Fast ion chromatography separations of strontium and some metal ions by activated carbon produced from mazot ash

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Abstract: A fast ion chromatographic system is described which uses shorter column lengths and compares various eluent profiles in order to maximize the performance without sacrificing the chromatographic resolution. Equilibrium distribution coefficient, k_d for the different metal ions such as Sr(II), Fe(II), Zn(II), K(I), Ca(II) and Ba(II) in the presence of nitric acid and nitric acid + alcohol mixture of variable concentrations were determined at 25°C. The separation and determination of six target cations was achieved using a short column packed with activated carbon produced from mazot ash. The adsorption strength is influenced by the polarity of alcohol. It has been shown that adsorption strength increases in the order methanol < ethanol < propanol < acetone for each individual cation, and in the order Fe < K< Ca< Zn < Sr < Ba series for individual alcohol. K (I) and Fe(II) is not adsorbed on the adsorbent from 0.25 M HNO_3 in methanol, while K(I) are adsorbed from ethanol, propanol and acetone. Separation is also possible from alcohol mixtures. Strontium separation, is may be from iron in presence of 0.25 M HNO_3 – methanol or ethanol or propanol or acetone while the efficiency of separation increases with a decrease of the polarity of the used alcohol.

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1.Introduction:

Common strontium compounds in natural environments are important resources for the preparation of various kinds of strontium products. Rapid and precise determination of strontium (Sr) in many industrial and environmental samples such as rocks, water, and minerals is of vital importance. However, these samples often contain large amounts of metal ions such as Na, K, Ca, Mg, and Ba, which interferes in the determination of Sr. One of the methods to separate strontium from other elements is ion chromatography **[1,2].**

The separation and recovery of metal ions from industrial wastewater have been a significant concern in all industrial branches owing to economic and environmental factors. Various separation – preconcentration techniques like solvent extraction [3], electro-deposition [4], coprecipitation [5], cloud point extraction [6], membrane filtration [7] and chromatography [8,9] are used for that purpose. Ion chromatography (IC) is an important and popular analytical technique for the aqueous determination of ions. Similar to most other procedures in analytical chemistry, where decreasing the overall analysis times is of major importance in order to obtain the information as rapidly as possible, there has been a recent trend in IC towards minimizing run times. There are a number of advantages to reducing analysis times, such as faster results, higher sample throughput, rapid method development, improved productivity and a reduction in system costs.

Until now, several kinds of sorbents, such as Amberlite XAD resins, activated carbon, ion exchange resins, chelating resins and various polymers have been used as solid phase material **[10].**

Adsorption by activated carbon has been widely studied as an effective technique for removing heavy metal from wastewater. Activated carbon (AC) is still the main noted adsorbent for the removal of pollutants from polluted gaseous and liquid streams. The high adsorption capacity is mainly due to the high surface area and the existence of functional groups on its active sites. The challenge in utilizing AC is, however, to cater to the demands with reasonable costs for end-users. AC production costs can be reduced by either choosing a cheap raw material and/or by applying a proper production method **[11].**

Little information is found in literature for the separation of strontium from alkaline earth elements as well as on the adsorption of alkaline metals on the activated carbon from alcoholic solution. The purpose of our study is to demonstrate the feasibility of using activated carbon produced from mazot ash as a solid phase extracting for separation of strontium ions from synthetic binary mixtures. The equilibrium distribution coefficient for ion exchange separation of some metal ions in the presence of different eluent was calculated.

2. Experimental

2.1 Materials

Stock solutions of 1000 mg/l of Sr(II), Fe(II), Zn(II),K (I), Ca(II) and Ba(II) were prepared by dissolving an accurate quantity of $Sr(NO_3)_2$, $Ca(NO_3)_2$, KNo_3, $Fe(NO_3)_2$, $Ba(NO_3)_2$, and $Zn(NO_3)_2$ respectively in double distilled water. Other concentrations were prepared from stock solution by dilution. All the chemicals used were of analytical reagent grade and were obtained from Merck (Germany).

