Determination of alpha particles concentration in Clay Bricks Samples by CR-39 Detector

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Abstract:

The aim of the present work is to determine the alpha particles concentration in clay bricks samples taken from Hilla, Karbala, Najaf, Baghdad, Diyala, and Samarra governorates, emitted from the radioactive elements (radionuclides) (U-238, Th-232, Ra-226, and Po-218) by using nuclear track detector (CR-39), taken from many places of Iraq. Used one month irradiation time and then etched by 6.25 N of NaOH solution at temperature of 60 ^{o}C for 6 h.

The results obtained have shown that the highest average alpha particles concentration in clay bricks samples was found in Najaf region which was 4.65 ppm, while the lowest average alpha particles concentration was found in Diyala region which was 1.26 ppm.

Keywords: alpha concentration, clay bricks, CR-39.

الخلاصة:

الهدف من البحث الحالي هو حساب تركيز مطلقات ألفا في نماذج طابوق باستخدام تقنية عد آثار جسيمات ألفا المنبعثة من النوى المشعة (^{238}U, ^{232}Th, ^{226}Ra, ^{218}Po) باستخدام كاشف الأثر النووي (CR-39) لمناطق مختلفة من العراق هي الحلة، كربلاء، نجف، بغداد، ديالى، وسامراء. شععت النماذج لشهر واحد ومن ثم تم استخدام هيدروكسيد الصوديوم كمحلول قاشط وبعيارية 6.25 N وبدرجة حرارة مقدارها 60 ^{o}C لمدة 6 ساعات. وقد أوضحت النتائج التي حصلنا عليها أن أعلى معدل لتركيز مطلقات ألفا في نماذج الطابوق النجف حيث بلغت 4.65 ppm، بينما اقل معدل لتركيز مطلقات ألفا في نماذج الطابوق كان في ديالى حيث بلغ 1.85 ppm.

الكلمات المفتاحية : تركيز الفا ، طابوق صيني ، CR-39.

1. Introduction

Radioactivity is the number of disintegrations per second, its unit for measurement is Becquerel (UNEP, 1985). There are two main sources of radiation found in the environment: Natural Radioactivity Sources (which include terrestrial, cosmic rays and cosmogenic) and Man-Made Radioactivity Sources (which include medical, fallout and nuclear power) (UNSCEAR, 1993). The radioactive elements emits ionizing radiation like alpha particles (α), beta particles (β), and gamma rays (γ), its well known that all these types of ionizing radiation have a biological effects on the living system. Radioactive elements emits alpha particles, which in direct physical contact, the insoluble parts of these particles enters the body of an exposed person will stay there and consequently ionize the body organ and the tissue surrounding it and causing different types of cancer (Hoskens, 1997). Radiation and radiation emitters radioactive elements (radionuclides) can expose the whole body (direct exposure) or expose tissues inside the body when inhaled or ingested. The health effects of alpha particles depend heavily upon how exposure takes place. External exposure is of far less concern than internal exposure, because alpha particles lack the penetration power of the outer dead layer of skin; However, if alpha emitters have been inhaled, ingested (swallowed) or absorbed into the blood stream, sensitive living tissue can be exposed to alpha radiation. The result of biological damage increases the risk of cancer in particular, alpha radiation is known to cause lung cancer in humans when alpha emitters are inhaled (Environmental Protection Agency, 2005). The use of solid state nuclear track detectors (SSNTDs) has already become a well-known technique

which has been widely applied in monitoring concentrations by recording their emitted alpha particles(Yi, 2004).

The aim of the present work is to determine the alpha particles concentration in clay bricks samples for selected regions in many places of Iraq by using alpha-emitters registrations which are emitted form samples by using nuclear track detector (CR-39).

2. Experimental procedure

Determination of the concentration of alpha particles emitted from U-238,Th-232, Ra-226, and Po-218 nuclei in clay bricks samples by using the nuclear track detector (CR-39) of thickness 250 μm and area of about 1×1 cm^2. The measurements carried out in the laboratories of physics department in college of education for pure science/ Babylon university.The clay bricks samples were collected from different sites in Iraq, and then were dried and cleaned from the doping grinds by using special sieve (0.27 mm in diameter). The clay bricks samples of 1 g weight were pressed in to a pellet of 1cm diameter and 1mm thickness, the clay bricks samples were covered with nuclear track detector (CR-39) as shown in Fig. (1).

