# PREPARATION AND PHYSIOCHEMICAL CHARACTERIZATION OF LOW COST TEMPLE FLORAL WASTE ADSORBENTS

***Shilpi Shrivastava*, Dr. Sarita Shrivastava , Dr. Anand Sharma***

***Department of chemistry, Institute for Excellence in Higher Education, Bhopal, India***

***Department of chemistry, Motilal vigyan maha vidhyalaya, Bhopal, India***

**ABSTRACT**

The present research work is based on to prepare adsorbents from a low value temple floral waste (*Aegle marmelos* leaves and *Chrysanthemum morifolium* flowers).The adsorbents were prepared by chemical activation using ortho phosphoric acid. The physiochemical parameters for both adsorbents leaves and flowers were pH (7.5, 7), moisture content (33%, 11%), ash content (24%, 58%), volatile matter (6.7%, 19%), fixed carbon (36.3%, 12%). Surface area calculated by iodine number and found to be (2.855, 5.139) and the surface chemical nature was determined by Fourier Transform Infrared spectroscopy (FTIR) analysis. Functional groups OH (Alcohal, carboxylic acid), CH(Alkane, Aldyhide), O=C=O(carbon dioxide), C=C(Alkene, Conjugated alkene), were present at surface of both the adsorbents. The objective of this work is to utilized the temple floral waste and this work indicated that both adsorbents could be employed as low cost adsorbents in removal of dyes from water bodies.

**Key words :** Characterization, temple floral waste, adsorbent, *Aegle marmelos, Chrysanthemum morifolium*

## INTRODUCTION

Adsorption is said to be one of the efficient ways for removal of heavy metals from waste water stream. Adsorbtion is made easy due to the highly porous nature of carbon which provides large surface area.[**1**] There are many techniques associated with waste water that are used for the removal of the pollutants from aqeuous solution some of them are reverse osmosis, membrane filteration, coagulation and adsorption. Adsorption is widely acceptable technique because of its simplicity and cost effectiveness [**2**]. The most common adsorbent is activated carbon, having properties like high porosity, large surface area and high carbon content. Activated carbons are widely used as water purifier adsorbents in industrial and domestic sectors but they are expensive therfore, necessity to develop low cost adsorbents derived from plant and agriculture biomass or from any waste came into existence. Bioadsorbents are cheaper than the adsorbents that are available commercially in waste water treatment.[**3**]

Adsorbents that are used without any treatment are such as bamboo husk[**4]**, blue pine[**5**],walnut**[5]**, fruit cortex**[6]**, banana husk[**7]**, coffee husk**[8]**. The plant based adsorbents are lignocellulosic materials and often applied in the removal of the heavy metals, dyes, phenols and other organic pollutants. These materials are commonly considered as low cost due to easy availability in nature. *Aegle marmelos* leaves and *Chrysanthemum morifolium* flowers are offered to god in most of the temples. Having offered in the temple this stuff is considered as waste material. Adsorbents prepared from these temple floral waste can reduce the problem of waste disposal.

Present research paper aims to study the temple floral waste adsorbent derived from *Aegle marmelos* leaves and *Chrysanthemum morifolium* flowers collected from temples of Vidisha city for the purpouse of waste management. The floral waste that is collected as very large amount does not have any instant use, having offered to deities this waste is discarded and often discharged either into the water bodies or heaped in open which is hazardous to the environment With the help of this research work we can not only control tons of floral waste but also make it a source of the employment. At last it can be assessed as one of the future project that will help environmental disbalance in country.

## MATERIAL AND METHODS

### Collection and preparation of adsorbent

For adsorbent preparation the leaves of *Aegle marmelos* and flowers of *Chrysanthemum morifolium* were collected from temples waste of Vidisha. The materials were washed with double distilled water several times to remove impurities. Then leaves and flowers were crushed and dried at room temperature for a few days and then oven dried at $110^0$C overnight. Dried material was ground to an average particle size of 1 mm.

