Study of Bio Sorbents for the Treatment of Simulated Dyes Waste Water

Atiya Firdous[1*]

[1]*Department of Chemistry, Jinnah University for Women, 5C Nazimabad, 74600, Karachi, Pakistan.*

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Original Research Article

ABSTRACT

Water pollution is one of the burning issues of today's world; it is the primary cause of different diseases in living beings. Textile effluent is the primary source of water pollution. Marine lifespan, environment and our ecosystem are affected severely by the dumping of dyes from industries into the water. The objective of this research is adsorption, thermodynamics and kinetic studies of two different organic dyes onto abundantly available inexpensive adsorbents like *Phoenix dactylifera* (date pits), *tea waste* (tea leaves), *Zea covering* (corn husk) and *Prunus persica* (peach seeds) for the elimination of acidic (Congo red) and basic (Malachite Green oxalate) dyes from solutions. Selected adsorbents have high surface reactivity and adsorption capability to eliminate the mentioned dyes from the wastewater system.

_____

*Corresponding author: E-mail: firdous.atiya@live.com;

1. INTRODUCTION

Many dyes used in the textile industry cause environmental and health problems It is well known that malachite green oxalate and congo red, are incredibly toxic dyes, considered as the primary pollutants. Colours are not biodegradable and tend to accumulate in living organisms causing illnesses and disorders [1]. Therefore, removal of dyes from water is currently one of the most critical environmental issue being investigated. Treatment processes of malachite green oxalate and congo red dye removal from seawater through the process of adsorption have recently been studied [2]. However, it has become a challenge for researchers to seek cheaper and more efficient adsorbents for an elimination of dyes.

Tea leaves, corn husk, date pits and peach seeds are the most widely consumed products throughout the world for its beneficial effects on health, such as antioxidant, anti-carcinogenic, antimicrobial activities [3]. The objective of the present recent is to eliminate malachite green oxalate dye and congo red dye from water. Mentioned natural adsorbents were instigated to be reliant on contact time, dye concentration and amount of adsorbent by using spectrophotometric technique before and after adsorption of dye. Maximum adsorption of date pits observed in 20 min with percentage removal of 96.3 %, maximum adsorption of tea leaves observed in 30 min with 94.23%, extreme adsorption of peach seed powder found in 40 min with percentage removal of 95.48% and the maximum adsorption of corn husk observed in 40 min with 94.40%. The investigational data fitted well to pseudo-second-order kinetics model and have a regression coefficient value of 0.999 approximately [4]. Values of percentage removal and K_D for all the adsorbents and dyes systems were also examined at temperatures from 298K to 318K. The adsorption isotherms like Langmuir and Freundlich were employed, and the values of constants were calculated to estimate the adsorption characteristics [5]. Thermodynamic parameters like ΔG°, ΔH° and ΔS° were also calculated and it was observed that adsorption is spontaneous and endothermic [6]. The surface morphology of adsorbate and adsorbent was resolute by SEM technique of Jeol Japan with model number JSM 6380A. K_D (the adsorption-desorption coefficient) values are determined over a range of concentrations at a constant temperature [7].

2. EXPERIMENTAL SECTION

2.1 Preparation of Malachite Green Oxalate and Congo Red Dye Solutions

Dye solution of congo red was prepared by using double distilled water. The absorbance of respective concentrations of dye was measured by UV-Visible spectrophotometer of Jeol Japan with model number EX-54175JMU showed a maximum peak in diluted concentration of dye around 498 nm. Molar extinction coefficient of congo red is approximately 45000 $M^{-1}cm^{-1}$. Similarly, Malachite green oxalate dye showed a peak in the diluted concentration of dye around at wavelength 621 nm and its molar extension coefficient is $1 \times 10^5 \, M^{-1}cm^{-1}$ [8].

2.2 Preparation of Natural Adsorbents

Peach, corn, tea and date wastes were collected from Nazimabad suburb of Karachi, Pakistan, washed with distilled water, ground and sieved into powder of sizes 0.146-0.342 mm, 0.1546-0.4623 mm and 0.0365-0.2876 mm, 0.265-0.435 mm, respectively dried in an oven at 390 K for 2 days, after complete drying all adsorbents were stored in desiccator for further use [9].

2.3 Optimization of Adsorbent Dosage

The number of adsorbents varied from 0.1g to 1.2g. All the flasks were placed in shaking incubator for 30 min, and the temperature was adjusted. The analyte of each flask was filtered by using filter paper and an absorbance of both the dyes were analyzed by using spectrophotometer at their particular wavelengths. The optimum dose of all the adsorbents were obtained by calculating % removal values and distribution coefficient values [10].

2.4 Optimization of pH

The pH of Point Zero Charge (pH_{PZC}) was determined by adopting pH drift method for the efficient removal of dyes solution. The 0.005M NaCl solution was prepared and initial pH was adjusted by adding either 0.1M HCl or 0.1M NaOH in such a manner that 3 flasks have acidic pH (2, 4, and 6) and other 3 flasks have basic pH (8, 10, 12). The solutions were agitated with 0.05g of adsorbents and pH was recorded. pH of flasks was noted after 24 and 48 hours.

2.5 Ionic Strength (KCl)

Different concentrations of KCl (0.01–0.05 M) were added to investigate the effect of ionic strength for the adsorptive removal of dyes. The increase in ionic strength causes an increase in the adsorption of congo red and malachite green oxalate dye [11].

2.6 Determination of Shaking Time

For optimum shaking time, 30ml of dye solution was taken in shaking flask and the optimized amount of adsorbents were added in all flasks. The shaking time was varied from 10 to 50 min for both dyes. After a specific interval of time content of each flask was filtered, and the absorbance of the filtrate was recorded using UV-visible Spectrophotometer. The optimum shaking time of adsorbent was determined by finding distribution coefficient (K_D) and percentage removal values [12].

Table 1. Analysis of amount

Optimization of Amount for the Elimination of Congo Red Dye by Using Tea leaves powder			
Amount(g)	Equilibrium Conc.$\times 10^6$ (M)	% Removal	K_D
0.1	2.933	93.139	1.761
0.2	1.842	77.452	1.751
0.3	9.111	78.690	1.822
0.4	4.066	90.488	0.612
0.5	7.601	82.224	0.912
0.6	9.602	77.546	0.961
0.7	2.977	93.035	0.255
0.8	2.466	94.230	0.185
Optimization of Amount for the Elimination of Congo Red Dye by Using Date pits powder			
Amount(g)	Equilibrium Conc.$\times 10^7$ (M)	% Removal	K_D
0.1	0.213	67.123	128
0.2	6.888	89.383	20.666
0.3	0.153	76.369	30.666
0.4	0.106	83.561	16
0.5	3.333	94.863	4
0.6	2.444	96.232	2.444
0.7	6.444	90.068	5.523
0.8	7.555	88.356	5.666
0.9	4.222	93.493	2.814
Optimization of Amount for the Removal of MGO Dye by using Corn Husk powder			
Amount(g)	Equilibrium Conc.$\times 10^6$ (M)	% Removal	K_D
0.1	1.712	89.579	10.275
0.3	1.141	93.052	2.283
0.5	9.200	94.401	1.104
0.7	1.423	91.336	1.220
0.9	1.920	88.312	1.280
1.2	1.631	90.069	0.815
Optimization of Amount for the Removal of MGO Dye by Using Peach seeds shell powder			
Amount(g)	Equilibrium Conc.$\times 10^6$ (M)	% Removal	K_D
0.1	0.210	89.605	4.905
0.3	0.152	90.134	5.081
0.5	8.193	94.697	1.638
0.7	7.051	95.436	1.007
0.9	8.193	94.697	0.910
1.2	6.984	95.480	0.582

