International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.2, pp 829-836, 2017

Adsorption of lead (II) from industrial waste water by tea leaf leaves as adsorbent

Luma A. Mohammed Ali

Department of Chemistry, College of Science, University of Babylon, Babylon, Iraq

Abstract : The aim of this work is to absorb the lead (II) with an occasional value adsorbent (heavy metal) that comes within the effluents of textile industries throughout removal processes. though industrial carbon may be a most popular material for (heavy metals) removal, its wide unfold use is restricted because of high price. At present, tea leaf leaves as an occasional value material for removing (heavy metals) has assorted researchers operating during this field. within the gift work, tea leaf leaves within the diversity of crushed was achieved for removing (heavy metal) taking lead (II) as exemplar system. The tea leaf leaves procured from India and was achieved the parameters like (dose of adsorbent, agitation time, particle size and initial dye concentration). associate quantity of (0.1) g/l of tea leaf leaves may take away (99.5 %) from associate solution of (50) ppmlead (II) with the shaking time (150) minute. The standard Freundlich and Irving Langmuir isotherm paradigm due to the equilibria sorption statements.

The results indicate that tea leaf leaves may well be used as an occasional value different to industrial activated charcoal in waste to removal of (heavymetal).

Keywords : lead (II), sorption capability , isotherm models , black tea.

Introduction:

Toxic heavy metals like copper, cadmium, lead, nickel, mercury and Zn, There are one among the foremost necessary environmental issues that has got to be resolved, and establish ways that to get rid of them from waste water[1.2] as a result of its toxic and no perishable naturally. As it's passed from the waste material employed in irrigation to humans through the organic phenomenon and caused him health issues[3,4].

The lead element is that the most toxic than the remainder of the significant elements as a result of it accumulates within the brain, bones, kidneys, muscles and causes a series of disorders like anemia, uropathy and neurologic epidemic disorders that result in death[5,6]. It additionally affects kids beneath the age of (six), as a result of a tiny low quantity of it cause them to, scrubby growth, learning disabilities, impaired hearing disorders, behavioral issues, attention deficit and excretory organ harm. However if it's of a high level, it'll result in sub normality, coma and later death. As in adults, lead will increase vital sign, memory or concentration issues and cause fertility issues, nerve disorders, muscle and joint pain, irritability[7]. Also, lead will replace Ca that is critical for the strength of bones and teeth, as can also replace the metallic element within the hematin catalyst and it works on inhibition it within the body[8,9].The concentration of lead allowed in drinking water, according to United States Environmental Protection Agency is less than $50 \mu g L^{-1}$, $15 \mu g L^{-}$ Consecutively[10].

Many industries area unit thought-about to be the most reason for the pollution of natural water in Lead like coat, oil processing, and battery producing[11].There ar many ways that to get rid of significant metals from waste water like chemical precipitate[12], flocculation[13],reverse diffusion[14], curdling[15], and extraction[16]. However these ways have several disadvantages there use is therefore restricted due to a high price[17], and incomplete removal, therefore you wish to feature methods to finish the removal process[18].

The ways that area unit supported the adsorption area unit the foremost common as a result of these techniques have important benefits like simplicity, simple handling, high property, high potency in removal, lower operation value and minimum biological sludge or production of chemical and regeneration of adsorbent[19].

The removal of lead from waste water by exploitation tea dregs as an adsorbent surface an analysis is formed through the study of many parameters.

Materials and Methods

Preparation of adsorbent

A quantity was taken from the dregs tea and place during a great amount of H_2O and boil for (10) hours. it's then filtered and washed with H_2O until the dark color disappears from the filtrate. and so it absolutely was dried at a temperature of (80) C_0. Then the tea leaves were brought to a halt into completely different sizes by special sieves. With this technique the tea leaves area unit prepared the material surface for the aim of adsorption.

Preparation of adsorbate

The Pb(II) solution was prepared by dissolving specifically (0.0799) g from $Pb(NO_3)_2$ in (500) ml from water. it's used it to prepared completely different concentrations by diluting.

