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ESTIMATION THE CONCENTRATION OF UEANIUM IN THE SEDIMENTS OF THE NORTHERN PART OF THE SHATT AL-ARAB RIVER, NORTH OF BASRAH GOVERNORATE USING SSNTDS(CR-39)TECHNIQUES

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ABSTRACT

The present work deals with measuring concentrations of uranium in 23 samples taken from sediments of different sites of northern Shatt al-Arab located south of Basra Governorate Located in the northern 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 23 samples were taken from 23 different sediment sites in the northern part of the Shatt al-Arab in the northern part of Basra Governorate, northen Iraq indicated that the uranium concentrations in the study area ranged between 1.911 ppm near Sinbad Island1and 4.120 ppm near water pumping station 1. The results of the study have shown that the uranium concentrations in the studied surface sediment samples were less than the allowed value (11.7 ppm) recommended by UNSCEAR, 1993.

1. INTRODUCTION

Natural radiation is always a part of the human environment. Its main components are cosmic radiation, terrestrial gamma radiation from natural radionuclides in soil and rocks , and natural radioactive materials in the air we breathe and in our diet [1]. Radionuclides 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 radionuclides. 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].

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The aim of this research is to determine the concentration of uranium in surface sediments under the waters of the northern 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

This part of the research includes the practical aspects as well as how to measure the concentration of uranium

2.1 Collection of soil sample:

Twenty three samples of sediments distributed within the northern part of the Shatt al-Arab River in the north of Basra Governorate, passing through areas near the Hartha and Qurna. 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- Irradiation of 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 ($5 * 10^3$ n cm^{-2} s^{-1}), The paraffin wax is usually used for moderating the fast neutrons to thermal neutrons energies as shown in figure 1

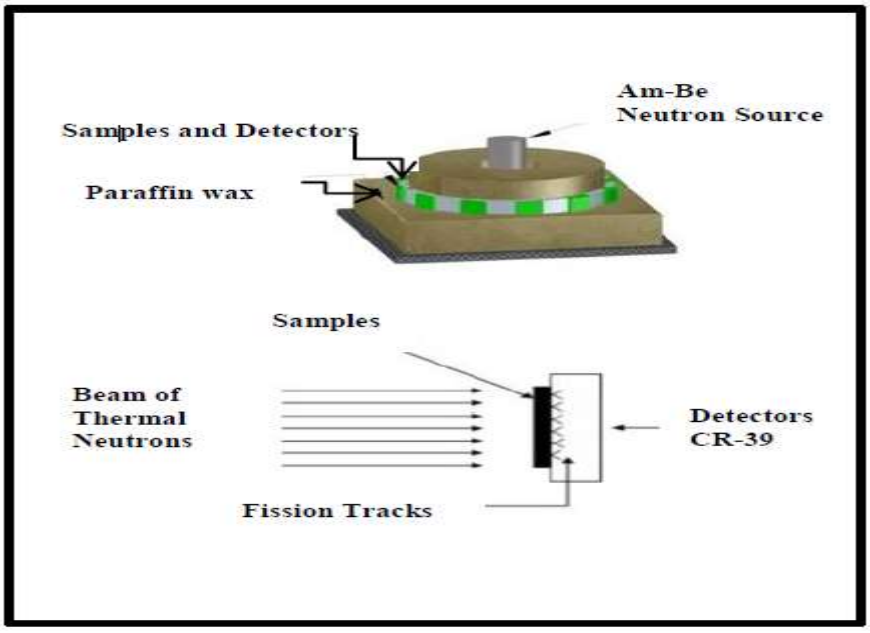

Figure 1: The Irradiation of the Detectors with Samples for Neutron Source[7]

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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 $(\rho_x) = \frac{N_{ave}}{A}$ .... (1)

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

2-4 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.

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

so that:

$$Cx = \rho x \,.\, (Cs / \rho s) \text{ ...(3)}$$

where ρ_X and ρ_S are the induced fission track density for unknown sample and standard solution (in tracks/mm²), C_x and C_s 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]:

$$c_x = \frac{\rho_x}{\text{slope}} \qquad (4)$$

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 .

