International Journal of Engineering & Technology, 7 (4.36) (2018) 713-717

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Adsorption Study of Malachite Green Dye of New Schiff Base Liquid Crystal Surface (Thermodynamic and Kinetic)

Adraa Abdul Kadhim Wasaf AL-Fatlawy[1*]

[1]Lecturer, Department of Chemistry, Faculty of Education for Girls, Iraq

Abstract

This work incorporates blends of new heterocyclic mixes of (2-amino-6-methoxy benzothiazole), from response with (p-hydroxybenzaldehyde) to yield Schiff bases, the compound have been distinguished (FT-IR ,HNMR) the misomorphic stages were recognized by energized light magnifying lens (POM) and estimated change temperatures for compound by differrntion checking calorimeter (DSC) at that point investigation of fluid precious stone properties and we will contemplate the adsorption of malachite green color on this fluid gem as a surface. Likewise The examination incorporated the trial of applying the isotherm models of Langmuir, Freundlich, harkinsjura and Temkin to the handy adsorption information of the color under investigation utilizing the UV spectroscopy. The active information were demonstrated by utilizing pseudo-first-arrange, pseudo-second-request, Elovich and intra-molecule dispersion energy conditions, Adsorption adsorbents were additionally used to get the estimations of the thermodynamic capacities (Free vitality ΔG, enthalpy ΔH, and ΔS entropy and actuation vitality).

Keywords: *Schiff basis, liquid crystal, adsorption, isotherm, kinetic.*

1. Introduction

The synthetic equation of 2-amino-6-methoxy benzothiazole (C21H24NSO2) is framed by along chain which additionally contains one aryl ring , essential amine gathering and methoxy gathering. The adsorption wonder persuades a measure of particularly noteworthy procedures of utilitarian importance its reasonable applications in; industry, ecological security, strategies for detachment of blend, filtration of water, particle trade et cetera. Additionally the adsorption of substrates is the primary stage in numerous reactant process3. In this investigation cluster adsorption tests were performed at temperature extend from 30oC to 60 oC utilizing UV-Unmistakable spectrophotometer. The target of this examination was to degree the past work of adsorption onto some horticulture squanders or normal Karoline for expulsion the compound from watery arrangements, its thermodynamic and active parameters.

2. Experimental

All substance utilized were provided from Merk Compound, Fluka& BDH synthetic concoctions. Softening focuses were recorded utilizing Electrothermal dissolving point mechanical assembly. FT.IR-spectra were recorded with shimadzu FT.IR-8300 ,H1.NMR-sepectra in (PPm) unit were acquired in DMSO arrangement utilizing (Bruker, Ultra Shield 300 MKZ Switzerland), For estimating the absorbance of each color fixations an UV-Unmistakable spectrophotometer (shimadzu UV 4000,Japan) was utilized.

Blend of Schiff premise compound (1) from 2-amino-6-methoxy benzothiazole:4,5

2-amino-6-methoxy benzothiazole compound (0.005)mole was broken down in(50)ml of supreme ethanol and (2)ml of hot cold acidic corrosive, at that point included (0.005)mole of (4-hexeloxy benzaldehyde) which disintegrated in total ethanol the response blend was refluxed with mixing (6hrs) at 120 C0 the encourage was separated and recrystallized.

