Measurement of Alpha Emitters Concentration in Imported Cigarettes

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Abstract

The aim of this study was to measured the alpha emitters concentration of (15) different kinds of imported cigarettes.

The nuclear reaction used U-235(n, f) obtained by the bombardment of U-235 with thermal neutrons from (Am-Be) neutron source with thermal flux of (5×10^{3} n. cm^{-2}. s^{-1}).

The Results obtained showed the values of the Uranium concentration, and varies from (0.041 ppm) in five stares kind to (2.374 ppm) in Macbeth (chocolate) 100´s kind. All the result obtained are within the limit levels as given by UNSCAR data.

Keywords: Cr-39, Cigarettes, radio nuclides, health physics.

Introduction

Radioactive material is also found throughout nature. It is in the soil, water, and vegetation. Low levels of uranium, thorium, and their decay products are found everywhere. Some of these materials are ingested with food and water, while others, such as radon, are inhaled. The dose from terrestrial sources also varies in different parts of the world. Locations with higher concentrations of uranium and thorium in their soil have higher dose levels [1].

Dependent on aerosol properties, inhaled daughter products are deposited on air way surface throughout the human respiratory tract by subsequent transfer to the blood by elearance mechanisms the radio nuclides are transported via the blood circulation to the other organs to the body [2].

Alpha- emitters like Uranium, for example, enters the body through the food we eat, or the water we drink and the air we breathe and also by absorption through the skin. When we breathe the dust of the α- emitting material, some of it is exhaled and some stays in our lungs. The size of these dust particles and how easily they dissolve determine where in the body the α- emitting element goes, and how it leaves our bodies [3].

Theory

CR-39 track detector

CR-39 is a polymer ($C_{12}H_{18}O_7$) with a density of 1.3g/cm^3. Operation of the solid state nuclear track detectors is based on the fact that a heavy charged particle will cause extersive ionization and excitation of atoms along their path. They produce narrow trails of material damage on an atomic scale (about 10 nm in diameter) [4]. With the chemical form shown in Fig.(1).

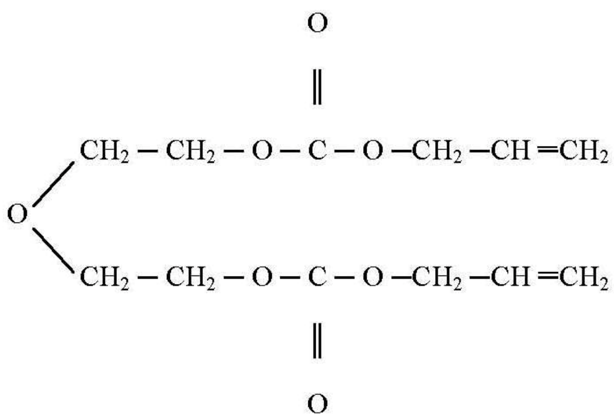

Fig.(1) The chemical form of CR-39 plastic [5].

Experiment

Irradiation method

In the irradiation method an Americium-Beryllium (Am-Be) neutron source with thermal flux (5×10^{3} n/cm^{2}.s) was used. It emits fast neutrons from the (α, n) relation such as:

$$^{9}Be+\alpha\rightarrow {}^{12}C + {}^{1}_{0}n + 5.76Mev$$

This source consists of a rod of (Am- Be) surrounded by a paraffin wax. This wax is usually used for moderating the fast neutrons to thermal energies [6] show in Fig. (2)

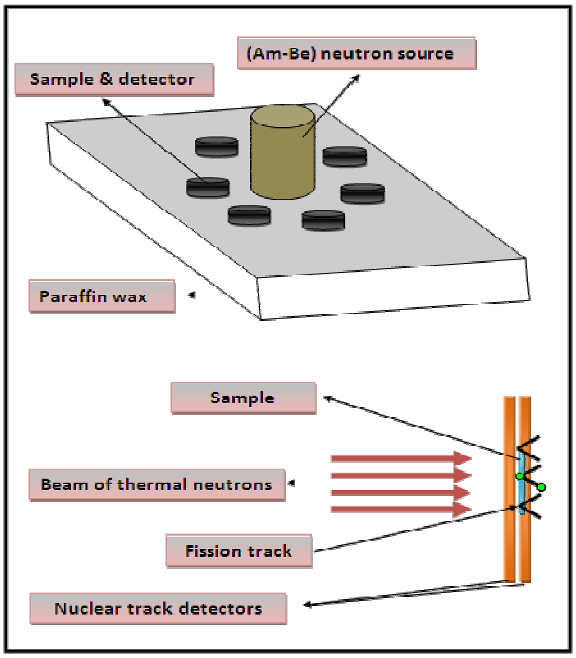

Fig.(2) The irradiation of the detectors and the samples to the neutron source.

