Zagazig J. Agric. Res., Vol. 51 No. (3) 2024 493-504

Soil Science and Agricultural Engineering

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?JournalId=1&queryType=Master

A DYNAMIC STUDY ON REMOVAL SOME HEAVY ELEMENTS USING NATURAL ORANGE PEELS AS LOW-COST SUBSEQUENT ADSORBENT FROM AGRICULTURAL WASTE

Refaat R. Abd-Alhamid*[1], W.M. Youssef[2], M.M.N. Khalil[1], I.R. Mohamed[1] and A.A. Shiha[1]

1. Soil Sci. Dep., Fac. Agric., Zagazig Univ., Egypt
2. Nuclear Materials Authority. P.O. Box 530, El Maddi, Cairo, Egypt

Received: 24/03/2024; Accepted: 29/04/2024

ABSTRACT: This training examined the adsorption properties of orange peel after treatment with D_2EHPA. Preserved examples remained categorized by Fourier Transform Infrared Spectrometer (FTIR) and Scanning Electron Microscope (SEM). The capabilities of adsorptive examples stayed examined through by Cd (II), Zn (II) sorption from these solutions. The numerous investigational factors require remained for example mixed time, concentration of media, RPM, Solid/Liquid ratio besides temperature, require stayed considered then enhanced situations remained resolute by equations. Balance line trainings stayed recycled to calculate the determined adsorption capability of orange peel behavior and the investigational of consequences are presented this Cd (II), Zn (II) about 14.12 and 11.1 mg/g respectively. The consequences displayed that Zn (II) ,Cd (II) adsorption was achieved after 180 min contacting time using (solid/liquid = 8g/L) adsorbent from 30% P_2O_5 at 25°C. Adsorption rate at pseudo-second order equation, thermodynamic parameters (ΔH°, ΔS° and ΔG°) reveal that the Cd (II), Zn (II) adsorption is calculated.

Key words: Cd (II), Zn (II), adsorption, Equilibrium isotherm and orange peel.

INTRODUCTION

Heavy elements elimination from that one aqueous answer concerned eye of numerous clinical groups, specifically after business besides home waste solution, because the search aimed at inexperienced interaction incomes Centre point. Heavy element reasons critical risky to the surroundings then consequently their elimination from waste solution earlier than settling into modern liquids is an outstanding vital issue, those materials are strong and continual environmental contaminants on the grounds that they're non-biodegradable. Ag, Cr, Cu, lead, Cd, Ni, and as reason a critical item of pollutants to the mortal build. As and Cr Conc. ions 0.05 ppm, 0.001 ppm for Cadmiun, Nickel and arsenic and 0.1 ppm for Copper, resolve deadly and reason infection in humans **(Srivastava, 2006; Barakat, 2011; World Health Organization, 2004)**.

For example a touch group, a few weighty elements (e.g. Se, Co, Cu, Fe, Mg, Mo, V, Sr and Zn) stay important towards hold digestion of dwelling animals. Though, on better their focuses will position a fitness threat towards human beings and towards the surroundings and result in destroying **(Vinod, 2012)** Not-important weighty element to precise problem towards floor liquid stay Cd, Cr, Ag, Zn and As **(Kennish, 1992)**. Moreover, hint elements including Zn and Cd intervene through important vitamins by comparable entrance, including Ca and Zn; electrochemical remedies consist of ion-change then electrodialysis, electrocoagulation, electro initiation, conductor location **(Kurniawan, 2006; Tonni, 2006)**.

However, similarly to strength costs, every other downside lies with inside the corrosion which can turn out to be a sizeable restricting thing considering electrodes have often to be replaced **(Janssen and Koene, 2002; Amin,**

*** Corresponding author: Tel. :**+0101012454444
E-mail address: mmnabil11@gmail.com

2005; Abdel-Samad, 2020; Hussein and Morsy, 2017; El- Didamony *et al.*, 2019; Mahmoud, 2022; Morsy, 2020; Youssef, 2020).

While a few elements stay regarded towards stay critical ore aimed at numerous biological actions, attendance of massive before perhaps lesser quantities of such elements similar Cu, Mg, Cd, or Zn, not simplest bring about extreme human fitness effects, however can similarly have an effect on breathes natures or level flowers (**Brinza, 2009; Ofudje, 2013)**. The situation stays widely recognized that treating of heavy elements through social frame may be exact hard for the reason that they may be no biodegradable and as such, they relax in extraordinary inner organs and will result in severe harm of frame system **(Gavrilescu, 2004)**.

Cd (II) takes remained said near stay any of maximum toxic factors thier guy might remain uncovered towards both with inside thier surroundings before on effort. Too, the situation is able to by way of nicely collect with inside the human frame as soon as absorbed and is effectively retained at some stage in life **(Bernard, 2008)**. It is basically toxic to kidney inflicting bone demineralization even as immoderate exposures to cadmium should harm the right feature lung besides growth danger disease lung. A quantity at herbal materials (as adsorbent) have been examined consisting of orange peel .The predominant goal of orang peel is value powerful and easy method to do away with heavy metals from waste water, orange peel, due to its cheap, powerful and monetary approach with excessive ability for the elimination metals, healing then reprocessing metallic metals after water resolution, then smooth toward evolve require acquired tons interest trendy heavy elements sorption after unwanted aquatic.

Software of orange peel as a bio sorbent cloth gives sturdy capability because of its predominant additives fiber, pectin, hemicellulose besides lignin which include useful organizations by way of feasible required web puts of elements **(Brinza, 2009)**. Orange peel remains an appealing and monetary opportunity aimed by the elimination for steel elements since unwanted aquatic **(Bernard, 2008)**. Therefore, thier advantages for the use of orange peel equally sorbent with inside removal of Cd metal since water solution resolve now no longer best function a way of pollutants decontamination however can even upload values to the to start with perceived agricultural waste. The purpose of this painting turned into to have a look at the adsorption ability of orange peel for doing away with a few heavy metals Cd (II), Zn (II) ions from its answer, additionally to research outcomes of touch time, acid concentration, bio sorbent dosage at the bio sorption efficiency.

