

Measurement of Uranium Concentration In different source (Milk powder) and countries By Using CR-39 Plastic Track Detector
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Abstract

The aim of this research is to measurement the alpha – emitter in milk powder samples taken from different source and countries using fission fragment track registration . The study includes collecting (13) sample .

The nuclear track technique by CR-39 plastic track detector sheets is used as detector in this research .

The nuclear reaction used as a source of nuclear fission fragments is U-235 (n , f) obtained by the bombardment of Uranium – 235 in sample with thermal neutrons from (Am – Be) sours which has flux of ($5 \cdot 10^3 \text{ n} \cdot \text{cm}^{-2} \cdot \text{s}^{-1}$) the irradiation time was (7) days .

The concentration values were calculated through the comparison with standard samples which were prepared .

The results give ranged between lowest degree in type Al- Modhesh made in Sultanate oman and highest type Amies made in French as follows (0.4583 – 1.8273 ppm) .

A Comparison of results to permissible limits of Uranium in milk also obtained.

Keywords

Depleted Uranium , CR-39 plastic , chemical etching , Solid State Nuclear Track Detectors (SSNTDs) , Milk powder .

CR قياس تركيز اليورانيوم في مختلف المصادر (الحليب الباودر) والبلاد باستخدام كاشف الأثر البلاستيكي
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الخلاصة:

يهدف البحث الحالي إلى قياس بواعث (مطلقات) ألفا في نماذج الحليب الاصطناعي (الباودر) المأخوذة من مختلف المناشئ لأقطار مختلفة ، باستعمال تسجيل أثار شظايا الانشطار (شملت الدراسة جمع ثلاثة عشر نموذج . إن تقنية عد الآثار النووية للكاشف البلاستيكي هي المستعملة في هذا البحث ، قِيم التركيز حُسِبَتْ خلال المقارنة بالعينات القياسية المحضرة . تم تحديد تركيز اليورانيوم للنماذج المراد دراستها باستخدام عد الآثار النووية بواسطة كاشف الأثر وذلك النووي الناتجة من التفاعل (n, f) U بتسجيله لأثار شظايا الانشطار ²³⁵ الناتجة من قصف النماذج بنيوترونات حرارية منبعثة من المصدر النيوتروني (Am – Be) بفيض نيوتروني ، $n \cdot \text{cm}^{-2} \cdot \text{s}^{-1}$ ولمدة سبعة أيام . $10^3 \cdot 5$ لقد تم تحديد تركيز اليورانيوم بالمقارنة مع الحسابات المعتمدة التي تعطىها النماذج القياسية التي تم تحضيرها حيث كانت النتائج تتراوح بين أقل تركيز نوع المدهش صنع في سلطنة عمان وأعلى تركيز هو أميس صنع في فرنسا وكانت كالاتي : (0.4583 – 1.8273 ppm) . من مقارنة النتائج مع المحددات العالمية تبين أن جميع النماذج هي ضمن المحددات العالمية

Measurement of Uranium Concentration

Uranium	U-238	4.5×10^9	y.	α
Thorium	Th-234	24.1	d.	β, γ
Proactinium	Pa-234	6.75	h	β, γ
Uranium	U-234	247×10^3	y.	α, γ
Thorium	Th-230	80×10^3	y.	α, γ
Radium	Ra-226	1600	y.	α, γ
Radon	Rn-222	3.823	d.	α, γ
Polonium	Po-218	3.05	m.	α, β
Lead	Pb-214	26.8	m.	β, γ
Astatine	At-218	2	s.	α
Bismuth	Bi-214	19.7	m.	β, γ
Polonium	Po-214	1.64×10^{-4}	s.	α, γ
Thallium	Tl-210	1.3	m.	β, γ
Lead	Pb-210	21	y.	β, γ
Bismuth	Bi-210	5.01	d.	β
Polonium	Po-210	138.4	d.	α
Thallium	Tl-206	2.19	m.	β
Lead	Pb-206	stable	

Goal of the Research

The main goals of this research is to measurement the Depleted Uranium in milk powder samples taken from different source to different country using fission fragment track registration .

