Mesopo. Environ. j, Vol:3, No:4, pp(6-14), 2017
ISSN 2410-2598
Mesopotemia Environmental journal
journal homepage:www.bumej.com

Physical and chemical modification of *Alhagi maurorum* waste for enhancement removal safranin-O from aqueous solution

Alaa R. Omran

Environmental Research Center, University of Babylon , Hilla, 5001, Iraq.

Corresponding author: Rrashedalaa333@yahoo.com

To cite this article:

Omran. Alaa R. physical and chemical modification of *Alhagi maurorum* waste for enhancement removal safranin-O from aqueous solution. *Mesop. environ. j*., 2017, Vol. 3, No.4, pp. 6-14.

Abstract

On the way to accomplishing a supportable chemical and physical processes, *Alhagi maurorum* a low cost, natural waste and available material was explored to operate as an adsorbent for removal safranin-O in the industrial effluents. In addition to enter some of the enhancement such as acidic and thermal activation. The work was achieve in a batch with same dye concentration, adsorbent dosage, and contact time. Firstly, the removal of dye was very rapid, then step by step reduced representative diffusion into the inner of the adsorbent particles, increasment of the removal Sfranin-O dye percentages, taken the following sequences:

Acidic or wet activation 97% > thermal or dry activation 90.4 > orginal or non activation adsrpent 84.6%.

Keywords: *Alhagi (Alhagi maurorum*; *Alhagi persarum*; *Alhagi Camellorum*) or *A.pseudoalhagi.)*, Removal, safranin-O dye and Thermal enheansement.

Introduction

The researches and publications about industrial wastewater treatments growing attention of more the researchers at the last few years due to harmful of the materials dissolve in these waters, which are cause risky atmospheric changes. In recent time's more than ten thousand commercial dyes and more than seventy hindered thousand ton per year produced in the world to the textile industries[1].

Safranin-O, a cationic dye discharged mostly in textile and pharmaceutical industries (veterinary medicine). Exposure to these effluents may be irritating to respiratory systems, skin, and digestive tract infections when ingested[2-5].

These dyes due to have higher stability toward (bio, thermal, and photo degradation, his come from complex structure), removal these dyes from wastewater is very difficult and not fully[6-8]. Normally to get an effluent of higher quality appropriate for reuse must be there are effective treatment methods, these methods can be allocated in three classes can itemized in the table.1[9].

table.1. classes of wastewater treatment[3].

No	C+lass	type
1	physical	Adsorption, ion exchange, electro kinetic coagulation, irradiation in oxidizing medium
2	chemical	Fenton reagent, sodium hypochlorite, photochemical oxidizing, zonation, electrochemical distraction
3	biological	Adsorption on living or dead biomass, anaerobic treatment with single or mixed cultures of bacteria, biodegradation by white-rote fungi

The adsorption one of these physical methods is more operate to wastewater treatment due to its effective, and economical, particularly if the adsorbent is derived from natural sources such as plants wastes, to decreased cost hazardous problems[10-12].

Alhagi is genus of old world in the family Fabaceae. They are commonl called camel thorns or manna trees[13] there are three to five species. The genus name comes from the Arabic word for pilgrim[14]

Alhagi species have a main root mor than 15mm long due to their deep root system *Alhagi* species are drought avoiding plants the ground water, adapting in the that way perfectly to the hyper-arid environment[15]

Fig.1. Photo of adsorpant plant (*Alhagi (Alhagi maurorum*; *Alhagi persarum*; *Alhagi Camellorum*) or *A.pseudoalhagi*)

In this present paper will achieve examination of use *Alhagi maurorum* waste as adsorbent material for adsorption Safranin-O, at the same time identification the adsorption process by using Fourier Transform infrared spectroscopy (FTIR) to identifying type of the function groups of adsorbent that are responsible for entrapping the dye molecules. And study effect of enhance the surface of the adsorbent by thermal treatment and acidic treatment on the adsorption process comparing with the non-treatment adsorbent material.

