STUDY ON ADSORPTION OF METHYLENE BLUE BY ACTIVATED CARBONDERIVED FROM IPOMOEA CARNEA

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ABSTRACT

Activated carbon has been prepared from stem of Ipomoea Carnea by acid treatment Surface structureinvestigation is carried out by scanning electron microscopy (SEM). Ipomoea Carnea stem waste has been evaluatedas raw material for the preparation of activated carbon using HCL with the temperature ranging from 5000C to 8000C.The activated carbon prepared was characterized, by iodine value, moisture contain, ash content, pore volume andporosity. The BET surface areas between 864.653 m²/g and 1159.06 m²/g and micropores and mesopores with volumesbetween 0.004 and 0.358041 cc/g. Characterization studies such as SEM, BET, bulk density, moisture content, ashcontent, fixed carbon content, and surface area have been carried out to assess the suitability of derived carbons asadsorbents in the water and wastewater. The effects of factorssuch as contact time, adsorbent dose, pH and initialconcentration were investigated. The kinetics and equilibriumdata were confronted to several models. A study onadsorption of Methylene blue by activated carbon derived from Ipomoea Carnea was done.

Key words: Activated Carbon, Ipomoea Carnea, Carbonization, Activation, Methylene Blue.

INTRODUCTION

Solid waste disposal has become a majorproblem in India, either it has to be disposed safely or usedfor the recovery of valuable materials as agricultural wasteslike turmeric waste, ferronia shell waste, jatropha curcusseed shell waste, delonix shell waste and Ipomea Carniastem. Therefore these wastes have been explored for thepreparation of activated carbon by various techniques. Inorder to serious water pollution, we must understand theproblems and become part of the solution.

Activated carbon has since then been used in manyindustries. In particular, it has been commonly used for theremoval of heavy metal and organic dyes from textile wastewater. Many agricultural by products and waste materials usedfor the preparation of activated carbons. The plant IpomoeaCarnea belongs to family Convolvulaceae. Ipomoea Carnea,is a species of morning glory. Activated carbon is widely usedfor the purpose due to the large surface area available foradsorption or chemical reactions.Dyes are used in chemical,textile, paper, printing, leather, plastics and various foodindustries. Waste water passed out from the industry. So inthis work Activated carbon used as an adsorbent for MethyleneBlue dye.

MATERIAL AND METHOD

Collection of sample - The Ipomoea Carnea (morningglory), a low-cost and abundantly available plant, was usedfor removal of heavy metal from aqueous solutions.Ipomoea Carnea stems were collected in and around Neelbad Bhopal M.P., India. The stemof Ipomoea Carnea was dried at room temperature for afew days and then oven dried at 110^0C over night.

Activation with HCL-

Ipomoea Carnea stem wastematerial was treated with HCL for a period of 24 hours.Then the material was placed in the muffle furnace andcarbonized at 400-800^{0}C, for a period of 60 minutes. Afteractivation, the carbon obtained was washed sufficiently withplenty of water, dried and sieved then to desired particlesize.

Characterization

Moisture Content Determination-

A 1.0 g of the activatedcarbon sample was weighted and dried in an oven for fourhours at 150^{0}C, until the weight of the sample becameconstant.

$$X_0 = \frac{W_1 - W_2}{W_1}$$

W_1

Where

X_0 = Moisture content on wet basis

W_1 = Initial weight of sample, in gm

W_2 = Final weight of sample after drying in gm

Particle Size

For the particle size determination, lots ofsamples were weighed and placed on top of a set of sievesranging from 75 to 1.4 × 103 μm. The sieves were shakenmanually for two minutes, after which the weight percent ofthe active carbon retained on the sieves and bottom panwas determined.

pH –

1 gm of the sample was weighed and dissolved in 3 ml of de-ionized water. The mixture was heated and stirredfor 3 minutes to ensure proper dilution of the sample. The solution was filtered out and its pH was determined using adigital pH meter.

