MINAR International Journal of Applied Sciences and Technology

Article type : Research Article

Date Received :11/07/2021
Date Accepted : 08/08/2021
Date published : 01/09/2021
: **www.minarjournal.com**
http://dx.doi.org/10.47832/2717-8234.3-3.4

ESTIMATION THE CONCENTRATION OF URANIUM IN THE SEDIMENTS OF THE SOUTHERN PART OF THE SHATT AL-ARAB RIVER, SOUTH OF BASRAH GOVERNORATE USING SSNTDS(CR-39)TECHNIQUES

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Abstract

The present work deals with measuring concentrations of uranium in 20 samples taken from sediments of different sites of southern Shatt al-Arab located south of Basra Governorate Located in the southern part of Iraq, using a uranium fission fragment U-235 (n-f), obtained by the bombardment of U-235 with thermal neutrons. Irradiation was performed, then chemical etching was performed, and then the number of tracks was counted using a microscope. The results computed through the solid state nuclear track detector (SSNTDs) techniques For 20 samples were taken from 20 different sediment sites in the southern part of the Shatt al-ArabIn the southern part of Basra Governorate, southern Iraqindicated that the uranium concentrations in the study area ranged between 1.886 ppm near Al-Shahiniya Road and 3.290 ppm at the AL-Dora 2 site. The t results of the study have shown that the uranium concentrations in the studied surface soil samples were less than the allowed value (11.7 ppm) recommended by UNSCEAR, 1993.

Keywords: Uranium, Soil Samples, CR-39 Detector, Shatt Al-Arab River, Basrah Governorate.

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1. Introduction

Natural radiation is always a part of the human environment. Its main components are cosmic radiation, terrestrial gamma radiation from natural radionuclide in soil and rocks, and natural radioactive materials in the air we breathe and in our diet [1].Radionuclide are found in the environment as naturally occurring elements and as products or by-products of nuclear technologies, Uranium is one of the most common radionuclide. All uranium isotopes are radioactive, so it is very important to control their quantity[2].The technique of the tracks count of the fission fragments was used to find the concentration of uranium in soil , because of its ease and accuracy in determining the emitting elements of the alpha particles even if the concentration is very small, the CR-39 detector is considered of the best detectors to record the tracks of alpha particles and nuclear fission fragments , that is because of the advantage of its high sensitivity and the efficiency[3,4].

The aim of this research is to determine the concentration of uranium in surface sediments under the waters of the southern part of the Shatt al-Arab, south of Basra Governorate, to find out the extent of contamination of these sediments using the solid state nuclear track detection technology. The radiation in the soil is the upper part of the earth's crust and is formed as a result of the deformation of rocks by complex physical-chemical processes that include weathering, decomposition and water movement, and thus soil is a result of weather and human activities.On the earth's rocky crust. The soil is naturally radioactive, because of the mineral content. The natural radioactivity may vary considerably from one type of soils to another[5].

2 .Material And Methods

2.1 Collection of soil sample:

Twenty samples of sediments distributed within the southern part of the Shatt al-Arab River in the south of Basra Governorate, passing through areas near the confluence with the Shaheenya River, Sihan, opposite Abadan refinery, Al-Wasiliya, Kot Bandar, Al-Dawasir, Al-Dora, Al-Maamer, Al-Mukhrak, Al-Nakqa, Al-Faw, and Ras Al-Bisha. It was brought in and then dried in an oven at 70 ° C for a few hours, then it was ground well and then sifted with a 75 µm sieve[6].

2-2-Irradiationof the samples

Each sample of sediment weighing 5 g was taken and then mixed with 1 g of mesh cellulose powder which was used as a binder for the powder. Then the mixture was transferred to coherent tablets by a hydraulic press machine and the tablets were placed in contact with the nuclear track detector (CR-39) and put in a plate of paraffin wax at a distance of 5 cm from the neutron source Am-Be with the flux of thermal neutron (5 * 103 n cm-2 s-1), The paraffin wax is usually used for moderating the fastneutrons to thermal neutrons energies as shown in figure 1