### Chemical activation of adsorbents with orthophosphoric acid

The dried material were used for the preparation of adsorbent using chemical activation method. Both temple floral waste plant material was treated with $H_3PO_4$ for a period of 24 hours. Then the material was placed in the muffle furnace and carbonized at $400^0$c. The dried material were powederd and activated in muffle furnace kept at $800^0$c for 60 minutes. After activation, the carbon was washed sufficiently plenty of water until the pH 7.0, dried and sieved then to the desired particle size. Finally, it was ground and then these adsorbents used for all adsorption experiments.**[9]**

## PHYSIOCHEMICAL CHARACTERIZATION OF ADSORBENTS
### Proximate Analysis

### 1. Moisture content

A 1.0 g of the adsorbents sample was weighed and dried in an oven for four hours at 150$^o$C, until the weight of the sample became constant.[**10**]

$$Xo = \frac{W1 - W2}{W1}$$

Where:

Xo = Moisture content on wet basis

W1 = Initial weight of sample, in gm

W2 = Final weight of sample after drying

### 2. Volatile matter content

A known amount of sample was put in the crucible and placed in a muffle furnace at 920+10$_o$C, covered with lid, & placed for exactly seven minutes. The crucible was taken out, allowed to cool & weighed. The formula of volatile matter content is given as:

$$VM=100(100(B-F)-M(B-G))/((B-G)(100-M)$$

G = Wt of empty crucible with lid
B = Wt of empty crucible + lid + sample(before heating)
F = Wt of empty crucible + lid + sample (after heating)
M=Moisture content in %
VM = % of volatile matter content

**3. pH**

1 gm of the adsorbent was weighed and dissolved in 3ml of de ionized water. The mixture was heated and stirred for 3 minutes to ensure proper dilution of the sample. The solution was filtered out and its pH was determined using a digital pH meter. **[11]**

**4. Iodine Adsorption Number (IAN)**

One gram of sample was weighed into a beaker and 25ml of standard iodine solution (0.023M) was added. The mixture was swirled vigorously for 10 minutes and filtered by means of a funnel impregnated with clean ash less glass wool. 20 ml of the clear filtrate was titrated with the standard thiosulphate solution (0.1095M) to the persistent of a pale Yellow color. 5 ml of freshly prepared starch indicator was added and titration resumed slowly until a colorless solution appeared, the procedure was carried out two more times. The titration were also repeated with 20 ml portion of the standard iodine solution not treated with the sample to serve as the blank titration. The iodine number (IAN) was calculated from the following relationship.

$$\mathbf{IAN = \frac{12.69\,N\,(V_2 - V_1)}{W}\ mole\ iodine/g\ sample}$$

Where:

N is the normality of thiosulphate solution

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

$V_2$ is the volume of the thiosulphate (ml) used for the blank titration

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

5. **Ash content**

2.0 grams of sample was placed into a crucible and reweighed with its content heated in a furnace at 900˚C for 3 hours. The sample was cooled to room temperature and reweighed. Ash content was calculated between the differences in weight.

$$\mathbf{A=100(F-G)/(B-G)}$$

**Where**

G = Wt of empty silica crucible
B = Wt of empty crucible + activated carbon sample (before heating)
F= Wt of empty crucible + ash (after heating)
A = % of ash content

**6. Fixed carban content**

Fixed carbon content can be calculated by using following formula :

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

**FT-IR analysis**

The FTIR studies were performed to determined the various functional group on the surface of the adsorbents. The experiment was performed in Pharmacy Department of Sagar Institute of Research and Technology, Bhopal. FTIR spectra of different samples were recorded within 700- 4000cm. IR spectra of the adsorbents were recorded on Bruker-Alpha FT-IR spectrophotometer using KBr pellet technique.**[12]**

## RESULTS AND DISCUSSION

The physiochemical characterization of both the adsorbents *Aegle marmelos* leaves and *Chrysanthemum morifolium* flowers are mentioned in table 1:

**pH** analysis of *Aegle marmelos* and *Chrysanthemum morifolium* was reported neutral(7.5 and 7) which will be helpful in the treatment of all classes of dye waste water.