Iodine Adsorption Number (IAN)-

1 g sample and 25 mlof standard iodine solution (0.023 M) added. 20 ml of thisfiltrate solution was titrated with the standard (0.1095 M)thiosulphate solution to the persistent of a pale yellow colour.5 ml of starch indicator was added and titration resumedslowly until a colorless solution appeared, the procedurewas carried out two more times. The titrations were alsorepeated with 20 ml portions of the standard iodine solutionnot treated with the sample to serve as the blank titration.The iodine number(IAN) was calculated from therelationship.

IAN = 12.69 N (V_2-V_1) mole iodine/g sample

W

Where:

N is the normality of thiosulphate solution

V_1 is the volume of the thiosulphate (ml) used for the titration of the sample-treated aliquot

V_2 is the volume of the thiosulphate (ml) use for the bank titration,

W is the mass of the sample used (gm).

Ash content-

2.0 grams of sample was placed into acrucible and reweighed with its content heated in a furnaceat 9000C for 3 hours. The sample was cooled to roomtemperature and reweighed. Ash content was calculatedbetween the differences in weight.

Volatile matter content –

A 2 gm of sample was taken incylindrical crucible closed with a lid. It was then heated to925Úc for exactly 7minutes in a muffle furnace. Then thecrucible was cooled in desiccators and weighted volatilematter on dry basis.

VM = 100[100(B-F) – M(B-G)]
[(B-G)(100-M)]
B=Mass of crucible, lid and sample before heating
F=Mass of crucible, lid and contents after heating
G=Mass of empty crucible & lid
M=% of moistures determined above

Fixed carbon content-

Fixed carbon FC = 100 – (%moisture content+ % volatile matter + % ash content)

BET Test

(Brunauer, Emmett and Teller) - The results ofBET surface area, macropore, mesopore and microporevolumes of the produced activated carbon. The surfaceareas were higher for HCL activated carbons and this isexpected because chemical activation normally developsmore porosity and it gives high surface area.

Scanning electron microscope analysis (SEM)

Thesurface morphology of the activated carbon was testedusing scanning electron microscopy.At such magnification,SEM micrographs clearly revealed that wide variety of poresare present in activated carbon along with fibrous structure.It is also found that there are holes and caves type openingson the surface of the adsorbent.

Adsorption studies of activated carbon-

Removal ofMethylene Blue dyes from aqueous solution by usingIpomoea Carnea stem waste.

Batch adsorption study-

The batch adsorption wascarried out at room temperature.The effects of contacttime, adsorbent dose, pH of solution and the initialconcentration of these adsorbates were studied. Thequantity adsorbed by a unit mass of an adsorbent atequilibriumand the adsorption percentage were calculatedusingthe following relations:

$$\% R = \frac{C_o - C_e}{C_o} \times 100$$

$$Q_e = \frac{(C_o - C_e)}{....} \times V$$

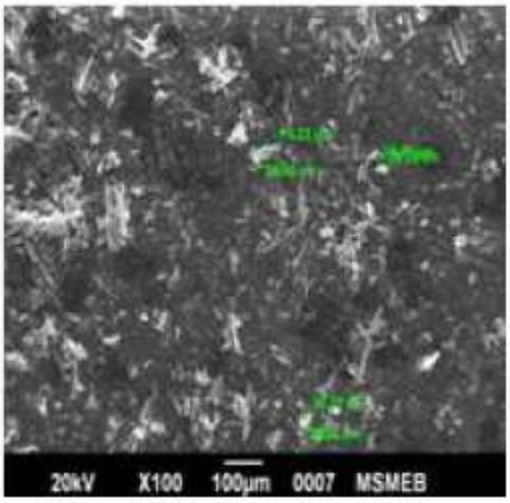
Where is the concentration of adsorbate at equilibrium(mg.L-1); is the initial concentration of adsorbate (mg.L-1).