Material and Methods

Constituents and substances

All substances recycled remained of investigative substance rank accepting orange peel, industrial through Aldrich AG, remained of a viable position then recycled deprived of decontamination. Cd (II), Zn (II) determined by Atomic Absorption Spectrometer in solutions. Chemical analysis of preparation of phosphoric acid media remains assumed in Table 1.

Sorbent planning

Orange peel attained by farming wastelands by orange produce. The produces remained leading flayed off to attain the outside film of the produces of shell remained washed with normal blow aquatic to eliminate likely external resources current (dust and soils). Sweep away examples substantial remained dehydrated on 80oC in furnace dramatic and then creased with a putty and crusher to decrease the mass. 250 g of the lesser bits was carbonized at 400°C for 1.5hr and then then actuated by 0.01 M D_2EHPA at 2-3 hr. The actuated resources were allowable to equable obviously private the heater to area hotness already they were detached for analysis **(Akinhanmi, 2020)**.

Experimental procedure

Collection sorption trials remained achieved through trembling 8g of orange peel activated through one liter of preparation solution popular a thermo stated at ($25\pm1^{o}C$). Altogether experimentations remained approved available in triplicate besides the despicable standards remained obtainable. The quantity of metals sorbed remained calculated by the change between balance focus then original focus.

Table 1. Chemical composition of preparation phosphate media

Component	Concentration
P_2O_5	44 %
Cd	20 ppm
Co	8 ppm
Zn	150 ppm

$$q_e = (C_o - C_e) \times \frac{V}{m} \quad (1)$$

$$\text{Metal adsorption \%} = \frac{C_o - C_e}{C_o} \times 100 \quad (2)$$

$$K_d = \frac{C_o - C_e}{C_o} \times \frac{V}{m} \quad (3)$$

Where C_o and C_e are the initial and equilibrium concentrations of the element (mg/L), respectively, V is the volume of the qqueous phase (L), and m is the weight of sample used (g).

RESULTS AND DISCUSSION

Characterization for Raw Materials

FTIR study

FTIR spectroscopy method remained recycled to display the useful collections current on the external of the shells. Fig. 1 displays FTIR bands of the orange peel. Proceeding the peels shallow around are numerous useful collections remained obtainable, the OH groups act about the peak of 3450 cm^{-1}, free OH groups and bonded OH bands of carboxyl group were observed as the OH stretching vibrations **(Pérez marín, 2010)**. The peak of CH stretching vibrations of CH, CH_2, and CH_3 collections remained seemed at 2925 cm^{-1} **(Kamsonlian, Suantak, 2011)**. The unequal and symmetric stretching vibrations of the C-O groups appeared at peaks around 1760 and 1620 cm^{-1} separately. Also, peaks at 1060 cm^{-1} is due to stretching shaking of C–OH of alcohols and carboxylic acids **(Sha, 2009)**. by equate the FTIR bands before and after sorption, the statistics presented that there is seem an supplementary bands 2950 cm^{-1} ,703 cm^{-1} , 425 cm^{-1} and severe band1160 cm^{-1} after sorption. These consequences may be established that the development of new bonds or difficulty of elements by peel.

Surface morphology studies

Fig. 2 displays that varied changes of building in the actuated carbon beforehand and later elements adsorption, superficial need a flat pore by convinced measurement beforehand sorption. Afterward bio sorption, several modifications must been happened owing to the contact of elements **(Annadurai *et al.*, 2003)**.

Influences Moving of Sorption

Influence of solution concentration

Result of solution concentration is greatest important factor for the sorption trials. In this education, the solution concentrations remained diverse among (10% - 44%), keeping the other parameters constant. Fig. 3 shows the effect of acid concentration on the adsorption of Cd^{+2}, Zn^{+2} ions onto orange peel. Ratio of sorption losses with growing solution media concentration (about 50 to 20% sorption) at Cd^{+2} and (from 95 to 55% adsorption) at Zn^{+2} **(Hussein, 2017)**.

Influence of mixed time

Sorption of Cd^{+2}, Zn^{+2} metals on peel actuated D_2EHPA stayed considered as a purpose of mixed time; 1000 mL of acid media (P_2O_5: 30%) was shaking with 8 g of peel impregnated D_2 EHPA for diverse breaks of time among from 5 to 700 min. Fig. 4 shows the variety of adsorption percentage of Cd^{+2}, Zn^{+2} with shaking time. As can be seen from the Fig. 4, during the first 180 min of the experiment, the concentration of Cd^{+2}, Zn^{+2} adsorbed on the orange peel increases with the prolonged time. From 180 to 700 min, no significant change of Cd^{+2}, Zn^{+2} concentrations is experiential. The consequences designate that the sorption balance is gotten afterward only 240 min. Likewise, the sorption of Cd^{+2}, Zn^{+2} **(YI, 2016)** on the orange peel also occurs quickly and 180 min are enough to achieve the adsorption equilibrium.