2.1. Harmony adsorption explore

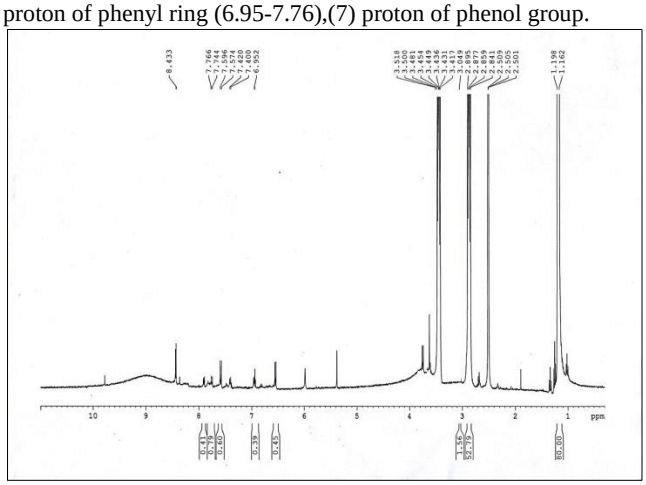
In the wake of deciding the best time and the best weight of the compound was examined with the end goal to ascertain the active and thermodynamic parameters, group procedure was utilized in adsorption ponders by including the best measure of fluid precious stone to a progression of 50 ml fixed cone shaped carafes loaded up with 25 ml of known starting convergence of malachite green. After that the adsorption isotherm of the color was gotten by getting ready 5 centralizations of the spongy material inside the range (2-10 mg/L) in volumetric glass (100ml). The focus was taken and set in contact with a specific weight Of the adsorb ate surface shifts for the color and put in a cone shaped carafe limit (50ml)) and afterward set at a temperature controlled by water shower, furnished with shaking and in the wake of shaking for a specific timeframe. At the point when the pH was impartial, at that point filtration of the arrangements utilizing channel sheets to dispose of the surface minutes. By methods for the UV spectrometer at the λmax of the color to decide the absorbance esteems The focus at the harmony (ce) mg/L was resolved from the adjustment bend then the amount of the spongy substance (qe) mg/g was found and the level of evacuation.

3. Results and Discussion:[6,7]

1-The aromatic aldehyde such as(4-hexeloxy benzaldehyde) as in absolute ethanol in the presence of glacial acetic acid as catalyst and aromatic amine like 2-amino-6-methoxy benzothiazole the

products were characterized by the FTIR spectrum which show appearance of the stretching vibr(CO)carbonyl of 2-amino-6-methoxy benzothiazole(1330) cm^{-1},(CH) aromatic group (3036),C=N of imine (1583),C=C aromatic(1506),(CH) (CH_3) alifatic group (2928-2868)cm^{-1},(C-N)at(1251),(C-C) at(1153)(C-S)at (1095)

H^1NMR spectra-showed signal at δ(8.43) due to (CH=N) proton of imine group in compound ,signal & showed appear signal at (1.16-3.51)(13)proton from (C_6H_{13})and (3)proton of (OCH_3),Ar-H proton of phenyl ring (6.95-7.76),(7) proton of phenol group.