Batch Adsorption Studies

The final concentration of Lead was measured by atomic absorption. the quantity of lead adsorbate was calculated from the subsequent equation:

$$q_e = \frac{V}{W}(C_o - C_e) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

qe : quantity of lead adsorbate per unit weight of dregs tea (mg/g); Co: initial concentration of lead; Ce: concentration of lead(II) at equilibrium time (ppm); V:volume of solution (l); W: dregs tea dose (g).
the proportion removal potency of lead calculated by the subsequent relation:

$$Removeal\ efficiency\ (\%) = \frac{C_o - C_e}{C_o} \times 100 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Adsorption Isotherm Models

There are many models to describe adsorption isotherms such as Langmuir, Freundlich, Temkin and Harkins-Jura isotherm models[20].It has been chosen as model Freundlich and Langmuirto evaluate the adsorption process as these models describe the surface properties and material affinity.

The Langmuir isotherm is expressed by[21]:

$$q_e = \frac{q_m K_a C_e}{1 + K_a C_e} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3)$$

qe : quantity adsorbate per unit mass (mg/g) of sorbent material at equilibrium, qm : sorption capability (mg/g), Ce: equilibrium dregs tea concentration of the solution (mg/L) and Ka : sorption constant.in equation (4) the plot of Ce/qe versus Ce is linear this indicate the surface assimilation of lead upon dregs tea follows Langmuir isotherm.

$$\frac{C_e}{q_e} = \frac{1}{q_e K_a} + \frac{C_e}{q_m} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The essential characteristics of Irving Langmuir model are often categorical by a dimensional constant referred to as equilibrium parameter, RL that's outlined by:

$$R_L = \frac{1}{1 + bC_0} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

b: Irving Langmuir constant and Co: initial concentration. the worth of RL indicates the form of the isogram to be either not apropos (RL >1), linear (RL=1), apropos (0< RL<1) or irreversible(RL=0).
The Freundlich model is expressed by [22]:

$$\log q_e = \left(\frac{1}{n}\right) \log C_e + \log K_f \dots\dots\dots\dots\dots\dots\dots\dots (6)$$

qe: quantity adsorb able per unit mass of adsorbent at equilibrium (mg/g), C_e : equilibrium lead (mg/L). kf and n : Freundlich constants, n provides a sign of the favorability and kf [mg/g (L/mg) 1/n], Kf and n:'often obtained from the plate of log qe versus log (Ce) and that they capable the intercept and slope of the plate severally. the worth of n lies between a pair of and ten, which suggests sensible sorption.

Results and Discussion

Sorption of Lead

The sorption of lead were investigated within the study exploitation totally varied parameters:

Effect of adsorbent dosage

The result of adsorbent amount of tea leaf dregs on the proportion of removal of lead was studied. The experiment was done by putt (100) milliliter of (50) mg/L lead solution in conical flasks with totally different amounts of material addition from (0.1 – 1.5) g , with (concentration of lead (50) mg/L, (300) µ particle size). These flasks were unbroken in shaker for three hours. These samples were then analyzed exploitation atomic instrument at (217) nm. The removal proportion of lead will increase with increase in initial tea dregs concentration, in (0.1)g the removal proportion of lead was found (86)% and also the quantity of dye adsorbate (43mg/g) Figure (1). These results were kind of like previous analysis[23,24].