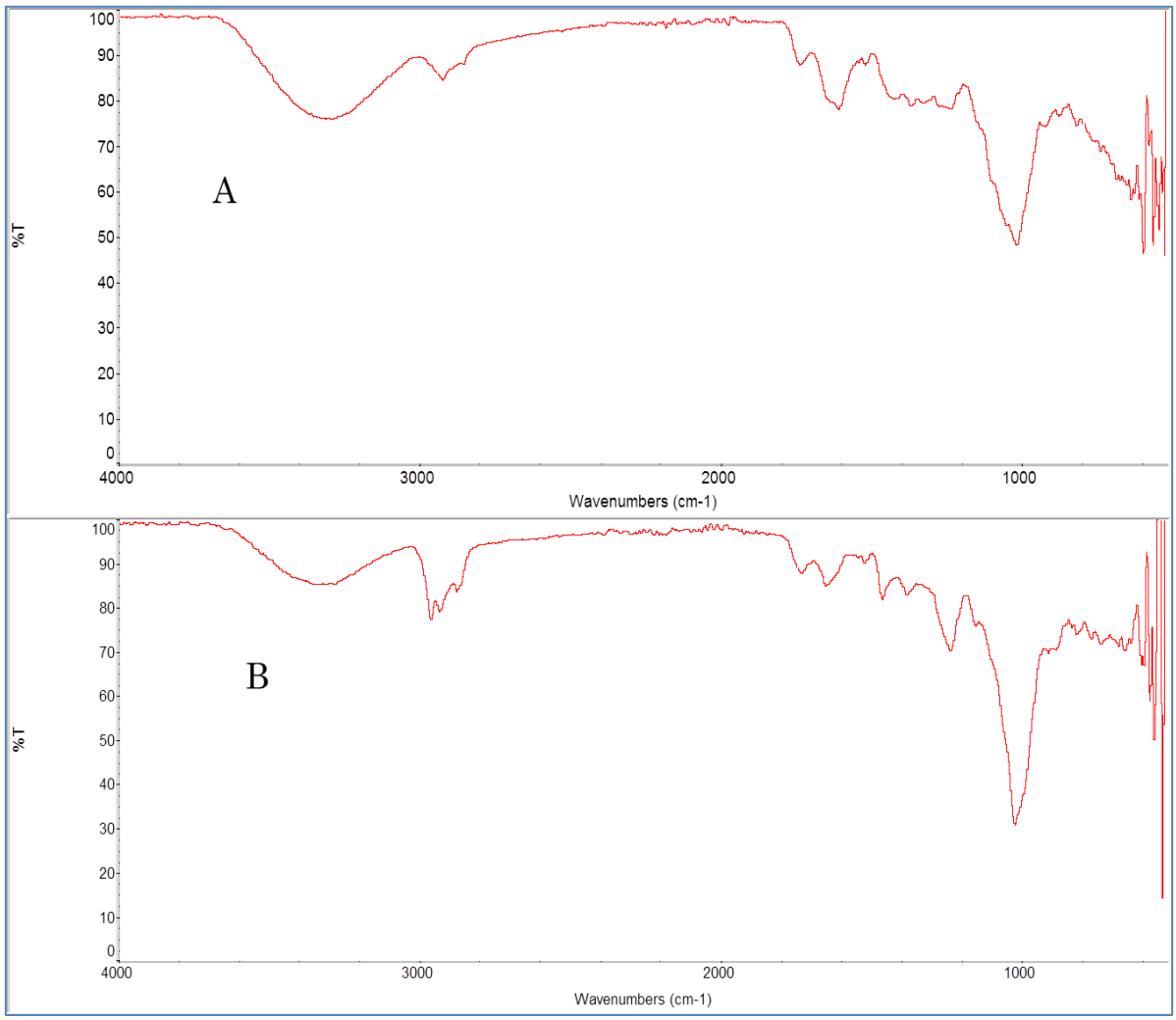

Fig. 1. FTIR spectra of orange peel (A) before and (B) later elements adsorption

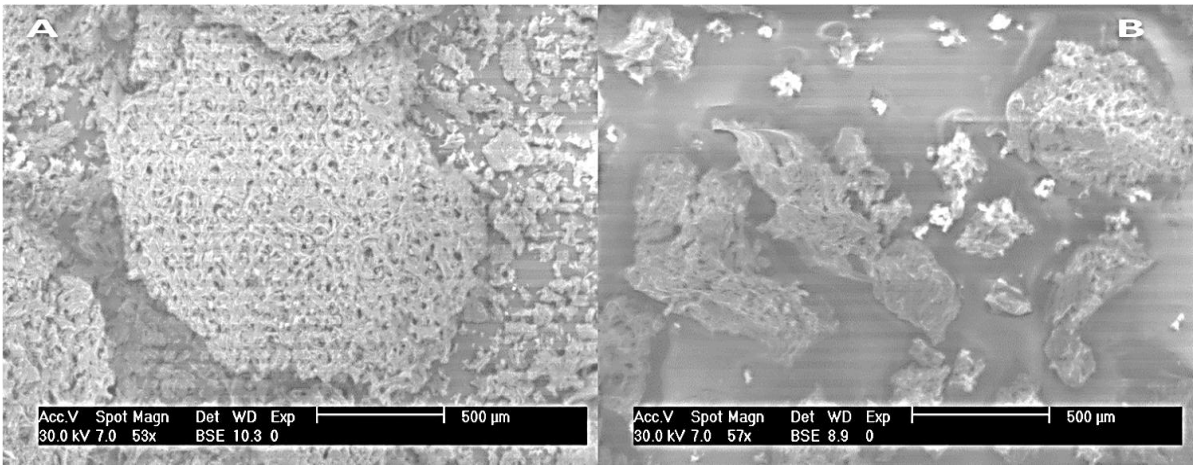

Fig. 2. SEM imaginings of orange peel (A) beforehand and (B) later metals sorption