Experimental part

Preparation of Adsorbent

The plant *Alhagi maurorum* waste were used as adsorbent were collected from middle Mahawell region in the north Babylon city middle of Iraq country. After collection process the waste was treated with tap water for2-3 hours to purification the plant waste, this step flowed by washing the martials by distilled water until obtained color less solution. The pure plant waste was leave to dried process for three days under sun light. the pure and dry waste plant were taken to grind in pulverized mill, and the powder was dried by the use oven at 50 ^{o}C for 24 hours.

Acidic activation

2g from purie and dry *Alhagi maurorum* waste powder was treated with 50ml 0.1M of hydrochloric acid for 2hours with starrier, and then powder washed with excess amount of distill water and dried oven dried at 50 ^{o}C for 24 hours. activeation powder was used for adsorption safranin-O from aquouse solution[16].

thermal activation

2g from dry *Alhagi maurorum* waste wast plant was heated at 100 ^{o}C for 4hours, the activation powder was used for adsorption safranin-O from aquouse solution[16].

Preparation Adsorbate Solution

The Safranin-O dye have Chemical formula= $C_{20}H_{19}N_4Cl$, Formula weight=350.8g.mol^{-1}, and chemical stracture in show in the fig 2[17]. supplied by BHD Chemicals. The standered solution (100mg/L) of the dye was prepared by dissolving appropriate amounts (accurate weighed) of dry powdered dye in double distilled water. The experimental solution was obtained by dilution were made to obtain the working solution at desired concentrations.

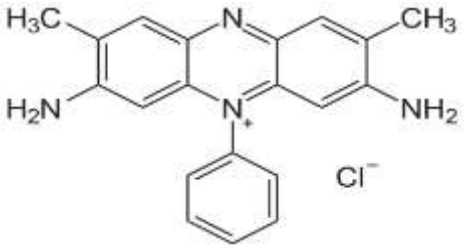

Fig. 2: Chemical Structure of Safranin O dye.

Adsorption study

Whited 0.05g from *Alhagi maurorum* waste powder from both activated (acidic and thermal powder activation) and non-activated powder (i.e. adsorbent) was put each sample alone into 250ml conical flasks. 100ml of the solution safranin-O with 20ppm concentration of Dye was added to the content in each conical flask. The content of each conical flask were shaken continuously for 100 min and take sample for each 20 min. The particles of the adsorbent were separation by centrifuged from solution to obtain the clear solution. The final absorption of dye was estimated for each sample spectrophometrically at the wavelength corresponding to maximum absorbance for safranin-O (λmax=518nm) using a spectrophotometer (UV/VIS-JENWAY,1600, Jerman). the amount of dye removal was calculated from following equation:

$$removal\% = (A° - A)\ A° \times 100\ldots$$

A^o and A is the absorption of concentration of dye before and after adsorption respectively[18].

FTIR spectroscopy

FTIR spectra were obtained using a PerkinElmer Tensor 27 Fourier transform infrared spectrometer (Germany). The spectral region between 4000 and 500 cm^{-1} was scanned. Specimens prepared as KBr pellets were used. Dried *Alhagi maurorum* powder (2 mg) was mixed thoroughly with KBr (300 mg) and then pressed in vacuo to homogeneous disc with a thickness of about 0.9 mm.

Results and discassion

A washing *Alhagi maurorum* powder was utilized as adsorbent material after washing and drying processes as the figure 4, and to increase the adsorption dye molecules, the powder was obey to the washing processes by the water tap, ethyl alcohol, and by distilled water until the washing solution become colorless.

Fig.3. *Alhagi Camellorum*, after washing drying, and grinded processes.

This stage was very useful for prevent interaction spectrophotometrically the extract absorbent solution and dye solution at shaken processes. Initially to sure the washing solution was analyzed spectrophotometrecally at 518nm[19].

Adsorption analyses

The contact time experiments for removal Sfranin-O by employed *Alhagi maurorum* powder (non, thermal, acidic activation) were carry out for time 160 minutes to reach the equilibrium time in the each experiment, and optimum conditions were concentration of dye was 20mg/L, adsorbent dosage 5g/L, PH. 6, room temperature was 23±2.
Originally the findings were recorded in the figure (5).