Table 2. Analysis of time

Optimization of time for the elimination of CR dye by using tea leaves powder				
Amount(g)	Time (min)	Equilibrium concentration(Ce)x10^6	% Removal	K_D
0.5	10	1.991	53.430	2.389
0.5	15	4.933	88.461	0.592
0.5	20	1.468	65.644	1.762
0.5	25	4.888	88.565	0.586
0.5	30	2.466	94.230	0.296
0.5	35	2.133	95.010	0.256
0.5	40	2.111	95.062	0.253
0.5	45	2.133	95.010	0.256
Optimization of time for the removal of CR dye by using date pits powder				
Amount(g)	Time (min)	Equilibrium concentration(Ce)x10^7	% Removal	K_D
0.6	10	6.889	89.383	6.888
0.6	15	5.333	91.780	5.333
0.6	20	1.776	97.260	1.777
0.6	25	2.221	96.575	2.222
0.6	30	2.454	96.232	2.444
0.6	35	1.911	70.547	19.111
0.6	40	1.012	81.506	12.000
0.6	45	9.551	85.273	9.555
0.6	50	4.667	92.808	4.666
Optimization of time for the removal of MGO Dye by using corn husk powder				
Amount(g)	Time (min)	Equilibrium concentration(Ce)x10^6	% Removal	K_D
0.5	10	1.296	92.112	1.555
0.5	15	1.182	92.807	1.418
0.5	20	1.081	93.420	1.297
0.5	25	1.141	93.052	1.370
0.5	30	9.402	94.278	1.128
0.5	35	1.141	93.052	1.370
0.5	40	8.596	94.769	1.031
0.5	45	8.730	94.687	1.047
0.5	50	1.148	93.011	1.378

Optimization of time for the removal of MGO dye by using peach seeds powder					
S. No.	Amount Of Adsorbent (g)	Time (min)	Equilibrium Concentration Ce (M)x10^7	% Removal	K_D (M)
01	0.7	10	5.104	96.697	0.729
02	0.7	15	4.499	97.088	0.642
03	0.7	20	8.260	94.654	1.1801
04	0.7	25	7.051	95.436	1.007
05	0.7	30	7.051	95.436	1.009
06	0.7	35	5.036	96.740	0.719
07	0.7	40	3.492	97.740	0.498
08	0.7	45	5.439	96.479	0.777

Table 3. Analysis of temperature

% Removal of CR dye by using tea leaves at different temperatures					
Dye	Ci (M) (10^5)	% REMOVAL			
		303K	308K	313K	318K
	0.1	79.96071	90.56	84.67	79.96
	0.3	88.14383	95.9	98.54	90.53
CR dye	0.5	99.45455	93.8	82	65.45
	0.7	71.20448	44.14	96.5	97.47
	0.01	77.37643	81.36	83.4	87.45
	0.003	93.83562	80.46	93.49	72.26

% Removal of CR by using date pits powder at different temperatures					
Dye	Ci (M)	% REMOVAL			
	(10^5)	303K	308K	313K	318K
	0.1	93.90	85.46	96.86	97.24
	0.3	70.74	98.2	99.22	96.89
CR dye	0.5	92.181	74.18	96.545	96.72
	0.7	91.372	98.03	98.823	99.66
	0.01	85.741	96.38	92.96	96.95
	0.003	94.863	95.27	93.15	91.78
% Removal of MGO dye by using corn husk powder at different temperatures					
Dye	Ci (M)	% REMOVAL			
	(10^5)	303K	308K	313K	318K
	0.1	88.6	91.40	87.94	88.18
	3	92	94.10	93.11	95.45
MGO dye	5	95	95.30	91.58	89.61
	7	91	91.44	91	90.43
	8	94	95.95	93	93.69
	9	90	90	92.07	99.25
% Removal of MGO dye by using peach seed powder at different temperatures					
Dye	Ci (M)	% REMOVAL			
	(10^5)	303K	308K	313K	318K
	0.1	95.836	95.970	95.903	96.642
	3	98.522	92.366	98.365	93.082
MGO Dye	5	89.939	98.616	98.186	98.871
	7	95.074	91.269	90.597	91.045
	8	94.224	88.314	94.358	90.463
	9	95.202	91.844	96.450	94.531

Table 4. Langmuir isotherms

Langmuir parameters for used tea leaves powder					
S. No.	Temperature K	Intercept 1/K Vm	Slope 1/Vm	Constant K_L	Constant Vm x10^5	R^2
01	303	2.2228	94396	42467.158	1.059	0.005
02	308	1.6251	11680	7187.250	8.516	0.344
03	313	-0.5367	12888	24013.415	7.759	0.738
04	318	0.9372	75764	80840.802	1.319	0.212
Langmuir parameters for date pits powder					
S. No.	Temperature K	Intercept 1/K Vm	Slope 1/Vm	Constant K_L	Constant Vm x10^5	R^2
01	303	0.586	21313	36351.697	4.691	0.604
02	308	2.697	46629	17286.005	2.144	0.744
03	313	2.818	13955	4950.512	8.425	0.188
04	318	0.556	9277.2	16682.611	1.077	0.471
Langmuir parameters for prunus persica seeds shell powder					
S. No.	Temperature K	Intercept 1/K Vm	Slope 1/Vm	Constant K_L	Constant Vm	R^2
01	303	0.483	0.006	0.01240	166.66	0.0466
02	308	0.151	0.0254	0.1674	39.370	0.7065
03	313	0.331	0.0234	0.070652	42.7350	0.7999
04	318	0.252	0.0294	0.11638	34.0136	0.5833
Langmuir parameters for corn husk powder					
S. No.	Temperature K	Intercept 1/K Vm	Slope 1/Vm	Constant K_L	Constant Vm	R^2
01	303	0.238	4792	20100.677	2.086	0.004
02	308	0.168	0.0555	0.330	18.018	0.003
03	313	0.013	0.0012	0.092	8333.330	0.028
04	318	0.127	0.0626	0.497	15.974	0.007

Table 5. Freunlich isotherms

Freundlich parameters for tea leaves powder

S. No.	Temperature K	Intercept log k	Slope 1/n	Constant $K_F \times 10^4$	Constant N	R^2
01	303	-3.212	0.188	6.136	5.302	0.181
02	308	-3.143	0.291	7.189	3.427	0.236
03	313	-3.221	0.194	6.010	5.154	0.289
04	318	-3.687	0.107	2.055	9.302	0.025

Freundlich parameters for date pits powder

S. No.	Temperature K	Intercept log k	Slope 1/n	Constant $K_F \times 10^4$	Constant N	R^2
01	303	-3.2842	0.2823	5.197	3.542	0.445
02	308	-4.7056	0.0155	0.198	64.516	0.003
03	313	-4.4907	0.0836	0.323	11.961	0.055
04	318	-2.9024	0.3074	1.251	3.253	0.443

