Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

Studies on the Characterization of *Azadirachtaindica L.* Bark Activated Carbon and *Vignaunguiculata L.* Seed Shell Activated Carbon

Sivakumar A[1*], Ramachandran G [2] and Thamilarasu P[3]

R&D Centre for Barathiyar University, Coimbatore, 641046, India

[1]Department of Chemistry, Rajah Serfoji Government College, Thanjavur, 613005, India

[2]Department of Chemistry, Dr.AmbedkarGovt Arts College, Vyasarpadi ,Chennai, 600039 India

[3]Department of Chemistry, Arignar Anna Government Arts College, Namakkal,637002,India.

*Corresponding Author E-mail: mietsivakumar@gmail.com&thamilarasu2011@gmail.com

ABSTRACT

The attempt was made to study a number ofcharacterizationsfor*Azadirachtaindica L*. Bark Activated Carbon and *Vignaunguiculata L.* Seed Shell Activated Carbon. The number of parameters of characterization such as pH, conductivity,bulk density, moisture content, volatile matter, fixed carbon, ash content, solubility in 0.25 M HCl, solubility in water, porosity,specific gravity, phenol adsorption capacity, particle size and surface area. The instrumental studies are done by using Fourier Transform Infrared Spectroscopic Study and Scanning Electron Microscope Study for activated carbons. Based on the above studies, predict the efficiency of activated carbons to use for removal dyes impurities present in aqueous solution.

Keywords:-Activated carbons, Characterization, Adsorption, FTIR,SEM.

I. INTRODUCTION

Contamination intended for generous threats worldwide for equally biotic creature and surroundings. Peroxides are unique significant and elementary contaminants in H_2O contamination. Hastened method of industrialization growth, supplementary and added wastewater comprising peroxides is liquidated several social deeds and bases stern extortions to the surroundings[1-3]. Principally, the peroxide wastes release in the H_2O indications adversative, Owed to relief as a fine collapse of produces with toxic, carcinogenic, mutagenic

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

constituents to biotic creature counting composites such as aromatic element, benzidine and naphthalene[4].

An extensive range of photo catalytic process, ozonation, membrane filtration and flocculation have been working to marshal of the waste[5-9]. Amongst these numerous distillation handlings, liquid-phase adsorption is held to remain furthermost operative manner to confiscate organic peroxides from wastewater by using activated carbons. There are certain activated carbons such asyam peels[10], almond shell[11],oil palm shell[12] , coconut shell[13,14],coconut coir[15], pistachio shells[16], walnut shell[17], hazelnut shell[18], palm shell[19],chickpea husks[20] apple pulp[21], rice husk[22], Banana shells[23] adsorbents for confiscation of dyes from water.

Based on the above literature review, Our results validate that the carbonized *Azadirachtaindica L.* Bark Activated Carbon(AIBAC), *Vignaunguiculata L.* Seed Shell Activated Carbon (VUSSAC)are economical and low cost material obtained from the local area and found to have great potential to adsorb dyes from aqueous media; hence these materials was used in this work.

II. MATERIALS AND METHODS

2.1. Preparation of Activated Carbons

Activated carbons primed from *Azadirachtaindica L.* Bark and*Vignaunguiculata L.* seed shell. The uncooked quantifiable acquired from native purveyor. The material was eroded in hot distilled water to confiscate down-to-earth, scratch into slight smithereens and dehydrated up. For carbonization, above materials permeated with concentrated sulphuric acid, a proportion of 0.5:1 of acid volume and weight of the material employed for 24 hours. Subsequently that, the scorched material carries away numerous numbers of times by using distilledwater until the pH of washing develops impartial. Formerly the material was dehydrated and carbonized at 500^0C expending dampen kiln. Lastly, it crushed and shifted to obtain activated carbons by using ball mill technique.

2.2. Methods of Characterization

Using standard procedure, the various parameters of characterization such as pH, conductivity, solubility in H_2O, solubility in 0.25 M HCl, moisture content, bulk density, volatile matter, fixed carbon, ash content specific gravity, porosity, phenol adsorption

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

capacity, particle size and surface area. The instrumental studies are also done by using FTIR Spectroscopic studies and SEM studies for activated carbons [24].