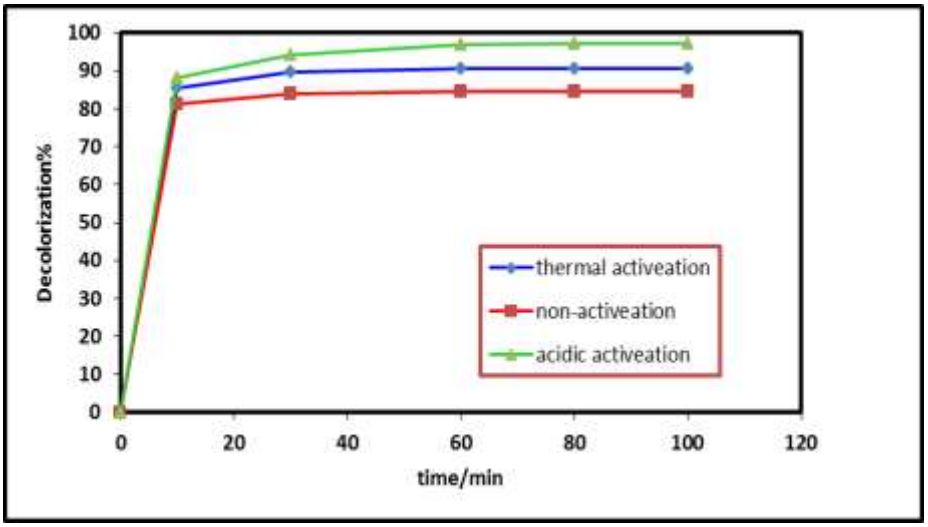

Fig.4. Removal of the Sfranin-O by employed *Alhagi maurorum* powder (enhanced and raw material), concentration of dye was 20mg/L, adsorbent dosage 5g/L, PH. 6, room temperature was 23±2.

The figure appear the removal sfranine- O dye percentage is increase with progress contact time for each carry out exterminates, at the same time can observed this incensement was gradual till the time 60 minute, that after this time the removal percentage was approximately constant.

At the first minutes for contact the adsorbents and dye solution the removal dye percentage was fast increasing that 90% for acidic activation, 86% for thermal activation, 80% for non-activation release at first ten minutes from the adsorption, because of amount of available localized active site on the surface of adsorbent. The rate of adsorption was gradually due to repulsion forces between dye molecules and adsorbed dye molecules, and electrostatic hindrance between of both dye molecules. The equilibrium time was 60 minute because of maximum amount of dye molecules were saturated the active sites of adsorbent[20-22].

Activation analyses

The activation experiments for enheance the removal Sfranin-O by employed *Alhagi maurorum* powder (non, thermal, acidic activation) were carry out optimum conditions were concentration of dye was 20mg/L, adsorbent dosage 5g/L, PH. 6, room temperature was 23±2, and contact time 70 minute.

At first the obtained results were documented in the figure (6), from the figure (6), observed there are enhance in the removal dye percentages which obtained from acidic and thermal activation of adsorbents comparing with removal dye percentages which obtained by used original material (non-active). In general the increasment the removal Sfranin-O dye percentages, taken the following sequences:

Acidic or wet activation 97% > thermal or dry activation 90.4 > orginal or non activation adsrpent 84.6%.