Freundlich parameters for prunus persica seeds shell powder

S. No.	Temperature K	Intercept log k	Slope 1/n	Constant $K_F \times 10^3$	Constant N	R^2
01	303	0.049	0.9475\	1.121	1.055	0.707
02	308	-2.315	0.460	4.835	2.172	0.436
03	313	-2.814	0.391	1.533	2.556	0.805
04	318	-2.385	0.466	4.114	2.141	0.359

Freundlich parameters for corn husk powder

S. No.	Temperature K	Intercept log k	Slope 1/n	Constant K_F	Constant N	R^2
01	303	4.652	1.835	44946.926	0.544	0.889
02	308	2.604	1.415	401.883	0.706	0.799
03	313	3.411	1.570	2581.071	0.032	0.895
04	318	-0.409	0.773	2.565	1.292	0.894

Table 6. Adsorption kinetics

Pseudo second order kinetics			
Adsorbents	**Intercept**	**Slope**	**R^2**
Date pits powder	1E+06	2026.3	0.006
Peach seeds powder	-87390	46005	0.712
Grounded Tea leaves	-102615	9140.5	0.887
Grounded Corn Husk	17524	-26456	0.904

Table 7. Thermodynamic parameters

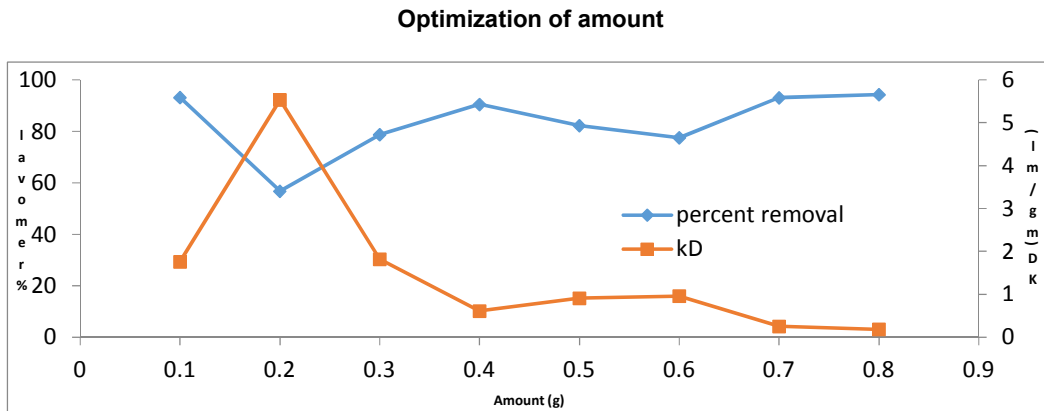| Samples	T (K)	ΔG° (KJmol^{-1})	ΔH° (KJmol^{-1})	ΔS° (KJmol^{-1})	Ln k	1/T
Tea Leaves	303	-26845.520	-1816.9	16.181	10.656	3.30×10^{-3}
	308	-22739.286			8.880	3.246×10^{-3}
	313	-26247.573			10.086	3.194×10^{-3}
	318	-29876.154			11.300	3.144×10^{-3}
Date Pits	303	-26453.500	3318.4	-0.9188	10.502	3.30×10^{-3}
	308	-24986.537			9.757	3.246×10^{-3}
	313	-25542.153			9.815	3.194×10^{-3}
	318	-25703.852			9.722	3.144×10^{-3}
Corn Husk	303	-24960.939	52465	-170.4	9.908	3.30×10^{-3}
	308	2838.9656			-1.108	3.246×10^{-3}
	313	6186.4274			-2.382	3.194×10^{-3}
	318	1876.566			-0.709	3.144×10^{-3}
Peach Seeds	303	1204.465	-8486.3	25.048	-4.390	3.30×10^{-3}
	308	4576.937			-1.787	3.246×10^{-3}
	313	6896.0183			-2.649	3.194×10^{-3}
	318	5686.646			-2.150	3.144×10^{-3}

Optimization of amount

Fig. 1. Optimization of amount for elimination of Congo red dye by using used tea leaves powder
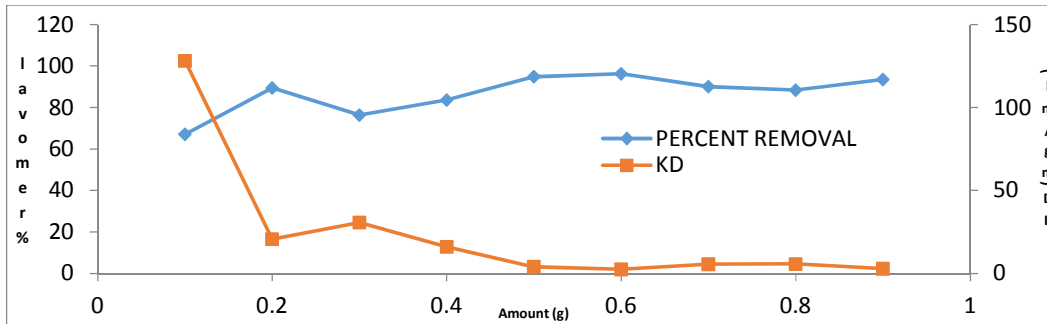

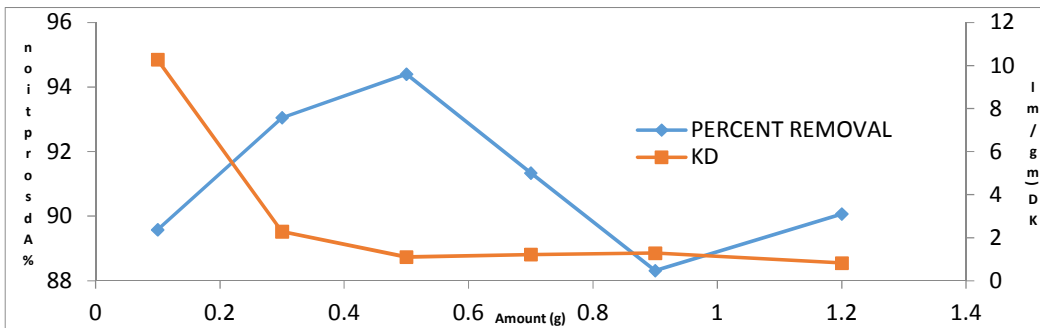**Fig. 2. Optimization of amount for elimination of Congo red dye by using date pits powder**

Fig. 3. Optimization of amount for elimination of Malachite green oxalate dye by using Corn Husk powder
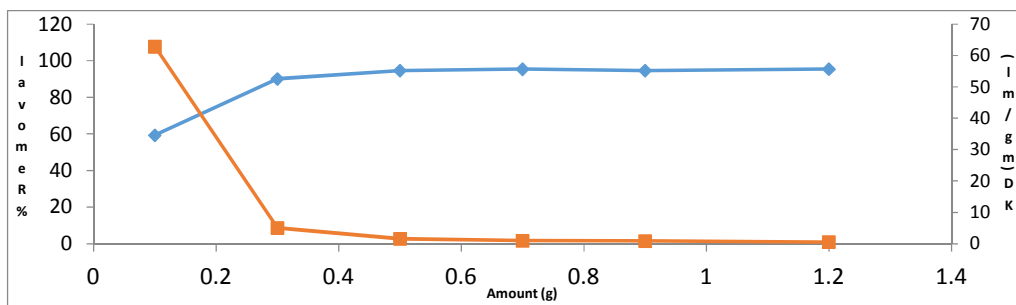