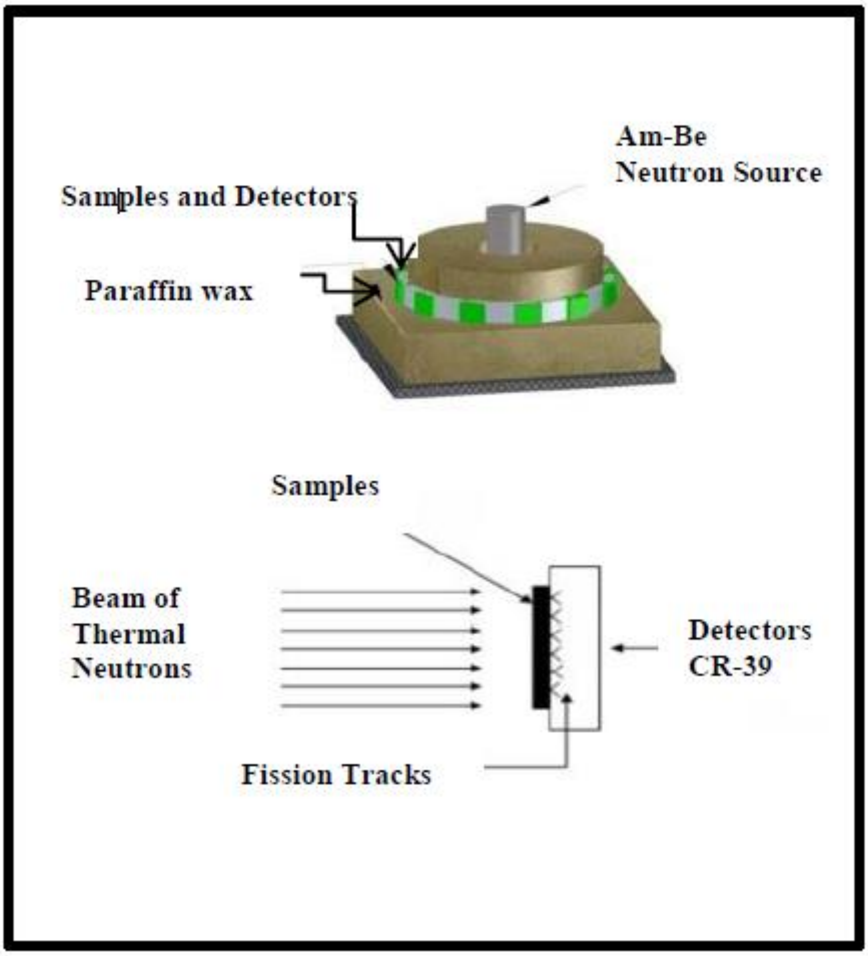

Figure 1: The Irradiation of the Detectors with Samples for Neutron Source[7]

2.3 Chemical etching and microscopic scanning:

The process of showing tracks in most cases involves conducting the chemical etching process for specific periods of time in order to remove reagent particles affected by the charged particles. A lot of researches and studies have been conducted regarding the types of solutions used and the temperature ranges for many types of charged particles and for different scraping periods[8-10].

After irradiation for a period of 7 days[4], the detectors were removed in front of the radioactive source and etch them in a 6.25 N aqueous solution of NaOH for 6 hours at a temperature of 60 ° C, which was the normal employed etching time[5]. After that, the reagent is rinsed with distilled water and dried. Then the tracks recorded in the CR-39 detectors are calculated using a 400X optical microscope. The density of the traces and the concentration of uranium are calculated .The fission track density (ρ) was calculated according to the following equation[11]

Track density $$(\rho_x) = \frac{N_{ave}}{A} \qquad (1)$$

where: ρ is the Track density (Track/mm2), N is the a average of total tracks and A is the area of field view

4-2- Uranium Concentration:

The uranium concentration in the soil samples was measured by comparison between track densities registered on the detectors of the samples and that of the standard solutions by the following equation.

$$\frac{c_x}{\rho_x} = \frac{c_s}{\rho_s} \quad (2)$$

so that:
Cx = ρx . (Cs /ρs)
where ρX and ρS are the induced fission track density for unknown sample and standard solution (in tracks/mm2), Cx and Cs denote the uranium concentration for unknown sample and standard solution (in μg/l). The slope of the linear relation between uranium concentration and track density for standard samples, Figure (2), is equal to the reciprocal of the second term on the right-hand side of Eq. (3), then [12]:

$$cx = \frac{\rho_x}{slope} \quad (3)$$

The accumulated data of the registered induced tracks density for standard solutions was plotted as a function of the uranium concentration. The blank's tracks density was subtracted from all measurements .The Figure 2 illustrates this.