In this study CR-39 plastic track detector used due to its high sensitivity and availability in Iraq, using Can technique the most widely used technique.

Experimental Details

1. Milk Samples

The study includes collecting (12) samples of powder milk which were collected from different source to different country as follows in table (2), hence taken powder sample measurement uranium concentration (concentration unknown) and to press on form pellet (weight 0.5g , thickness 1.5 mm , diameter 2 cm) .

2. Track Detector

Sheets of 250 μm thick CR-39 plastic (supplied by per shore molding LTD Co.UK) were used . these sheets were cut into small piece each of 1cm x 2cm area . then stored at normal laboratory conditions [10] .

3. Etchant solution

Sodium hydroxide solution with (6.25 N) has been used for the etching process . This process was performed at (70 $^{\circ}\text{C}$) .

4. Water Bath

An etching bath of the type (Memmert) Germany was used .It includes a thermostat which can be operated over arrange of (20 – 120 °C) . A distilled water was used as the bath liquid . The accuracy of regulation of temperature was better than ± 0.1 °C .

5. Optical Microscope

The counting of all the chemically etched tracks was carried out using an optical microscope (Bausch & Lamb , Japan) . It is capable of giving magnifications of up to x 400 .

6. Neutron Irradiation Source

The nuclear reaction used as source of nuclear fission fragments is U-235 (n,f) obtained by the bombardment of Uranium -235 in sample with thermal neutrons from (Am – Be) source which has flux of ($5 \cdot 10^3$ n.cm⁻².s⁻¹) the irradiation time was (7days) as shown in figure (1) [11] .

7. Standard Samples

The standard geological samples of Uranium concentration recommended by IAEA were prepared . The pellet were covered with (CR-39) on both sides and enclosed in aluminum capsules and put in aplate of paraffin wax at adistance of (5cm) from the neutron source (Am-Be) . was measured by comparison between track densities register on the detectors from the relation : [12 , 13]

$$C_{ppm} (Sample) = \frac{\rho(Sample)}{\rho(S\ tan\ dard)} * C_{ppm} (S\ tan\ dard) \dots\dots(1)$$

Were (p) is the induced fission track density and C_{ppm} denotes the Uranium content [14 , 15 , 16] , Figure (2) show this relation .

$$C_{ppm} (Sample) = \frac{\rho(Sample)}{Slope} \dots\dots\dots(2)$$

Table (2) the producer name and the origin

Country of origin	Producer name	Sample code
SULTANATE OF OMAN	Al-Modhesh	S ₁
EGYPT	Pure	S ₂
KSA	Crystal	S ₃
FRENCH	NIDO	S ₄
FRENCH	Lacto	S ₅
INDONISIA	AL- Aham	S ₆
OMAN	Al-Atiaf	S ₇
SULTANATE OF OMAN	Fresh	S ₈
FRENCH	Dielac	S ₉
RUSIA	Dolce	S ₁₀

Measurement of Uranium Concentration

HOLANDA	Two Cows	S ₁₁
INDONESIA	Milgro	S ₁₂
FRENCH	Amie's	S ₁₃

Result and Discussion

Table (3) show the results of uranium concentration in (ppm) in the (13) sample (milk powder) .

By comparison between the results obtained and the permissible limit of EPA for milk , there are two samples of higher level , which are samples (13) with (1.8273) ppm and sample (12) with (1.4841) ppm .

Conclusions:

The low uranium concentration in milk sample measurement in this work (Al – Moudhesh , made in sultanate Oman) while high concentration in (Amie's , made in French) .