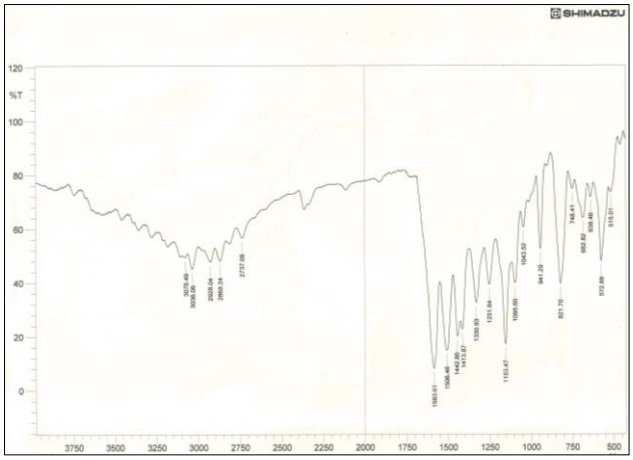


Fig. 1: I.R of compound 2-liquid crystal study

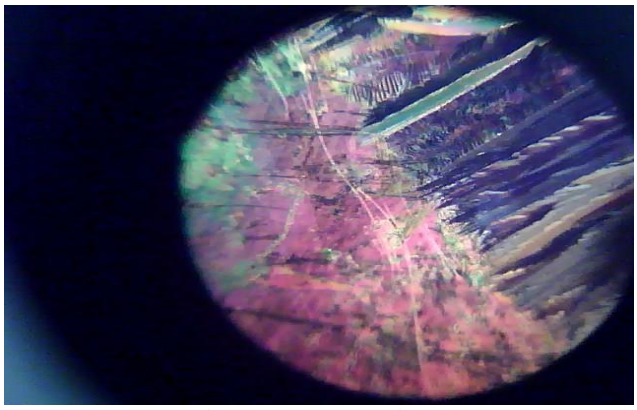


Fig. 2: COMP.transformation at 65.12 C°from N to Cr by cooling

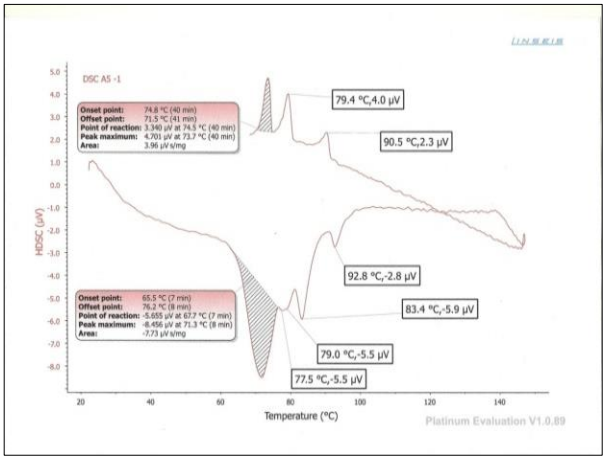


Fig. 3: Data of differntion scanning calorimeter (DSC) of comp

Table 1: Data of Thermodynamic

No. comp.	M. P	Color	Yield	Cr–Cr			Cr–N		
				$T_{c°}$	ΔH	ΔS	T	ΔH	ΔS
1	85	yellow	78 %	65.5	7.73 -	22.83 -	83.4	-5.9	16.55 -

(ΔH=KJ/mol; ΔS =J /mol .K°)

3.1. Adsorption study

With the end goal to comprehend the adsorptive conduct for strong - fluid adsorption framework, it is critical to locate the most suitable relationship for the balance bend, the pertinence of the sort isotherm models to the adsorption consider have been thought about by the connection coefficients, R2values. In this exploration different isotherm models have been tried for clarifying the adsorption procedures, for example, Langmuir, Freundlich, Temkin, Harkins jura8,9,10,11

Table1, and Figure1 (a,b,c,d) have been demonstrated the isotherm constants, connection coefficients, the aggregate sorption limit and the isotherm models. From these table and figures, connection coefficients of Langmuir, Freundlich and harkinsjuraisotherms models were the great fitting for malachite green adsorption, The Langmuir isotherm11 which is material for monomolecular layer adsorption has been effectively connected to get a most extreme adsorption limit. Langmuir isotherm accept that most extreme particle trade spends on the immersion level of monolayer of adsorb ate atoms on the adsorbent surface that the vitality of particle trade is steady, and there is no transmigration of adsorb ate particles at first glance plane while Freundlich isotherm12 (an experimental condition) portrays adsorption onto a heterogeneous surface through a multilayer adsorption instrument and Temkin and pyzhev13takes into record of the adsorbent – adsorb ate communications on adsorption isotherms. It dependent on the presumption that because of the adsorbate shocks the warmth of adsorption of the considerable number of particles in the layer diminishes directly with the inclusion of atoms and the adsorption of adsorbate is consistently appropriated, finally Harkins-Jura is an isotherm parameter which represents multilayer adsorption and clarifies the presence of heterogeneous pore distribution11.the results sees that Langmuir isotherm is the great fitting and Harkinsjura, Temkin isotherm likewise a decent fitting for malachite green adsorption , that implies the adsorption locales increment exponentially with adsorption and the warmth of adsorption of all atoms in the layer would diminish straightly with coverage14 additionally we demonstrated house that adsorption on heterogeneous surfaces are multilayer adsorption with an exponential dispersion of site vitality 15.

Energy examination of adsorption

Pseudo – first-arrange, Pseudo-second-request, Elovich and Intra-molecule dispersion were utilizing as an energy models to portray the adsorption mechanism11,,15,16,17. The estimations of connection coefficients (R2) demonstrated that. Table2and figure 2(a,b,c,d)showed the active models conditions and the active constants for malachite adsorption onto surface ,From this table plainly the pseudo – second – arrange active model is the best fitting to the test information superior to alternate models (R2 esteems are the higher for the color) that implies the energy of this color adsorption is pursued pseudo-second request show instrument.