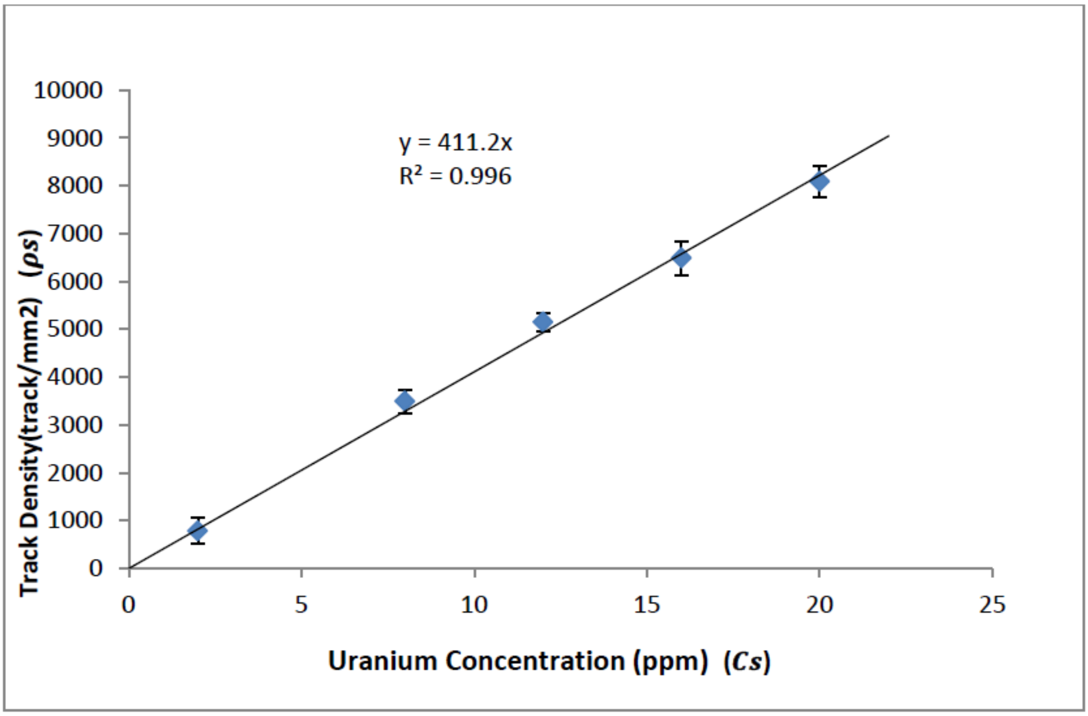

Figure 2:The Calibration Curve Between Track Density and Uranium Concentrations for Standard Samples by SSNTDs

Where :y is the track density , x is the concentration and R is the resolution factor

3. Results and Discussion
In this research, samples were collected from various samples from the southern part of the Shatt al-Arab River, which passes through Basra Governorate in southern Iraq. It was taken into account that all samples were from sediments. A nuclear track detector (CR-39) was used to calculate the uranium concentration in the studied samples. Table 1 shows the concentrations of uranium in the studied samples, as it was noticed that there is a relative convergence between the concentrations.

Table 1: Uranium concentrations in sediment samples in different parts of the southern part of the Shatt al-Arab in Basra Governorate

Sites numbers	Sites	Uranium Concentration (ppm)
S1	Ras Al-Bisha1	2.331
S2	Rass al-Bisha2	2.105

S3	Faw 1	2.654
S4	Faw 2	2.345
S5	Al-naghaa Ah- oula	2.867
S6	Al-naghaa Ah- thanea	2.994
S7	Faw3	2.748
S8	AL- meghraq	3.251
S9	Maamer1	2.827
S10	Maamer2	2.247
S11	Al- dora1	2.751
S12	Al- dora 2	3.290
S13	Al- dwaser	3.196
S14	Kout bander	2.991
S15	Al- waslea	2.449
S16	Near the Abadan refinery	2.338
S17	Near the Abadan refinery2	2.775
S18	Sehan1	2.428
S19	Sehan 2	2.265
S20	Al-shahenea road	1.886