Determination of Uranium Concentration for Sampling

The samples had taken from the (15) imported cigarettes, (0.5) g for each sample was pressed with (3000kg) into a pellet. The pellet were covered with CR-39 track detectors where cut into small piece each of [1cm×1cm] area, on one side and put in a plate of paraffin wax at a distance of (5 cm) from the neutron source[7].

The samples were putting in front of the neutron source with thermal flux (5×10^{3} n/cm^{2}.s), as shown in Fig. (2).

After seven days of exposure to an (Am- Be) neutron source with total influence (3.024×10^{9}) n/cm^{2}, the CR- 39 detectors were etched using (NaOH) solution at 60^{0}C for 7hr., after etching, the detectors were washed by distilling water then dried and count the number of tracks under an optical microscope with magnification of (400×) as shown in Fig. (3) & (4) [8].

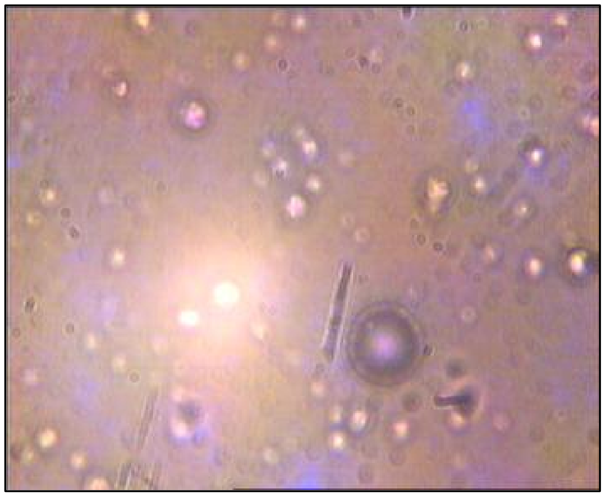

Fig. (3) represent the etched track of fission fragment in sample No.12.

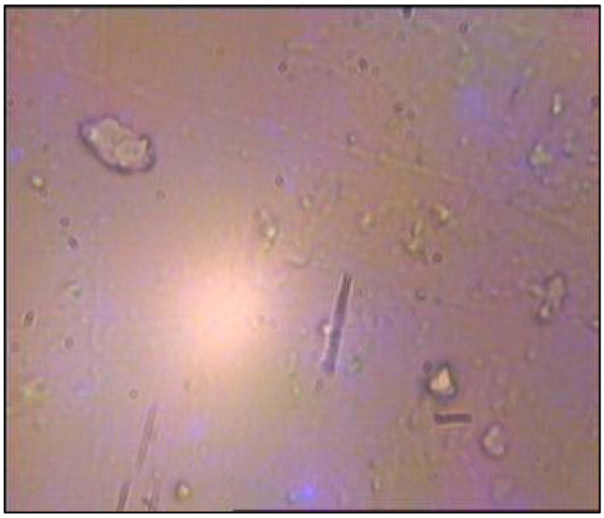

Fig. (4) represent the etched track of fission fragment in sample No.15.

Result and Discussion

The density of the fission tracks (ρ) in the samples was calculated according to the following relation:-

$$\text{Track density } (r) = \frac{\text{Average of total pits (tracks)}}{\text{Area of field view}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The Uranium concentration is determine by comparing mean track densities recorded in CR-39 detector covering samples pellets, by using the following formula:-

$$\frac{C_X(\text{Samples})}{\rho_X(\text{Samples})} = \frac{C_S(\text{Standard})}{\rho_S(\text{Standard})} \quad .... (2)$$

Where:

C_X = Uranium concentration for the sample.

ρ_X = track density for the sample.

C_S/ρ_S = is the slop between the track density and Uranium concentration (ppm) for standard sample [9].

Fig.(5) shows the relation between track density in CR-39 detectors and uranium concentration in the standard samples.

The kinds of imported cigarettes for show in Table (1).