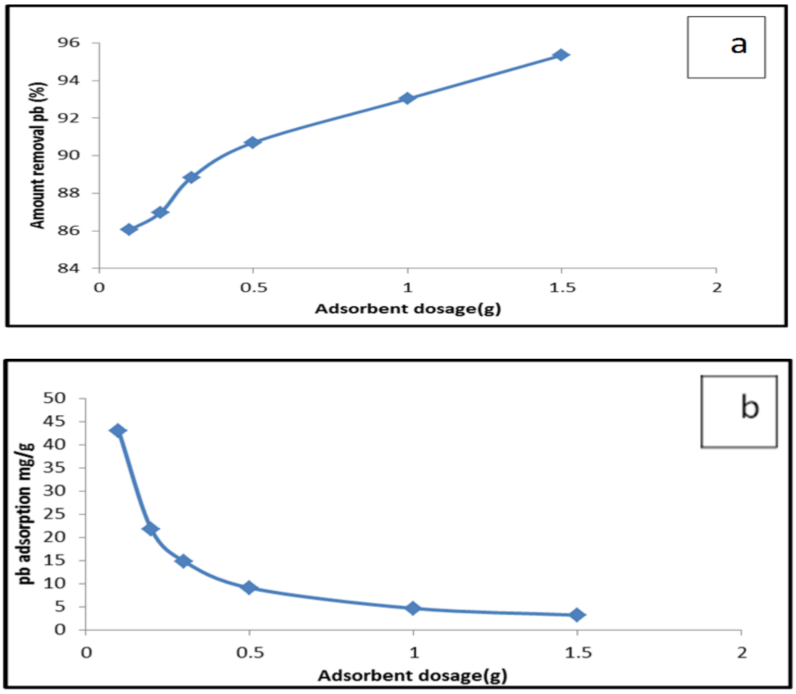


Figure (1) Effect of adsorbent dosage in the removal of pb (II) by (BT)(a)Adsorption percentage. (b) Amount of dye adsorbed(mg/g).

Effect of Contact Time

Contact time experiments were allotted by exploitation the (8) conical flasks, every stuffed with (0.1) g of the tea dregs, then extra (100) milliliter of (50) mg/litter concentration of cause this conical flasks. These flasks were unbroken in shaker for various time periods (20 – 180) minute. The results showed that the simplest contact time is (150) minutes [7]. Figure (a pair of) shows removal potency of lead when completely different contact time.

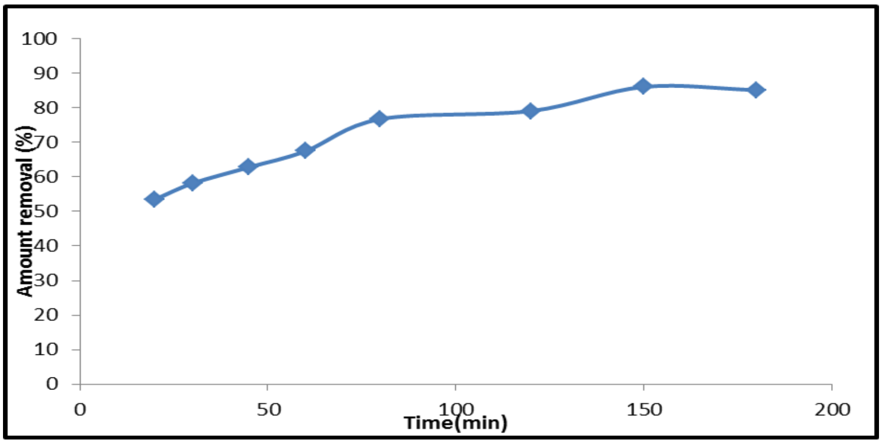
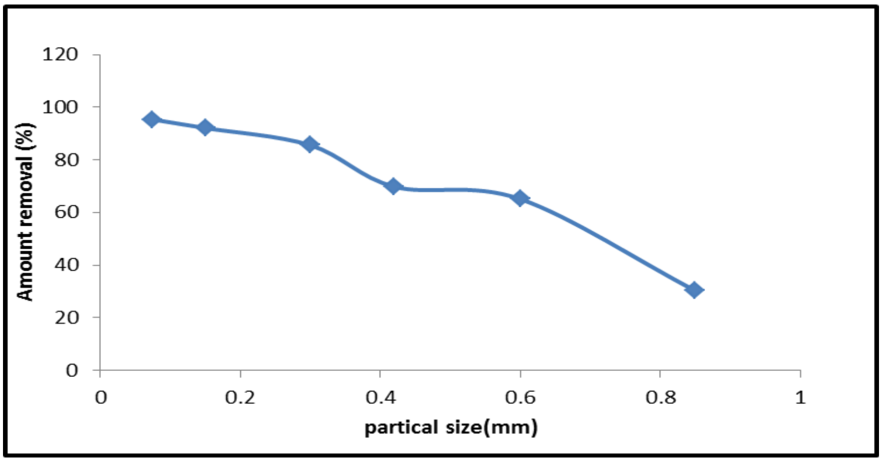


Figure (2) : Effect of contact time for adsorption of 50 mg/l from pb (II) onto 0.1 g (BT).