**The ash content** was found for leaves adsorbent has less ash content (24%) as compared to flowers adsorbent (58% ), which may increase the fixed carbon value in comparison to the adsorbent of flowers. Ash content shows the amount of inorganic substituents present in the carbon. Lower value of ash content favour the good adsorbents characterstics.Higher ash content value reduces the mechanical strength of carbon and effects adsorption capacity**[13].**

**The moisture content** value for flowers adsorbent has three times less (11%) in contrary to adsorbent of leaves having 33%. Moisture free activated carbon have good value. Some activated carbon adsorb the moisture when stored under humid conditions but still appear dry. Some times the adsorption capacity of activated carbon does not affected by moisture content but they dilutes the carbon.[**14**]
**Volatile matter** percentage of volatile matter was higher (19%) in adsorbent of flowers which was approximately thrice of leaves, having 6.7% of volatile matter. The presence of organic compounds in the raw material is cause of Volatile matter. As activator concentration increases the levels of volatile substances decrease. Because of the addition of activators causes changes in the structure and properties of activated carbon absorption **[15].**

**fixed carbon** The value of the resulting fixed carbon content of flower i.e., 12% is just thrice lesser with reference to the percentage of fixed carbon in activated carbon of leaves i.e., 36.3%.

**Iodine number** Iodine number is usually used to roughly estimate the surface area of activated carbon at room temperature condition. It is known that activated carbon do absorb iodine very well and hence the iodine adsorption number is an indication of the total surface area of the activated carbon. It shows that the higher the number, the higher the degree of activation. The smaller the volume of iodine adsorbed the bigger the iodine number adsorption. Consequently, the bigger the surface area and the more effective it is [**16**].
It was found from this work that iodine number was higher (5.139) for adsorbent of flowers in comparison to adsorbent of leaves (2.855).

| S.No. | PARAMETERS | PERCENTAGE OF ACTIVITY SHOWN BY ADSORBENT OF FLOWER | PERCENTAGE OF ACTIVITY SHOWN BY ADSORBENT OF LEAVES |
|---|---|---|---|
| 1. | pH | 7 | 7.5 |
| 2. | Ash Content | 58% | 24% |
| 3. | Moisture Content | 11% | 33% |
| 4. | Volatile Matter | 19% | 6.7% |
| 5. | Fixed Carbon | 12% | 36.3% |
| 6. | Iodine Number | 5.139 | 2.855 |

## FT IR analysis

Fig 1 shows the IR spectra of leaves adsorbent the band occured at 3241.4677 $cm^{-1}$ with O-H stretch corresponds to carboxylic acid. Peaks ranged from 3944.8444 $cm^{-1}$to 3071.3604 $cm^{-1}$ was assigned to O-H stretch due to alchohal. The appearance of band at 3443.2831 $cm^{-1}$ can be attributed to N-H stretch. Bands located at 2987.5672 $cm^{-1}$, 2941.8541 $cm^{-1}$ & 2883.8968 $cm^{-1}$ with C-H stretch were associated to alkane. Bands at 2388.4635 $cm^{-1}$ with O=C=O stretch, at 2288.6160 $cm^{-1}$with N=C=O stretch, at 2224.5595 $cm^{-1}$ with CΞN stretch, at 2161.3638 $cm^{-1}$with S-CΞN stretch and at 2066.8482 $cm^{-1}$with N=C=S stretch corresponding to carbon dioxide, isocyanate, nitrile, thiocynate, isothiocyante.