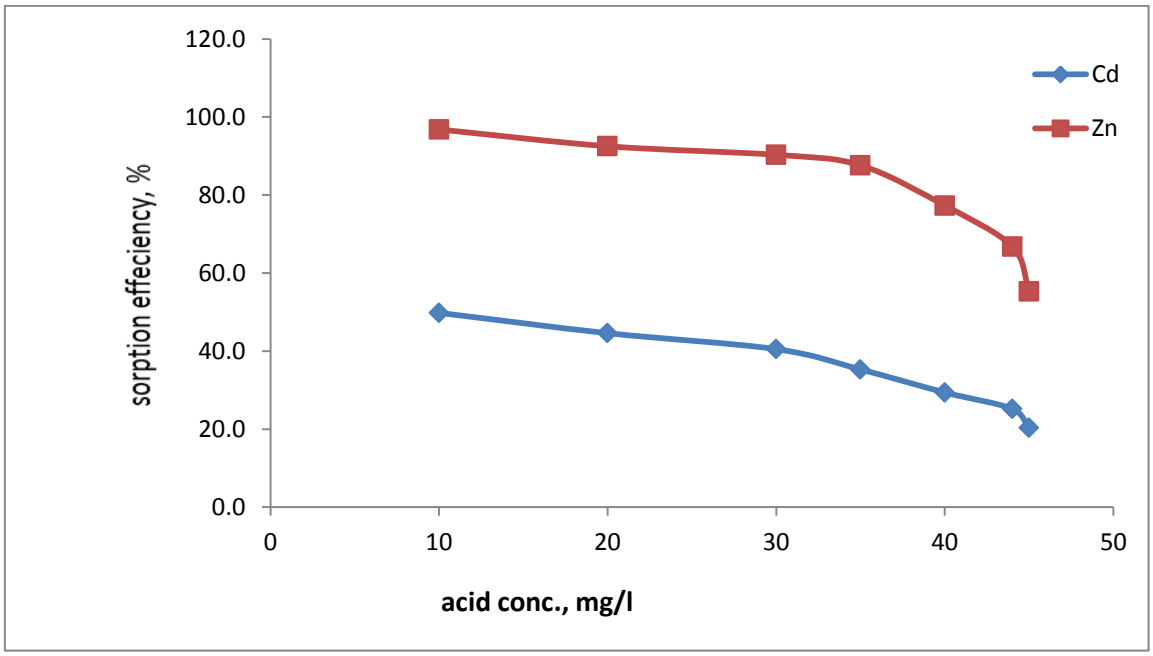

Fig. 3. Effect of concentration on sorption of Cd^{+2}, Zn^{+2} using orang peel at room temperature, 180 min., 8g/L

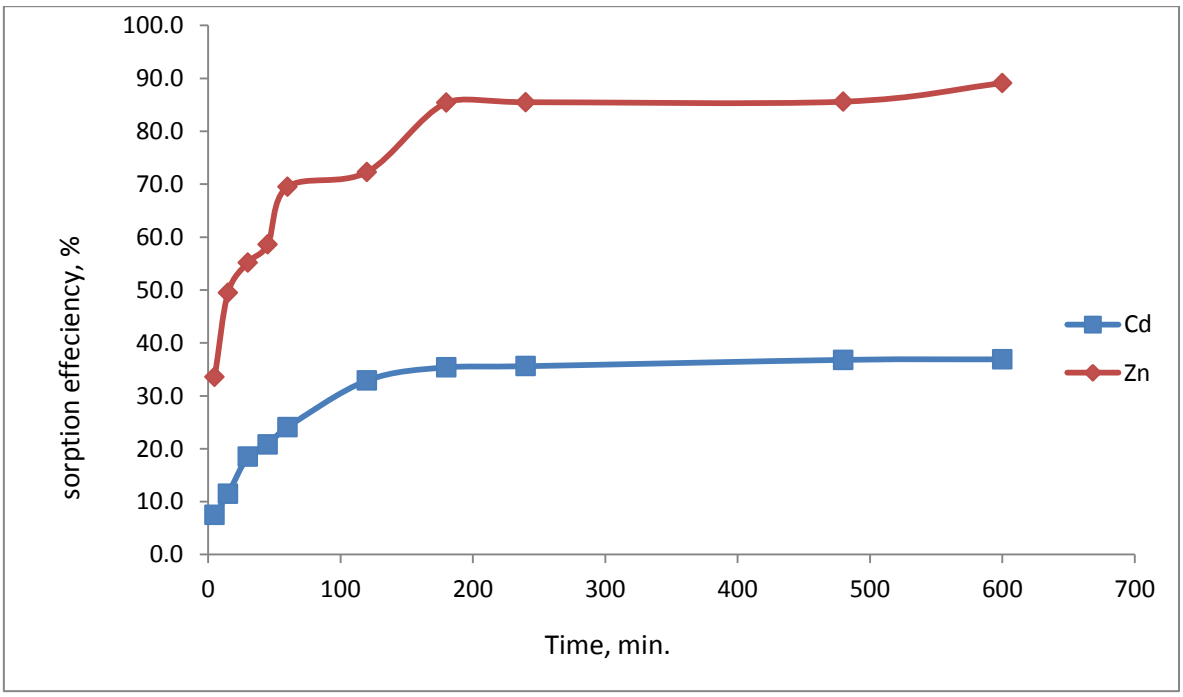

Fig. 4. Influence of mixed time on sorption of Cd^{+2}, Zn^{+2} using orang peel at room temperature, P_2O_5 : 30%, 8g/L

Effect of the temperature

The effect of different temperature on Cd^{+2}, Zn^{+2} removal is carried out at different temperatures (25-50^{o}C), and the plot is illustrated in Fig.5. By means of the obtained data from Fig. 5, it is clear that increase temperature the adsorption efficiency slowly decreased with the temperature down indicated that the Cd^{+2}, Zn^{+2} adsorption has an exothermic nature in a manner to be favored at room temperature.

Influence of adsorbent weight

Consequence of sorbents concentration measured by way of unique of the greatest powerfully factors that moves the elimination competence and sorption capability between extra calculated limits. Fig. 6 displays the result of the diverse adsorbents dosages (2-12 g/L) solution for 240 min. at room temperature 25^{0}C. The adsorption capacity of Cd^{2+} and Zn^{2+} increased with increasing the dosage of orange peel activated carbons. Full elimination of Cd^{2+} and Zn^{2+} as 50, 90%was attained at 8 gm adsorbent. Hence 8 g remained selected as the best sorbent amount for elimination of the planned. Advanced amount of sorbent gradually improved the sorption. This can be attributed to increase adsorbent surface area and availability of more adsorption active sites resulting from the increased adsorbent weight **(Uddin *et al,* 2007)**. So the adsorption process is less when decrease the weight of adsorbent material.