Effect of Particle Size of Adsorbent

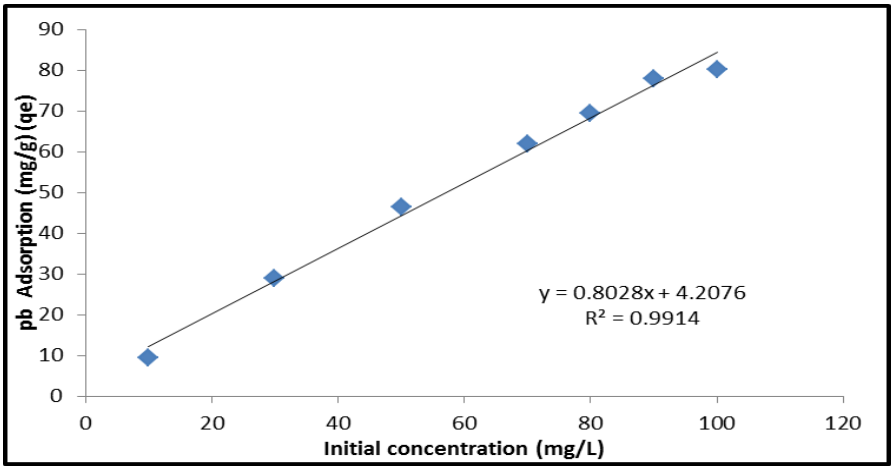
The result of Particle size of adsorbent (BT) on surface assimilation of lead has been studied on tea dregs particle of variable size (75 - 850)µ. The experiments were allotted by exploitation the half dozen conical flasks, for the half dozen sizes and weight (0.1) g from the tea dregs, then more a hundred milliliter from (50) mg/ litter of cause these conical flasks. These flasks were unbroken in shaker for (150) minute. The results showed decreases that quantity of lead adsorb able with increase within the Particle size of tea dregs. This shows that the dimensions particlesmaller of the adsorbent provides a larger area and therefore will increase the quantity of binding sites[23,25,26].The figure (3) shows that the most effective removal occurred in size (75) µ (95.34%).



Figure(3) :Data of particle size effect on amount removal ofpb(II) onto (BT) at concentration (50) mg/L , adsorbent dose (0.1)gm

Effect of Initial Lead Concentration

For finding the result of initial lead concentration, experiments were dispensed in several flasks by provoking (100) milliliter of lead solutions of various concentration like (10, 30, 50, 70, 80, 90 and 100) mg/l and fill every flask (0.1) g with particle size (75) µ from the tea dregs. These flasks were unbroken in shaker for (150) minute. The figure (4)shows the result of initial lead concentration on adsorbent. It accuse that the adsorption of lead enhanced with increase in initial lead concentration, as a result of necessary propulsion are often bagged by augment lead concentration to beat all mass move of the lead among two phases the liquid phase and solid [27,28]. wherever we tend to note sorption capability enhanced from (9.53 – 80.23) mg/g.



Figure(4) : Effect of initial concentration on adsorption capacity of pb(II) onto(BT)(75µ particle size and 0.1gm adsorbent dose)