Result

Activated carbon prepared from Ipomoea Caeneastem waste was found effective in adsorption of dye fromaqueous solution. The activated carbon was characterizeda pH, moisture content, bulk density, pore volume, porosity,and ash content. Iodine no. a measure of the microporecontent of the activated carbon is 254 mole iodine/g sample.Moisture content of activated carbon have less than 1% .Ash determination shows that increase in carbonizationtemperature reduces the ash content. It is known thatmaterials with the lowest ash content are most active. ThepH of sample is 6.5.The result showed that the Activatedcarbons activated with HCL are neutral after washing.Anadsorption test has been carried out for Methylene Blueunder different experimental conditions in batch mode. Theadsorption of Methylene Blue was dependent on adsorbentsurface characteristics, adsorbent dose, Methylene Blueconcentration, time of contact and temperature. The resultsindicated that the activated carbon is very useful forremoving Methylene Blue from wastewater.

Table – 1 : Characteristics of Activated Carbon

S.No.	Parameters	Observations
1	Moisture content in 2.0g	2.3%
2	pH 6.5	
3	Iodine adsorption number (IAS)	254
4	Ash content	1.40%
5	Fixed carbon %	81%
6	ccl adsorption capacity in %	64$
7	Pore size/value A	1.89839 nm
8	BET Surface area in m2/g	1159.06 m^2/g
9	Langmuir Surface area in m2/g	2152.48 m^2/g
10	Volatile matter	15.3%



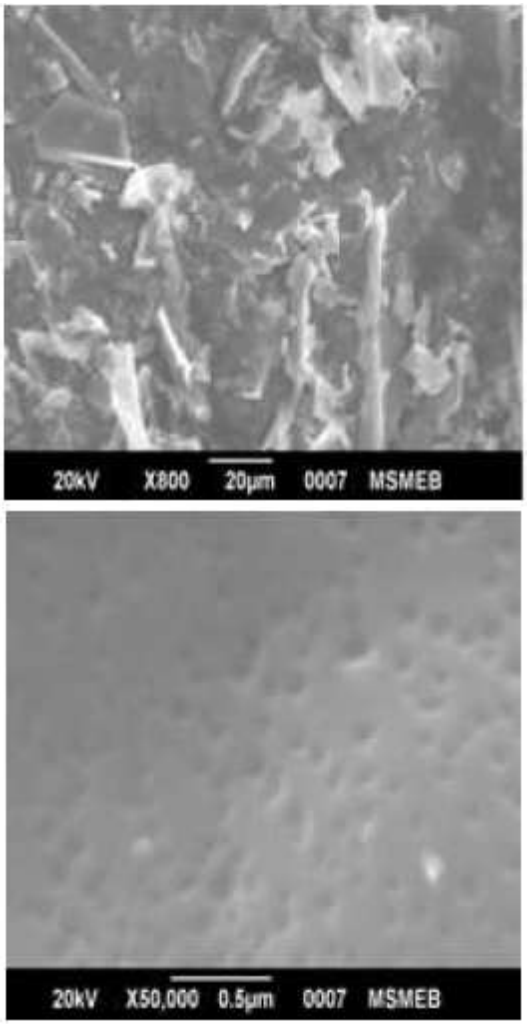


Fig. 1: Activated carbon from Ipomoea Carnea SEM

Adsorption result –

The highest adsorption of 95.1% occurred at pH 6. When increase adsorbent dose MB adsorption was increase. Figure-4 shows that the equilibrium was attained at 110 minute when the maximum adsorption onto activated carbon was reached. When Methylene Blue concentration was increase the rate of adsorption was decreases (Fig-5).