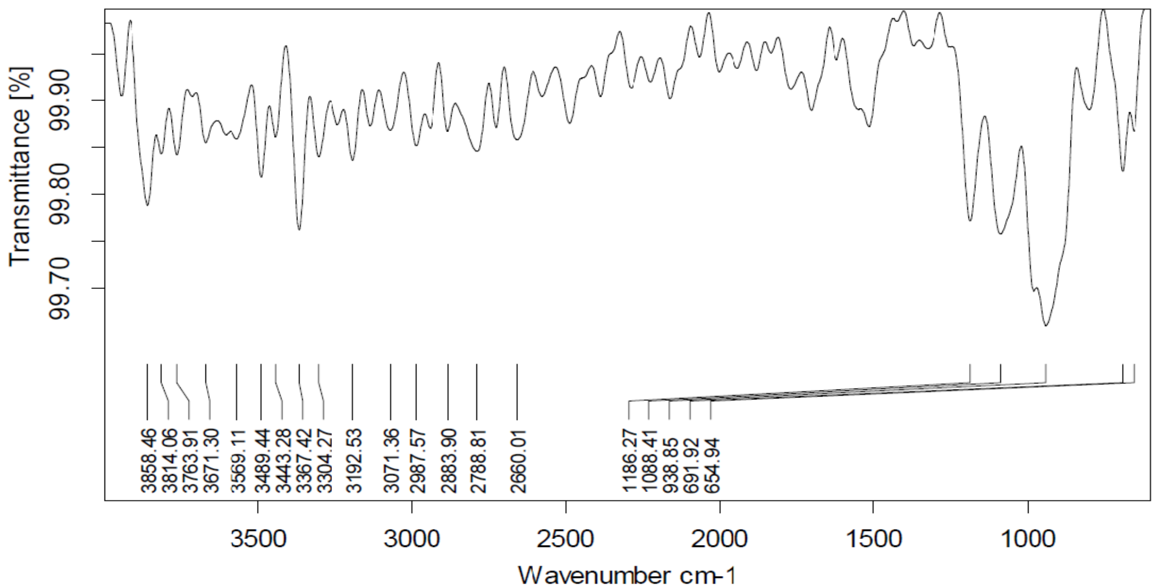


**Fig 1: FT-IR spectra of leaves adsorbent**

**Fig 2:** shows the IR spectra of flower adsorbent the peaks at around 3837.7316 $cm^{-1}$, 3737.4436 $cm^{-1}$and 3194.4719 $cm^{-1}$ corresponding to O-H stretching. Peaks at 2398.8008 $cm^{-1}$ & 2304.1286 $cm^{-1}$ were associated with O=C=O stretch. The peak at 2795.3043 $cm^{-1}$with C-H doublet indicated the presence of aldehyde group. Bands at 1605.9653 $cm^{-1}$ and 958.8350 $cm^{-1}$with C=C stretch and C=C bending correspond to conjugated alkene. and alkene. Band at peak 1443.6905 $cm^{-1}$ was indicating C-H bending. The peak at 1127.7484 $cm^{-1}$ associated with C-O stretch**.**