3.2. Thermodynamic parameters

Thermodynamic parameters, the enthalpy ΔH), entropy ΔS) and Gibbs free vitality ΔG) changes were resolved to compute the thermodynamic possibility and precipitously nature of the

adsorption process and they were computed and the outcomes saw that the response was endothermic and the adsorption is physical and the entropy diminishes inside increments of the temperature and the response was precipitously nature ,finally the actuation vitality was sure which arraigned the physical response. as appeared in figure 3 and table 3

Table 2: Show the Comparison of the Values of the Adsorption Equations of Isotherm and the Correlation Coefficients for Adsorption of Pigment Dye Malachite Green on the Surface at a Weight of 0.05g and the Equilibrium Time of 30 min within the Thermal Range 308 to 338 K.

Dye	Isotherms Equation	Parameters	Temperature			
			303K	313K	323K	333K
Malachite Green	Langmuir $\frac{C_e}{q_e} = \frac{1}{K_L q_m} + \frac{C_e}{q_m}$	q_m	0.75987	0.5722	0.4551	0.2891
		K_L	o.2837	1.1295	1.1129	9.8138
		R^2	0.9869	0.9192	0.9523	0.9453
	Freundlich $\ln q_e = \ln K_F + \frac{1}{n}\ln C_e$	N	8.635	17.2117	9.7847	9.7847
		K_f	0.7182	1.7296	2.3598	2.3598
		R^2	0.2671	0.5897	0.459	0.459
	Temkin $q_e = B\ln K_T + B\ln C_e$	B	0.0428	0.034	0.0428	0.034
		K_T	0.0664	0.06145	0.06644	0.06145
		R^2	0.6987	0.814	0.6987	0.814
	Harkins jura $\frac{1}{q_e^2} = \frac{B}{A} - \frac{1}{A}\log C_e$	A	1.64717	2.9770765	0.63283	19.53125
		B	1.40382	1.0936904	10.1314	o.41147
		R^2	0.453	0.1036	0.3069	0.567

Table 3: Show the Constants of the Kinetic Equations and the Correlation Coefficient for Adsorption of the Dye at a Weight of 0.05g of Liquid Crystal and the Acid Function pH = 7 and at a Primary Concentration of 6 mg/L.

Dye	Linear equation of Kinetic model	Parameters	Temperature			
			303K	313K	323K	333K
Malachite Green	Pseudo-first- order $Ln(q_e - q_t) = \ln q_e - Kt$	k	0.008	0.0123	0.012	0.0157
		R^2	0.7761	0.8812	0.8799	0.8738
	Pseudo-second- order	k	1.937496	2.9797	14.867	13.4353
		R^2	0.3707	0.316	0.562	0.1532
	Elovich $q_t = \frac{1}{\beta}\ln(? \beta) + \frac{1}{\pi}\ln t$	B	49.50495	46.51162	49.019	56.17977
		?	7.141245	1.034791	1.0554	1.110710
		R^2	0.9783	0.9938	0.9882	0.958
	Intra – partical - diffusion $q_t = k_{diff} t^{1/2}$	k	0.0202	0.0215	0.0204	0.0178
		R^2	0.9783	0.9938	0,9882	0.958