Influence of tension quickness RPM

Fig. 7 shows the variety of adsorption percentage of Cd^{+2}, Zn^{+2} with RPM. As can be seen from the Fig. 7, during increasing of RPM, the concentration of Cd^{+2}, Zn^{+2} adsorbed on the orang peel growths by the extended RPM. From 100 to 1000 RPM, sorption efficiency increased (from 10 to 50% adsorption) at Cd^{+2} and (from 20 to 90% adsorption) at Zn^{+2}.

Sorption Kinetic Showing

Pseudo-first-order model

The kinetics of sorption was examined through the Lagergren pseudo-first-order **(Rehman *et al.*, 2010)** equation as showed in equation (4):

$$\frac{dq_t}{dt} = k_{p1}(q_e - q_t) \qquad (4)$$

Where q_e and q_t (mg/g) are the adsorption capacities at equilibrium and time t (min) respectively, kp1 (min^{-1}) is the pseudo-first-order rate constant for the kinetic model. Integrating equation (5) with the boundary conditions of q_t= 0 at t= 0 and qt at t=t, yields.

$$\log(q_e - q_t) = \log q_e - \frac{k_{p1}}{2.303}t \qquad (5)$$

Pseudo-second-order model

Pseudo-second order equation **(Rehman *et al.*, 2009)** Table 2 is showed as charts:

$$\frac{dq_t}{dt} = k_2 (q_e - q_t)^2 \qquad (6)$$

Where k_2 is the rate constant of pseudo second-order adsorption (g mg^{-1} min^{-1}), for the boundary conditions t= 0 to t= t and q_t= 0 to q_t= q_t, the integrated form of equation (7) becomes:

$$\left(\frac{t}{qt}\right) = \frac{1}{k_2 q_e^2} + \frac{1}{q_e}(t) \qquad (7)$$

Kinetic thermodynamics

Van't Hoff relative **(El-Saieda, 2018)** assumed through Calculation (8) container be recycled to determine the enthalpy changes related with the sorption procedure of heavy element since result on orange peel.

$$\log K_d = -\frac{\Delta H}{2.303R}\cdot\frac{1}{T} + C \qquad (8)$$

Where R is the universal gas constant, and C is a constant. From the plots of log K_d versus (1/T), a straight line was observed, from which ΔH (the enthalpy change) can be calculated

The Gibbs free energy change, ΔG was also calculated based on the logarithmic value the distribution ratio Log K_d at 25ºC according to the Equation (9):

$$-\Delta G = 2.303\ RT \log K_d \qquad (9)$$

Also, the entropy change, ΔS was obtained from ΔG and ΔH with the Equation (10):

$$\Delta G = \Delta H - T\Delta S \qquad (10)$$

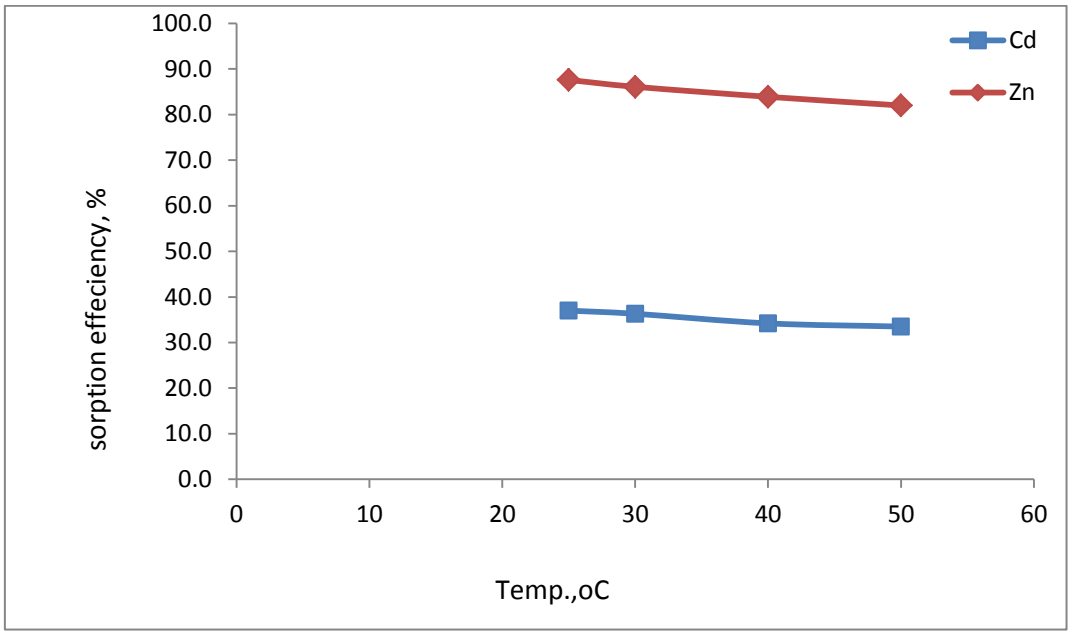

Fig. 5. Influence of temperature on sorption of Cd^{+2}, Zn^{+2} using orang peel at 240 min., P_2O_5 : 30%, 8g/L