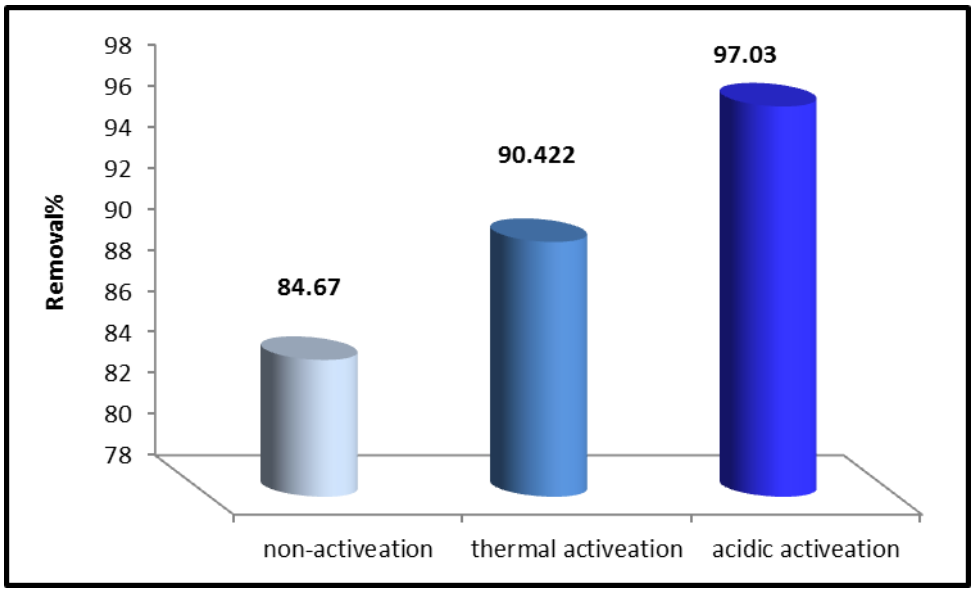

Fig.5. Removal of the Sfranin-O percentage by employed *Alhagi maurorum* powder (enhanced and raw material), concentration of dye was 20mg/L, adsorbent dosage 5g/L, PH. 6, room temperature was 23±2, and contact time 70 min.

The results show the acidic activation more active compared with the thermal and non-activation because of obtained structural chemical changes in the raw material like cation exchanges[23], in addition to the favorable because of its more economical than physical modefication, the degradation of the adsorbents is regulated by the acid concentration, temperature, impregnation time[24-25].

While the dry or thermal activation, is including release the moister and dry the absorbent, for this reason the surface area of the adsorbent is increasing[26].

Spectroscopic measurements

The idea for use Fourier Transform Infrared Spectrophotometric (FTIR) was for detecting types of Functional groups that are organized the structure of raw adsorbent material, and which responsible for entrapping the molecules of dye at same time. The FTIR spectrum of raw adsorbent material powder in the form of KBr pallet is shown in Figure 4.

Table 2: Infrared spectrum data of *Alhagi maurorum* powder

No	Frequency cm^{-1}	Assignment	
1	3390.86	O-H	Alcohol
2	1641.42	O-H	bending (of H_2O)
3	1056.99	C-OH	bending

The band between 3300 and 3400 cm^{-1} reprecent O–H stretching vibrations of alcohols in the structure of the *Alhagi maurorum* powder [27]. The band at the position 1641.42 cm^{-1} represented the bending vibration of absorbed water meanwhile fibers of hemicellulose have a strong affinity for water [28]. Usually there are numerous position changes in the bandes location or peack area when likening tow spectra before and after adsorption. These results agree with numerous reslutes in the paststudies[29-30].

