

Journal of Chemical, Biological and Physical Sciences



An International Peer Review E-3 Journal of Sciences

Available online at www.jcbps.org

Section C: Physical Sciences

CODEN (USA): JCBPAT

Research Article

Uranium Adsorption from Aqueous Solution by Trioctylamine Impregnated Polyurethane Foam

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Received: 28 July 2018; Revised: 18 August 2018; Accepted: 24 August 2018

Abstract: The present work indicates that the recovery of uranium from dilute aqueous solutions. The sorption behavior of uranium (VI) was investigated in dilute uranyl nitrate solutions by polyurethane foam impregnated with trioctylamine (TOA) and the fact that extraction is high at use acidic solutions, such as waste acidic leach solutions. The polyurethane foam acts as a cheap and readily available support material for TOA, percentage of solvent and extraction efficiency were evaluated together. The stripping of uranium is easy using H₂O; 1M NaOH+0.1M H₂SO₄; HNO₃; Tartaric acid; citric acid and Na₂CO₃. This method can also be used for concentrated uranium solutions because the TOA-impregnated foam has a high extraction capacity. On the other hand, the effects of some interfering impurities need to be studied in order to apply this method to real solutions.

Keywords: Uranium, Trioctylamine (TOA), polyurethane foam, urethane polymers, sorption.

INTRODUCTION

Uranium is one of the most hazardous elements to the environment due to its radioactivity and toxicity^{1,2}. Now a days, separation and determination of uranium is gaining more importance due to its increasing applications in different fields such as nuclear energy generation, shielding of industrial

radioactive sources, anti-tanks ammunition, catalysts, staining pigments, burning of fossil fuel (oil and coal) and uranium containing phosphate minerals^{3,5}. Uranium can cause non-malignant respiratory disease (fibrosis, emphysema), nephrotoxicity⁶ and the target organ to be considered for uranium toxicity is mainly kidney⁷.

Several methods have been developed for the detection and determination of uranium at trace and ultra-trace levels^{3, 8,10-16} such as Novel extractants impregnated resin for pre concentration and determination of uranium from environmental samples⁹. However, to achieve high sensitivity by minimizing effects of the matrix caused by commonly present interfering ions, separation and/or pre concentration procedure is required to be developed prior to the analysis of uranium³. Various methods available for pre concentration and separation of uranium are: ion-exchange^{20,21}, solid phase extraction (SPE)²²⁻²⁶, ion imprinting polymers^{27,29,22-} and cloud point extraction and determination^{30,31} liquid-liquid extraction¹⁷⁻¹⁹. Recently, SPE has increasingly been used for pre concentration, separation and removal of trace and ultra-trace amounts of uranium species from complex matrices³²⁻³⁵. Rao et al. have presented an overview of the pre concentration techniques used prior to the determination¹⁰ of U⁺⁶.

The use of polyurethane foams in the separation and extraction of various inorganic and organic species was first demonstrated³² and the field has been reviewed³³. The polyurethane foams act as weak anion-exchangers with low capacity since the chemical nature of these foams contain amido and amino groups. High molecular weight tertiary amines [(C_nH_{2n} + 1)₃N] that are selective to uranium and are readily available have been used in the solvent extraction of uranium³⁴. The extraction is specific with polyurethane foams having high distribution coefficients. Polyurethane foams have important and fundamental applications in analytical chemistry because of the hydrodynamic properties of polyurethane foams are excellent due to its quasi-spherical membrane structure³⁵. It has been reported by several authors that polyurethane foams can be used as effective and inert supports for various extractants and are used for the recovery of metal ions in analytical and water treatment processes.^{36,37} Polyurethane foams containing different functional groups can be prepared by immobilizing various organic extractants or chelating agents³⁸. The stripping of uranium from amines can be achieved easily. In our work, polyurethane foams were impregnated with trioctylamine (TOA), as tertiary amine, and the parameters affecting uranium extraction efficiency were investigated.

MATERIALS AND METHODS

Stock uranium solution of 0.01 M was prepared by dissolving 0.5279g of UO₂ (NO₃)₂.6H₂O (Merck, Darmstadt, Germany) in 0.1 M nitric acid. The commercial polyurethane foam was obtained from (aldora, Turkey). Trioctylamine was supplied from Merck. All other chemicals used were analar grade. Polyurethane foam plugs, 4.5 cm in diameter and 2.2 cm long (average weight = 0.5500 ± 0.0020 g), were cut from a foam sheet. To increase active porous site each foam plug aq1 was squeezed in 2M HCl in a batch extractor for 1 h, washed with distilled water until free of HCl, and again squeezed, and air-dried overnight before using. The extraction was carried out by a dynamic method in an automatic squeezing system. The uranium concentration in aqueous solution was determined by the 1-(2-pyridylazo) - resorcinol (PAR) method by using a Shimadzu UV/VIS 260 Recording Spectrophotometer (Shimadzu, Kyoto, Japan.) The amount of uranium extracted by the TOA was determined from the difference between the initial and final concentrations of uranium in aqueous solutions.

Weight change: The weight change percent also was determined for each experiment by using the mass difference in the resin weight before and after impregnation (by measuring the increase in the weight of the resin) according to the following expression.

$$\text{Weight change \%} = 100 \times \frac{m_2 - m_1}{m_1}$$

Where m_1 and m_2 are the dry polyurethane foam weight before and after impregnation process respectively in gram.

Sorption Studies: Studies on the sorption behaviors of uranium (VI) were carried out by using batch method. Unless otherwise given, 10 ml of aqueous solution containing known amounts of uranium equal to $0.3 \times 10^{-3} \text{ mol L}^{-1}$ were add to 0.1 g of solvent impregnated resin loaded with selected TOA, and then were shaken well at room temperature until equilibrium was reached. The aqueous phase was separated by filtration and the uranium concentrations were determined in the aqueous phase solution. The uptake of the metal ion (quantity of uranium booked in the solid phase q_e) by using impregnated resin can be determined according to the following relation:

$$q_e, \text{ mg/g} = \frac{(C_0 - C_e) \times V}{M}$$

Where C_0 and C_e are the initial and equilibrium concentrations of the metal in the aqueous phase in mol/L, respectively, V gives the volume of the aqueous phase solution in ml and m is the weighed dry impregnated resin in gm. Where the uptake percent of the metal ion by the impregnated resin was calculated according to the following relation:

$$\text{Uranium adsorption, \%} = 100 \times \frac{C_0 - C_e}{C_0}$$

RESULTS AND DISCUSSION

Measurements of the foam extraction capacity: The concentration of UO_2^{2+} in the solution was determined spectrophotometrically with sodium salicylate. [39] The 0.05 ± 0.005 g of foams impregnated with TOA were brought into contact with uranyl nitrate solution for 0.25 and 24 h. After it was equilibrated, the sorbed amount of UO_2^{2+} (UO_2^{2+} m mol g^{-1} foam) was calculated by measuring decreasing UO_2^{2+} concentration in the solution.