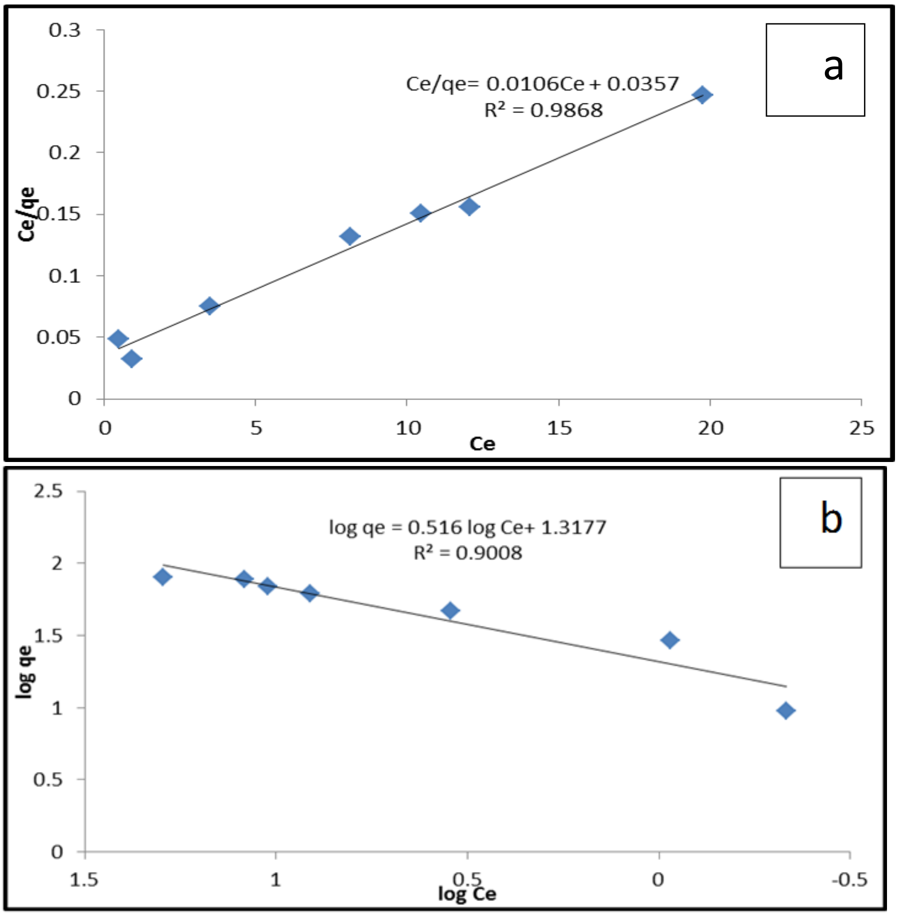
Isothermal Analysis

By applying Freundlich and Langmuir equation(4,6) we tend to get the figure (5a, b) that it corresponds with 2 equations. Table (1) shows that the surface assimilation of lead exploitation tea dregs each gratified of Freundlich and Langmuir isotherm.

Table (1) : Adsorption isotherm parameters for pb(II) removal

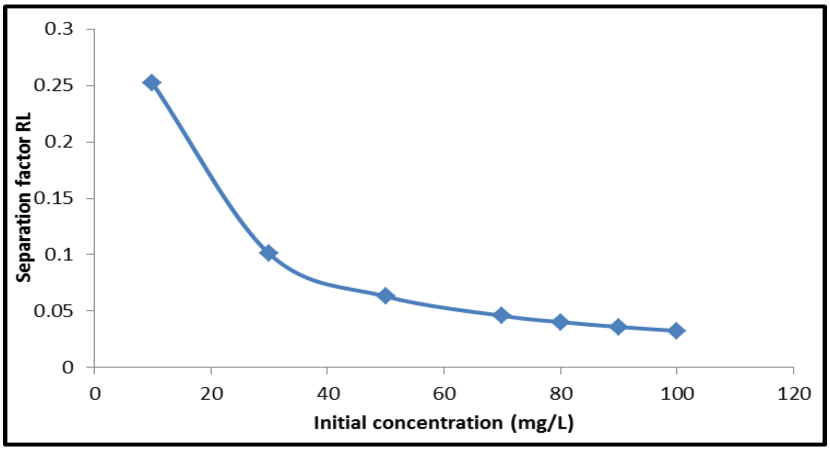
Langmuir	Freundlich
q_m(mg/g) 94.3396	K_F(mg/g)(1/mg)$^{1/n}$ 20.782
Ka(L/mg) 0.2969	1/n 0.516
R^2 0.9008	R^2 0.9868
R_L (0.2519 – 0.0325)	

The equilibrium of Langmuir natural process curves relating solid and liquid half concentration of pb(II) and so the Freundlich equilibrium natural process bend pertaining solid and liquid half concentration of pb(II).