2.2 Preparation of adsorbent

The activated carbon was prepared by mixing a mazot ash and 5% sulfuric acid solution (S/A ratio 1/3). The obtained slurry was agitated for 4 h at 100^oC and the insoluble residue was separated by filtration. The insoluble residue was treated with 10% hydrochloric acid using stirring for 2 h, S/A ratio 1/3 at ambient room temperature. The insoluble activated carbon was obtained by filtration and drying. Dried activated carbon was stored in desiccators until used **[12].**

2.3. Procedures

The study tested the possibility of adsorption and separation of Sr(II), Fe(II), Zn(II), K (I), Ca(II) and Ba(II) on activated carbon produced from mazot ash from nitric acid, various alcohol solutions of nitric acid as well as from nitrate solutions of acetone and ethylene glycol. The ability and strength of adsorption was determined through the distribution coefficient. The ``batch" method was used. The dependence of k_d of tested metal ions on the composition of the alcohol and on the concentration of nitric acid in alcohol was also tested. Alcoholic solutions of nitric acid were prepared by mixing of 5 M HNO_3 and corresponding alcohol. The solutions of acetone and ethylene glycol were prepared in the same manner. For this purpose 0.5 g/L of activated carbon was placed in flasks. The quantity of 50 ml of nitric acid alcohol solution of one cation of a concentration of 100 mg /l was mixed with the adsorbed. Adsorption of metal ions was carried out at $25^{\circ}C$ for 24 h in batch system and the mixture was shaken at a constant speed (200rpm) for 30 min. The change of the cation concentration in the solution with time was measured by atomic emission spectrometry. Distribution coefficients k_d were calculated from the expression:

$$k_d = \frac{C_O - C_O}{C} \cdot \frac{V}{m} \qquad (1)$$

where C_O is the initial concentration (mg ml^{-1}), C the concentration after equilibrating (mg ml^{-1}), V the solution volume (ml) and m is the mass of exchanger (g).

2.3.1Column separation

The activated carbon (0.02 g) was transferred into a chromatographic column (0.4cm×10 cm), and it was pressed slightly with a glass rod to eliminate air bubbles. A 30-μm polyethylene frit was placed on top of the column bed to prevent the disturbance of the adsorbed during the elution phase. The column was preconditioned with 8–10 mL of the same concentration of eluant. A solution containing a mixture of metal ions 100 mg/L to be separated was then loaded into the column. The elution separation was carried out with eluants composed of various alcoholic solutions of nitric acid as mobile phases using gravity flow. The concentrations of metal ions in the fractions of the effluents were determined using atomic emission spectrometry, and the elution curves were drawn by plotting the concentration against the effluent volumes.

2.4 Instruments

Perkin Elmer 3110 atomic absorption /emission spectrometer and Perkin Elmer 2000 FT IR spectrometer were used.

3. Results and Discussion

It has already been mentioned that, in order to develop the method of the determination of strontium, it was necessary to test whether it would be possible to separate Sr(II) from a number of elements which are mostly present in natural samples, such as Fe(II), K (I), Ca(II), Zn(II), Sr(II), and Ba(II) which may impede the detection of strontium. Since in the process of separation the method of elution ion chromatography was applied, the choice of adsorbent and eluent was crucial in the individual separations. For this reason, studies were carried out which comprised the determination of the distribution coefficients of ions on activated carbon produced from mazot ash from different nitric acid - alcohol mixture, as well as the rate of establishing equilibrium and the possibility of the separation of ions on the columns filled with activated carbon produced from mazot ash, with different compositions of eluents.

3.1. Effect of nitric acid on distribution coefficient, k_d

The distribution coefficient, k_d is defined as the ratio of metal ion concentration on the adsorbent to that in the aqueous solution and can be used as a valuable tool to study metal ion mobility. High values of distribution coefficient, k_d indicate that the metal has been retained by the solid phase, while low values of, k_d indicate that a large fraction of the metal ions remains in solution. The effect of different nitric acid concentrations at 25 °C on k_d values of each metal ions by activated carbon produced from mazot ash was studied. Fig. 1 illustrates that the values of k_d

for Fe(II), K(I), Ca(II), Zn(II), Sr(II), and Ba(II) in the presence of 0.25, 0.5, 0.75,1.00 and 1.50 M nitric acid. The result indicates that the k_d values increase with decrease in the concentration of nitric acid due to the anionic complex formation. Since the action of the nitric acid on the exchange equilibrium is a twofold one viz. action of the hydrogen ion as government by the mass reaction equation for a simple exchange and action of the nitrate ion by lowering the effective concentration of the cation in solution through complex formation **[13].** The effect of the nitric on the numerical value of k_d indicate that nitrate complexes with stabilities decreasing in the order: Fe (II) < K (I) < Ca(II) < Zn(II) < Sr(II) < Ba(II).