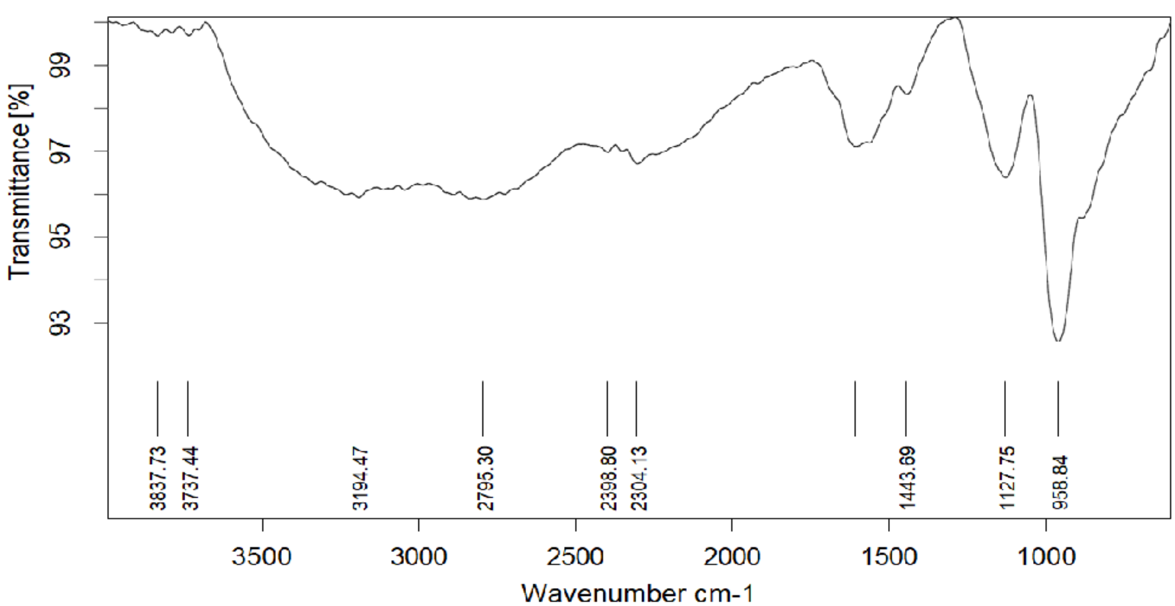


**Fig 2: FT-IR spectra of flowers adsobent**

## CONCLUSION

The low cost adsorbent were prepared from *Aegle marmelos* leaves and *Chrysanthemum morifolium*. The prepared adsorbents were characterized by analyzing different physiochemical parameters such as pH, ash content, moisture content, volatile matter, fixed carbon, iodine number, functional group analysis. The chemical properties indicated that the functional groups present on the surface of both the adsorbents were analysed by FTIR analysis. It was found that functional group such as OH (Alcohal, carboxylic acid), CH(Alkane, Aldyhide), O=C=O(carbon dioxide), C=C(Alkene, Conjugated alkene), SH(Thiol), N=C=O(Isocynate), N=C=S(Isohtiocynate), CΞN( Nitrile), S-CΞN(Thiocyanate), N-H(Aliphatic primary amine) groups are present. If we noted the large amount of floral waste collected from different religious places we find that it is a greater threat to environment and living being if heaped in open without proper disposal. Thus, the temple floral waste can be utilized by preparing the adsorbent for removal of toxic pollutant from water bodies. The preparation of these adsorbents are inexpensive and cost effective.

## REFERENCES

1. Deshmukh. 2012. Synthesis, Characterization And Adsorption Studies For Adsorbent Synthesized From Aegle Marmelos Shell For Removal Of Cr (VI) From Aqueous Solution. International Journal of Advanced Engineering Research and Studies, 3(1): 95-96.

2. Yadanaparthi, S.K.R, graybill, D.and Wandruszka, R. 2009. Adsorbents for the removal of arsenic, cadmium and lead from contaminated waters. J. Hazard. Matter, 171, 1-15.

3. Malik and Yadav. 2015. Preparation and characterization of plant based low cost adsorbents. 4(1): 1824-1829.

4. Asberry, H.B, Kuo,C.Y, Gung,C.H, Conte,E.D, Suen,S.Y. 2014. Characterization of bamboo husk biosorbents and their application in heavy metal ion trapping. Microchemical journal, 113, 59-63.

5. Saqib, A.N, Waseem,A, Khan,A.F, Mahmood,Q, Khan,A, Habib,A. and Khan, A.R. 2013. Arsenic bioremediation by low cost material derived from blue pine (Pinus wallichiana) and walnut(Juglans regia). Ecological Engineering, 51, 88-94.

6. Kelly- Vergas, Cerro-Lopez, M, Reyana, Tellez, S., Bandala, E. R. and Sanchez-Salas. J.L. (2012). Biosorption of heavy metals in polluted water, using different waste fruit cortex. Physics and chemistry of Earth, 37-39, 26-29.

7. Achak, M, Hafidi, A, Quazzani, N, Sayadi, S. and Mandi, L. 2009. Low cost biosorbent "Banana peel" for the removal phenolic compound from olive mill wastewater: Kinetic and equilibrium studies. J. Hazard. Mater, 166, 117-125.

8. Oliveria, W. E, Franca, A. S, Oliveria, L.S. and Rocha S. D. 2008. Untreated coffee husks as biosorbents for the removal of heavy metals from aqueous solution. J. Hazard. Mater, 152, 1073-1081.

9. Arockiaraj I and Renuga V. 2016. Sorption kinetics dynamic studies of basic dye by lowest nanoporous activated carbon derived from Ipomoea carnea stem waste by sulphate process. Frontiers in Nanoscience and Nanotechnology.

10. Hameed, B.H, Din, A.T.M & Ahmad, A.L. 2006**.** *Journal of hazardous materials.* 141(**3**): 30 – 60.

11. Madhu P. C. and Lajide L. J. 2013. Physiochemical characteristics of activated charcoal derived from melon seed husk. Chem. Pharm. Res, 5(5): 94-98,

12. L. J. Bellemy. 1986. The infrared spectra of complex molecules, Chapman and Hall, ISBN 0412138506, USA,

13. S Maulina and M Iriansyah. 2018. Characteristics of activated carbon resulted from pyrolysis of the oil palm fronds powder. IOP Conf. Series: Materials Science and Engineering 309 012072 doi:10.1088/1757-899X/309/1/012072.

14. J. RaffieaBaseri, P. N, Palanisamy and P. Sivakumar. (2012). Preparation and characterization of activated carbon from the vetiaperuviana for the removal of dyes from textile waste water. Advances in Applied Science Research, 3 (1): 377-383.

15. Yakout S M and Deen G S E. 2016. Characterization of activated carbon prepared by phosphoric acid activation of olive stones. Arabian Journal of Chemistry 9.

16. Metcalf, A & Eddy, F. 2003. Waste water engineering treatment and re – use. 6th ed., John Wiley & sons, 1138 – 1139.