After the irradiation time (one month), the CR-39 etched in 6.25 N of NaOH solution at temperature of 60 ^oC for time 6 h as a beast conditions for appearing the tracks (Tawfiq, 1996), and the tracks density were recorded using an optical microscope with magnification 400X. The density of the tracks (ρ) in the samples were calculated according to the following relation (Amalds et al, 1989):

Track density (ρ) = Average number of total pits (tracks)/ Area of field view …. (1)

The alpha particles concentration in the clay bricks samples were measured by the comparison between tracks density registered on the detector of the sample pellets and

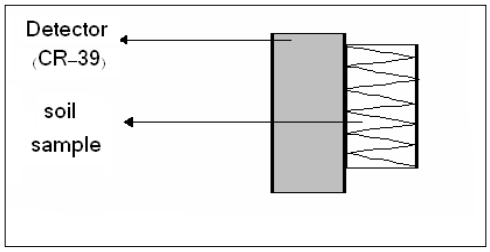

Fig. (1): The irradiation of the detector by soil sample.

that of the standard soil sample pellets from the relation (2)(Durrani, and Bull, 1987). The standard sample is shown in Fig.(2).

$$C_X = \rho_X . (C_S / \rho_S) \quad \ldots\ldots\ldots (2)$$

Where : C_X : alpha particles concentration in the unknown sample (ppm).

C_S : alpha particles concentration in the standard sample (ppm).

ρ_X : track density of the unknown sample (track/mm^2).

ρ_S : track density of the standard sample (track/mm^2).

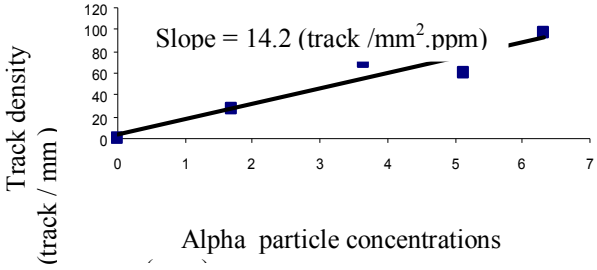

Fig.(2): Relationship of alpha particles concentration with track density in the standard samples.

3. Results and Discussion

The concentration of alpha particles emitted from the radioactive elements (radionuclides) (U-238, Th-232, Ra-226, Po-218) in clay bricks samples by using nuclear track detectors (CR-39) are calculated by optical microscope type (ALTAY BIO-1007). The selection of the detector material is very important and the chemical etching and reading parameters must be optimized for each type of material(Zaki and El-Shaer, 2007). The solid state nuclear track detectors (SSNTDs) when exposed to a certain dose of radiation one or more than one measurable parameters will change. The passage of heavy ionizing nuclear particles (such as alpha particles) through most insulating solids creates narrow paths of intense damages on an atomic scale(Hushemi and Durrani, 1981). These damages (tracks) can be revealed and made visible indirectly by chemical etching (using NaOH solution) and using an ordinary optical microscope.

Alpha particles concentration for clay bricks samples in different regions in Iraq (Hilla, Karbala, Najaf, Baghdad, Diyala, and Samarra) are listed in Table (1).

Table (1): Alpha particles concentration for clay bricks samples.

Region		Samples 1	2	3	4	5	Average
Hilla	Alpha particle concentration (ppm)	2.45	2.45	2.66	2.52	2.52	2.52
	Track density (track .mm^{-2})	35	35	38	36	36	36
Karbala	Alpha particle concentration (ppm)	2.87	2.03	2.87	2.66	2.80	2.64
	Track density (track .mm^{-2})	41	29	41	38	40	37.80
Najaf	Alpha particle concentration (ppm)	4.97	4.97	3.92	4.76	4.62	4.65
	Track density (track .mm^{-2})	71	71	56	68	66	66.40
Baghdad	Alpha particle concentration (ppm)	2.45	2.03	2.87	2.59	2.45	2.48
	Track density (track .mm^{-2})	35	29	41	37	35	35.40
Diyala	Alpha particle concentration (ppm)	2.03	2.45	1.05	2.03	1.68	1.85
	Track density (track .mm^{-2})	29	35	15	29	24	26.40
Samarra	Alpha particle concentration (ppm)	3.08	2.66	3.92	2.80	3.36	3.16
	Track density (track .mm^{-2})	44	38	56	40	48	45.20

It can show from the Table that the highest average alpha particles concentration in clay bricks samples was found in the Najaf region which was (4.65 ppm), while the lowest average alpha particles concentration was found in Diyala region which was (1.85 ppm). The rocks of substances with a high concentration of radiation, depending on the type of these rocks, then the results which obtained refer to the variation of rocks nature of deferent regions in Iraq. In general, it can show the rising values of alpha emitters concentration in clay bricks. The present results shows that the alpha particles concentration in clay bricks samples for all regions are in the allowed limit from United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) agency which is (11.7 ppm) (UNSCEAR, 1993).

4. Conclusion

The result of biological damage increases the risk of cancer in particular, alpha radiation is known to cause lung cancer in humans when alpha particles are inhaled.

From the present work, it can be concluded that the highest average alpha particles concentration in clay brick samples was found in Najaf region which was (4.65 ppm), while the lowest average alpha particles concentration was found in Samarra region which was (1.85 ppm).

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