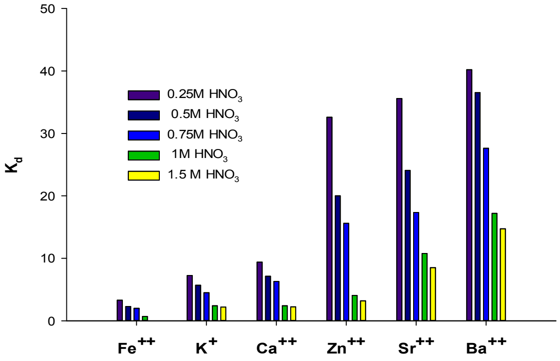


Fig. 1 Effect of nitric acid on distribution coefficient, k_d

3.2 Effect of nitric acid - alcohol mixtures on distribution coefficient

The dependence of k_d of Fe(II), K (I), Ca(II), Zn(II),Sr(II), and Ba(II) on the concentration of nitric acid - alcohol mixture was tested. Since the separation rate and efficiency primarily depend on the adsorption strength of a given ion on the adsorbent, it is important to know the distribution coefficients in order to determine the working conditions for the chromatographic separation. Table (1) represents the distribution coefficients k_d of tested cations on activated carbon produced from mazot ash increase with the decrease of solvent polarity.

It is obvious that Fe (II) and K (I) are not adsorbed on the activated carbon from the solution of methanol, that Ca(II),Zn(II) and Sr(II) is adsorbed slightly, while Ba(II) is adsorbed strongly. Fe (II) is not adsorbed on the adsorbent from a solution of ethanol, propanol and acetone also all the tested cations not adsorbed in presence of ethylene glycol. Zn(II),Sr(II) are adsorbed less than Ba(II), but more than Ca(II). Such tendencies are maintained in all other alcohols. Potassium is slight adsorbed from a solution of ethanol and propanol and acetone. The k_d values in the methanol, ethanol and propanol series, indicate that strontium, barium and zinc are higher than for iron, potassium and calcium.

In addition, the tested cations except Fe(II) are adsorbed strongly on the adsorbent from 0.25 M HNO_3 – acetone mixture, while they are not adsorbed from 0.25 M HNO_3 - ethylene glycol mixture. The distribution coefficient, k_d increases in the series methanol < ethanol < propanol < acetone

For the values of the distribution coefficients shown in Table (1) and Fig.(2), it is noted that k_d values for strontium are higher than Fe(II), K (I), and Ca(II) therefore the separation of Sr(II) will be accomplished in the solution of 0.25 M HNO_3 – ethanol mixture and in the solution of 0.25 M HNO_3 – methanol mixture.Furthermore, the distribution coefficients for Sr(II), and Ba(II) substantially increase in less polar alcohols whilst there is also a large difference in k_d between them at this point. Therefore, an improved separation of Sr(II) from Fe(II), K (I),Ca(II) and Zn(II) in less polar alcohols propanol is to be expected. While the separation of Sr(II) from Zn(II) and Ba(II) cannot be performed in acetone. Whilst Sr(II) from Fe(II), K (I) will be accomplished.

Apart from the influence of the nitric acid - alcohol mixture, the adsorption strength depends also on the concentration of the acid, as shown in Tables (1,2). From these results it follows that an increase of the concentration of the acid decreases the efficiency of separation, it can be indirectly deduced that a decrease of pH causes a decrease of the distribution coefficient. Consequently the most efficient separation of metal ions was achieved with 0.25 M HNO_3 in alcohol.

Table1: Effect of 0.25M nitric acid - alcohol mixture on distribution coefficient, k_d of tested cations on activated carbon produced from mazot ash.

Solvents	Fe(II)	K(I)	Ca(II)	Zn(II)	Sr(II)	Ba(II)
Ethanol	0.00	8.56	18.89	85.62	109.77	1032.01
Methanol	0.00	0.00	7.9	17.09	30.74	114.86
propanol	0.00	17.9	106.86	200.72	1030	10148
acetone	0.00	164.39	10012.84	10312.65	10628.39	10740.62
Ethylene gly.	0.00	0.00	0.00	0.00	0.00	0.00

Table2: Effect of 0.5M nitric acid - alcohol mixture on distribution coefficient, k_d of tested cations on activated carbon produced from mazot ash.