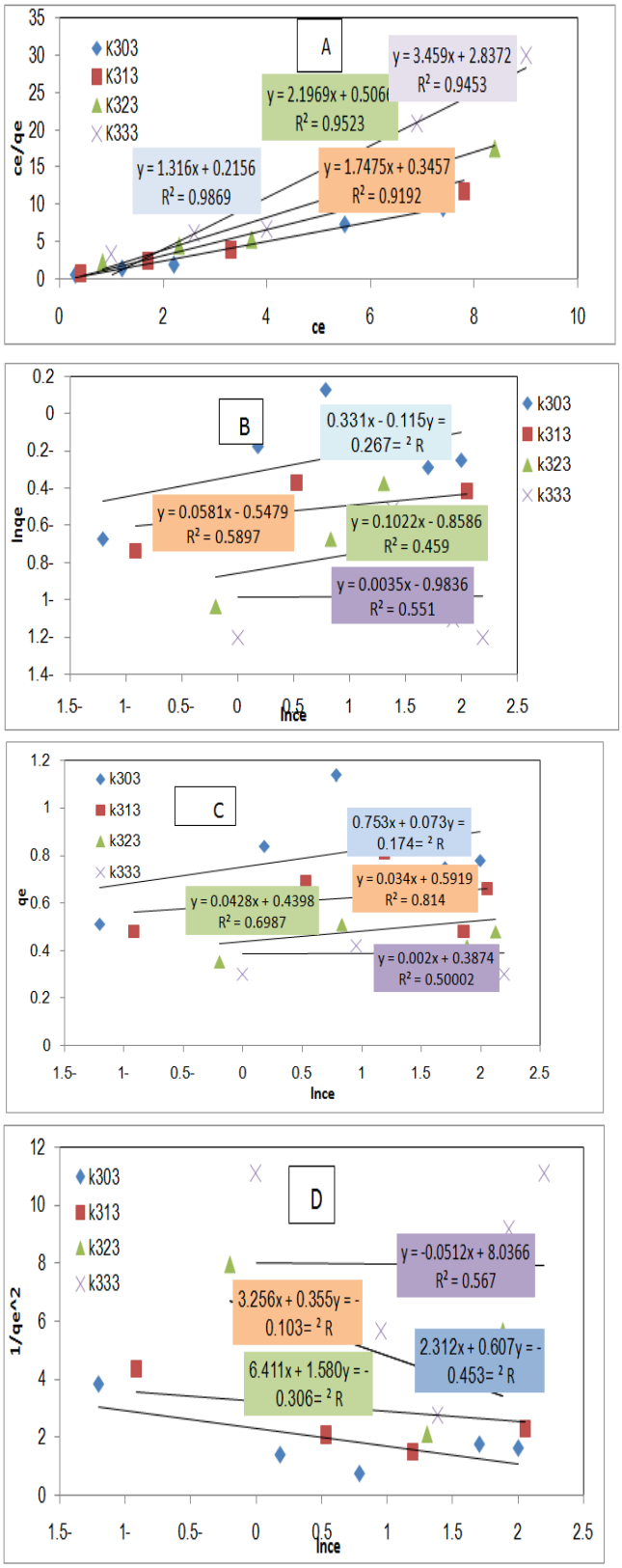
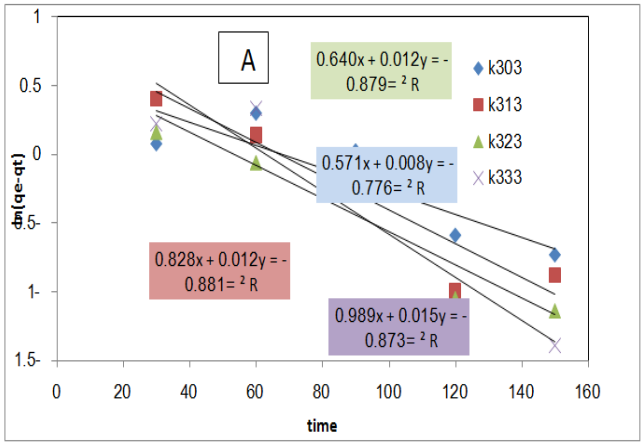
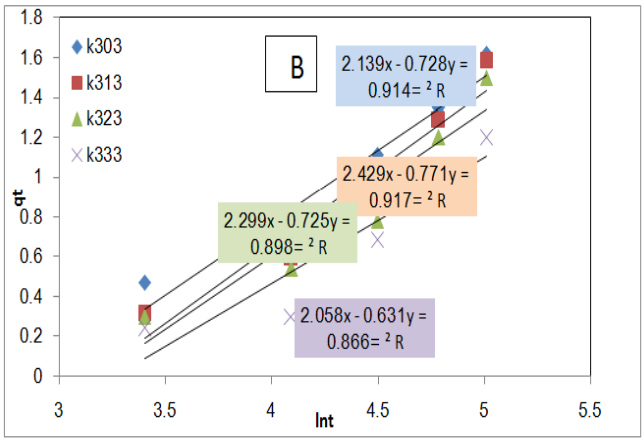
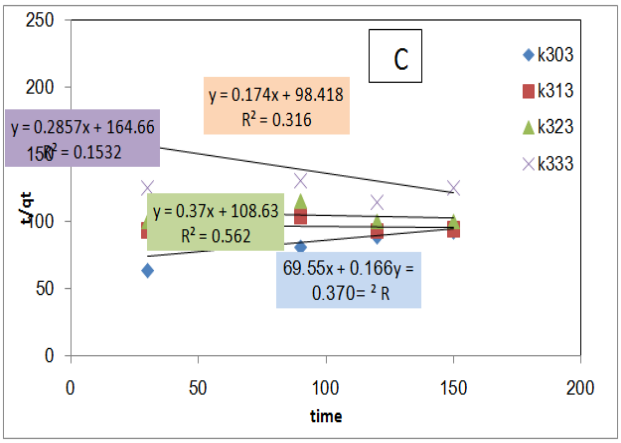