III. RESULTS AND DISCUSSION

3.1. Characterization of Activated Carbons

Physico-chemical characteristics of *Azadirachtaindica L.* Bark Activated Carbon(AIBAC), *Vignaunguiculata L.* Seed Shell Activated Carbon (VUSSAC)were studied and given in Table 3.1. pH values were indicated that the activated carbons are merely neutral medium. Conductivity standards mean that cations and anions in activated carbons might be accountable intended the conductivity. Moisture content of activated carbons were found to be below 1 % and devises no outcome on adsorptive capacity, but it reduces the activated carbons which needs the usage of surplus mass of carbon through the dealing progression. The lesser bulk density value indicated the highly cleft and leaky structure of activated carbons with additional annulled space. Acid solvable substance wasoriginatedmarginally greater than the solubility in water in the activated carbons because of amalgamated carbonate clusters in the holes of activated carbons.

TABLE 3.1.CHARACTERIZATION OF ACTIVATED CARBONS

S.No.	Parameter	AIBAC	VUSSAC
1	pH	6.75	6.56
2	Conductivity (mS/cm)	0.25	0.21
3	Bulk density (g/mL)	0.38	0.56
4	Moisture content (%)	0.16	0.63
5	Volatile matter (%)	5.34	6.12
6	Ash content (%)	4.07	4.96
7	Fixed carbon (%)	90.43	88.29
8	Solubility in water (%)	0.83	1.25
9	Solubility in 0.25 M HCl (%)	5.32	8.17
10	Specific gravity	1.14	1.02
11	Porosity (%)	66.67	45.09
12	Phenol adsorption capacity (%)	63.24	56.04
13	Particle size (nm)	525	460.1
14	Surface area (m^2/g)	795.57	692.22

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

The order of porosity and surface area was found to be AIBAC greater than VUSSAC, it showed that these materials are more useful for removal of impurities such as heavy metals, dyes etc present in the industrial wastewater. Higher specific gravity showed that the activated carbons were castoff as a virtuous column stuffing drive for the exclusion of contaminants from wastewater. The lower ash content and explosive matter accredited to inferior inorganic content and higher fixed carbon. Higher value of fixed carbon showed that the activated carbons are more efficient for fit in column package. Higher phenol adsorption percentage showed that the activated carbons have higher adsorption of organic components existent in the aqueous solution and wastewater. The lower particle size and high surface area is deliberated to be the most appropriate for adsorption of dyes in aqueous solution and wastewater [25].

3.2. Fourier Transform Infrared Spectroscopic (FTIR) Studies

The adsorption capability of activated carbons are depends upon porousnessand the chemical reactivity of functional groups at surface. This reactivity makes an imbalance amongst forces at surface as equated within the frame and consequently foremost to molecular adsorption by the vanderwaals force. Novelty of the nature and sort of adsorption, the FTIR spectra of AIBAC are taken which are exposed in Figure 3.1.

The AIBAC spectrum at 3783 cm^{-1}identified the existence of –OH group presented in activated carbon. The N-H stretching of amines presented at 3409 $cm^{-1}$and –CH stretching of alkanes observed from the region 2922 $cm^{-1}$and 2853 cm^{-1}. A peak at 2023 cm^{-1}identified indicated the presence of –C-C triple bond group of adsorbent. The region at 1704 cm^{-1} specified the C=O stretching of carbonyl group and 1612 cm^{-1}shown the N-H bending of primary amine. The region at 1364 cm^{-1} specified –CH rock of alkanes group. The regions at 1229 cm^{-1},1160$cm^{-1}$and 1116 cm^{-1}indicated C-N stretching of aliphatic amines. Therefore, the presence of these active groups are shown that the participation of adsorption of dyes on AIBAC[26].