Fig. 4. Optimization of amount for elimination of MGO dye by using Peach Seed powder
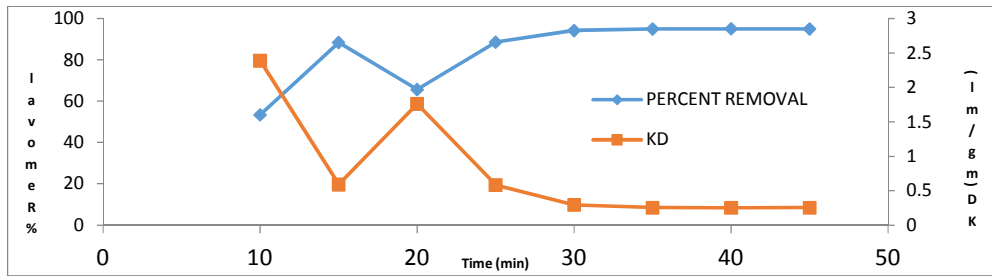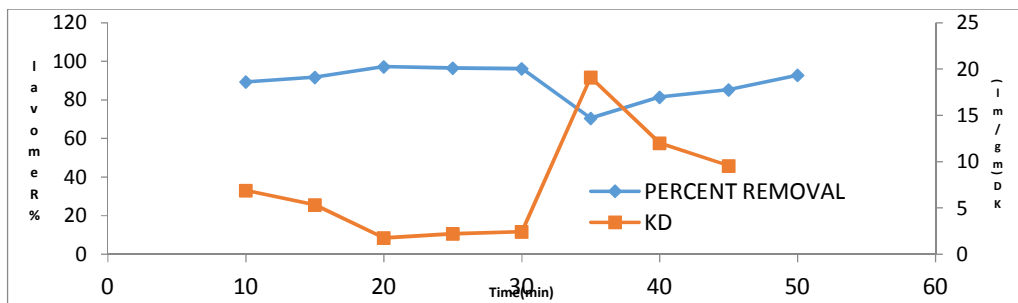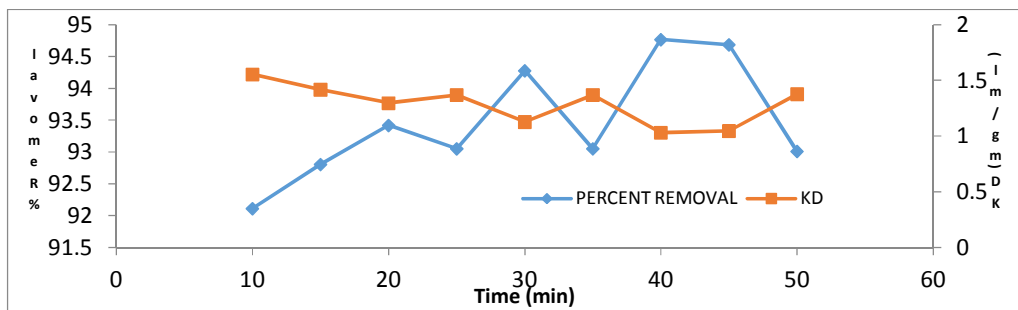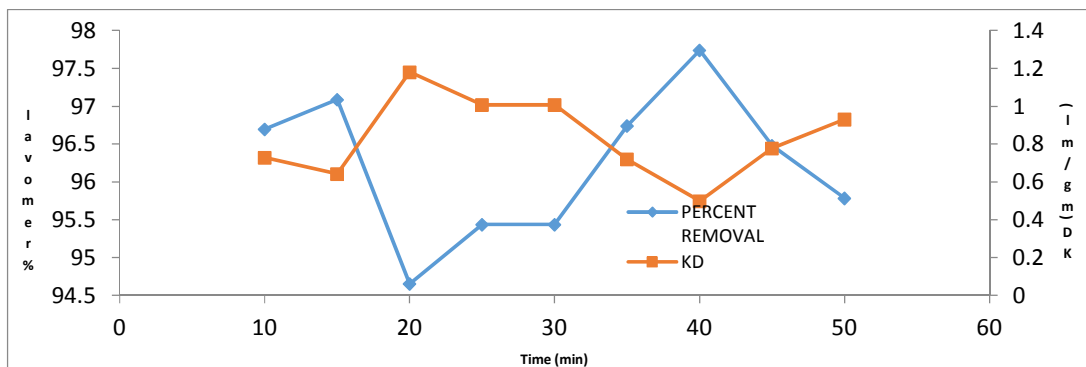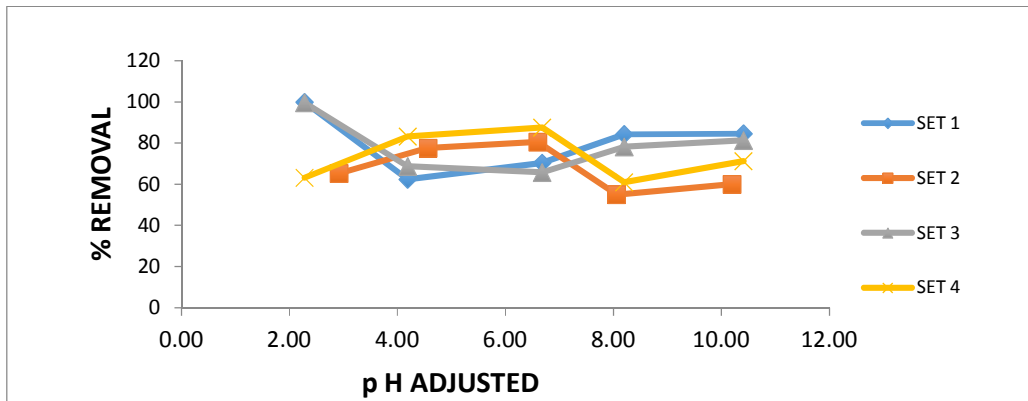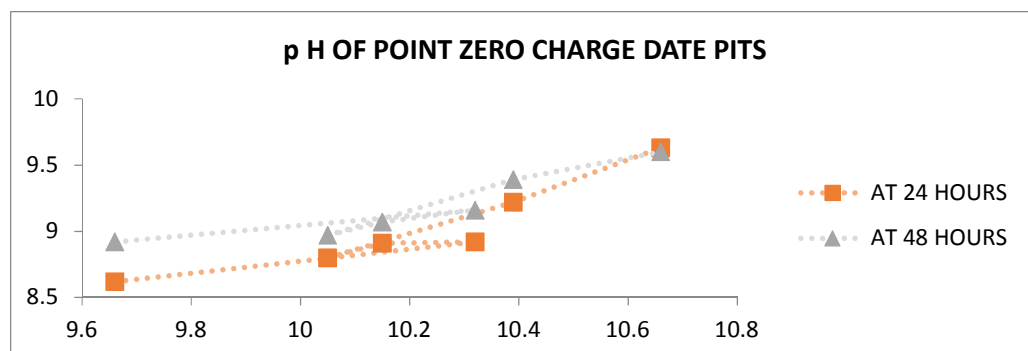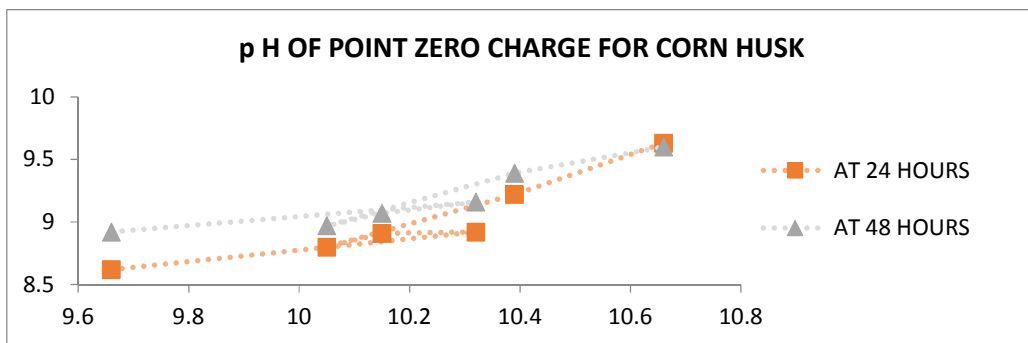
OPTIMIZATION OF TIME