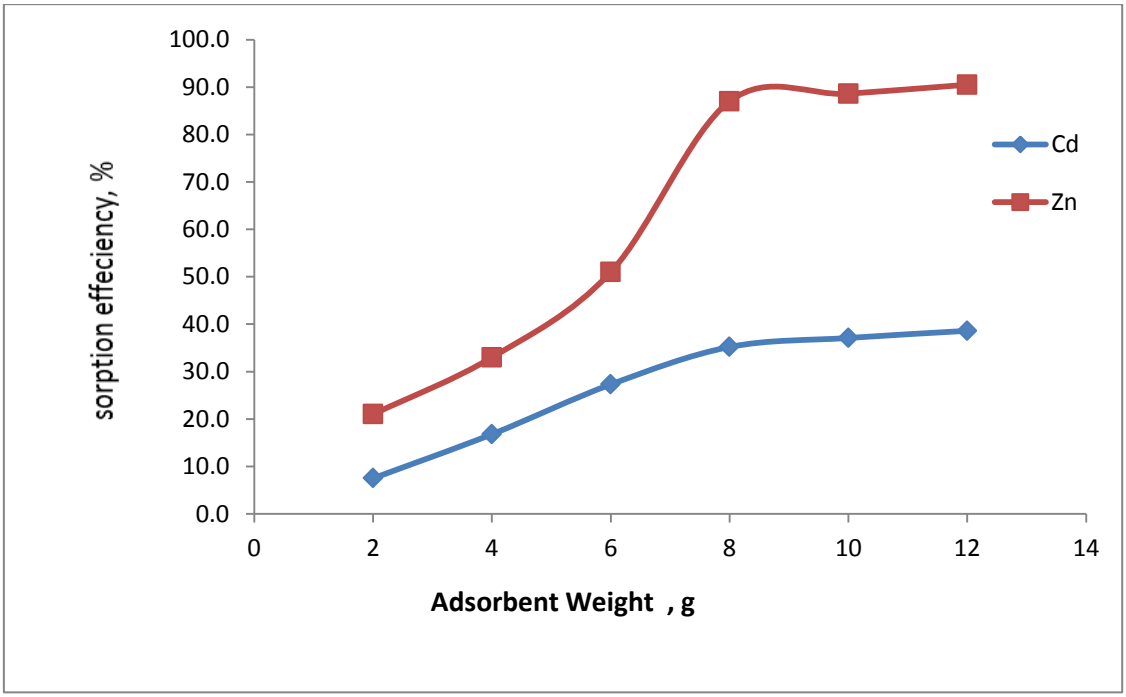

Fig. 6. Influence of Adsorbent Weight on sorption of Cd^{+2}, Zn^{+2} using orang peel at 240 min., P_2O_5 : 30%, room temperature

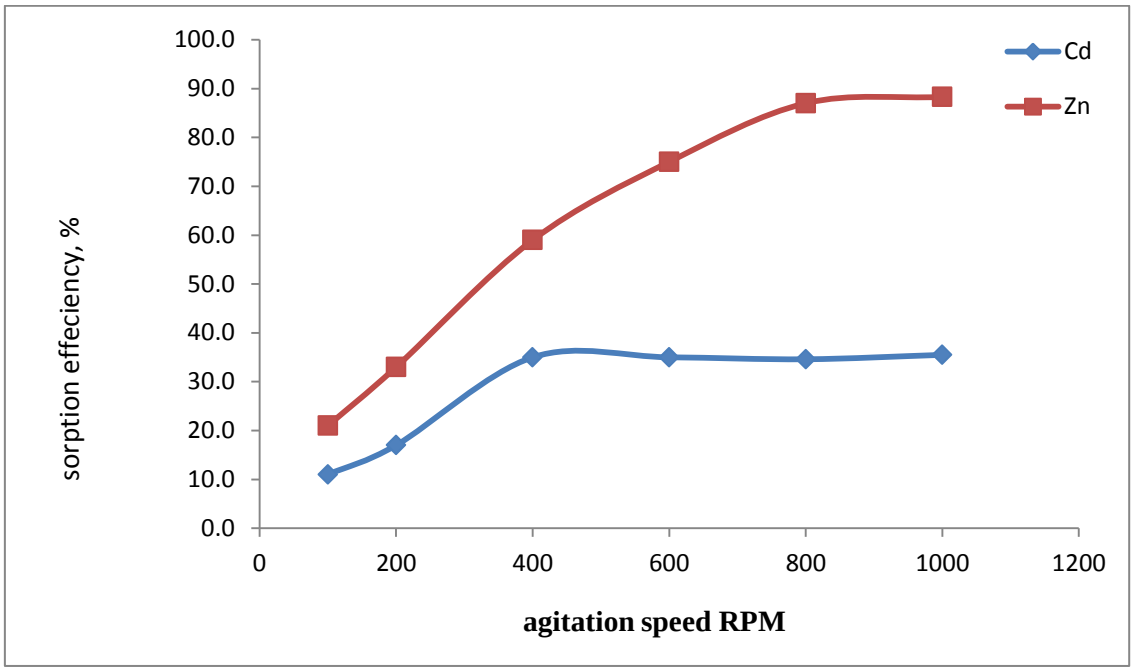

Fig. 7. Influence of RPM on sorption of Cd^{+2}, Zn^{+2} using orang peel at 240 min., P_2O_5: 30%, room temperature

Table 2. The Designed Limits of the Kinetic Simulations by the Linear Correlation Coefficients (R^2) of all plan

		Cd	Zn
Lagergreen pseudo first-order	k_1 (min $^{-1}$)	0.011	0.011
	qe_{cal} (mg/ g)	2.48	4.88
	qe_{exp} (mg/ g)	4.58	10.88
	R^2	0.88	0.91
Pseudo second-order	k_2 (min $^{-1}$)	0.007	0.005
	qe_{cal} (mg/g)	4.78	11.3
	qe_{exp} (mg/g)	4.6	11.0
	h (mol g^{-1} h^{-1})	0.157	0.659
	$t_{1/2}$ (h)	29.48	17.15
	R^2	0.99	0.99

The thermodynamic parameters of the sorption of heavy elements since result on orange peel are assumed in Table 3.

Enthalpy variation for complexing (ΔH_c) which determination brand ΔH extra negative owing to creation of element composite, the negative ΔH worth gotten of adsorption of heavy elements designates that complexation appears to be additional important than dehydration in the sorption system. Although the negative sign of the free energy alteration worth designated the spontaneous occurrence of heavy element sorption and the worth symbol of the entropy variation recommended that the system exhibition a complaint.