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

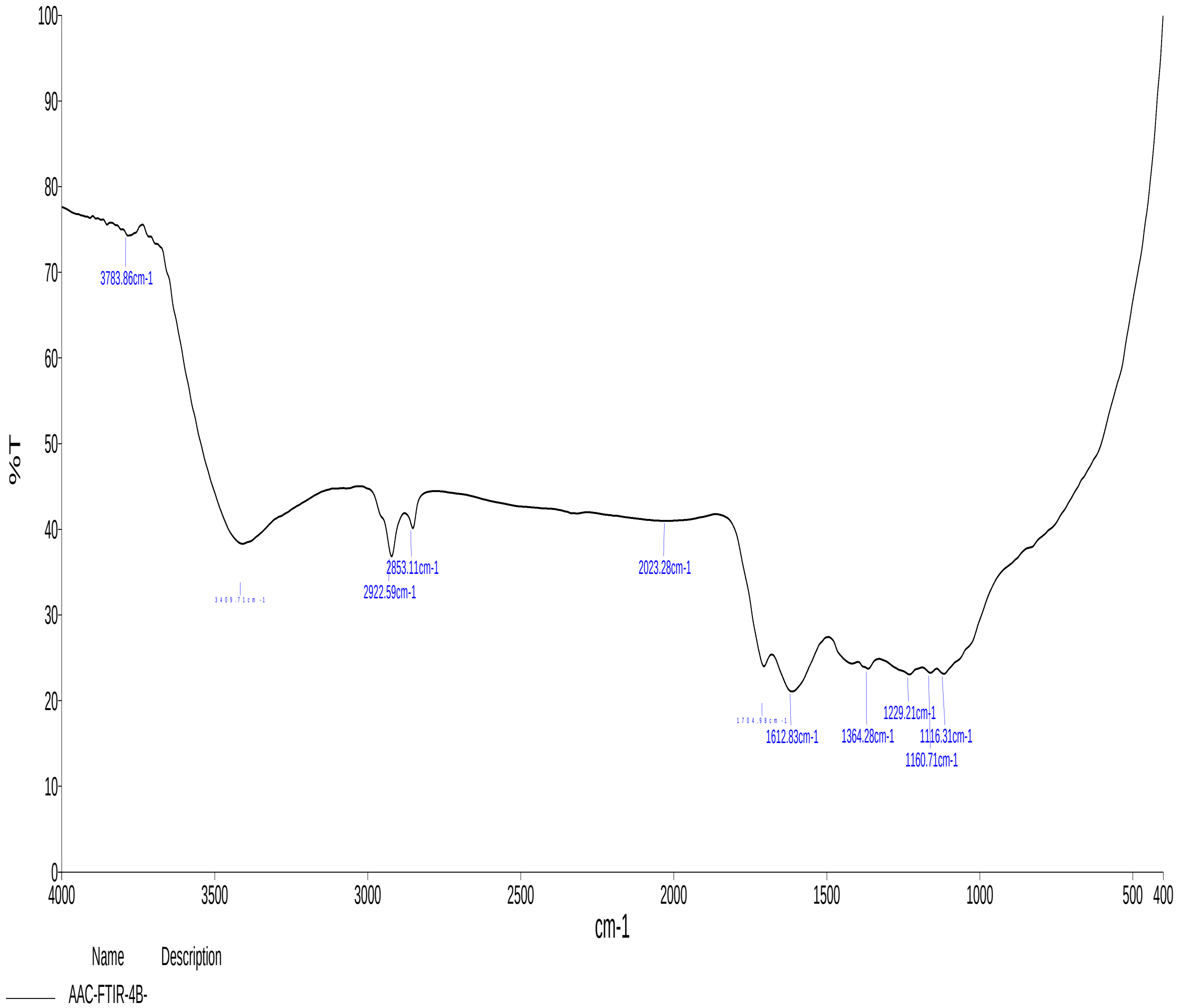

Figure 3.1. FTIR Spectra of AIBAC before adsorption

FT-IR spectra of VUSSAC are taken before adsorption and shown in Figure 3.2. The VUSSAC spectrum at 3794 cm^{-1} indicated the existence of –OH group. The N-H stretching of amines indicated at 3361 cm^{-1}; a peak at 2923 cm^{-1} and 2852 cm^{-1} identified the existence –CH of alkanestretching group. The region at 1702 cm^{-1} specified the C=O carbonyl stretching group and 1591 cm^{-1}indicated the N-H bending of primary amine. The region at 1383 cm^{-1} specified –CH rocking of alkane group. The regions at 1236 cm^{-1},1154 cm^{-1}and 1112cm^{-1}shown to be C-N stretching of aliphatic amines. The peak at 760cm^{-1}indicated the presence of N-H wagging of amines and 676 cm^{-1}shown to be C-H stretching of aromatics. The region 594 cm^{-1} and 610 cm^{-1} indicated the C-Br alkyl halides stretching group. Therefore, the presence of these active groups are shown that the participation of adsorption of dyes ontoVUSSAC [27].