Solvents	Fe(II)	K(I)	Ca(II)	Zn(II)	Sr(II)	Ba(II)
Ethanol	0.00	6.09	14.62	32.16	50.21	457
Methanol	0.00	0.00	5.2	7.4	20.24	76.47
propanol	0.00	11.41	65.35	99.08	644.68	4620
acetone	0.00	76.53	5617.6	7676.5	7949.16	8156.8
Ethylene gly.	0.00	0.00	0.00	0.00	0.00	0.00

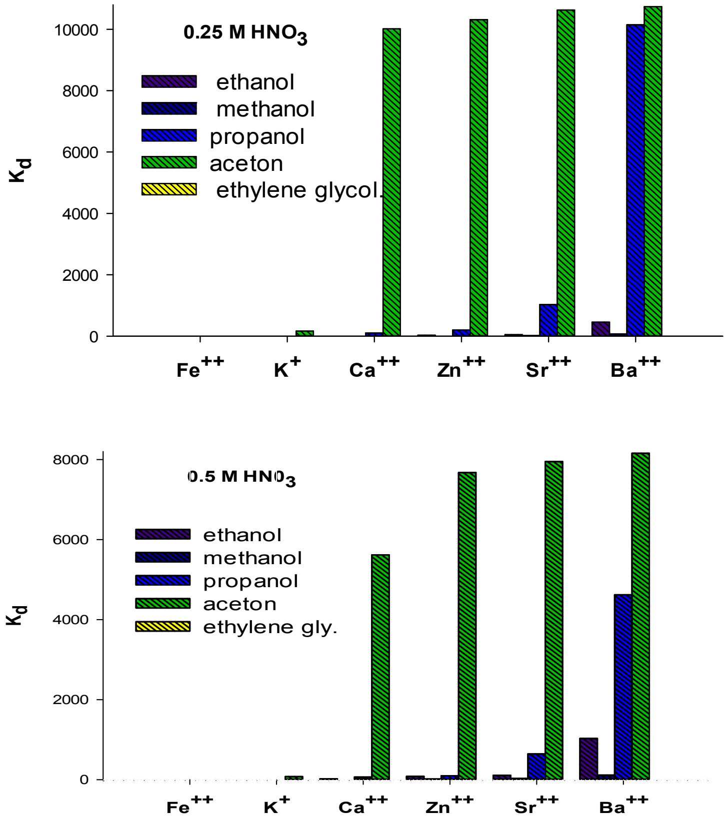


Fig. 2 Effect of (0.25,0.5M) nitric acid - alcohol mixture on distribution coefficient, k_d of tested cations on activated carbon produced from mazot ash.

3.3 Adsorption mechanism

No information is available in literature on the mechanism of the adsorption of alkaline and earth alkaline elements on the activated carbon from alcohol solutions. Since the issue is the adsorption of cations in the presence of nitrate anions from an alcoholic medium on the activated carbon, it would be necessary to create a negatively charged cation complex. However, it is known that alkaline and earth-alkaline elements do not have the tendency to form complexes with inorganic anions, in contrast to the organic ligands with which they can form very stable chelate complexes of different charges. For that reason, an attempt has been made to use the IR spectrum for the determination whether any change is visible in the structure of the adsorbent after the adsorption of strontium. Fig.3 (A) - (D). shows the FT-IR spectra of activated carbon produced from mazot ash as adsorbent before and after adsorption of strontium.

FT-IR analysis is used to identify some characteristic functional groups and the spectra of activated carbon produced from mazot ash (ACMA) before and after K(I),Sr(II)and Ca(II) adsorption are shown in Fig. 3 (A) - (D). The broad absorption peak at 3420 cm^{-1} indicates the presence of OH group, which was probably attributed to adsorbed water on the carbon **[14,15].** The bands appearing at

1376 and 1653 cm^{-1} are ascribed to the formation of oxygen functional groups like a highly conjugated C=O stretching in carboxylic groups, and carboxylate moieties, respectively **[16]**. The additional peaks at 1456 and 1154 cm^{-1} indicate the presence of C-H and S=O groups, respectively **[17].** Peaks at 1068 cm^{-1} may be due to the stretching vibration of C-OH of alcoholic groups and carboxylic acids **[18].** The C= O and S=O functional groups show very high coordination with heavy metals. Hence, the good sorption properties of the adsorbent towards metal ions can be attributed to the presence of these functional groups on the adsorbent. Comparing with the spectra Fig.3 (A- D), it shows band shifting and possible involvement of hydroxyl groups around the broad peak 3420 cm^{-1}. Very little change is observed in the free carboxyl band 1653 cm^{-1}, but an increase in the asymmetric stretching vibrations of C=O in ionic carboxylic groups (-COO-) at 1376 cm^{-1} in spectrum of M-ACMA after metal adsorption indicates some carboxyl binding. Change is observed the stretching vibration band of C-OH of alcoholic groups and carboxylic acids. From these spectra it appears that hydroxyl, carboxyl is involved in metal ions binding on the (ACMA). The (ACMA) can adsorb metal ions through ion exchange, or complexation, or by a combination of both processes. The possible reactions are showed blow:

$2R\text{-}OH + M^{2+} = (R\text{-}O)_2M + 2H^+$

Energy Dispersive X-ray analyses (EDX) were used to observe the structural morphology and composition of activated carbon. (EDX) spectrum of (AMA) before and after interaction with Ca(II),Sr(II) and K(I) is shown Fig.4 (A - D**).** The spectrum of adsorbent presented in Fig4 **(**A**)** shows that the major elements present.

An additional signal compared with the control ones Fig 4 **(**A**)** observed in EDX profile (B), (C). and (D) suggesting the interaction of metal with functional groups present in adsorbent. The EDX data of the (ACMA) (Figs A-D) and Table (3) confirmed the binding of the metal ions to the activated carbon surface. The spectra reflected Ca (II) and Sr(II) with a high adsorption than K(I).

$2R\text{-}COOH+M^{2+}=(R\text{-}COO)_2M+ 2H$

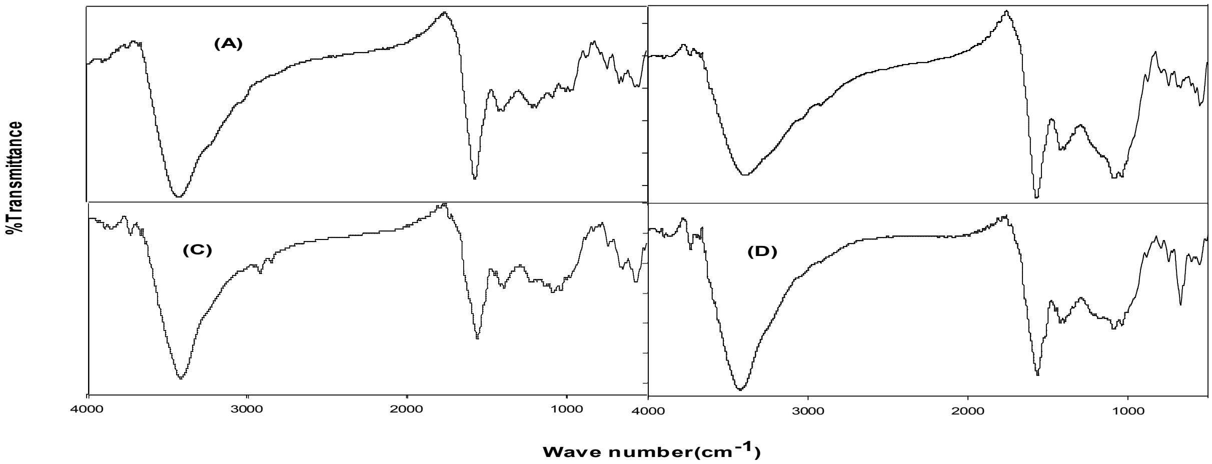
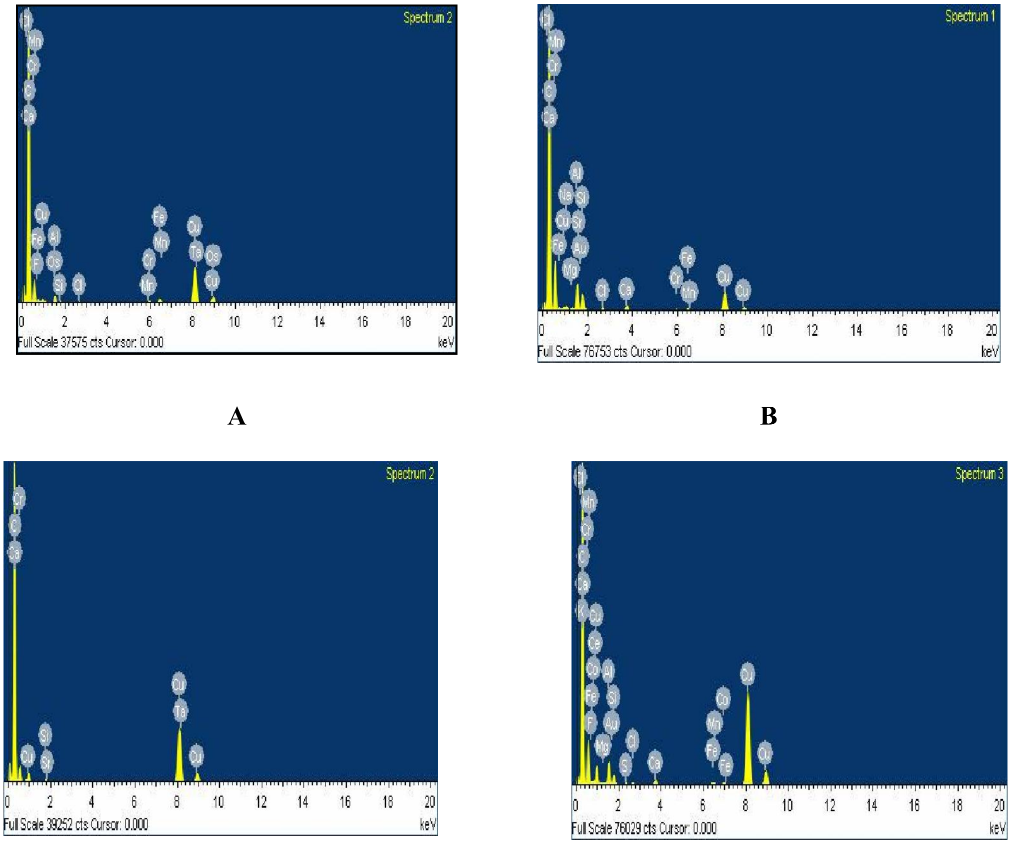