Fig. 5. Optimization of time for removal of Congo red dye by using Tea leaves powder

Fig. 6. Optimization of time for elimination of Congo red dye by using Date pits powder

Fig. 7. Optimization of time for elimination of Malachite green oxalate dye by using Corn husk powder

Fig. 8. Optimization of time for elimination of Malachite green oxalate dye by using Peach seed powder

ADSORPTION KINETICS
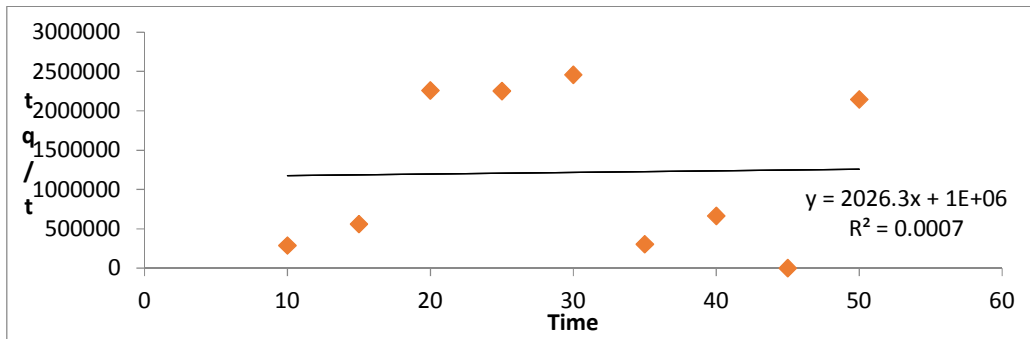
Fig. 9. Kinetics of date pits by Pseudo -second order
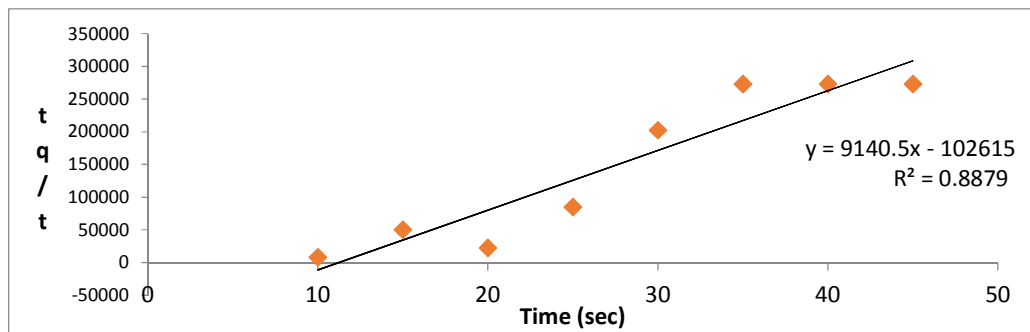
Fig. 10. Kinetics of tea leaves by Pseudo -second order
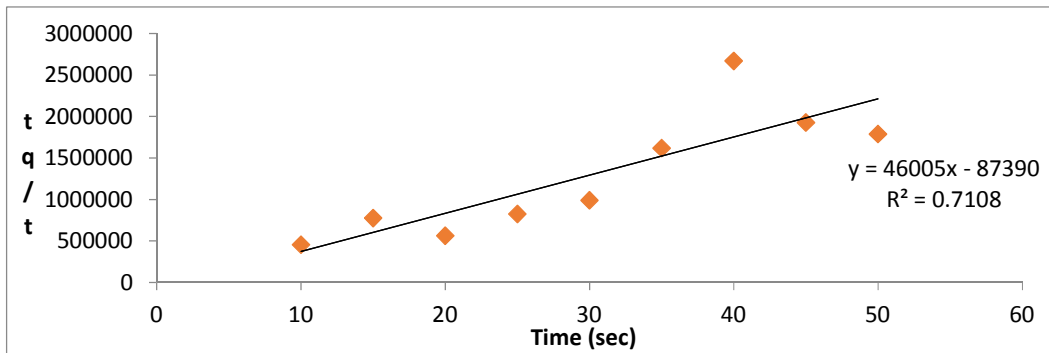
Fig. 11. Kinetics of peach seeds by Pseudo -second order
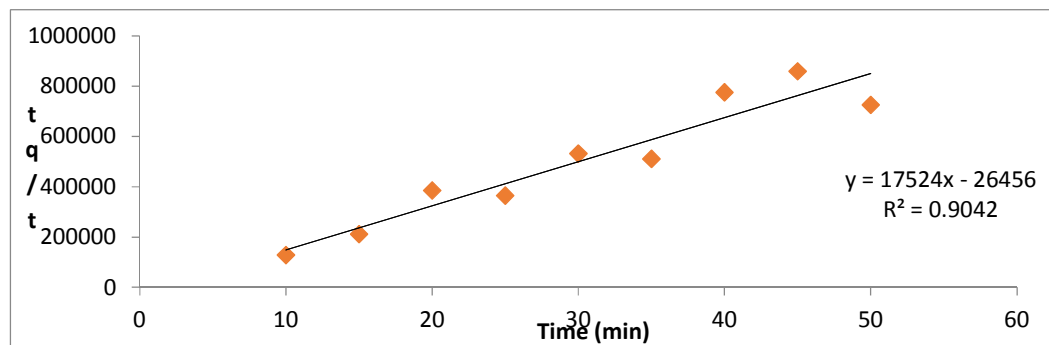
Fig. 12. Kinetics of corn husk by Pseudo -second order
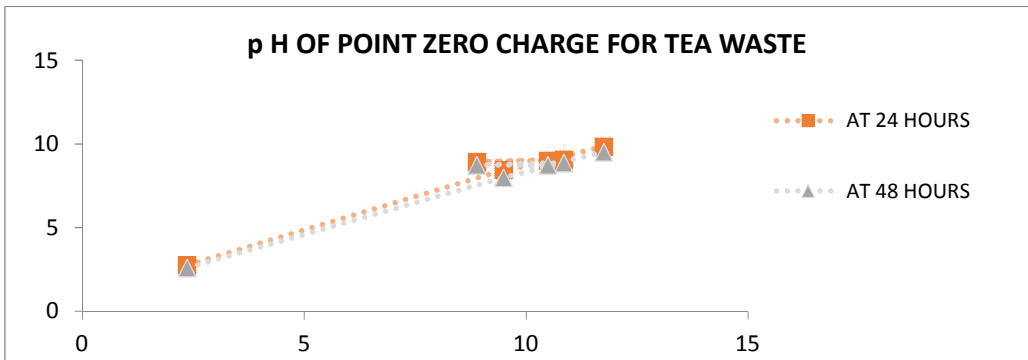
Set 1: Tea waste, Set 2: corn husk, Set 3: peach seeds Set 4: date pits
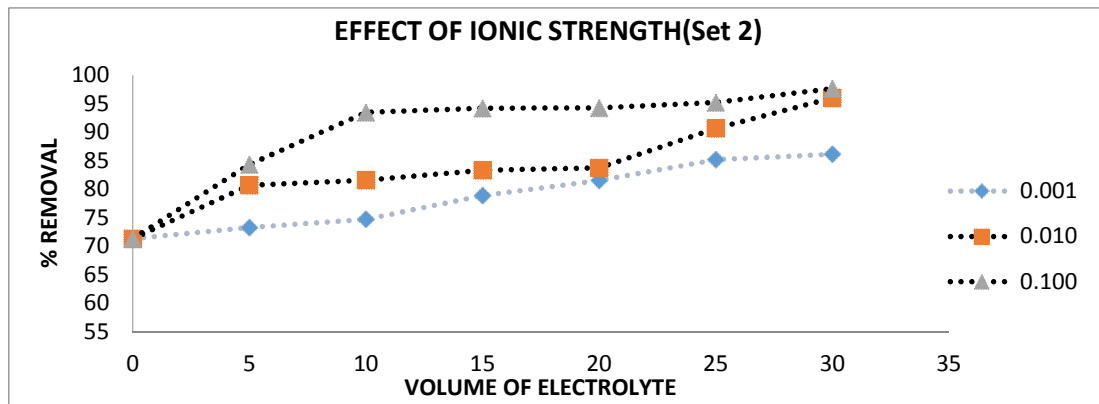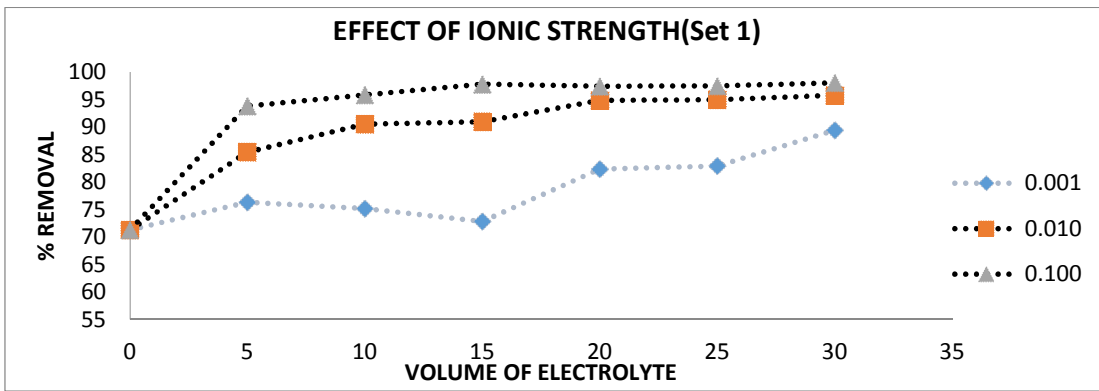