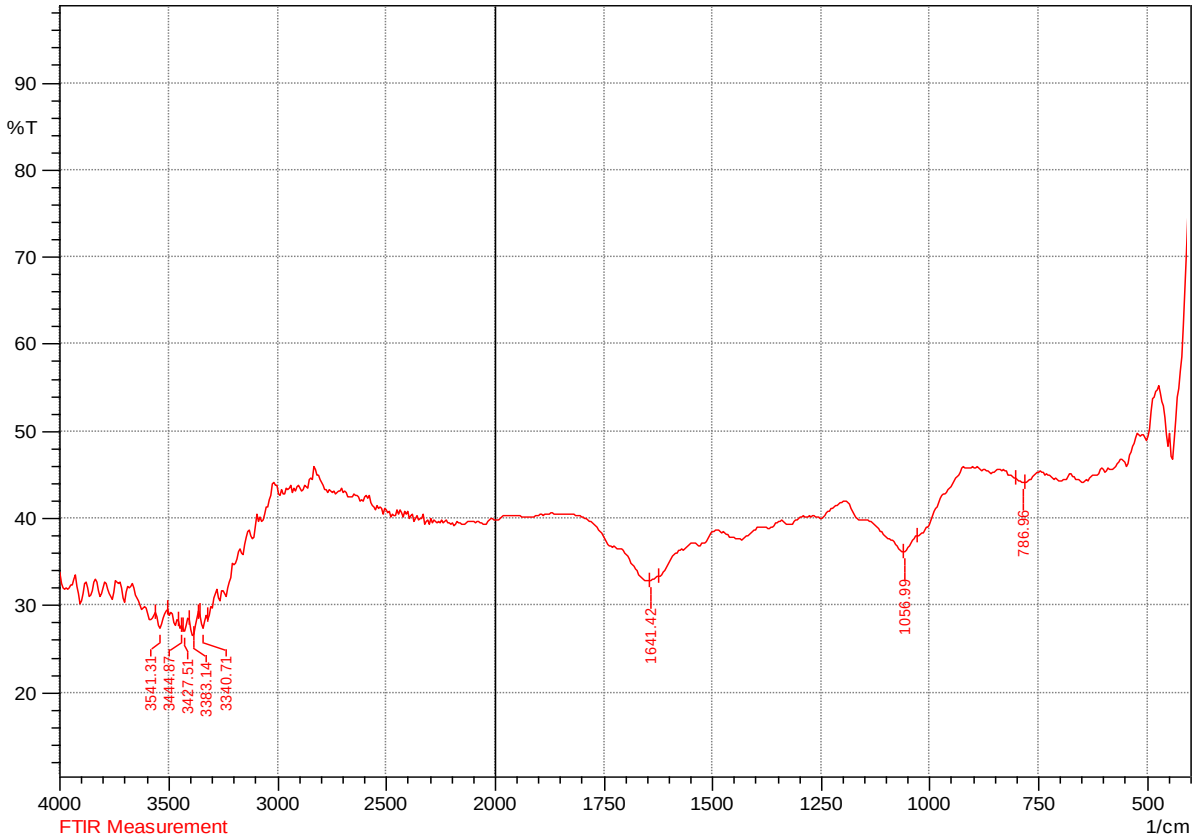

Fig. 6. FTIR spectrum of *Alhagi maurorum* powder before adsorption.