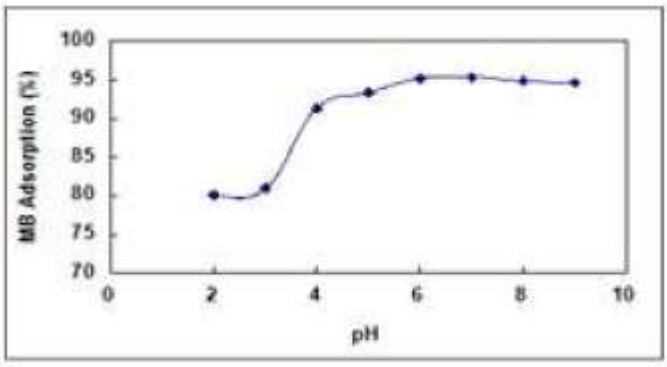


Figure -2 Effect of pH on adsorption of Methylene Blue

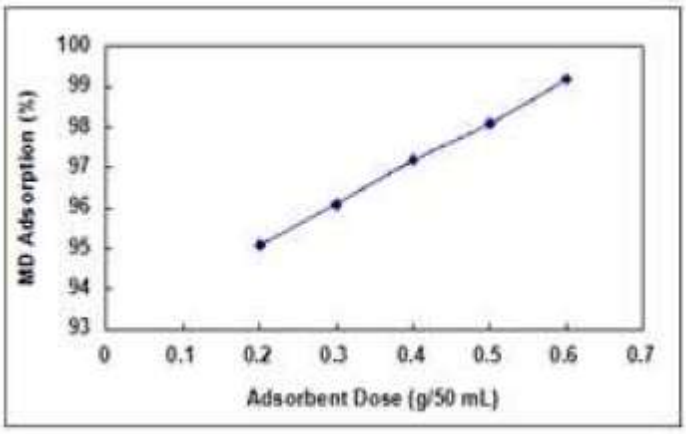


Figure-3: Effect of Adsorbent Dose on adsorption of Methylene Blue

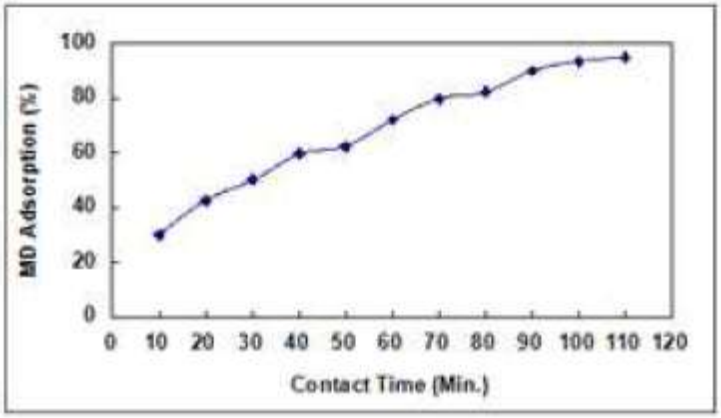
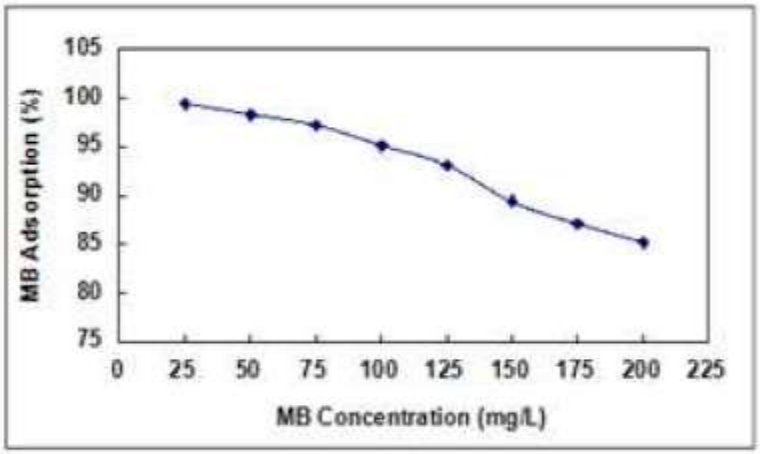


Figure -4. Effect of Contact Time on adsorption of Methylene Blue



CONCLUSIONS

This study indicates that efficient activatedcarbons can be obtained from Ipeomea Carnea by controlledactivation with HCL for a number of industrial and residential applications. Due to the presence of high surface area,porosity, the activated carbon prepared from the agriculturalwaste it can be used for a variety of environmental application,dye removal, wastewater treatment and adsorption processtoo. The present study has shown the effectiveness of usingAC in the removal of Methylene Blue dye from aqueoussolutions. Acid Activated Ipomoea Carnea in different formshas a great role in modern life to clean environment.

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