Figure 3: (a) Langmuir isotherm (b) Freundlich isotherm (c) Temkin isotherm (d) Harkinsjura isotherm plots for different initial concentrations ranging 2-10ppm of the Malachite adsorption







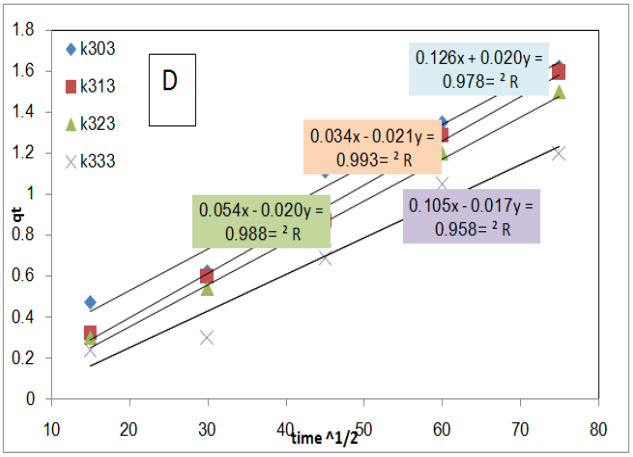
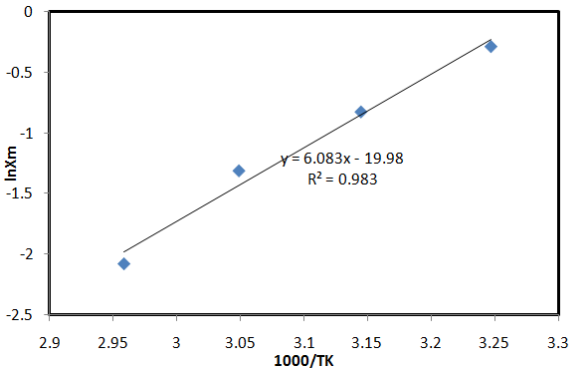


Figure 4: (a) pseudo – first – order (b) pseudo –second – order (c)Elovich (d) intra partical diffusion, kinetic plots for adsorption of Malachite green.

Table 4: Shows the Equations of the Thermodynamic Functions of the Adsorption of the Malachite Green Dye

dye	Equation parameter	Δ G Jmol^{-1}				ΔH Jmol^{-1}	ΔS Jmol^{-1} K^{-1}	EaJ/mol
	$\ln X_m$=-ΔH/R+C	308K	318K	328K	338K			
MG	ΔG=-RTlnXm ΔG=ΔH-TΔS Ea=ΔH+RT	736.67	2185.6	3578.32	5843.5	50.5765	-2.2275	2611.288