Fig. 3 The FT-IR spectrum of activated carbon produced from mazot ash (ACMA) before and after interaction with metal ions, (A) activated carbon produced from mazot ash (ACMA), (B) (ACMA) with Ca(NO$_3$)$_2$ in 0.25 M HNO$_3$ - ethanol mixture, (C) (ACMA)with Sr(NO$_3$)$_2$ in 0.25 M HNO$_3$ - ethanol mixture, (D) (ACMA) with KNO$_3$ in 0.25 M HNO$_3$ - ethanol mixture.

Table 3. Weight % of (A) activated carbon produced from mazot ash (ACMA). (B), (C) and (D) (ACMA) with Ca(NO$_3$)$_2$, Sr(NO$_3$)$_2$ and KNO$_3$ in 0.25 M HNO$_3$ and ethanol mixture.

Sample	Element	Weight%	Atomic%	Formula
(B)	Ca(II)	89.57	50.00	CaO
(C)	Sr(II)	84.56	66.67	SrO
(D)	K (I)	83.02	33.33	K_2O



A B

C D

Fig. 4 The EDX analysis of activated carbon produced from mazot ash (ACMA) before and after interaction with metal ions. (A) Activated carbon produced from mazot ash (ACMA). (B), (C) and (D) (ACMA) with $Ca(NO_3)_2$, $Sr(NO_3)_2$ and KNO_3 in 0.25 M HNO_3 and ethanol mixture.

3.4. Separation of Sr(II) and some metal ions

Quantitative binary separations of metal ions were performed by column chromatography using elution technique. Various interesting separation of metal ions from other ions has been studied. These separations are based on the exploitation of the difference in the exchange potential of different ions with respect to the adsorbent. Certain ions were capable of forming anionic complexes; passed through the column unadsorbed leaving behind the second metal ions on the column. This was later eluted with suitable eluent. The metal ions adsorbed by the adsorbent were then eluted with different eluents depending on the k_d values. After the metal elutions were complete the adsorbent was regenerated to hydrogen form using mineral acids such as HNO_3.

Separation of binary mixture between Fe(II), K (I), Ca(II), Zn(II),Sr(II), and Ba(II) by activated carbon produced from mazot ash using 0.25MHNO_3 - alcohol mixture were studied. The ability and strength of adsorption was determined through the distribution coefficient. The ``batch" method was used. The separation describes the selectivity of extractant between metals ions. The reason for selective sorption and desorption of certain metal ions can be attributed to the larger difference in k_d values. From results obtained on the basis of distribution coefficient values Table (1) it can be assumed that Sr(II) can be separated from Fe(II) in presence of 0.25 M HNO_3 - different solvent, Sr(II) and Ba(II) from K(I) in presence of 0.25 M HNO_3 - methanol, Ba(II)from Fe(II) by 0.25 M HNO_3- methanol, Ca(II), Zn(II) and Ba(II) from Fe(II) by 0.25 M HNO_3- propanol, Ba(II) and Zn(II)from Fe(II) by 0.25 M HNO_3- ethanol, Ba(II)from K(I) by 0.25 M HNO_3-ethanol and K(I), Ca(II), Zn(II)and Ba(II) from Fe(II) by 0.25 M HNO_3- acetone, on activated carbon produced from mazot ash.