Fig. 13. Optimization of pH

p H OF POINT ZERO CHARGE PEACH SEEDS
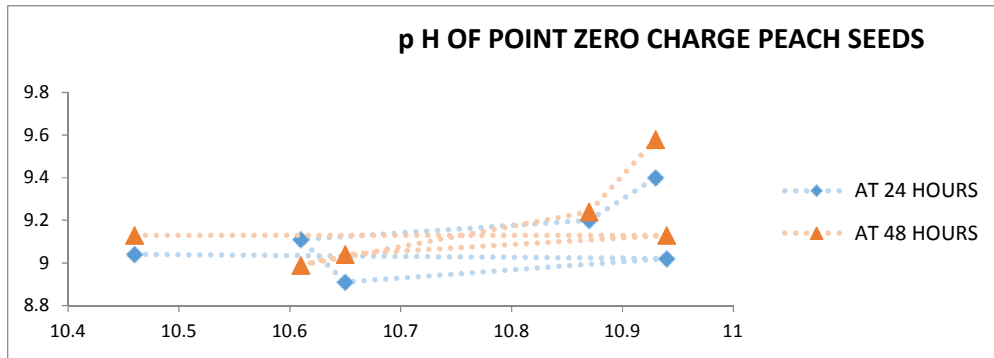
Fig. 14. Optimization of pH of adsorbents

EFFECT OF IONIC STRENGTH(Set 1)

EFFECT OF IONIC STRENGTH(Set 2)