Variables Affecting Impregnation Process

Effect of Amine Concentration: In order to study the effect of solvent concentration upon the amount of trioctylamine (TOA) impregnated on the working foam sample, a series of impregnation experiments were performed under fixed conditions namely, at impregnation temperature of about 25°C for 1 h using volume/mass ratio of 5/1 and using benzene as diluents. The applied solvents concentrations ranging from 0.02 up to 0.5 M. The obtained results plotted in Figure (1) was clearly that the amount of solvent loaded onto the foam increased with increasing the solvent concentration from 0.028 M to 0.5 M, due to the increasing of amine amounts available in the impregnation

solution. Beyond the 5th experiment there is no significant increasing in the amount of the loaded solvent because of the entire foam surface covered by the solvent, so the amine concentration of 0.45M will be applied in further experiments as the optimum solvent concentration.

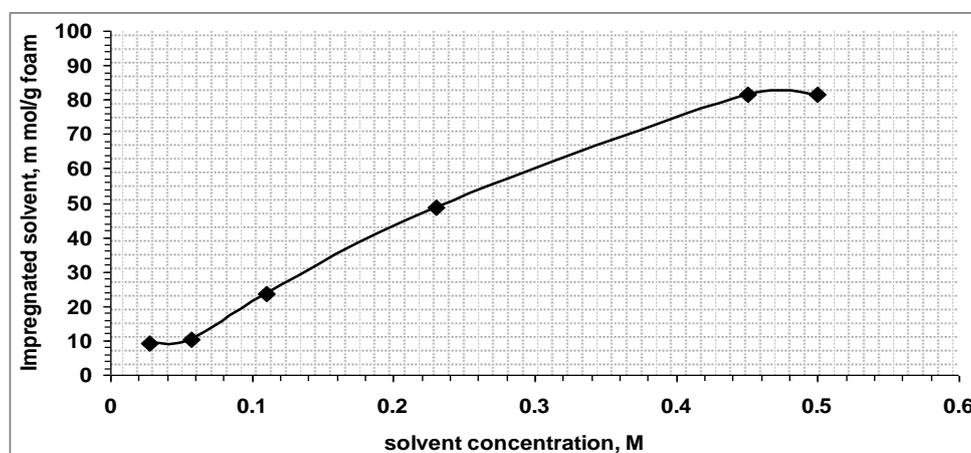


Fig. (1): Effect of TOA concentration upon the loaded amount onto the dry polyurethane foam (T: 25 °C, t: 1 h., ratio: 5/1 and Diluents: benzene. Conc.: 0.028 - 0.5 M)

Effect of contact time: To study the influence of shaking time upon the amounts of solvent (TOA) impregnated upon the dry polyurethane foam working sample, a series of impregnation experiments were performed by shaking 0.05g of dry clean foam with the properly prepared impregnation solutions under fixed conditions namely, 0.5 mol/L solvent concentration at impregnation temperature of about 25 °C using volume/mass ratio of 5/1 and using benzene as diluents. The applied shaking time ranging from 1/2 h to 24 h. The obtained results were plotted in Figure (2) clearly obvious that the amount of TOA loaded onto the foam increased with increasing the impregnation time from 1/2 h up to 24h. Beyond 5 h there is no significant increasing in the amount of the loaded solvent because at this time all porous foam surface covered with amine solvent and don't take another amount. So it is decided to choose impregnation time of 3h as an optimum time.

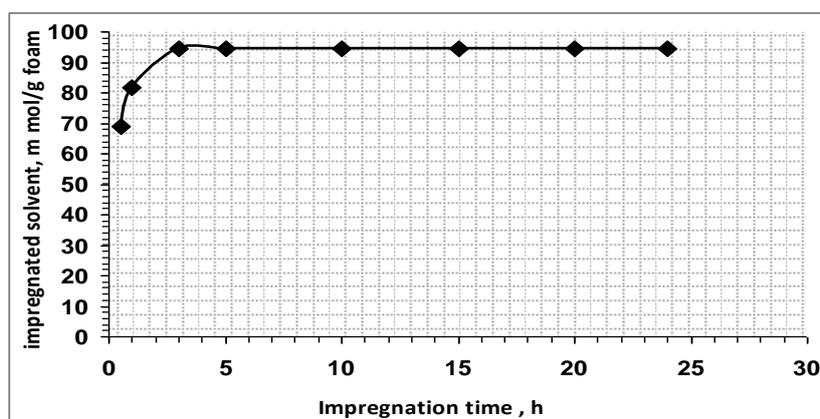


Fig. (2): Effect of shaking time upon the loaded amount onto the dry polyurethane foam (T: 25 °C, t: 0.5-24 h., ratio: 5/1 and Diluents: benzene. Conc.: 0.45 M)

Effect of volume/mass ratio : To study the effect of volume/mass ratio upon the amount of TOA impregnated upon the working foam sample, a series of impregnation experiments were performed under fixed conditions namely, at impregnation temperature of about 25 °C for 5 h using amine concentration of 0.5 M and using benzene as solvent diluents. The applied impregnation solution volume / foam mass ratios ranging from 1/L up to 10/L. The obtained results shown in plotted in Figure (3) was clearly obvious that the amount of solvent loaded onto the foam increased with increasing the impregnation solution volume due to the increasing of the amounts amine present in the solution. There is no significant increasing in the amount of the loaded TOA beyond 6/1 because of at this ratio all porous of polyurethane foam surface was covered with solvent. So it decided to choose 5/1 as an optimum volume /mass ratio.