The results of k_d values presented in Table (1) indicate that activated carbon produced from mazot ash shows a selective sorption of Sr(II) in presence of 0.25 M HNO_3-methanol,0.25 M HNO_3- ethanol,0.25 M HNO_3- propanol and 0.25 M HNO_3- acetone. The reason for selective sorption and desorption of certain metal ions can be attributed to the larger difference in k_d values. As a result it can be assumed that strontium can be separated from Fe(II) in presence of 0.25 M HNO_3 - different solvent. Fe(II) were taken up weakly by the adsorbent in comparison with other ions and hence it was eluted first, while strongly adsorbed ions Sr(II) were eluted later with suitable eluent. It can be expected that the separation will be more efficient with a decrease of the polarity of the applied solvent. These possibilities and their practical application have been presented by Grahek **[19]**. The eluting curve of the separation of Sr(II) from Fe(II) by 0.25 M HNO_3 - different solvent was obtained, as shown in Fig (5). More than 92.8, 97.8, 95.75 and 96.4 % of Sr(II) were eluted in presence of 0.25 M HNO_3- propanol,0.25 M HNO_3- ethanol,0.25 M HNO_3- methanol and 0.25 M HNO_3- acetone respectively.

Separation of Sr(II) and Ba(II)from K(I) and Ba(II)from Fe(II) by 0.25 M HNO_3 – methanol are based on the fact that activated carbon produced from mazot ash shows a selective sorption for Sr(II) and Ba(II) in presence of 0.25 M HNO_3 - methanol but fails to sorption the K(I) and Fe(II). Table (1) shows that the distribution coefficient of Sr(II) and Ba(II) in 0.25 M HNO_3 – methanol are 30.740 and 114.860 respectively. Hence K(I)and Fe(II) was eluted first, while strongly adsorbed ions Sr(II) and Ba(II) were eluted later with suitable eluent. The eluting curve of the separation of Sr(II) and Ba(II)from K(I) and Ba(II)from Fe(II) by 0.25 M HNO_3 – methanol was obtained, as shown in Fig (6).

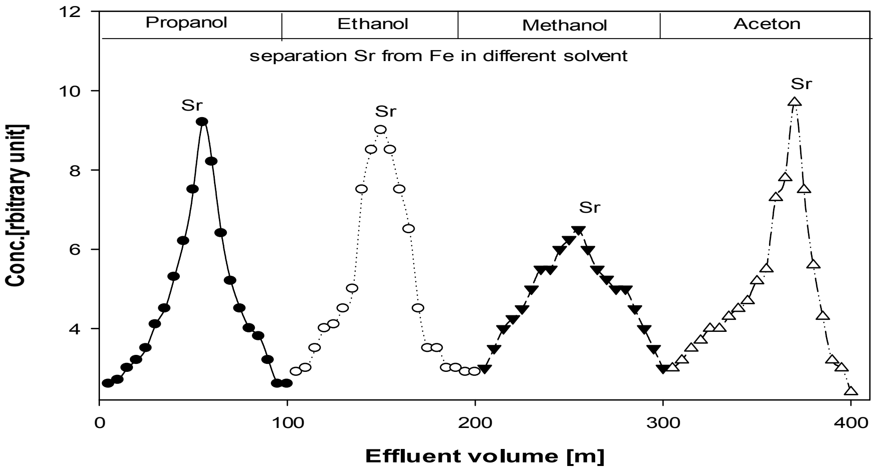


Fig. 5 Separation Sr from Fe on the column filled with activated carbon produced from mazot ash and 0.25M HNO_3 in propanol, ethanol, methanol and aceton.

The value of distribution coefficients k_d for given metal ions depends upon the nature and the stability of eluent. To achieve more clean separation of metal ions in short time with practical elution volume, maximum (k_d) value difference was selected for optimized conditions of chromatography. From the previous results obtained the values of the distribution coefficients k_d for Ca(II), Zn(II) and Ba(II) are 200.720, 1030.000 and 10148.000 respectively in presence of 0.25 M HNO_3-propanol.Therefore it can be assumed that these metal ions can be separated from Fe(II) (k_d= 0). The eluting curve of the separation of separation of Ca(II), Zn(II) and Ba(II) from Fe(II) in presence of 0.25 M HNO_3-propanol was obtained, as shown in Fig. (6).