Table 3. Thermodynamic parameters of heavy metal adsorption since solution media using orange peel

	ΔG (kJ/ mol)				ΔH	ΔS
	25°C	30°C	40°C	50°C	(kJ/ mol)	(J/ mol K)
Cd	-10.55	-10.62	-11.76	-10.86	-5.03	17.86
Zn	-16.93	-16.87	-16.95	-15.86	-16.16	2.59

Adsorption Isotherms

Langmuir isotherm

Agreeing to Langmuir model, sorption happens consistently on the lively places of the adsorbent, besides when a dsorbate conquers a place, no further adsorption container take place at this site. Therefore, the Langmuir model is assumed through the next equation **(Mellah, 1997 and Ho and McKay, 2000)** (Table 4).

$$C_e/q_e = 1/bQ_0 + C_e/Q_0 \quad (11)$$

Where Q_0 and b, the Langmuir constants, are the saturated monolayer sorption capacity and the sorption equilibrium constant.

Freundlich isotherm

Freundlich model specifies that the relation of solute sorbed to the solute focus is a purpose of the result. The experiential model stayed publicized to be reliable with exponential delivery of lively middles, specific of heterogeneous outsides. The quantity of solute sorbed at balance, q_e, is connected to the concentration of solute in the solution, C_e, next **(Mellah, 1997)**.

$$\mathbf{q_e = K_F C_e^{1/n}} \quad (12)$$

This look can be linearized to provide

$$\log q_e = \log K_F + 1/n \log C_e \quad (13)$$

Where K_f and n are the Freundlich constants, which represent sorption capacity and sorption intensity, respectively.

De-sorption

Next keys Sodium chlorid, Hydrochloric acid, Nitric acid and Sodium acetate stayed tried for Cd, Zn recycled since overloaded orang peel. recycling trials stayed approved out by 3 recycled trail by mixed the overloaded orang peel example (0.5 g) by 3 new recycled rations (25 ml). A methodical design of the recycled Cd, Zn quantities stayed approved out afterward its examination in the together recycled (for all recycled solution verified). Table 5 reviews the gotten documents, it is obviously clear that the Sodium chlorid recycled key is the greatest key tested as an recycled for Cd, Zn since the overloaded orang peel.

CONCLUSIONS

Now these training, orange peel actuated carbon sorbent stayed recycled positively for the sorption of Cd^{+2}, Zn^{+2} elements since their aquatic key. The gotten consequences exposed that the sorption of element is interval needy, media concentration and sorbent quantity needy. Orange peel is low-cost normal unused and gamely obtainable, therefore this education deliver a little charge active incomes for eliminating element from media. isotherm balance trainings established that together Langmuir and Freundlich sorption isotherms stayed around 14.12 and 11.1mg/g Cd^{+2}, Zn^{+2} individually. The gotten consequences of Cd^{+2}, Zn^{+2} sorption presented that ready orange peel is an well-organized sorbent aimed at Cd^{+2}, Zn^{+2} retrieval. We prospered to recycled additional than 86, 82 % of Cd^{+2}, Zn^{+2} individually sorbent by 1.0M Sodium chlorid as an recycled key.

Greetings

The authors would resembling to acknowledge Prof. Dr. I.R. Mohamed and Professor Dr. A.A. Shiha for his unlimited determination and provision throughout the effort.

Table 4. Langmuir and Freundlich considerations of heavy metal on orange peel

		Cd II	Zn II
Freundlich isotherm model	**K_f (mg/ g)**	0.41	4.9
	n	1.70	2.8
	R^2	0.98	0.98
Langmuir isotherm model	**Q_m (mg/g)**	14.12	11.1
	b (L/ mg)	0.010	0.97
	R^2	0.99	0.98

Table 5. Elution produces using diverse recycled **substances**

Eluent type	Elution efficiency, % Cd^{+2}	Elution efficiency, %Zn^{+2}
1.0M NaCl	86.0	82
1.0M HNO_3	71.0	74
1.0M HCl	70.0	78
1.0M CH_3COONa	62.7	24

REFERENCES

Abdel-Samad, A.A. (2020). Synthesis and characterization of functionalized activated carbon for removal of uranium and iron from phosphoric acid. J. Basic and Environ. Sci., 7: 140-153.

Akinhanmi, T.F. (2020). Orange peel as low-cost adsorbent in the elimination of Cd (II) ion: kinetics, isotherm, thermodynamic and optimization evaluations. Biores. and Bioproc., 7 (1): 1-16.

Amin, M.I. (2005). Purification of crude phosphoric acid primarily treated by nuclear materials authority, M.Sc. Thesis, Fac. Sci., Mansoura Univ., 2-12.

Annadurai, G., R.S. Juang and D.J. Lee (2003). Adsorption of heavy metals from water using banana and orange peels. Water Sci. and Technol., 47 (1): 185-190.

Barakat, M.A. (2011). New trends in removing heavy metals from industrial wastewater. Arab. J. Chem., 4 (4): 361-377.

Bernard, A. (2008). Cadmium and its adverse effects on human health. Indian J. Med. Res., 128 (4): 557-564.

Brinza, L. (2009). Cadmium tolerance and adsorption by the marine brown alga Fucus vesiculosus from the Irish Sea and the Bothnian Sea. Biores. Technol., 100 (5): 1727 - 1733.

El-Didamony, A.M., W.M. Youssef and A.A. Abdou (2019). Modification of Amberlite XAD-2 resin for U (VI) adsorption from Egyptian crude phosphoric acid. Egypt. J. Petroleum, 28 (1): 71-76.

El-Saieda, F. (2018). Synthesis, characterization and biological evaluation of metal complexes derived from 2-(phenylamino) acetohydrazide ligand. Eur. J. Pharm. Med. Res, 5: 86-93.

Gavrilescu, M. (2004). Removal of heavy metals from the environment by biosorption. Eng. Life Sci., 4 (3): 219-232.