Table 1 and Figure 3 reflect a relative variation in the uranium concentrations in the studied samples, but the variation was not significant. And that the concentrations were less than the permissible concentrations according to the United Nations Scientific Committee on the Effects of Atomic Radiation. The number of samples is 20 as shown in Table (1) and Figure (3). These samples were collected from 20 different locations south of the Shatt al-Arab River in Basra Governorate. The highest uranium concentration was in the sample taken from the Al-dora 2 site, where the calculated uranium concentration was 3.290ppm, while the lowest uranium concentration calculated within the geographical area of the study was near the entrance to Al-shahenea road, where it was 1.886ppm. Through the results, there are 8 samples that contain a concentration from 2.654ppm to 2.994ppm, while there are 8 samples whose calculated concentration ranges between 2.105ppm and 2.449ppm, and there are three samples whose calculated uranium concentration ranges between 3.196ppm and 3.290 ppm .There is a sample that contains a concentration higher than 2ppm, and specifically that the calculated uranium concentration is 1.886 ppm

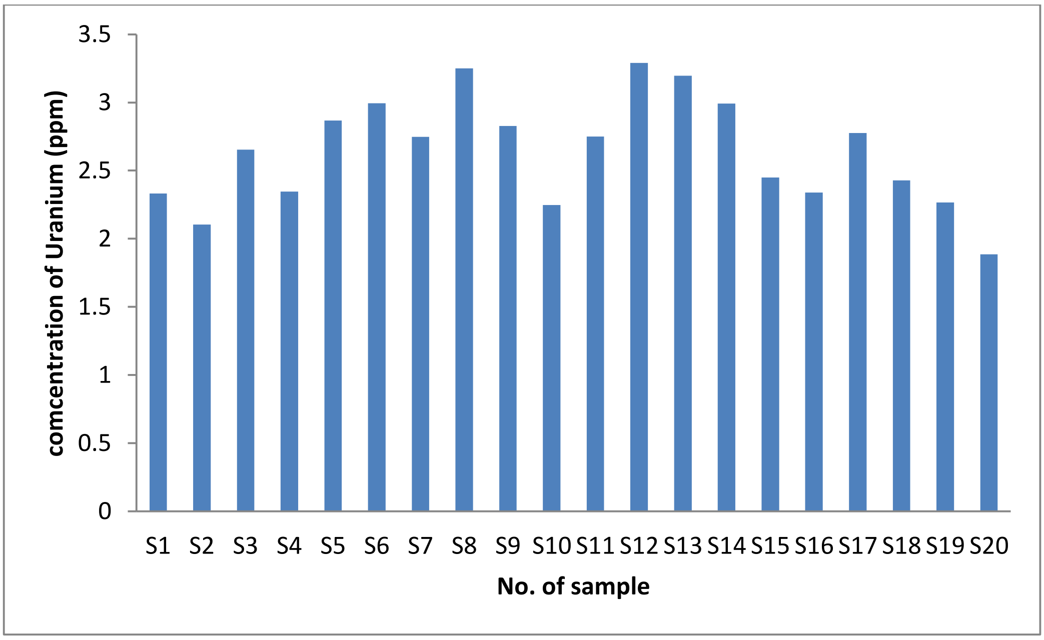

Figure (3): Concentration of uranium in soil samples of different district as a function of the number of the station by using SSNTDs

4. **Conclusion**

The results showed that the concentrations of uranium obtained in 20 samples were less than the permissible limit (11.7 parts per million). As the highest concentration obtained is 3.290 parts per million, which is much less than the permissible concentration that was referred to previously. However, the concerned authorities should monitor the concentration of uranium in the waters and sediments of the Shatt Al Arab River on an ongoing basis to ensure that it is free from high concentrations of uranium. Shatt al-Arab water is used for irrigation and domestic uses, as well as for catching fish from the Shatt al-Arab River and using it as food, which requires constant attention to the quality of the water and to ensure that it is free of any harmful substances.

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