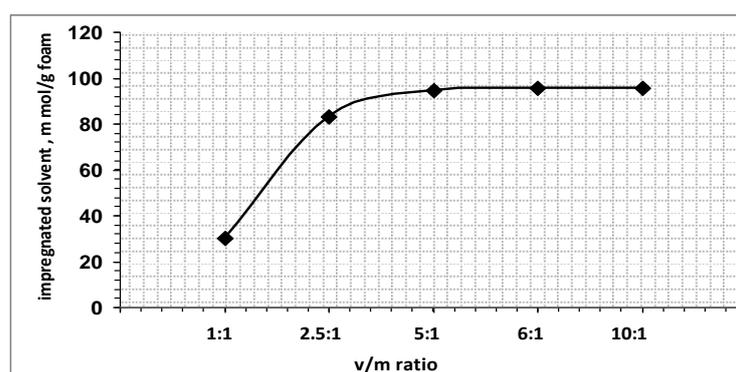


Fig.(3): Effect of shaking time upon the loaded amount onto the dry polyurethane foam (T= 25 °C, t= 3 h., ratio= 1/L: 5/l, Diluents= benzene and solvent Conc. = 0.45 M).

Effect of impregnation temperature: To study the effect of impregnation temperature upon the amount of TOA impregnated on the working foam sample, a series of impregnation experiments were performed under fixed conditions namely, using impregnation solution concentration of 0.45M for 3h using v/m ratio of 5/1 and using benzene as solvent diluents. The applied impregnation temperature ranging from 25 up to 70 °C. The obtained results were plotted in Figure (4) clearly obvious that the amount of solvent loaded onto the foam increased with increasing the impregnation temperature from ~25 up to 40 °C further temperature increasing beyond 40 °C the amount of solvent loaded onto the foam decrease this behavior due to the foam surface change (foam become more flexible and begin to shrank). So it decided to choose temperature of 40 °C as an optimum temperature.

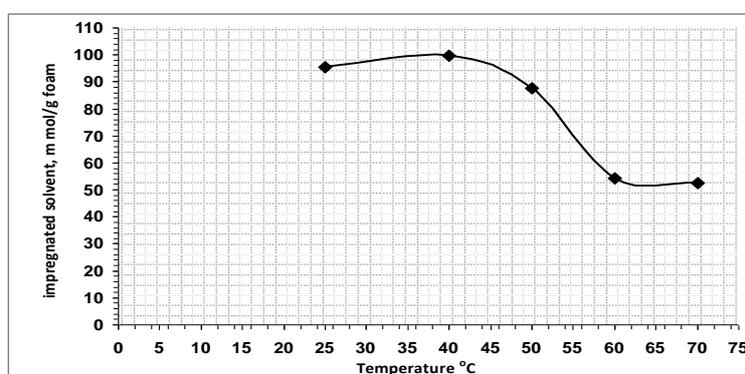


Fig. (4): Effect of shaking time upon the loaded amount onto the dry polyurethane foam (T= 25-70 °C, t= 3 h., ratio= 1/L: 5/l, Diluents= benzene and solvent Conc. = 0.45 M).

Effect of diluents type: The used impregnation solvents were diluted before its impregnation onto the urethane foam for reducing its viscosity. Such a process leads to solvent extension on the surface of the dry urethane foam for filling its interior pores. The following diluents were tested for dilution of the studied solvents (TOA), namely; benzene, toluene, acetone, but-1-ol, and kerosene. The impregnation experiments were carried out under fixed conditions of 0.45 M solvent concentrations, 5/L, 3h impregnation time for both and the impregnation temperatures were fixed 40 °C. Fig (5) summarizes the obtained results where from which it is clearly obvious that benzene is the most suitable diluents for TOA solvent.

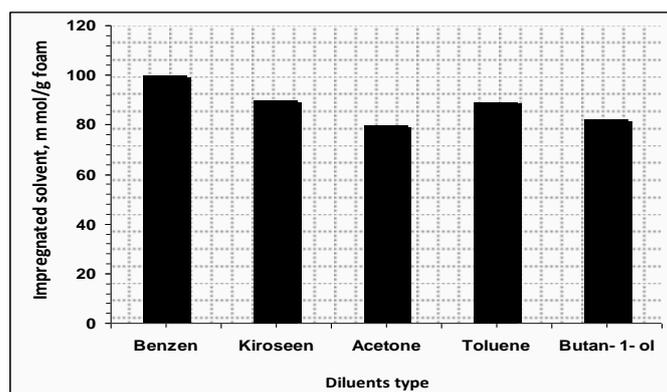


Fig. (5): Effect of diluents type upon the (TOA) amounts onto the dry polyurethane (TOA Conc. = 0.45 M; t=3 h., ratio= 5/1 and T= 40°C).

Impregnated studies

Effect of contact time: In order to study the effect of the contact time upon uranium adsorption onto the prepared TOA impregnated foam, a series of adsorption experiments were performed by contacting a fixed weight (0.05 g) with uranium solution of 10 mg/L at room temperature (≈ 25 °C) and pH = 2.12. The applied time ranging from 0.25 up to 5 hours, uranium concentration= 160 ppm and v/m ratio=5g/l. The obtained results were plotted in Fig. (6). From this figure, the uranium adsorption efficiency about 86.5% was observed at the beginning of the adsorption operation. By increasing the contact time behind 0.25 h, slight adsorption efficiency increases (from 83% up to 86.25%) at 1 hour shaking time was observed. Therefore, 1 hour was found to be appropriate for adsorption and was used in the subsequent experiments.