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

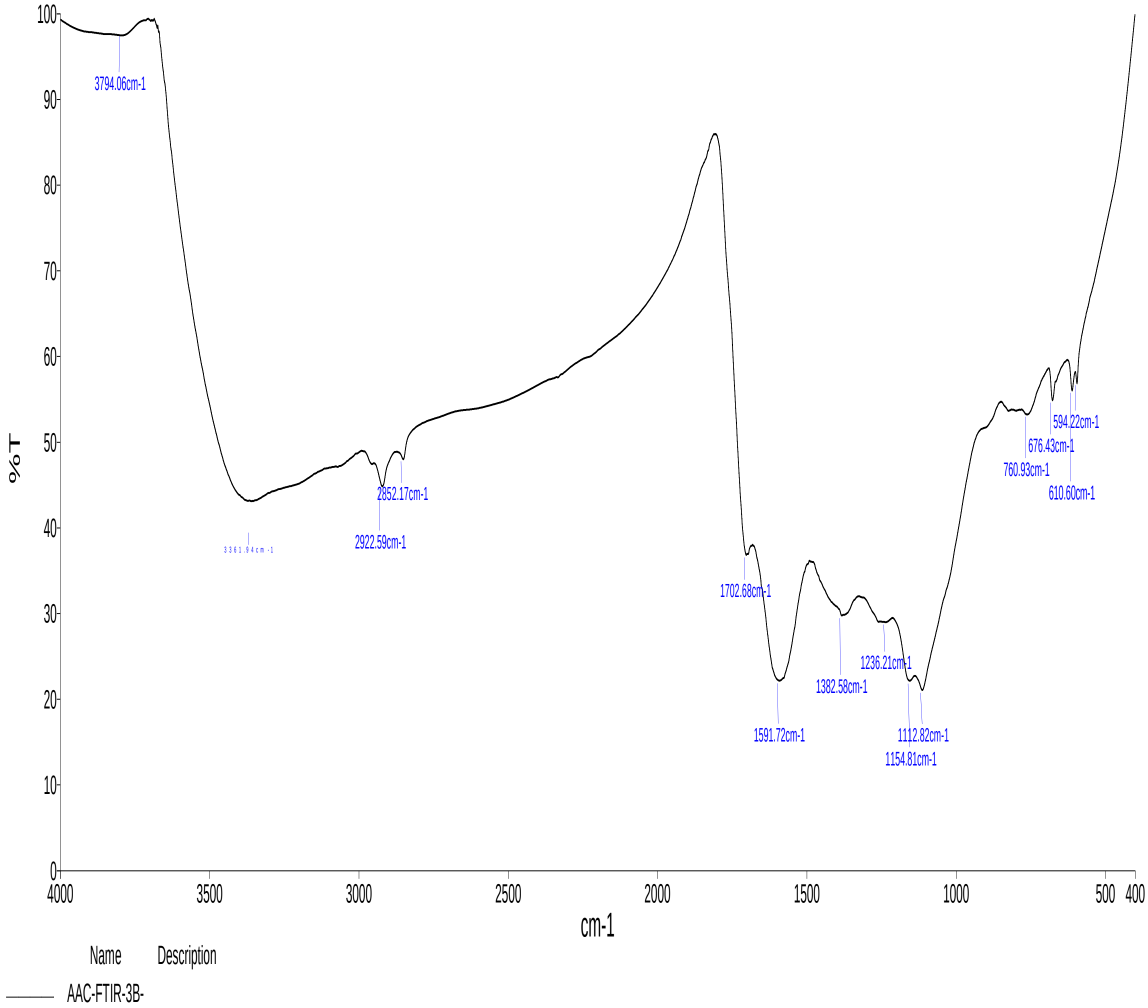

Figure 3.2. FTIR Spectra of VUSSAC before adsorption

After the adsorption of Methylene blue dye aqueous solution on AIBAC and VUSSAC, there was a small shift in wave number range and some of the wave number regions were not observed (figure not shown). It indicated that the there was a good participation of adsorption of dye solution onto the activated carbons.

3.3. Scanning Electron Microscope (SEM) Studies

The SEM images of AIBAC and VUSSACbefore adsorption are shown in the Figures 3.3 and 3.4. It is plainly specified that existence of adsorbent structure of activated carbons beforeadsorption. It has fleapits and cavern type openings on surface which could certainly enhance the surface area accessible for adsorption which increases the adsorption capacity [28].