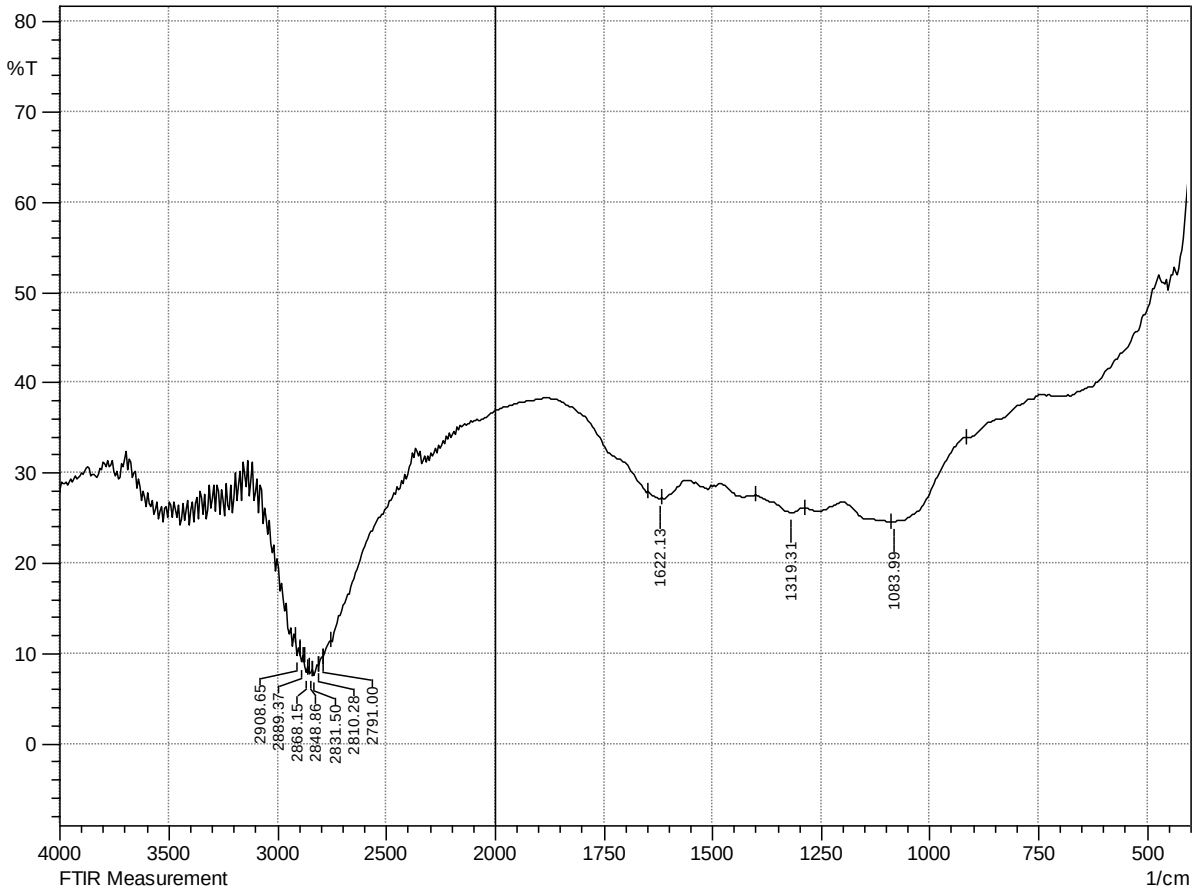

Fig. 7. FTIR spectrum of *Alhagi maurorum* powder after adsorption.

Conclusion

Alhagi maurorum a low cost, natural waste and available material was investigated to operate as an adsorbent for removal safranin-O in the industrial effluents. Study enhancement such as acidic and thermal activation.

1- Acidic or wet activation 97% > thermal or dry activation 90.4 > orginal or non activation adsrpent 84.6%.

2- Hydroxyl group was represent active site for adsorption dye.

References

[1] Rafatullah.M, Sulaiman,M.O. Hashim.R. and Ahmad,**A.** Adsorption of methylene blue on low cost adsorpents a review journal of hazardous matierals 177(1): 70-80, 2010.

[2] Clive,T. The Pesticide Manual, incorporating The Agrochemicals Handbook, Tenth Edition, British Crop Protection Council and the Royal Society of Chemistry, Farnham UK. 1994.

[3] Kumar,K. Ramamurthi,V., and Sivanesan S., "Modeling the Mechanism Involved During the Sorption of Methylene Blue onto Fly Ash," J. Colloid Interf. Sci., vol. 284, pp.14–21, 2005.

[4] Salman,J.M. Amrin,A.R. Jouda,**S.A.** Use of aquatic plant (*lemna minor*) as adsorbent materials to removal of methylene blue dye from aqueouse solution Journal of advance chemical scinces 2(1),192-194, 2016.

[5] Benhima,H. Chiban,M. Sinan,F. Seta,P. Persin,**M.** Removal of lead and cadmium ions from aqueous sodium by adsorption onto micro-particles of dry plants, Colloids Surface Biology: Biointerfaces. 61 10-16. 2008.

[6] Moulay,A. and Abdelilah,C, Electrochemical Studies of Adsorption of Paraquat onto Ca10(PO4)6(OH)2 from Aqueous Solution. Leonardo Journal of Sciences. 12, 25-34, 2008.

[7] Somasekhara,R Sivarama,K.L. Varada,R.A. The use of an agricultural waste material, Jujuba seeds for the removal of anionic dye (Congo red) from aqueous medium. J Haz. Mats. 203, 118-127, 2012.

[8] Gupta,V.K. R. Jain, T. Saleh, Nayak,A. Malathi,S. and Agarwal,**S.** Equilibrium and Thermodynamic studies on the removal and recovery of Sfranine-T dye from industrial effluent . separation Scince and technology, 46(5), 839-846, 2011.

[9] Nasuha,N. Hameed B.H., Azam T. and Mohd Din, Rejected Tea as a Potential Low-Cost Adsorbent for the Removal of Methylene Blue, J. Hazardous Materials, vol.175, pp.126–132, 2010.

[10] Chern,J.M. C.Y. Wu , Desorption of dye from activated carbon beds: effect of temperature, pH and alcohol, Water Research. 35, 4159-4165. 2011.

[11] Salman,J.M. Amrin,A.R. Jouda,S.A. Aquatic crusteans shell as adsorpents for paraquate pesticide removal from its aqueous solution by thermal activation Mesop environ J. 1 4, 75-83, 2015.

[12] Olusegun,S. and Ugba,**E.** Adsorption of textile wastes containing methylene blue and Congo red using activated carbon produced from coconut shell. IJCEM International Journal of Computational Engineering & Management. 16, 5. 2015.