Table (3) Track density (P) and Concentration of U – 238

Sample code	No. of track	Track density (P) (track/mm ²)	Concentration Of Uranium (ppm) * 10 ⁻⁷
S ₁	0.1059	169.59 ± 5.00	0.4583
S ₂	0.1441	230.56 ± 7.30	0.6231
S ₃	0.1783	285.34 ± 3.00	0.7711
S ₄	0.2085	333.67 ± 6.53	0.9018
S ₅	0.2314	370.24 ± 1.05	1.0006
S ₆	0.2488	398.19 ± 4.16	1.0761
S ₇	0.2649	423.93 ± 3.60	1.1457
S ₈	0.2690	430.41 ± 4.60	1.1632
S ₉	0.3129	500.77 ± 4.44	1.3534
S ₁₀	0.3239	518.33 ± 0.15	1.4009
S ₁₁	0.3320	531.34 ± 0.25	1.4360
S ₁₂	0.3432	549.12 ± 1.46	1.4841
S ₁₃	0.4225	676.12 ± 0.83	1.8273

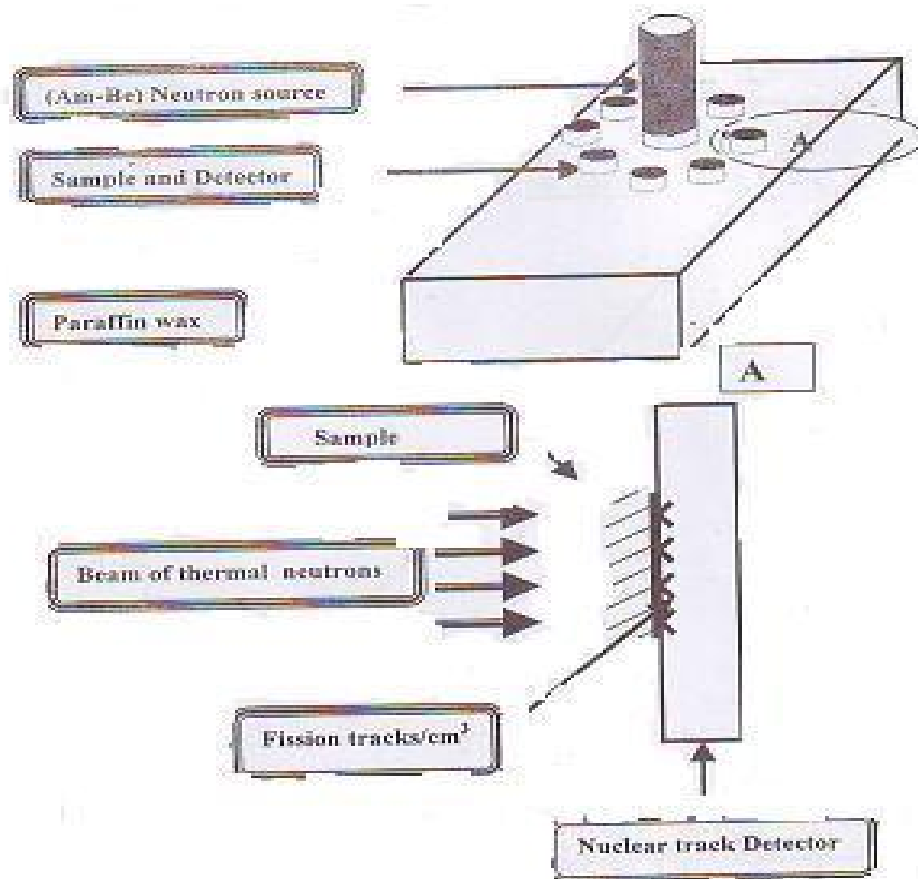


Figure (1) The irradiation of the detectors and samples to the neutron source.