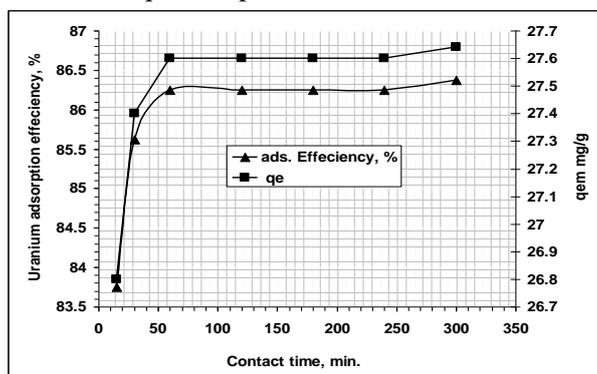


Fig. (6): Effect of contact time upon uranium adsorption efficiency onto impregnated polyurethane foam with TOA (wt =0.05 g; U soln. = 10 mg/L T= 25 °C; pH = 2.12; t= 0.25: 5 h; U concn. = 160 ppm and v/m ratio=5g/l)

Effect of Initial Uranium Concentration: For studying the effect initial uranium concentration upon the adsorption efficiency onto the prepared impregnated foam, a series of experiments were performed by contacting a fixed weight (0.05 g) for 1 h at room temperature ($\approx 25\text{ }^{\circ}\text{C}$) and $\text{pH} = 2.12$. The used initial uranium concentrations ranging from 60 up to 10000 mg/L. The results were plotted in Fig. (7) And, it was clearly obvious that uranium adsorption efficiency decrease with increasing its initial concentration. The uranium adsorption capacity of impregnated foam was determined (Fig.7) as about 1.88 mg U/g foam.

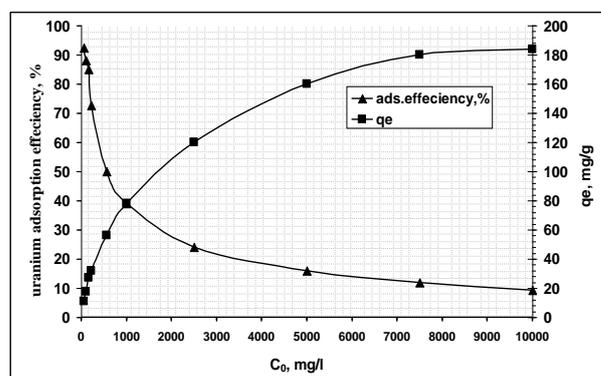


Fig. (7): Effect of contact time upon uranium adsorption efficiency onto impregnated polyurethane foam with TOA (wt =0.05 g; U soln. = 10 mg/L T= 25 °C; pH = 2.12; t = 1 h; U concn. = 60:10000 ppm and v/m ratio=5g/l)

Effect of pH : Different pH values ranging from 0 up to 7 under constant initial uranium concentration of 160 mg/L at room temperature ($\approx 25\text{ }^{\circ}\text{C}$) for contact time of 30 minute were performance. The results were plotted in **figure (8)** it is clearly obvious that, there is a significant increasing of the adsorption efficiency from pH of 0 up to 2.12 further increasing in pH value behind pH of 1 the adsorption efficiency was decrease significantly. Thus because the amines convert free salts up to pH 4 (*Merritt, 1971*). It can thus be concluded that the pH value of 1 ± 0.2 could be considered as the optimum value of the working solution.

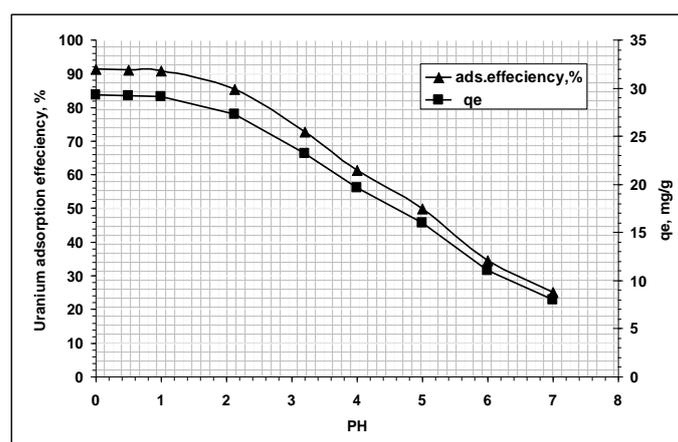


Figure (8): Effect of solution pH upon uranium adsorption efficiency onto TOA impregnated polyurethane ($T = 25^{\circ}\text{C}$; U concn. = 160ppm; ratio=5g/l, wt foam =0.05g, t=60 min.; pH distH₂O=6.85; increase pH by NaOH 0.1N, decrease pH by HNO₃).

The uranium adsorption mechanism was affected by the solution pH through the hydrolysis of uranyl ions in aqueous solution. At low pH value, the uranium is present in the solution mainly in the form of free UO_2^{2+} ions. As the pH of the uranium solution increases beyond 1.0, the uranyl ions are easily hydrolyzed, and these hydrolysis products are also polymerized. Uranium exists in hydrolyzed form and the following hydroxo complex species have been indentured: UO_2^{2+} monomer, $[(\text{UO}_2)_2(\text{OH})_2]^{2+}$ dimer, $[(\text{UO}_2)_3(\text{OH})_5]^+$ trimer. It is these species that are exchanged at the functional groups on the TOA impregnated foam. The relative proportion of these species is determined by the pH and total uranium concentration.

Effect of Adsorption Temperature: Different temperatures ranging from 25 up to 70 °C were studied. At an initial uranium concentration of 159.20 mg/L a constant pH value of 0.5 to 1 pH and a contact time of 60 minute. From the obtained results plotted in Fig.(10), it is clearly obvious that uranium adsorption efficiency decreased with increasing the temperature. This may due to foam surface change (become more flexible) and the foam volume decreasing. For this reasons, room temperature (≈ 25 °C) was chosen as the optimum temperature.

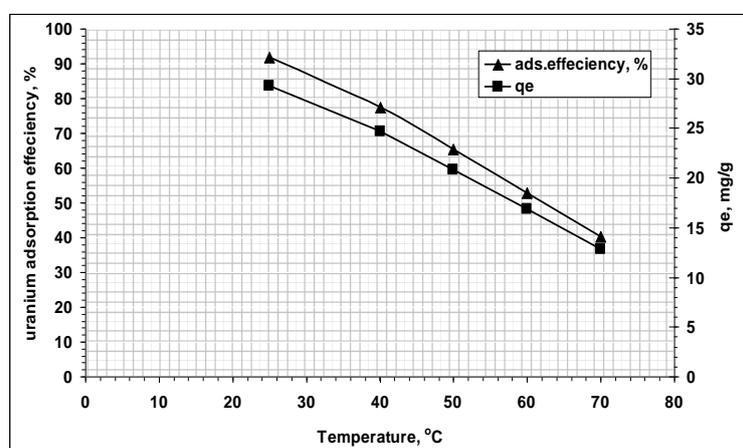


Fig.(9): Effect of temperature upon uranium adsorption efficiency onto TOA impregnated polyurethane (T= 25 – 70 °C; U conc. =159.2ppm; ratio=5g/l, wt foam =0.05g, t=60 min.; pH distH₂O=6.85; pH=0-1).