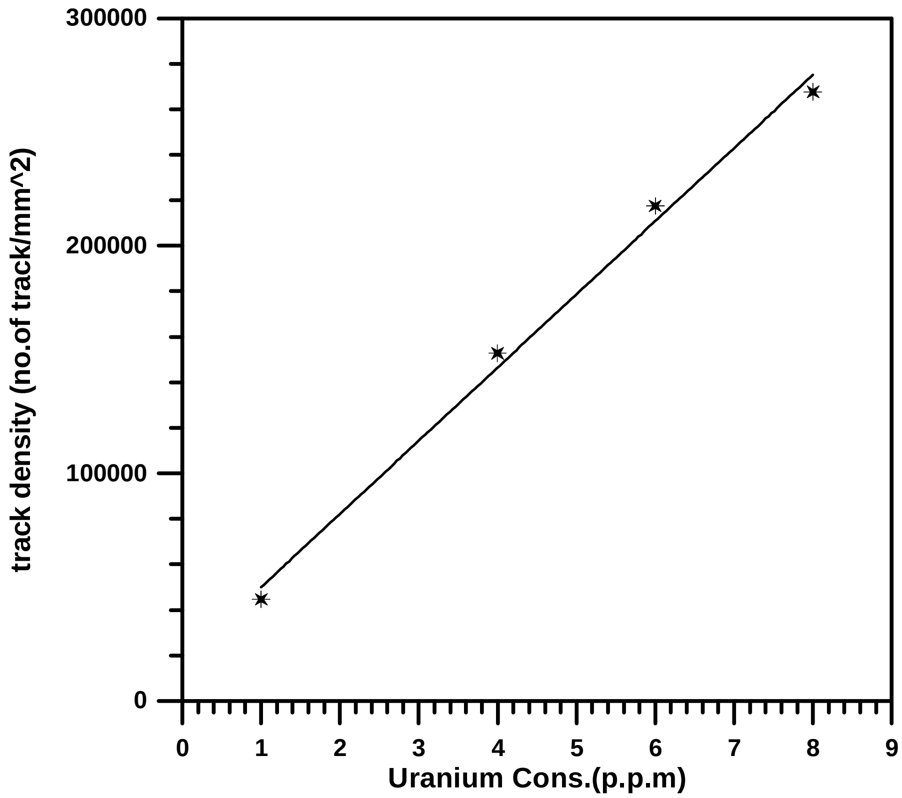

Fig. (5) Shows the relation between track density CR-39 detectors and uranium concentration (ppm) in the standard samples.

Table (1)
Demonstrates the types of imported Cigarettes.

	Sample	*Sample Code*	*country*
1	Gauloises Blonds(Ultra lights)	S_1	European Union
2	Gauloises Blonds(lights)	S_2	European Union
3	Pine (low tar cigarettes)	S_3	Korea
4	Miami (fine Virginia)	S_4	Jordan
5	Aspen Export (King Size)	S_5	Germany
6	Craven (A)(Virginia)	S_6	Jordan
7	Maddox (Sweet Blend)	S_7	Holland
8	Royale Club (menthol)	S_8	France
9	Zesty (feel moment)	S_9	Korea
10	Pine (Light)	S_{10}	Korea
11	Ghamdan	S_{11}	Yemen
12	Macbeth (Chocolate) 100's	S_{12}	Brazil
13	Pleasure (lights)	S_{13}	Korea
14	Ishtar (Original)	S_{14}	Jordan
15	Five Stars	S_{15}	Jordan

The minimum value of uranium concentration was in sample 15 (type of Five Stars) and the maximum value of uranium concentration was in sample 12 (type of Macbeth (Chocolate) 100's) as showen in Fig.(6), Table (2). All the results obtained are with in the international levels as given by UNSCAR (United Nations Scientific Committee on the Effect of Atomic Radiation) data [10].

Table (2)
Radionuclides for imported cigarettes measured by using the irradiation method.

	r (No. of tracks/mm^2)	*C_x (ppm)*
1	5207.1005±3.84	0.161
2	35443.786±24.566	1.102
3	30443.786 ±19.519	0.946
4	29881.656±12.028	0.929
5	3047.337 ±3.278	0.0947
6	5650.887 ±3.491	0.175
7	31745.562 ±5.117	0.987
8	38195.266 ±7.826	1.187
9	32603.550 ±49.216	1.013
10	23905.354 ±29.869	0.743
11	10059.171 ±5.059	0.312
12	76035.502 ±24.217	2.374
13	14378.698 ±4.716	0.447
14	11153.846 ±8.015	0.346
15	1331.360 ±2.598	0.041

