 30°c, natural pH=6

The effects of contact time and initial concentration of the adsorption studies was carried out and shown in Fig 4.4.1.contact time studies were carried out at 30 ˚C and pH 6 with 0.1g (100mg/L) of adsorbent dosage for three different concentrations (10,30,40,50 ppm). The adsorption capacity of activated carbon increased with contact time and attained maximum value at 100 min. Further, increase in contact time did not show a significant changes in adsorption capacity. The equilibrium time was hence considered as 100 min. Therefore, for further studies, the time for attaining equilibrium was 100 min and the concentration was optimized as 30 ppm.

4.2.2 EFFECT OF ADSORBENT DOSAGE:

To determine the necessary activated carbon quantity required for the removal of dye, the adsorption studies was carried out at pH 6, temperature 30˚C for 120 min taking 100 ml of 40mg/L of solution. It can be easily inferred that the adsorption capacity if activated carbon decrease from 60 mg/g to 20 mg/g when the weight of the carbon increases from 0.05 g to 0.2 g. This is due to the fact that more the activated carbon, greater will be the availability of the exchangeable sites or surface offered to the adsorption.

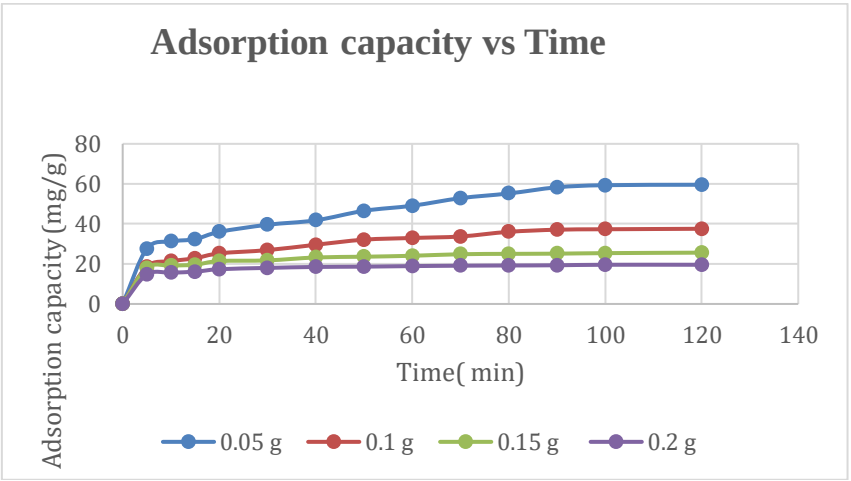

Fig.4.2.2. Effect of Adsorbent dosage for concentrations 40 ppm and varying the carbon dosage 0.05g, 0.1 g, 0.15 g and 0.2 g for temperature 30°c, pH=6

4.2.3. EFFECT OF pH

The effect of pH on the adsorption studies of an activated carbon were carried out at temperature 30 ˚C by varying initial pH of solution from 4 to 10 for constant carbon dosage of 0.1 g for 40 mg/L. The result shows that the adsorption capacity decreases with increase in p H.

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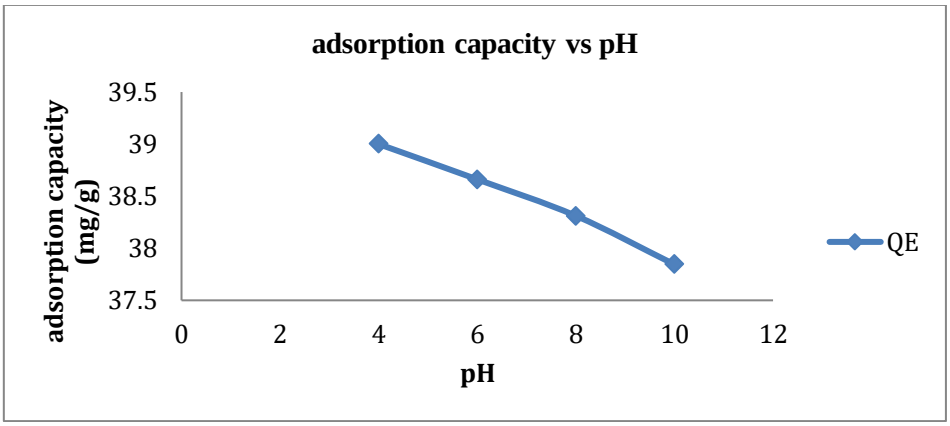

Fig.4.2.3. Effect of pH for concentrations 40 ppm and varying the pH range from 4, 6,8 and 10 for 0.1 g and temperature 30° C

4.2.4. EFFECT OF TEMPERATURE

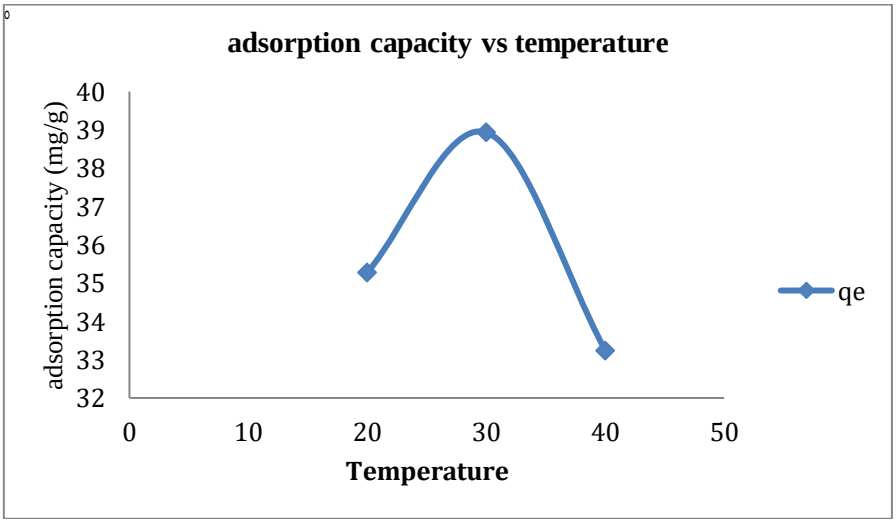

Fig.4.2.4. Effect of temperature for concentrations 40 ppm and the carbon dosage 0.1 g for different temperature such as 20°C 30°C and40 °C, pH=6

Temperature is an important parameter for adsorption processes and generally has significant impact on extent of removal. It has significant influence on the removal of brilliant yellow on JFAC also. The effect of temperature was investigated in the temperature range 20–40° C. The experimental results show that the adsorption capacity increases from 35% to 38 % by increasing temperature 20° C to 30 ° C and decreased gradually to 32 % when the temperature is increased to 40° C.Thus the room temperature is better for the adsorption studies.

CONCLUSION

The present investigation results that Prosopis Juliflora is an eco-friendly and cheap material found to be potential adsorbent for removal of dye by chemical activation using phosphoric acid. The precursor were characterized by carrying out proximate analysis. The values of impregnation ratio, activation temperature, activation time was found for the activated carbon. The optimal condition for maximum methylene blue number, iodine number, methyl violet number were found to the best for the impregnation ratio 1:2 and temperature 300°C. The Activation time is 100 minutes. The Batch adsorption results suggested that activated carbon produced were good adsorbent for removal of dye. The system attained the maximum equilibrium at 100 minutes. The optimal pH was found to br solution pH for adsorption of dye. The Langmuir isotherm was high and adsorption follows monolayer.

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