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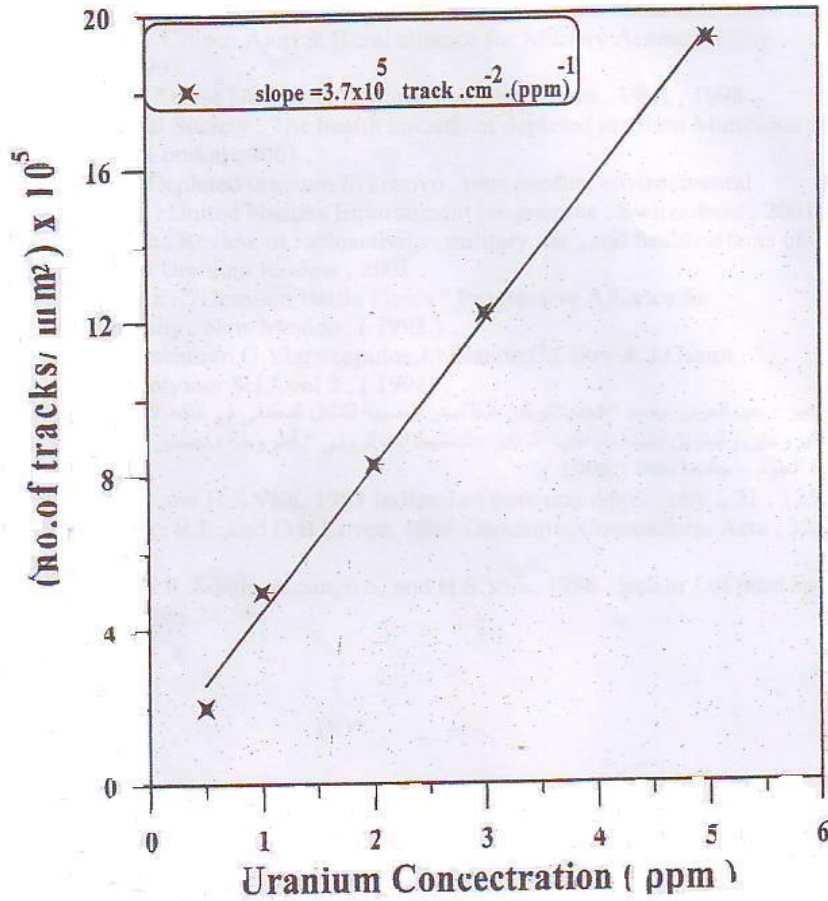


Figure (1) the density of track and Uranium concentration in the standard sample

Reference

1. [www.geocities.com / elhennawy 2005 / pollution . htm .](http://www.geocities.com/elhennawy2005/pollution.htm)
2. [http : // ar . wikipedia . org / wiki](http://ar.wikipedia.org/wiki)

3. M.Eisenbud and T. Gesell . " Environmental Radioactivity " 4th ed .
Academic press , US , 1997 .
4. G.Bukowski,D.A.Lopez & F.M.McGehee. Uranium battlefield home &
Abroad . Citizen Alert & Rural alliance for Military Accountability .
USA ,1993 .
5. D.Fahey " Case Narrative " Swords and Plowshares , USA , 1998 .
6. UK Royal Society . The health hazards of depleted uranium Munitions .
Part 1 . London , 2001 .
7. UNEP . Depleted uranium in kosovo . post conflict environmental
assessment . United Nations Environment programme . Switzerland,
2001.
8. V.S.Zajic . Review of radioactivity , military use , and health effects of
Depleted Uranium Review , 2001 .
9. L.A.Dietz , " Uranium Battle Fields " Progressive Alliance for
Community , New Mexico , (1993) .
10. J.Vanderschuren,G.Yianakopulos,J.Niezette,C.Clitry & J.Gasiot , "
J.Appl.Polymer Sci." vol 2 , (1998) .
11. بازهير : عبد العزيز محمد " تحديد تركيز العناصر المسببة للتآكل المعدني في النفط الخام والكبروسين والينزين باستخدام تقنية التحليل بالتنشيط النيوتروني " أطروحة ماجستير مقدمة
(إلى كلية العلوم – جامعة بغداد) 1996 .
- 12 . S.A.Durrani and R.K.Bull " Solid State Nuclear Track Detection " :
Principles,Methods and Application , pergamon press (1987) .
13. V.Bansal,A.Azam and R.Prasad,Health phys.27, 1989, 985 .
14. Singh S.and H.S.Virk, Indian J.of pure and Appli . phy ., 21 ,1983, 125.
15. Fleischer R.L.,and D.B.Lovett, Geochim . Cosmochim. Acta , 32,
1968, 1126 .
- 16 . Singh N.P.,Singh M.,Singh S. and H.S.Virk, 1986 , Indian J.of pure and
Appl. Phys.24,566 .