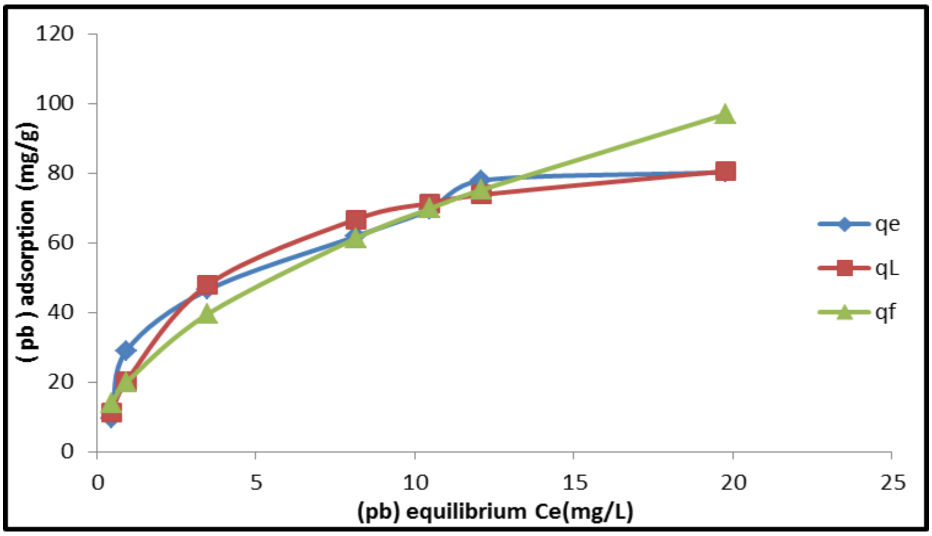
Figure(5): Linearized adsorption isotherm model of pb(II) onto (BT) (a) Langmuir model (b) Freundlich model

The separation factor issue (RL) with initial concentration f pb(II) is clear in Figure (6). The (RL) worthsfor the adsorption of pb(II) onto (BT) area unit discovered that was apropos technique.



Figure(6) : Separation factor versus initial pb(II) concentration on to (BT).

The delinquency between experimental information and information get to by 2 models of sorption capability, shown by Figure (7) . It will be detected that the sorption epitome for pb(II) upon tea leaf obedient each Langmuir and Freundlish isotherms appear inhomogeneous surface conditions and monolayer sorption



Figure(7): Data by Langmuir and Freundlich equilibrium isotherms for the system pb(II) – (BT)

Conclusion :-

The existing of this work show that the tea leaf leaves (BT) that simply and copiously accessible agro dumpin our country may be readily born-again upon sensible adsorbent by exploitation easy ways. an appropriate amount(0.1 g/l) of the tea leaf leaves adsorbent might removal the maximum amount as (93)% of the metal which have (50 ppm), if agitated for (150) mint incontestable enough potential of BT as an adsorbent for the removal of the pb(II) , from water solutions. The surface assimilation of the pb(II) was most round the natural pH of the solution of metal. This shows that surface assimilation of the metal may well be meted out on BT with applying each Langmuir and Freundlich isotherm.

Reference

1. Xuea, Y.; Houa, H.; Zhu, S., Competitive of copper (II), cadmium (II), lead(II) and zinc onto basic oxygen furnace slag, J. Hazard. Mat. (162) 391-401(2009).
2. Shi, W.Y. ; Shao, H.B. ; Li, H. ; Shao, M.A. ; Du, S. , Progress in remediation of hazardous heavy metal-polluted soils by natural zeolite, J. Hazard. Mat. (1701-6)(2009).
3. Alvarez-Ayuso E.; Garcia-Sanchez A.; Querol X., Purification of metal electroplating waste waters using zeolites. Water Res. 37:4855-62(2003).
4. Ruparelia J.; Duttagupta S.; Chatterjee A.; Mukherj S., Potentioal of carbon nanomaterials for removal of heavy metals from water. Desalination 232:145-56(2008).
5. Kazi T. G.; Jalbani N.; Kazi N. ; Jamali M. K., Arain M.B.,Afridi H. I., Kandhro A., Pirzado Z., Evaluation of toxic metal in blood and urine samples of chronic renal failure patients, before and after dialysis. Renal Failure. 30, 737-745(2008).
6. Afridi H. I.; Kazi T. G.; Kazi G. H.; Jamali M. K.; Shr G. Q., Essential trace and toxic element distribution in the scalp hair of Pakistani myocardial infarction patients and controls. Biol. Trace Elem. Res. 113, 19-34(2006).
7. Taha, D.N.; Samaka, I.S.; Natural Iraqi palygorskite clay as low cost adsorbent for the treatment of dye containing industrial wastewater, J. Oleo Sci.61(12)729-736(2012).
8. Skerfving S.; Gehardsson L.; Schutz A.; Stromberg U., Lead-biological monitoring of exposure and effects. J. Trace Elem. Exo. Med. 11, 289-301(1998).
9. Soylac M.; Elci L.; Akkaya Y.; Dogan M., On-line preconcentrayion system for determination of lead in water and sediment samples of lead in injection-flam atomic absorption spectrometry. Anal. Lett. 35, 487-499(2002).
10. Raungsomboon, S.; Chidthaisong, A.; Bunnag, B.; Inthron, D., Harvey N.W., Removal of lead Pb2+ by the Cyanobacterium Gloeocapsa sp.Bioresour Technol. 99, 5650-5658(2007).
11. Yurtsever, M.; Sengil, I. A., Bio sorption of Pb(II) ions modified quebracho tannin resin, J. Hazard. Mater, in press, doi:10.1016/j.ihazmat.06,077(2008).