4. Conclusion

A sorbents was effectively used for the expulsion of surface from watery arrangement by clump adsorption technique. The balance information were tried utilizing the Langmuir, Freundlich, Temkin, Elovich isotherms. Connection coefficients and Blunder examination showed the accompanying request to fit isotherms Langmuir>harkinsjura>Temkin>Freundlich, Active parameters were likewise dissected utilizing the pseudo-first request, Pseudo-second request, and Elovich and intra molecule dispersion demonstrate. Dynamic examinations demonstrated that the adsorption onto the color pursued Pseudo-second request motor model. Thermo dynamic impact demonstrated that the adsorption is exothermic and the entropy is decline and its unconstrained inside the breaking points of physical adsorption.

References

[1] Richard AH & Ferrier RD, Biochemistry Lippincott's Illustrated Reviews, (2010), pp.235-242.
[2] Guyton A & Hall J, *Textbook of medical physiology*, 11th edition, (2006).
[3] Dąbrowski A, "Adsorption—from theory to practice", *Advances in colloid and interface science*, Vol.93, No.1-3, (2001), pp.135-224.
[4] Sridevi C, "Designing New Vanillin Schiff Bases and their Antibacterial Studies", *Journal of Medical and Bioengineering*, Vol.4, No.5, (2014), pp.363-366.
[5] Haddad HH, "A New Schiff Base Derivatives Designed to Bind Metal Ion (Cu, Co): Thermodynamics and Biological Activity Studies", *American Journal of Analytical Chemistry*, Vol.7, No.5, (2016), pp.446-451.
[6] Silverstein RM, Webster FX & Kiemle DJ, *Spectrometric Identification of Organic compounds*, 7thed, John Wiley and sons Inc, New York, (2005).
[7] Pavia DN, Lampman GM & Kriz GS, *Introduction to spectroscopy*, 3thed,Thomson Learning, Inc, United states of Hanaa Hameed Haddad America, (2001).
[8] Ishaq M, Saeed K, Ahmad I & Sultan S, "Coal Ash as a Low Cost Adsorbent for the Removal of Xylenol Orange from Aqueous Solution Iran", *J. Chem. Chem. Eng.*, Vol.33, No.1, (2014), pp.53-58.
[9] Başar CA, "Applicability of the various adsorption models of three dyes adsorption onto activated carbon prepared waste apricot", *Journal of Hazardous Materials*, Vol.135, No.1-3, (2006), pp.232-241.
[10] Shouman MA & Khedr, SAA, "Removal of Cationic Dye from Aqueous Solutions by Modified Acid-Treated Pomegranate Peels

(PUNICA GRANATUM): Equilibrium and Kinetic Studies", *Asian J. of App. Sci.*, Vol.3, No.4, (2015), pp.574-588.
[11] Hamdaoui O & Naffrechoux E, "Modeling of adsorption isotherms of phenol and chlorophenols onto granular activated carbon: Part I. Two-parameter models and equations allowing determination of thermodynamic parameters", *Journal of Hazardous materials*, Vol.147, No.1-2, (2007), pp.381-394.
[12] Freundlich HMF, "Over the Adsorption in Solution", *Journal of Physical Chemistry*, Vol.57, (1906), pp.385-471.
[13] Temkin MJ & Pyzhev V, "Recent Modifications to Langmuir Isotherms", *Acta Physiochim URSS*, Vol.12, (1940), pp.217- 225.
[14] Hasan SA, Kadhm LH, Husain ZN & Tuaima AA, "Utilization of cement kiln dust f for removal of some water-soluble dyes", *Eur. J. of sci. Res*., Vol.93, No.1, (2012), pp.113-124.
[15] Langergren S & Svenska BK, "Zur theorie der sogenannten adsorption geloester stoffe", *Veternskapsakad Handlingar*, Vol.24, No.4, (1898), pp.1-39.
[16] Ho YS & McKay G, "Sorption of dye from aqueous solution by peat", *Chemical engineering journal*, Vol.70, No.2, (1998), pp.115-124.
[17] Weber WJ & Morris JC, "Advances in water pollution research", *First International Conference on Water Pollution Research*, Vol.2, (1962), pp.235-266.