Effect of v/m ratio: A series of experiments was performed using different v/m ratio. The experiments were performed under constant initial uranium concentration of 159.20 mg/L at room temperature (≈ 25 °C) for 60 minutes and pH value was 0.5 to 1. From the obtained results tabulated in table (3.5.6) and plotted in Fig. (11) it is clearly obvious that no significant change between v/m ratio 5g/L. Further increasing in v/m ratio value behind v/m of 5/L the adsorption efficiency was constant significantly. Thus because the uranium cover all porous of solvent make one adsorption layer.

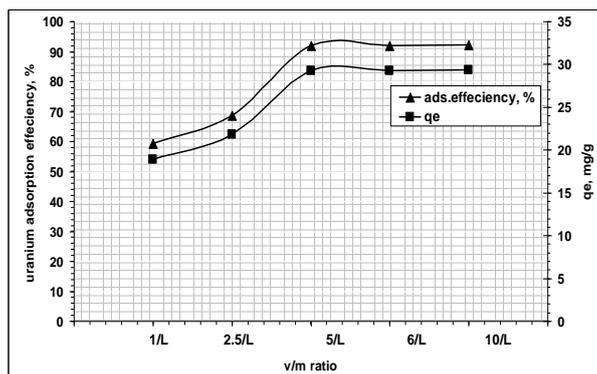


Figure (10): Effect of v/m ratio upon uranium adsorption efficiency onto TOA impregnated polyurethane ($T = 25^{\circ}\text{C}$; U conc. = 159.2 ppm; ratio = 5 g/l, wt foam = 0.05 g, $t = 60$ min.; pH dist $\text{H}_2\text{O} = 6.85$; pH = 0-1).

Extraction isotherms: The results obtained for the extraction isotherms of uranium from nitrate media reflect the efficiency of cationic solvent (polyurethane foam impregnated with TOA) for the extraction of uranium. The general adsorption isotherms calculated the variation of the initial concentration of uranium and calculating the remaining concentration. The distribution of the metal ion on impregnated solvent surface interfaces at equilibrium has been applied to different isotherms. The Langmuir isotherm was tested by plotting C_e/q_e vs. C_e where C_e (g/l) is the equilibrium concentration of the metal ion; q_e ($\text{mg}_{\text{metal}}/\text{g}_{\text{sorbent}}$) is the metal ion concentration. In the Fig. 11 the obtained linear relation indicates that the extraction of U (VI) obeys Langmuir isotherm. **Langmuir equation** can be written as:

$$C_e / q_e = 1/b q^0 + C_e / q^0$$

Where b is Langmuir constant, q^0 ($\text{mg}_{\text{metal}}/\text{g}_{\text{sorbent}}$) is the maximum amount of metal taken up. From the slope and the intercept of the linear relation obtained in Fig (9) b for U (VI) were 21.9 for polyurethane foam impregnated with TOA. Although the **Freundlich isotherm** is usually regarded as empirical, this isotherm is applied by drawing a plot of $\log q_e$ vs. $\log C_e$. The logarithmic form of the equation is

$$\log q_e = \log K_f + 1/n \log C_e$$

Where n , K_f are constants representing the adsorption capacity and intensity of adsorption respectively, they depend on the nature of the adsorbate, adsorbent, and temperature. The extraction of U (VI) was found to follow the Freundlich isotherm due to the linear relation which obtained in Fig. (11) From the slope and intercept of the plot, the Freundlich parameters are calculated K_f found to be 7.73 mg/g and $1/n$ equal 0.3667 for polyurethane foam impregnated with TOA. The higher value of K_f indicates higher affinity for the metal and the value of n (lie between 1 and 10) indicating favorable adsorption.

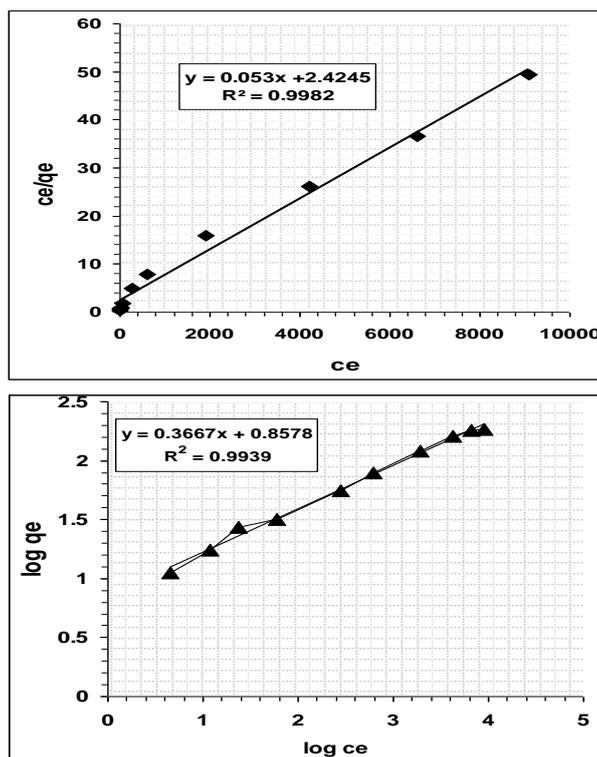


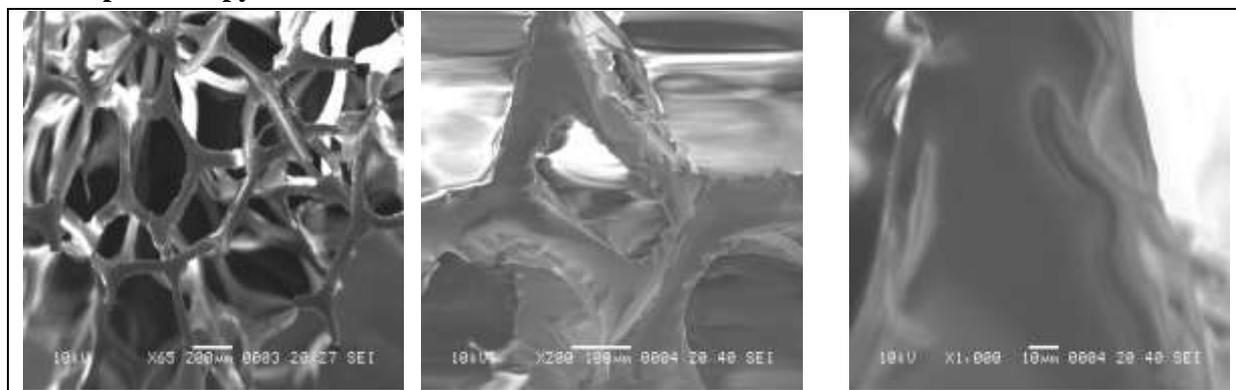
Fig (11): Langmuir and frundlich adsorption effect of uranium concentrations on adsorption onto the prepared polyurethane foam