Separation of Ba(II) and Zn(II) from Fe(II) and Ba(II)from K(I) in presence of 0.25 M HNO_3-ethanol are based on the fact that the strongly adsorbed of Ba(II) and Zn(II)and the low adsorbability of Fe(II) and K(I) using activated carbon produced from mazot ash in the presence of 0.25 M HNO_3-ethanol eluting agent. If a solution mixture containing Ba(II) -Fe(II), Zn(II)- Fe(II) and Ba(II)- K(I) is passed into a column in presence of 0.25 M HNO_3-ethanol, Fe(II) and K(I) can be elute first while Ba(II) and Zn(II) is adsorbed strongly. The eluting curve of the separation of separation of Ba(II) and Zn(II)from Fe(II) and Ba(II)from K(I) in presence of 0.25 M HNO_3-ethanol was obtained, as shown in Fig (6).

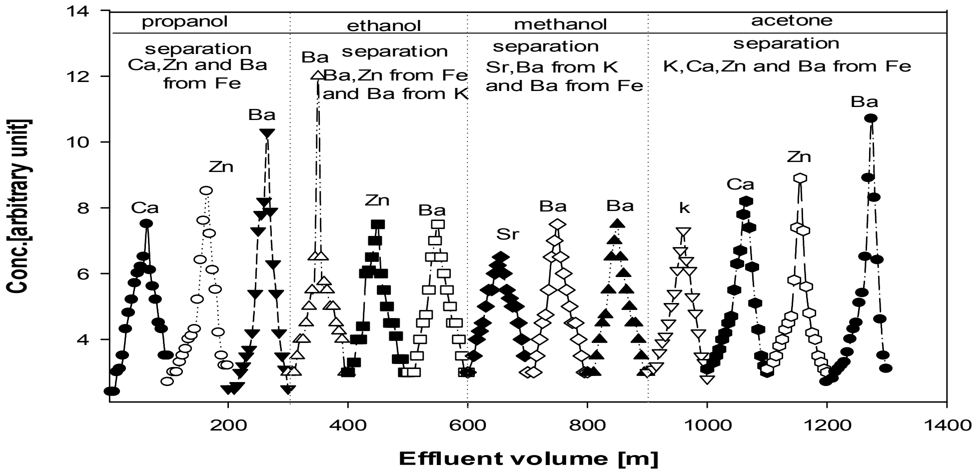


Fig.6 Separation of K,Ca, Zn, Ba and Sr from Fe and K, on the column filled with activated carbon produced from mazot ash and 0.25 M HNO$_3$ in propanol, ethanol, methanol and aceton

From the previous results obtained on the basis of the ratio of values of the distribution coefficients for Fe(II) and other tested cations, it can be assumed that Fe(II) can be separated from other cations. For Separation of K(I), Ca(II), Zn(II)and Ba(II) from Fe(II) advantage may be taken of the high adsorbability of K(I), Ca(II), Zn(II) and Ba(II) than adsorbability of Fe(II) using activated carbon produced from mazot ash in the presence of in the presence of 0.25 M HNO$_3$- acetone. If a solution mixture containing the K(I)- Fe(II), Ca(II)- Fe(II), Zn(II)- Fe(II) and Ba(II) - Fe(II) is passed into a column in presence of 0.25 M HNO$_3$- acetone Fe(II)can be removed first while K(I), Ca(II), Zn(II)and Ba(II) is adsorbed strongly. The eluting curve of the separation of separation of K(I), Ca(II), Zn(II)and Ba(II) from Fe(II) in presence of 0.25 M HNO$_3$-acetone was obtained, as shown in Fig. (6).

4. Conclusion

The present study indicated that Sr(II) can be separated from Fe(II) in presence of 0.25 M HNO$_3$ -different solvent by activated carbon produced from mazot ash.Separation of Sr(II) and Ba(II)from K(I) and Ba(II)from Fe(II) by 0.25 M HNO$_3$ – methanol are based on the fact that the adsorbent shows a selective sorption for Sr(II) and Ba(II) in presence of 0.25 M HNO$_3$ - methanol but fails to sorption the K(I) and Fe(II). Strontium separation is most difficult from calcium. While Fe(II) can be separated from K(I), Ca(II), Zn(II)and Ba(II).The separation will be more efficient with a decrease of the polarity of the applied solvent. Activated carbon produced from mazot ash can offered used as adsorbent for separation of Sr(II) and some metal ions from artificial solution,rock mineral and environmental samples.

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