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

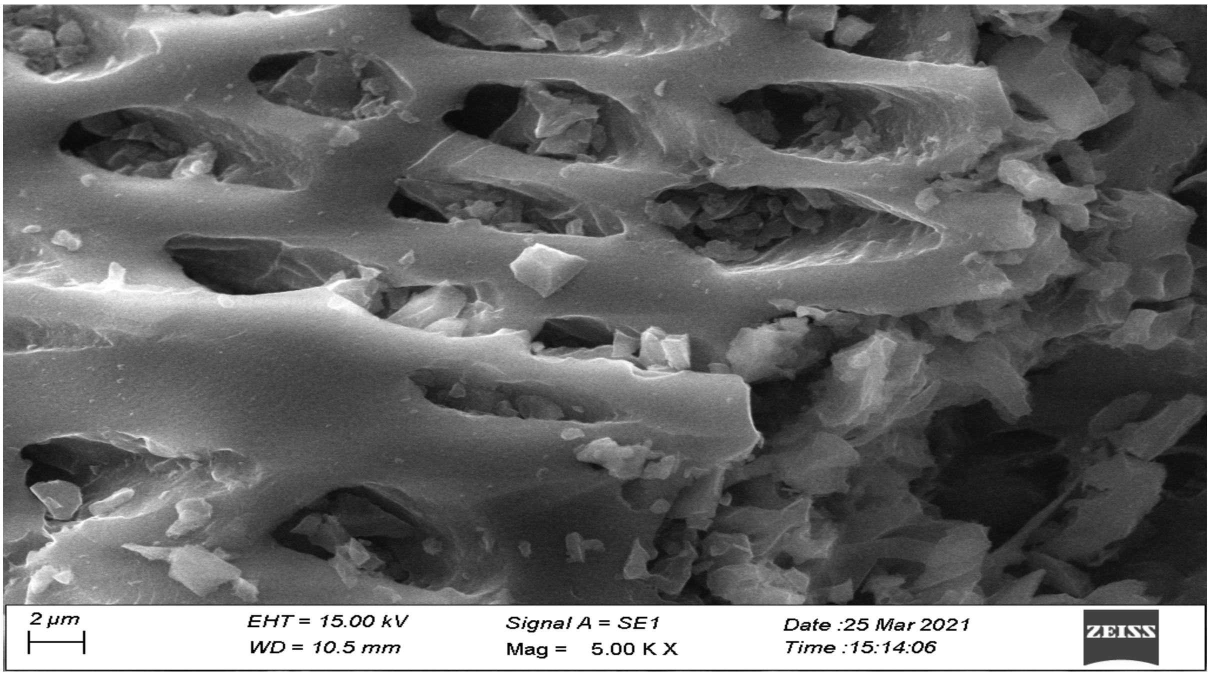

Figure 3.3. SEM Photograph of AIBAC before adsorption

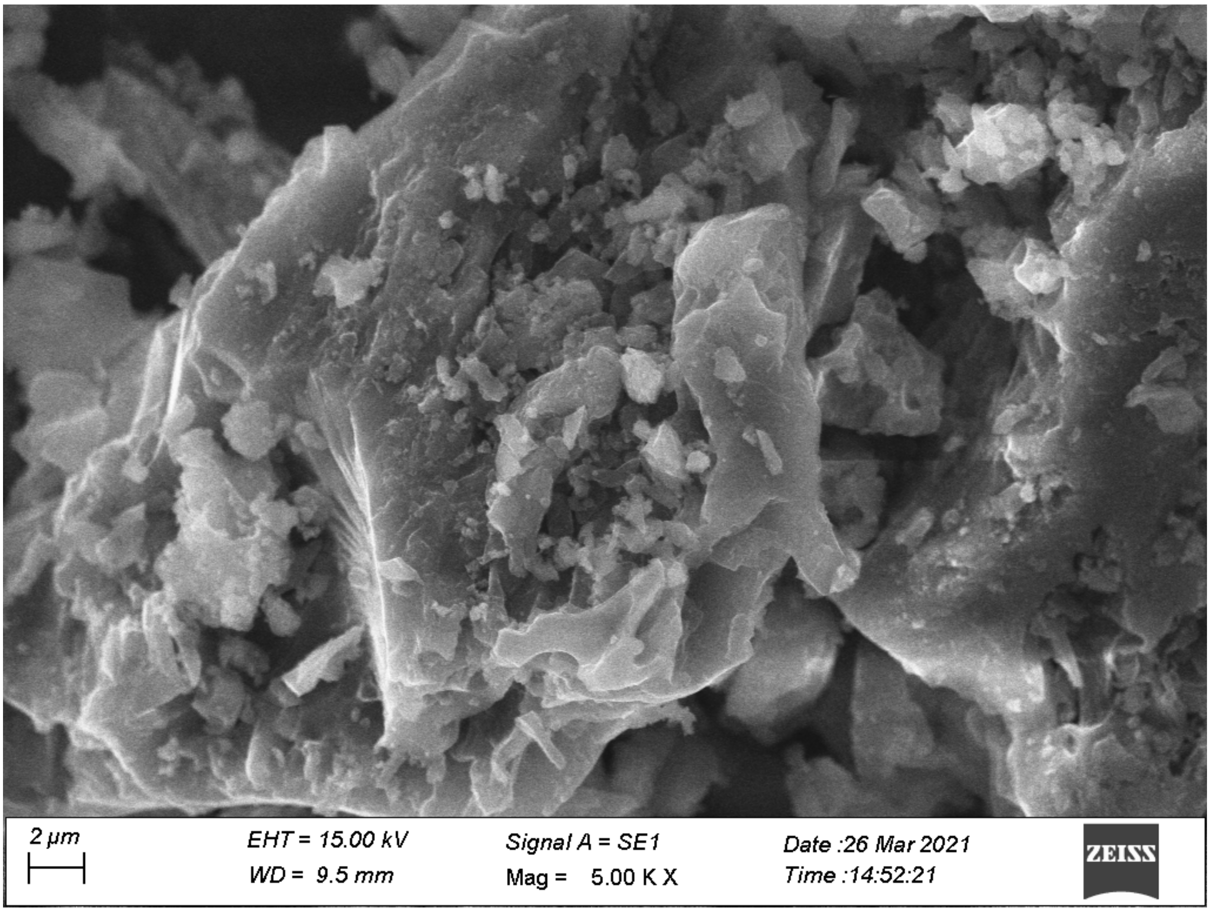

Figure 3.4. SEM Photograph of VUSSAC before adsorption

After adsorption of Methylene blue dye solution, SEM photographs are clearly shown that the surface AIBAC and VUSSAC are the caves, pores and surfaces of activated carbons enclosed by dye solution (figure not shown). It has clearly indicated that activated carbon structure is alteredby the adsorption of Methylene blue dye solution.