Table (1): Langmuir and Frundlich parameters for uranium adsorption onto TOA impregnated foam.

	Frundlich isotherm model			Langmuir isotherm model		
	n	Kf (mg/ Kg)	R ²	q ^o (mg/g)	b (L/ mg)	R ²
TOA	2.73	7.73	0.9939	1.88	21.9	0.9982

Characteristic studies:

Scan spectroscopy:



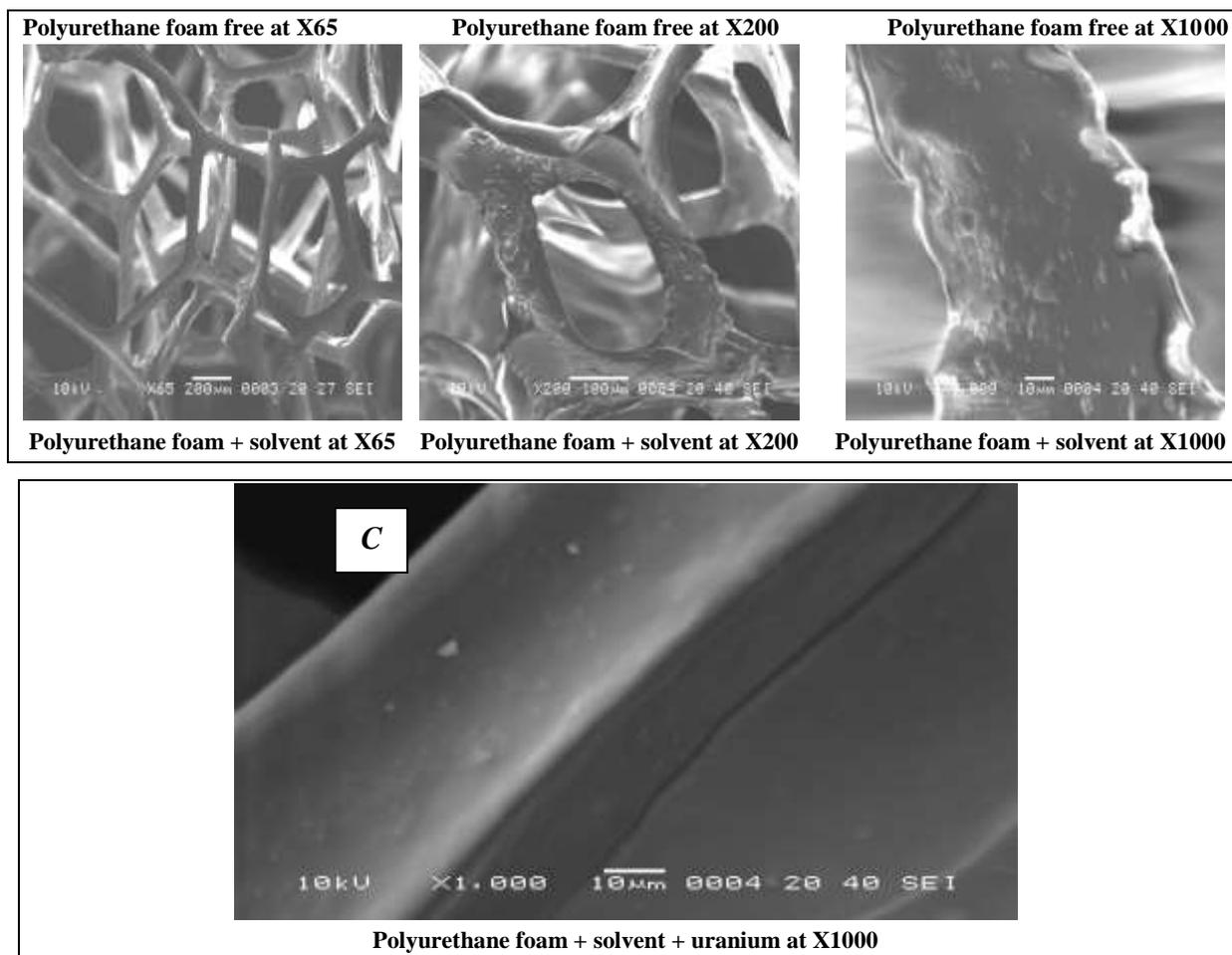


Figure (13): A, B, C: SEM photographs of the polyurethane foam Surface before impregnation and after Impregnation with TOA and Uranium.

Fourier Transform Infrared Spectrometer (FTIR)

Infrared spectroscopy: FTIR were applied to the polyester and charcoal before and after impregnation to evaluate the interactions that may occur between the extractants and the beads of polyester and charcoal impregnation with uranium. The result plotted in figs from 14-16

The impregnation process of TOA on polyurethane foam is mainly due to a combination of pore filling as well as surface adsorption i.e. extractants fill almost all porous system for polyurethane foam. This suggestion is confirmed using detailed investigation of quantitative IR spectroscopic characterization of polyurethane foam before and after impregnation step. The spectrum of untreated polyurethane foam is shown in Figure (12), and the spectrum of polyurethane foam loaded with trioctylamine is shown in Figure (13). Figure 3.5.7a shows the characteristic conjugated amides compounds band at 3413 cm^{-1} . This figure also shows CH aliphatic bands at 2927.4 cm^{-1} , CN bands at 2358 and 2225.4 cm^{-1} , C=O bands at 1727.9 , 1614.1 and 1549.5 , bands in the range of $1450.2 - 455.1\text{ cm}^{-1}$ arising from out of C-C, C-N, C-O and C-X (X= halogen) compounds. As shown in Figure 3.7b and comparing with Figure 3.5.7a, it could be observed that addition of trioctylamine shows a new CN stretching band at 2354.66 cm^{-1} . Also a stretching band of benzene cycle CH at 3764 cm^{-1} . All of these bands confirmed that TOA is typically impregnated on polyurethane foam.