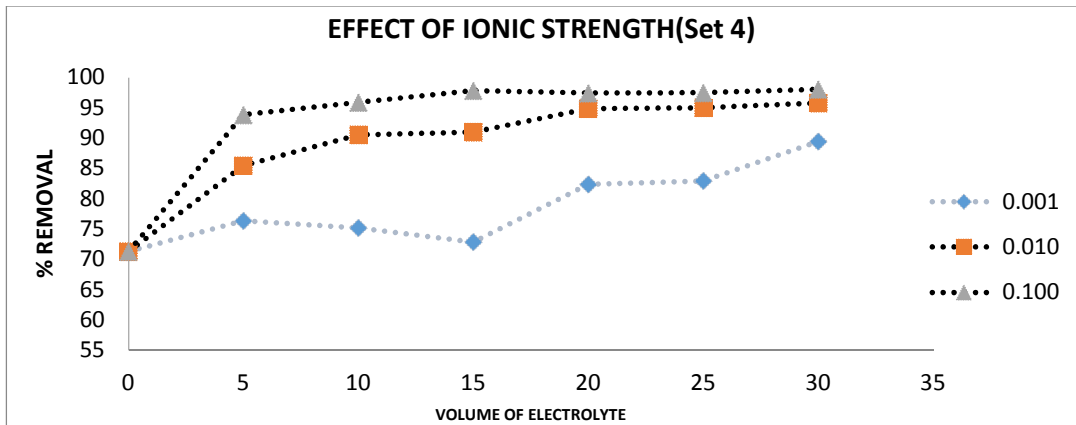**EFFECT OF IONIC STRENGTH(Set 3)**
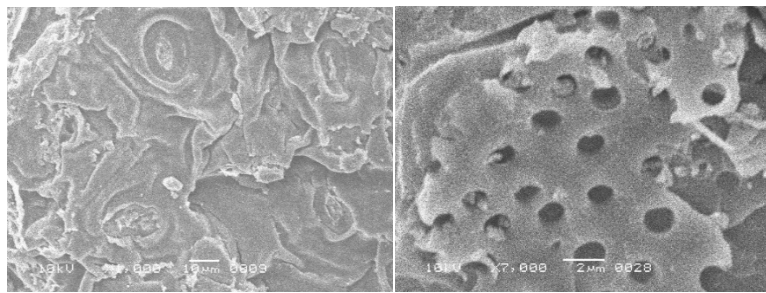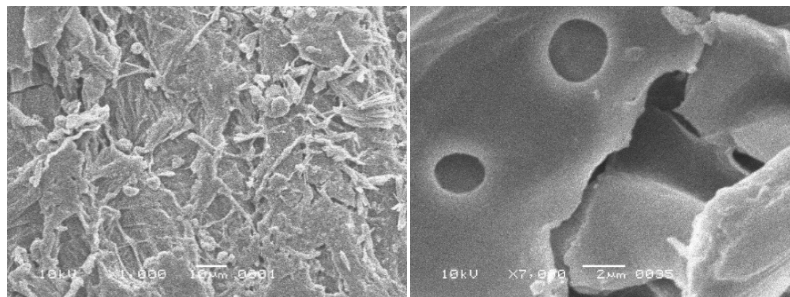
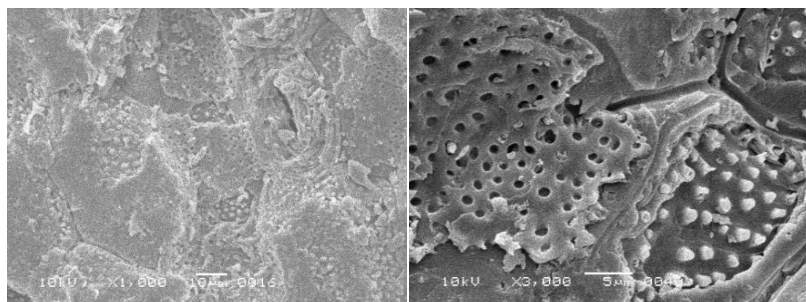**EFFECT OF IONIC STRENGTH(Set 4)**
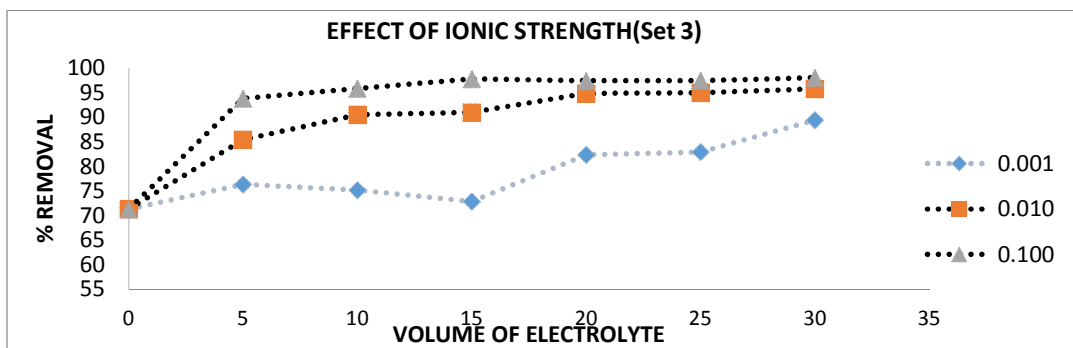
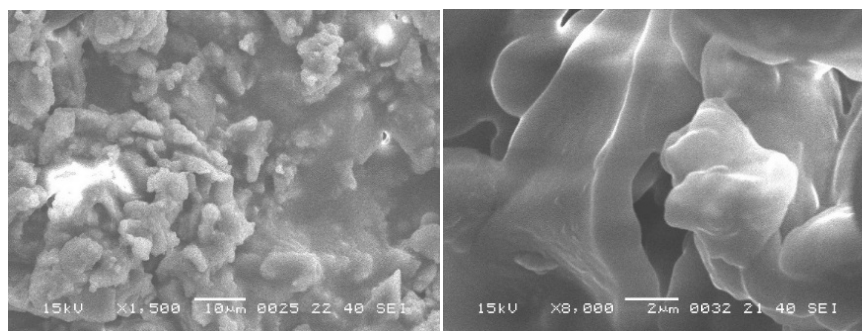**Fig. 15. Optimization of ionic strength**

SEM images of tea leaves before and after adsorption

SEM images of corn husk before and after adsorption

SEM image of peach seed before and after adsorption

SEM image of Date pits before and after adsorption

Fig. 16. SEM images of adsorbents

3. RESULTS AND DISCUSSION

Adsorption of carcinogenic dyes Congo Red (CR) was carried out by tea leaves powder and date pits powder. Adsorption of MGO dye was carried out by peach seeds powder and corn husk powder. Different experiments were performed in the adjusted circumstances of adsorbent's amount in Table (1), adsorbents stay time in Table (2) and adsorbents were analyzed at different temperatures in Table (3). Concentrations of dyes before and after adsorption were recorded by ultraviolet visible spectrophotometer. The structure of natural adsorbents were analyzed by SEM technique.

3.1 Examination of Effects of Adsorption Parameters on the Adsorption

3.1.1 Effect of adsorbent's amount

The optimum amount of adsorbent was taken as 0.4g for tea leaves in Fig. (1), 0.6g for date pits in Fig. (2), 0.5 g for corn husk in Fig. (3) and 0.5g for peach seeds powder in Fig. (4). By further increasing of amount of natural bio sorbents did not show any effective removal of dyes as shown in Table (1).

3.1.2 Effect of p H

The zero point charge (Ppzc) of tea waste, corn husk, peach seeds and date pits were determined. Adsorption of cation is favored at pH >7, while the adsorption of anion is favored at pH <7. At pH 2.0 a significantly high-electrostatic attraction exists between the positively charged surface of the adsorbent and anionic dye. As the pH of the system increases, the number of negatively charged sites increases and the number of positively charged sites decreases. A negatively charged surface site on the adsorbent does not favor the adsorption of dye anions due to the electrostatic repulsion. Also, lower adsorption of dyes at alkaline pH is due to the presence of excess ions competing with the dye anions for the adsorption sites. Nevertheless, significant adsorption of anionic dye on the adsorbent still occurred above due to the fact that a chemical interaction between the dyes and tea waste, corn husk, peach seeds and date pits.

3.1.3 Effect of Ionic strength

Different concentrations of KCl (0.01–0.05 M) were added to investigate the effect of ionic strength on adsorptive removal of dyes. The increase in ionic strength causes increase in the adsorption of congo red and malachite green oxalate. Salt addition increases the aggregation of dye molecules and decreases the solubility. An increase in aggregation promotes the adsorption of dyes molecules. Another possibility is that increase in ionic strength increases the positive charge of the adsorbent on the surface thus increases the electrostatic attraction between dyes and adsorbents. Thus increase in ionic strength was found to have an increase in adsorption of both dyes.

3.1.4 Effect of stay time

For tea leaves - congo red system, maximum adsorption was obtained at 35 minutes in Fig. (5), for date pits – congo red system, maximum adsorption capacity was obtained at 20 minutes in Fig. (6), for corn husk- malachite green oxalate system, maximum adsorption capacity was acquired at 30 minutes in Fig. (7) and for peach

seeds – malachite green oxalate system, maximum adsorption capacity was achieved at 15 minutes, as shown in Fig. (8).

3.2 Adsorption Isotherms

3.2.1 Langmuir adsorption isotherm

This isotherm shows monolayer adsorption on a consistent surface. Monolayer adsorption must be merely defined by Langmuir adsorption isotherm. Well-known Langmuir equation is as follows:

$$C_e/X/m = 1/KV_m + C_e/V_m$$

Here, equilibrium concentration is C_e (mol/dm^3), amount adsorbed at equilibrium is X/m (mol/g), intercept is Vm (mol/g) and slope is K (dm^3/mol). The adsorption of Congo Red (CR) and malachite green oxalate (MGO) were examined at different temperatures.