[13] Awaad,A.S. Maitland,D.J. and Soliman,**G.A.** Antiulcerogenic Activity of Alhagi maurorum, Pharmaceutical Biology, 44, 4, 292–296, 2006.

[14] Fakhri,K.P. Adelzadeh,P. Pharmacology and Medicinal Aspects of Plants listed in Holey Quran; Alhagi (*Alhagi maurorum*), Bull. Env. Pharmacol. Life Sci., 2 (6): 19-22, 2013.

[15] Gargoum,H.M. Muftah,S.S. Al Shalmani,S. Mohammed,H.A. A.N.Alzoki, A.H. Debani, O.Al Fituri, F.El Shari, I.E.Barassi, S.E Meghil, A.G.Abdellatif, Phytochemical screening and investigation of the effect of Alhagi maurorum (Camel thorn) on carbon tetrachloride, acetaminophen and adriamycin induced toxicity in experimental animals, Journal of Scientific and Innovative Research; 2 (6): 1023-1033, 2013.

[16] Zonoozi,M.H. Moghaddam,M.R. M. Arami, Coagulation/Flocculation of dye containing solutions using Polyaluminium chloride and alum, Water Sci. Technol. 59 1343-1351. 2009.

[17] Shrivastava,V.S. Photocatalytic degradation of Methylene blue dye and Chromium metal from wastewater using nanocrystalline TiO_2 Semiconductor Arch. Appl. Sci. Res, 4 (3) 1244-1254. 2012.

[18] Bulut,Y. Aydın, H., A kinetics and thermodynamics study of methylene blue adsorption on wheat shells, Desalination, vol. 194, pp.259–267, 2006.

[19] Fuchsman,**C.H.** Peat Industrial Chemistry and Technology, Academic Press, 1980.

[20] Nimkar,D. A. S. K. Chavan, Removal of Congo red Dye from Aqueous Solution by Using Saw Dust as an Adsorbent, 4, 4, 47-51, 2014.

[21] Han,R. Zou, W., Yu, W., Cheng, S., Y. Wang and J. Shi, Biosorption of methylene blue from aqueous solution by fallen phoenix trees leaves, J. Hazard Mater., vol. 141, pp. 156–162, 2007.

[22] Sutcu,**H.** Pyrolysis of Phragmites Australis and characterization of liquid and solid products, Journal of Industrial and Engineering Chemistry 14, 573–577, 2008.

[23] P.K. Malik, S.K. Saha, Oxidation of direct dyes with hydrogen peroxide using ferrous ion as catalyst, Sep. Purif. Technol, 31, 24-250, 2003.

[24] S.Marius, S.Benoit C., Igor C., Mariana D. and Stelian P., Removal of an Acid Dye from Aqueous Solution by Adsorption on a Commercial Granular Activated Carbon:Equilibrium, Kinetic and Thermodynamic Study, vol. 12, No. 4, pp. 307-322, 2011.

[25] Netpradit,S. P.Thiravetyan and S.Towprayoon, Adsorbtion of three azo reactive dyes by metal hydroxide sludge ; effect of temperature, Ph, and electrolytes journal of Colloid and interface Scince, 270 (22) 255-261, 2004.

[26] Bhatnagar,A. Sillanppa,M. Utilization of agro- industrial and municipal waste materials as potential adsorbents for water treatment a review Chem Eng J 157, 277-296, 2010.

[27] Yusuf,M. Elfghi,F.M. Mallak,S.K. Kinetic studies of Safranin-Oremoval from aqueouse solution using Pineapple Peels, iranica journal of energy& Environment 6(3), 173-180, 2015.

[28] Hameed,B. H Evaluation of papaya seeds as a novel non-conventional low-cost adsorbent for removal of methylene blue. J. Hazard. Mater. Vol.162, pp: 939–944, 2009.

[29] Salman,J.M. Amrin,A.R. Hassan,F.M. Jouda,S.A. Removal of congo red dye from aqueous solution by using natural materials . Mesop. environ. j. 1 (3) 82-89. 2015.

[30] Patil,A.K. and Shrivastava.V.S Alternantherabettzichiana plant powder as low cost adsorbent for removal of Congo red from aqueous solution. Int. J. ChemTech Res., 2, 842–850. 2010.