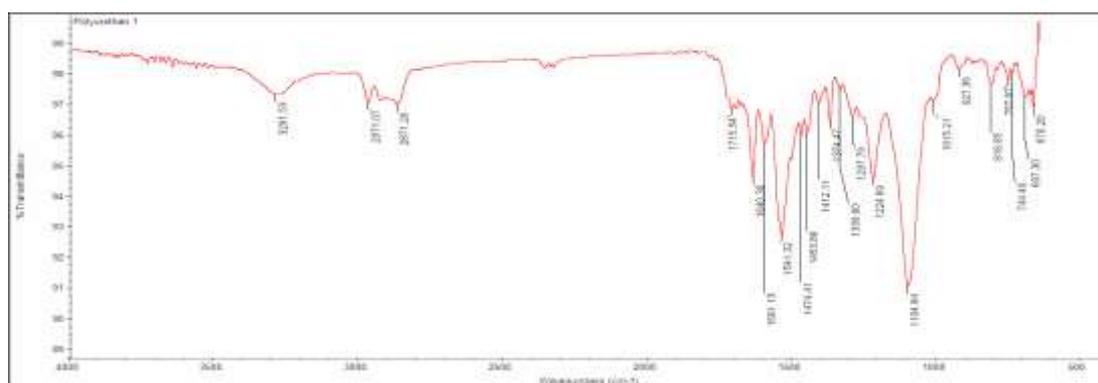


Figure (14): IR photographs of the polyurethane foam Surface free before impregnation with TOA

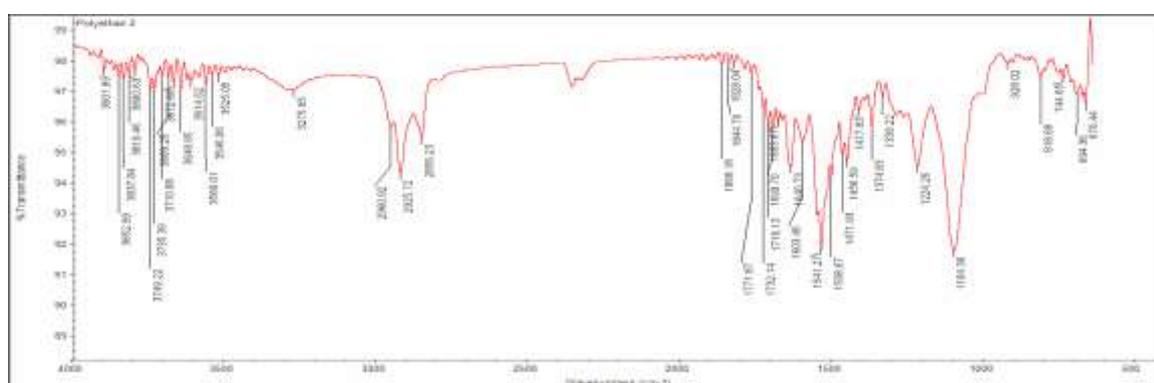


Figure (15): IR photographs of the polyurethane foam Surface after Impregnation with TOA

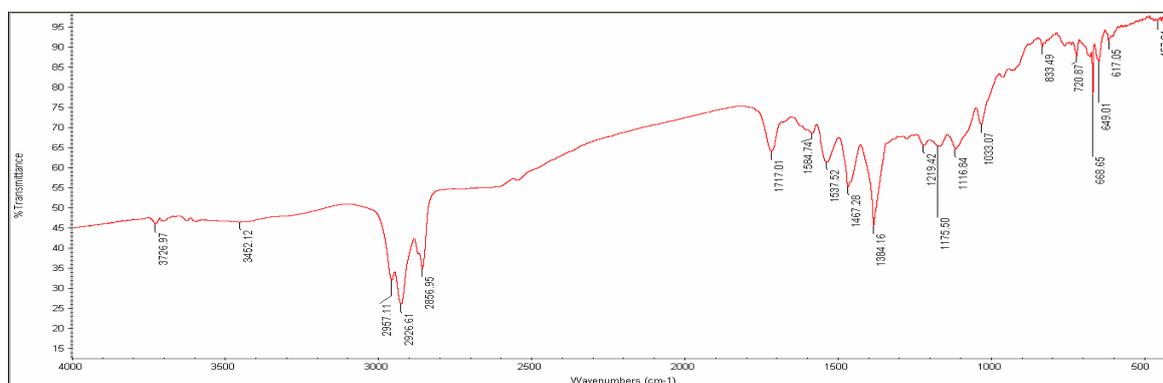


Figure (16): IR photographs of the polyurethane foam Surface after Impregnation with Uranium

Elution Studies

Type of elut: In order to achieve good metal elution form the inert support phase, number of elution testes were carried out to elute the metal ion from the amine impregnated resin after sorption process by using different mineral acids solutions such as distilled H₂O; 1M NaOH+0.1M H₂SO₄; HNO₃; Tartaric acid; citric acid and Na₂CO₃with different concentrations to obtain the maximum elution percent.

Elution experiments were performed using batch method at room temperature. The elution experiments were carried out by shaking 0.1g loaded resin and 10 ml of eluting reagent for 0.25 hours. The uranium concentration loaded onto the impregnated resin, can be determined as the difference between the initial and equilibrium concentration of the metal in the aqueous phase, after elution the concentration of the metal can be determined in the aqueous phase after elution step in order to determine the elution percent for the studied metal from the impregnated inert support.

$$\text{Elution \%} = \frac{C_a}{C_i - C_e} \times 100$$

Where C_i and C_e are the initial and equilibrium metal concentration in the aqueous phase before and after sorption process, respectively, and C_a gives the concentration of the studied metal in the aqueous phase .where the optimum recovery of metal for TOA was 70%.