12. Amuda, O.S.; Giwa, A.A.; Bello, I.A., Removal of heavy metal from industrial wastewater using modified activated coconut shell carbon, Biochem. Engine.J. 36, 174-181(2007).
13. Faur, C.B.; Kadirvelu, K.P., Removal of metal ions from aqueous solution by adsorption onto activated carbon cloths: adsorption competition with organic matter, Carbon, 40, 2387-2392(2002).
14. Ayhan, D., J. Haza. Mater, Heavy metal adsorption onto agro-based waste materials, 157, 220-229(2008).
15. Anoop, A.K.; Anirudhan, T.T, Kinetic and equilibrium modelling of cobalt(II) adsorption onto bagasse pith based sulphurised activated carbon, Chem. Engine. J., 137, 257-264(2008).
16. Vivek, N.; Mahesh, G., Use of adsorption using granular activated carbon (GAC) for the enhancement of removal of chromium from synthetic wastewater by electrocoagulation, J. Haza. Mater, 161, 575-580(2009).
17. Naser,N.A.;Kahdim, K.A. and Taha, D.N., Synthesis and characterization of an organic reagent 4-(6-Bromo-2-Benzothiazolylazo) Pyrogallol and its analytical application, J. Oleo Sci.61(7) 387-392 (2012).
18. Saffaj, N.; Loukili, H.; Alami, S.Y.;Albizane, A.; bouhria, M.; Persin, M.; Larbot, A., Filtration of solution containing heavy metals and dyes by means of ultrafiltration membranes deposited on support made of Moroccan clay, Desalination, 168, 301-306(2004).
19. King, P.; Rakesh, N.; Beenalari, S.; Prasamna, Y. K.; Prasad, V. S. R. K., Removal of lead from aqueous solution using Syzygium cumini L.: equilibrium and kinetic studies, J. Hazard. Master, 142, 340-347(2007).
20. Langmuir, I., The adsorption of gases on plan surface of glass, mica and platinum, J. Am. Chem. Soc., 40, 1361-1403(1918).
21. Freundlich, H.Z., Over the adsorption in solution, J. Phys. Chem., 57A, 385-470(1906).
22. Taha, D.N.; Samaka, I.S.; Mohammed, L.A., Adsorptive Removal of Dye From Industrial Effluents Using Natural Iraqi Palygorskite Clay As Low-Cost Adsorption, Journal of Asian Scientific Research, 3(9):945-955(2013).
23. Theivarasu, C.; Mylsamy, S., Equilibrium and kinetic adsorption studies of Rhodamine – B from aqueous solutions using cocoa (Theobroma cocoa) shell as anew adsorbent International Journal of Engineering science and Technology, 2 (11) 6284-6292(2010).
24. Mckay, G. ; Otterburn, M.S.; Sweeny, A.G., The removal of colour from effluent using various adsorbents-IV silica: equilibria and column studies, Water Res., 14,21-27(1980).
25. Al-Degs, Y.; Khraisheh, M.A., Ahmed, M.N., Evaluation of activated carbon adsorbents for the removal of textile reactive dyes from wastewater. Jordan International Chemistry Engineering Conference, 1, 159-167(2000).
26. Ho, Y.S. ; Chiang, T.H. ;Hsueh, Y.M., Removal of basic dye from aqueous solution using tree fern as a biosorbent , Process Biochem., 40,119-124(2005).
27. Taha D.N.; Samaka I. S.; Mohammad L. A.; Naige A. S., Adsorption Studies of Direct Red 28 Dye onto Activated Carbon prepared from low-cost material, Civil and Environmental Research, 6(7)149-159 (2014).

*****