Ho, Y.S. and G. McKay (2000). The kinetics of sorption of divalent metal ions onto sphagnum moss peat. Water Res., Feb., 15-34 (3):735-42.

Hussein, A.E.M. (2017). Uranium Adsorption from Aqueous Nitric Acid Solution by Solvent Impregnated Polypropylene. Arab J. Nuc. Sci. and Appl., 50 (4): 156-170.

Hussein, A.E.M. and A.M.A. Morsy (2017). Uranium recovery from wet-process phosphoric acid by a commercial ceramic product. Arab. J. Chem., 10: S361-S367.

Janssen, L.J.J. and L. Koene (2002). The role of electrochemistry and electrochemical technology in environmental protection. Chem. Eng. J., 85 (2-3): 137-146.

Kamsonlian, S. (2011). Characterization of banana and orange peels: biosorption mechanism. Int. J. Sci. Technol. and Manag., 2 (4): 1-7.

Kennish, L. (1992). Toxicity of heavy metals: effects of Cr and Se on human's health. J. Indian Public Health Ed., India, 2: 36-64.

Kurniawan, T.A. (2006). Comparisons of low-cost adsorbents for treating wastewaters laden with heavy metals. Sci. Total Environ., 366 (2-3): 409-426.

Kurniawan, T.A. (2006). Physico-chemical treatment techniques for wastewater laden with heavy metals. Chem. Eng. J., 118 (1-2): 83-98.

Mellah, A. and S. Chegrouche (1997). The removal of zinc from aqueous solutions by natural bentonite. Water Res., 31 (3): 621-629.

Ofudje, E.A. (2013). Assessment of Langmuir, Freundlich and Rubunin-Radushhkevich Adsorption Isotherms in the study of the biosorption of Mn (II) ions from aqueous solution by untreated and acid-treated corn shaft. Int. J. Sci. Eng. Res., 4 (7): 1628-1634.

Pérez marín, A.B. (2010). Biosorption of Zn (II) by orange waste in batch and packed-bed systems. J. Chem. Technol. and Biotechnol., 85 (10): 1310-1318.

Rehman, S., M. Ikram and S. Ehman (2010). Synthesis and biological studies of complexes of 2-amino-N (2-aminobenzoyl) benzohydrazide with Co (II), Ni (II), and Cu (II). Frontiers of Chem. China, 5: 348-356.

SHA, L. (2009). Adsorption of Cu2+ and Cd2+ from aqueous solution by mercapto-acetic acid modified orange peel. Colloids and Surfaces B: Biointerfaces, 73 (1): 10-14.

Srivastava, V.C. (2006). Adsorptive removal of phenol by bagasse fly ash and activated carbon: equilibrium, kinetics and thermodynamics. Colloids and Surfaces a: Physicoch. and Eng. Aspects,272 (1-2): 89-104.

Uddin, M.T., M.S. Islam and M.Z. Abedin (2007). Adsorption of phenol from aqueous solution by water hyacinth ash. *ARPN* J. Eng. and Appl. Sci., 2 (2): 11-17.

Vinod, V. (2012). Adsorption Studies of Zn (II) ions from Wastewater using Calotropis procera as an Adsorbent. Res. J. Recent Sci., 2277: 2502.

World Health Organization (2004). Guidelines for drinking-water quality. World Health Organization.

YI, Z. (2016). Uptake of hexavalent uranium from aqueous solutions using coconut husk activated carbon. Desalination and Water Treatment, 57(4): 1749-1755.

Youssef, W.M. (2022). Uranium (VI) sorption from liquid waste solution using functionalized polyurethane polymer: kinetic and isotherm characterizations. Russian J. Inorganic Chem., 67 (7): 1058-1068.

Youssef, W.M. (2020). Characterization and Application of Olive Stones Activated Carbon for Uranium (VI) Sorption from Wet-process phosphoric acid: Kinetic, equilibrium and thermodynamic studies. J. Basic Environ. Sci., 7: 1-12.

Youssef, W.M. (2020). Polyacrylic acid/ polyaniline composite as efficient adsorbent for uranium extraction from nuclear industrial effluent. J. Radioanalytical and Nuclear Chem., 324: 87-96.

دراسة ديناميكية لإزالة بعض العناصر الثقيلة باستخدام قشور البرتقال الطبيعية كمادة مازة منخفضة التكلفة ناتجة من المخلفات الزراعية

رفعت رفعت عبدالحميد[1]- وليد محمد يوسف[2]- محمد محمود نبيل[1]- ابراهيم رمضان محمد[1]- عادل عبدالرحمن شيحة[1]

1- قسم الاراضى – كلية الزراعة – جامعة الزقازيق – مصر
2- هيئة المواد النووية – القاهرة – مصر

تم تحضير كربون من قشر البرتقال كمخلف زراعى طبيعى وتم عمل معالجة للكربون لزيادة كفاءته وذلك باختلاطة مع 0.01 مولار من D_2EHPA. لاختبار قابلية تطبيقه لادمصاص بعض العناصر الثقيلة من المحاليل المائية. وتم توصيف المركب المحضر باستخدام التقنيات الاتيه: SEM ، و FT-IR. وقد تم اختبار عوامل الادمصاص المختلفة وهي :زمن التقليب، سرعة التقليب، ودرجة الحرارة، نسبة الماده المازة الى السائل . اظهرت تحقيق حركية التفاعل انه يصلح لنموذج النظام الثاني .وقد تم عمل استرجاع للمادة المازة لاعادة استخدامها بواسطة 1 مولار صوديوم كلوريد.

المحكمـــون:
1- أ.د. أكـــرم محمـــد الديـــدمـــواني أستاذ الكيمياء - كلية العلوم- جامعة الزقازيق.
2- أد. أيمن محمود حلمي محمد أبو زيد أستاذ ورئيس قسم الاراضي - كلية الزراعة - جامعة الزقازيق.