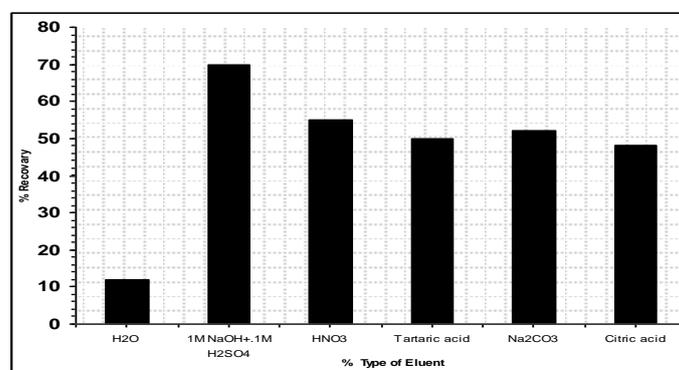


Fig (17): effect of metal elution from TOA where use H₂O; 1M NaOH+0.1M H₂SO₄; HNO₃; Tartaric acid; citric acid and Na₂CO₃with different concentrations (t=0.25h.; ratio= 5g/L T=25⁰c).

Effect of elute concentrations: different concentration from 1M NaOH acidified by different concentration with H₂SO₄ from 0.1 to 1.5 M for recoveries of uranium from polyurethane foam from were studied. The fig (18) the best concentration of elute was 1M NaOH + 0.5 M H₂SO₄.

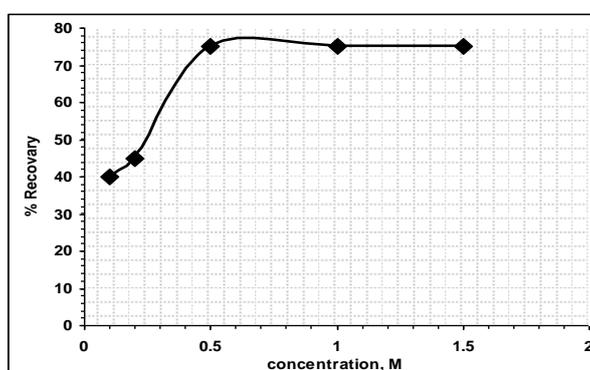


Fig (18): effect of metal elution from TOA where use ((1M NaOH+ (0.1-1.5)) M H₂SO₄; t=0.25h.; ratio= 5g/L T=25⁰c).

Effect of time on recovery of uranium: To study effects of time on recovery of uranium from TOA surface by use 1M NaOH+ 0.5 M H₂SO₄ and v/m ratio 5g/l. From fig (19) show that the 45 minute is the best time for recovery of uranium 97.4%.

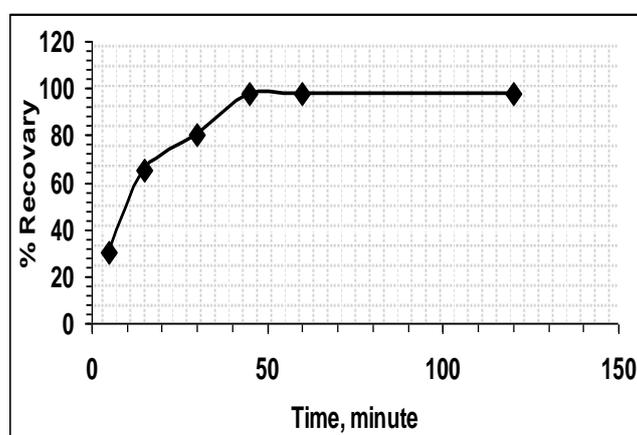


Fig (19): effect of metal elution from TOA where use (1M NaOH+ 0.5 M H₂SO₄; t=0.25-120min.; ratio= 5g/L T=25^oc).

Effect of v/m ratio on recovery of uranium: To study effects of v/m ratio on recovery of uranium from TOA surface by use 1M NaOH+ 0.5 M H₂SO₄ and v/m ratio 5g/l. From fig (20) show that the 5g/l is the best ratio for recovery of uranium from TOA was 97.4%.

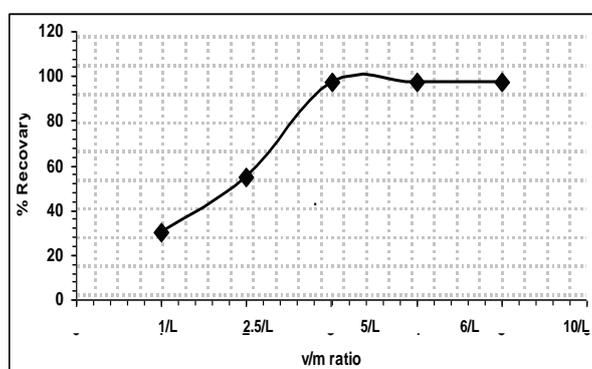


Fig (20): effect of metal elution from TOA where use (1M NaOH+ 0.5 M H₂SO₄; t=45min.; T=25^oc).

CASE STUDY

By application the optimum condition on real sample of waste solution (raffinate solution) that product from yellow cake refining from project 8, Nuclear Material Authority NMA, Anshas, Egypt that had analysis before and after extraction of uranium in [Table 2 and 3](#) that obtain extraction extremely 96.11%. then elution by 1M NaOH acidified with 0.5M H₂SO₄ and analysis product yellow cake that contain u=73%.

Table 2: before

content	unit	Analysis
U	mg/l	180
HNO ₃	M	0.90
Fe ₂ O ₃	g/l	0.5

Table 3: after

content	unit	Analysis
U	mg/l	7
HNO ₃	M	0.90
Fe ₂ O ₃	g/l	0.35

→

CONCLUSION

The Optimum condition for polyurethane foam "Inert support" impregnation with TOA were uranium concentration=160 ppm; contact time=60 min.; pH =1.0; v/m ratio= 5g/l and Temperature= 40⁰c. The extraction of uranium was 1.88mg u/g foam. Also for elution Uranium metal ion from impregnated resin surface the recovery percent was 97.4% use 1M NaOH acidified with 0.5M H₂SO₄; time of 45 minutes; v/m ratio=5g/L and temperature=25⁰c and application on real sample that extraction 96.11 % that product yellow cake that contain u=73%.

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Online publication Date: 24.08.20187