IV. CONCLUSION

The adsorbents such as *Azadirachtaindica L.* Bark Activated Carbon(AIBAC), *Vignaunguiculata L.* Seed Shell Activated Carbon (VUSSAC)is locally available, environmental friendly and low cost material. The values of fixed carbon, particle size and surface area values were shown that the AIBAC and VUSSAC are very powerful adsorbents confiscation dyes from aqueous solution and wastewater. Based on FTIR and SEM study, shown that presence of active sites and porous structure of activated carbons which are responsible for removal of dyes present in aqueous solution.

V. REFERENCES

[1] Jafari, A. J.;Kakavandi, B.;Kalantary, R .R.;Gharibi, H.;Asadi, A.;Azari, A.;Babaei,A.A.;Takdastan, A.;Application of mesoporous magnetic carbon composite for reactive dyes removal: Process optimization using response surface methodology.Korean Journal of Chemical Engineering.33(10), 2878-2890(2016)**.**

[2] Shakir, K.;Elkafrawy, A.F.; Shokry, H.F.G.;Beheir, G.E and Refaat,M, Efficient removal of crystal violet dye using EDTA/graphene oxide functionalized corncob: a novel low cost adsorbent, Water Research,44**(5)**, 1449-1461 (2010).

[3] Zhang, H.; Luan, Q.;Tang, H,;Huang, F.;Zheng, M.; Deng, Q.; Xiang. X., Yang, C.; Shi, J.;Zheng, C.; Zhou, Q.; Husk of Agarwood Fruit-Based Hydrogel Beads for Adsorption of Cationic and Anionic Dyes in Aqueous Solutions, Cellulose,24(2), 903-914(2017).

[4] Crini, G and Lichtfouse , E, Advantages and Letters, 17(1),145-155(2018).

[5] Nunez ,J.;Yeber, M.;Cisternas, N.; Thibaut, R.;Medinadisadvantages of techniques used for wastewater treatment, Environmental Chemistry, P.; Carrasco, C.;Application of electrocoagulation for the efficient pollutants removal to reuse the treated wastewater in the dyeing process of the textile industry,Journal of Hazardous Materials,371, 705-711(2019**)**.

[6] Sirirerkratana, K.;Kemacheevakul, P.;Chuangchote, S.; Water Pollution and Remediation Photocatalysis [1st ed.], Journal of Cleaner Production,215, 123-130(2019).

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1915 - 1924
Received 08 November 2021; Accepted 15 December 2021.

[7] Yue, Q.Y.;Gao, B.Y.;Wang, Y.; Zhang, H.; Sun, X.;Wang, S.G.;Gu R.R, A critical review on recent developments in the low-cost adsorption of dyes from wastewater, Journal of hazardous materials,152(1),221-227 (2008).

[8] Chaari, I.;Fakhfakh, E.; Medhioub, M.;andJamoussi, F,(2019), Removal of basic dyes from aqueous solutions by adsorption onto Moroccan clay (fez city),Journal of Molecular Structure,1179**,**672-677 (2019).

[9] Nikooe, N.;Saljoughi, E.; Adsorption of Reactive Orange 16 by using a macroporous polystyrene resin: Isotherm and kinetic studies, Applications of Surface Science, 413, 41-49 (2017).

[10]Hilary, I. Owamah; Ilabor S. Chukwujindu and Augustine, K. Asiagwu, Biosorptive capacity of yam peels waste for the removal of dye from aqueous solutions Civil and Environmental Research 3(1)(2013).

[11]Gergova, K.; Petrov, N. and Eser,S., Adsorption properties and microstructure of activated carbons produced from agricultural by –products by stream pyrolysis, carbon. 32, 693 -703 (1994).