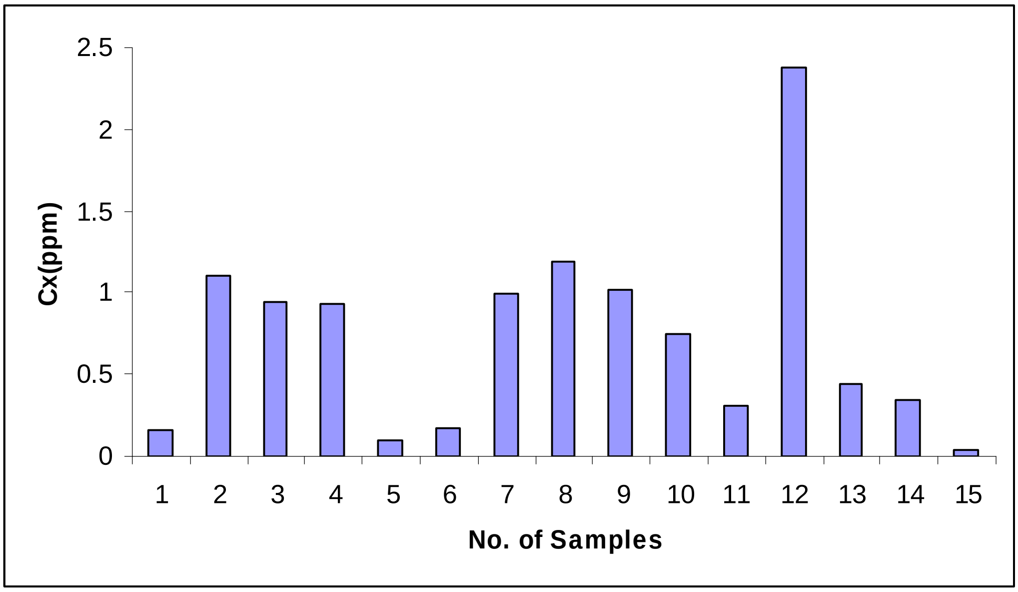

Fig. (6) The diagram of the concentration of radio nuclides (ppm) in samples.

Conclusions

1- The Uranium concentration varies from samples from 0.014 to 2.374 ppm in study samples and less than the allowed limit, for U-235 varies from(7.4-3.7Bq/kg) level as given by UNSCAR [11].

2- All the result obtained are within the allowed level as given by UNSCAR (united nations Scientific Committee on the Effect of Atomic Radiation) data.

References

[1] S.T.Al- Uboode, M.Sc. Thesis, University of Nahrain, 2006.

[2] Nada Farhan Al-Rubace Dr.Nada Fadil, Kabus Abd Al-Gabar, "determination of alpha emitter in the blood of the smokers by using CR-39 CSSNTDs detector", 2000.

[3] Hassan S. F, Ms.C, Thesis, "Determantion of Uranium concentration in human blood in some governorates of Iraq", 2006.

[4] Muller R. F and Young I. D., "Emerys elements of medical genetics", 10th Ed. USA, Harcourt brace and company limited, (1988)75-1100, 125-175, (1988).

[5.] S. C. Scharma and G. K. Meth, "NUCL. Inst, Meth."178-217, 1980.

[6] Hepburn C. and Windle A. H , "Journal of Material Science", 15, 279-301, 1980.

[7] S.A.Amin, M.Sc. Thesis, University of Bristol, U.K., 1981.

[8] D. H. Gayb, M.Sc. Thesis, University of Saddam, 2002.

[9] Jim T. Smith, "Are Passive Smoking, Air Pollution and obesity a greater mortality risk than major radiation incidents", Bmc Public Health, 2007.

[10] د. رواء زكي يونس, "بعض تأثيرات الأسلحة المشعة في العراق"., 2004 , ص .100-113 .

[11] ورود كريم عبود,"نبات التبغ المؤشر للتلوث الاشعاعي", ط, جامعة بغداد/كلية العلوم للبنات, 2010.

الخلاصة

يهدف البحث إلى قياس تراكيز باعثات ألفا باستخدام طريقة كاشف الأثر النووي CR-39 لخمسة عشر نموذج مختلف من السكائر المستوردة, استخدم التفاعل U- (n, f) 235 كمصدر لشظايا الانشطار النووي وذلك بقصف نواة اليورانيوم بالنيوترونات الحرارية من المصدر النيوتروني (Am- Be) بفيض نيتروني حراري $(5\times10^{3}$ n. cm^{-2}. $s^{-1})$.

تم الأعتماد في تحديد تراكيز باعثات الفا على الحسابات المعتمدة لنماذج عنصر اليورانيوم القياسية ومن خلال هذه النتائج المستحصلة نجد أن تراكيز باعثات ألفا في نماذج السكائر المستوردة تتراوح بين ppm (0.041-2.374). نستنتج من ذلك ان التراكيز في النماذج أعلاه ضمن الحدود المسموحة دولياً وحسب ما اصدرته الهيئة الدولية للطاقة الذرية.