3.2.2 The freundlich adsorption isotherm

This isotherm is specified by the following equation:

$$\textbf{LogX/m = log K +1/n log C}_\textbf{e}$$

Values of "K" and "n" were calculated from the intercepts and slopes of their relevant graphs and were written in tables. Increase in values of constant (K) with the increase in temperature for congo red dye and malachite green oxalate dye showed that adsorption of both dyes are favorable at higher temperatures [13]. The values of "n" lies in between -1 to10, which showed advantageous effect of the adsorption process. Values of R^2 proved that Freundlich isotherm, which showed formation of multilayer on the surface of adsorbent as shown in Table (5).

3.2.3 Influence of thermodynamic parameter

Thermodynamic parameters of adsorption progression were used to accomplish the process of spontaneity. Change in Gibb's free energy measures the spontaneity. Its negative value proves the reaction is spontaneous.

ΔH^0, ΔS^0 and ΔG^0 were premeditated by the following equations:

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$Ln\ K_D = \Delta S^0/R - \Delta H^0/RT$$

$$\Delta G^0 = -RT\ LnK_D$$

Here R, is the gas constant, absolute temperature is T, K_D is distribution constant. ΔH^0 and ΔS^0 were obtained from slopes and intercepts of "ln K_D" versus 1/T [14].

Negative values of $\Delta G°$ confirmed feasibility of method and spontaneity of adsorption with a maximum adsorption of dyes as shown in Table (7).

3.3 Kinetics of Adsorption

Linear graph of "t/qt" on y-axis and "t" on x-axis for different concentrations of CR dye and MGO dye were plotted which correspond that adsorption procedure followed pseudo-second order kinetic. Here qe and qt are the amount of the dye adsorbed on the adsorbent (mol/g) at equilibrium and t is time in minutes, k_2 is the adsorption of second order rate constant (mol/g.min). The correlation coefficients for the second order models are near to 0.999 shows the linearity with high degree of correlation coefficient as shown in Table (6) [15].

$$\mathbf{ln(q_e - q_t) = lnq_e - k_1 t}$$

$$\mathbf{\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e}}$$

3.4 SEM Interpretations of Natural Particles

Top characterization techniques is SEM. The scanning electron micrograph specifies that the particles are quite homogenous in nature and the size ranging from 50 - 120nm for natural bio sorbents. After the adsorption of tea leaves, date pits, corn husk and peach seed powder, the diameter of all the natural adsorbents were decreased because the dye coated onto their surfaces.

4. CONCLUSION

For the elimination of chemical toxins from water only adsorption is the familiar, effective and cheap method that yields high-quality results. The present research emphasizes on the removal of contaminants by using adsorption process with the collection natural

adsorbents. The characterization of natural adsorbents were analyzed by SEM. Malachite green oxalate dye adsorption was calculated and analyzed by using corn husk and peach seeds powder. Similarly adsorption of Congo red dye was analyzed by using waste tea leaves and date pits powder. Investigational data presented adsorption followed the pseudo second-order kinetics. Experimental data was form fitted well in Freundlich and Langmuir isotherms. The negative value of ΔG^o proved the spontaneity of adsorption of waste tea leaves powder, date pits powder and corn husk powder. The positive ΔG^o value of peach seeds powder confirmed non-spontaneity of the adsorption. It was concluded that this specific method could be employed on industrial scale for waste minimization. All natural adsorbents proposed a lot of auspicious benefits in the forthcoming era. Treatment of dyes using fresh seeds powder was a highly economic and simple method than other methods meanwhile it has an excellent capability of eliminating color. Hence, it is applicable for industrial pollutants for improving the worth of wastewater of fabric industries and numerous others. Furthermore effort for obtaining other constraints of dye waste using the mentioned method can be conceded out to develop the adsorption proficiency.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Ho YS. Comment on "Genetic characterization, nickel tolerance, biosorption, kinetics, and uptake mechanism of a bacterium isolated from electroplating industrial effluent". Canadian Journal of Microbiology. 2015;61(11):881-882.
2. Atiya Firdous, Uzma Hameed. The synthesis and characterization of nano composites of CdO and its applications for the treatment of simulated dye waste water. American Chemical Science Journal. 2016;13(1):1-10.
3. Balaz M, Bujnakova Z, Balaz P, Zorkovska A, Dankova Z, Briancin J. Adsorption of cadmium (II) on waste biomaterial. Journal of Colloid and Interface Science. 2015;454; 121-133.

4. Mahmoodi NM, Masrouri O. Cationic dye removal ability from multicomponent system by magnetic carbon nanotubes. Journal of Solution Chemistry. 2015;44(8):1568-1583.
5. Smart platform for hyperthermia application in cancer treatment: Cobalt-doped ferrite nanoparticles mineralized in human ferritin cages. ACS Nano. 2014;8(5):4705–4719.
6. Ho YS. Comments on "Isothermic and kinetic modeling of fluoride removal from water by means of the natural biosorbents sorghum and canola". Fluoride. 2015;48(3): 266-268.
7. Jia AY, Wu CD, Hu WC, Hu CX. Bromate Adsorption on three variable charge soils: Kinetics and thermodynamics. Clean-Soil Air Water. 2015;43(7):1072-1077.
8. Santos SCR and Boaventura RAR. Treatment of a simulated textile wastewater in a sequencing batch reactor (SBR) with addition of a low-cost adsorbent. Journal of Hazardous Materials. 2015;291:74-82.
9. Mahmoodi NM, Ghobadi J. Extended isotherm and kinetics of binary system dye removal using carbon nanotube from wastewater. Desalination and Water Treatment. 2015;54(10):2777-2793.
10. Liu SJ. A mathematical model for competitive adsorptions. Separation and Purification Technology. 2015;144:80-89.
11. Mahmoodi NM, Maghsoodi A. Kinetics and isotherm of cationic dye removal from multicomponent system using the synthesized silica nanoparticle. Desalination and Water Treatment. 2015; 54(2):562-571.
12. Mohammad AK, Saeed HR, Reza A, Abdolhamid H, Hadi K, Syed MZ. Synthesis and characterization of nanoparticles and Nano-composite of ZnO and MgO by sonochemical method and their application for Zinc polycarboxylate dental; 2010. Cementmariappan R, Vairamuthu R, Ganapathy A. Use of chemically activated cotton nut shell carbon for the removal of fluoride contaminated drinking water: Kinetics evaluation. Chinese Journal of Chemical Engineering. 2015;23(4):710-721.
13. Gupta N, Kushwaha AK, Chattopadhyaya MC. Kinetics and thermodynamics of malachite green adsorption on banana pseudo-stem fibers. J. Chem. Pharm. Res. 2011;3(1),284-296.

14. Sawai J, Kojima H, Igarashi H, Hashimoto A, Shoji S, Sawaki T, Hakoda A, Kawada E, Kokugan V, Shimizu M. Anti-bacterial characteristics of magnesium oxide powder, World J. Microb. Biotechnol. 2000;16:187-194.

15. Ong SA, Ho LN, Wong YS, Zainuddin A. Adsorption behavior of cationic and anionic dyes onto acid treated coconut coir. Separation Science and Technology. 2013;48(14):2125-2131.