[12] Arami- Niya A.; Daud, W.M.A. Wan, and Mjalli, F.S., Production of palm shell based activated carbon with more homogeneous pore size distribution , J. Applied Sciences , 10(24),3361 -3366 (2010)

[13] Hu, Z.; Srinivasan, M.P. Preparation of high-surface-area activated carbons from coconut shell, Micropor. MesoporMater. 27,11-18(1999).

[14]Tan, I.A.W.; Ahmad, A.L. and Hameed, B.H., Preparation of activated carbon from coconut husk: Optimization study on removal of 2,4,6-trichlorophenol using response surface methodology, J. Hazard. Mater. 153. 709-717 (2008).

[15]Kadirvelu, K. and Namasivayam, C., Activated carbon from coconut coir pith as metal adsorbent: adsorption of Cd (II) from aqueous solution, Adv. Environ. Res. 7, 471-478(2003).

[16]Ravanpaykar, A.; Asfaram, M. R.; Fathiemadaba, Removal of Dye (Blue 56) From Aqueous Solution via Adsorption onto Pistachio A. Shell: kinetic and isotherm study of removal process Journal of Chemical Health Risks 2(1)41-48 (2012).

[17]Juan F. Gonza ´ lez; Silvia Roma´n; Carmen M. Gonza ´ lez-Garcı ´a; Valente Nabais, J. M. and A. Luis Ortiz Porosity Development in Activated Carbons Prepared from Walnut Shells by Carbon Dioxide or Steam Activation Ind. Eng. Chem. Res., 48, 7474–7481 (2009).

[18] Balsi, S.; Dogu, T. and Yucel, H., Characterization of activated carbon produced from almond shell and hazelnut shell, Journal Chemical Technology and Biotech. 60,419-426 (1994).

[19]Daud WMAW; Ali WSW; Suleiman MZ., The effects of carbonization temperature on pore development in palm-shell-based activated carbon, Carbon 38, 1925-1932 (2000).

[20]Hayashi, J.; Kazehaya, A.; Muroyama, K.; Watkinson AP., Preparation of activated carbon from lignin by chemical activation, Carbon 38 ,1873-1878(2000).Sua´rez-Garcı´a F.;

[21]Martı´nez-Alonso, A.; Tascon, J.M.D., Pyrolysis of apple pulp: chemical activation with phosphoric acid, J.Analy. Appl. Pyrol. 63, 283-301(2002).

[22]Sharma, Y.C.; Singh, B. and Uma Fast Removal of Malachite Green by Adsorption on Rice Husk Activated Carbon The Open Environmental Pollution & Toxicology Journal 1, 74-78(2009)

[23]Sugumaran, P.; Priya Susan, V.; Ravichandran, P. and Seshadri, S., Production and Characterization of Activated Carbon from Banana Empty Fruit Bunch and Delonixregia Fruit Pod Journal of Sustainable Energy & Environment 3 ,125-132 (2012).

[24]APHA, AWWA and WPCF. “Standard Methods for the Examination of water and waste water”, 16th edition American Public Health Association, Washington, DC, 445- 456, 1985.

[25] Karthikeyan, S.;Sivakumar,P.; and Palanisamy, P.N, Novel activated carbons from agricultural wastes and their characterization, European Journal of Medicinal Chemistry,5(2), 409-426 ((2008).

[26]ViboonSricharoenchaikul.;ChiravootPechyen.;DuangdaoAht-ong.;DuangduenAtong.;Preparation and Characterization of Activated carbon from the Pyrolysis of Physic Nut Waste, Energy Fuels,22,31-37,(2007).

[27] He, H.; Yang, D.; Yuan, P.; Shen, W.; Frost, R. L. A novel organoclay with antibacterial activity prepared from montmorilloniteand ChlorhexidiniAcetas. J. Colloid Interface Sci. 297, 235−243 (2006).

[28] Gopinathan, R.;AvijitBhowa and Chandrasekhar Garlapati, Thermodynamic study of some basic dyes adsorption from aqueous solutions on activated carbon and new correlations, Journal of Chemical Thermodynamics,**107**, 182-188(2017).