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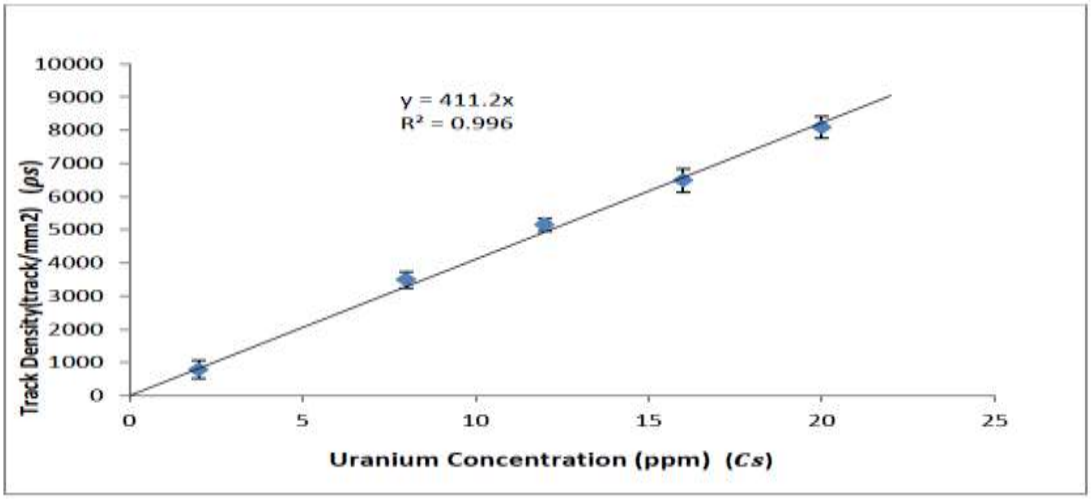

Figure 2: The Calibration Curve Between Track Density and Uranium Concentrations for Standard Samples by SSNTDs

Where
y: track density
x: concentration
R: correlation factor

3. RESULTS AND DISCUSSION

In this research, samples were collected from various samples from the northern 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. 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 northern part of the Shatt al-Arab in Basra Governorate

Sites numbers	Sites	Tracks density(ρ) (tracks/m m²)	Uranium Concentration (ppm)	Specific Activity (Bq/kg)
S1	Al-nagebea 1	1144	2.782	34.35
S2	Al-nagebea 2	2347	2.825	34.88
S3	near Khaled Bridge	962	2.338	28.87
S4	Sinbad Island 1	2052	4.120	50.88
S5	Al- Shallha	1294	3.144	38.86
S6	Sinbad Island 2	1567	3.811	47.06
S7	near AL-Dhabi river	1220	2.964	36.60
S8	AL-hartha	961	2.338	28.87
S9	Near a thermal power plant to generate electricity	1297	3.154	38.95
S10	Al-Diar	1138	2.768	34.18

S11	Paper Factory	1070	2.602	32.13
S12	Nehran omer	994	2.418	29.86
S13	water pumping station 1	787	1.911	23.60
S14	Near Dear bridge1	1591	3.867	47.75
S15	Dear bridge and Water project	1017	2.470	30.50
S16	Shafi 1	1228	2.984	36.88
S17	Shafi 2	1514	3.853	47.58
S18	Between shafi and shresh1	1302	3.165	39.08
S19	(Estuary of the Gomeg River)	1060	2.577	31.82
S20	Water project	970	2.358	29.12
S21	AL Sueb (estuary of the Sweib River)	807	1.962	24.23
S22	water pumping station	942	2.292	28.30
S23	Below the bombed Qurna Bridge	1072	2.606	32.18

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 23 as shown in Table (1) and Figure(3). These samples were collected from 23 different locations north of the Shatt al-Arab River in Basra Governorate. The highest uranium concentration was in the sample taken from the Sinbad Island 1 site, where the calculated uranium concentration was 4.120ppm, while the lowest uranium concentration calculated within the geographical area of the study was near the entrance to water pumping station 1, where it was 1.911ppm. Through the results, there are 14 samples that contain a concentration from 2.338ppm to 2.984ppm, while there are 6 samples whose calculated concentration ranges between 3.144ppm and 3.867ppm. Also, the average concentration of uranium within this part of the Shatt al-Arab was 2.839ppm .

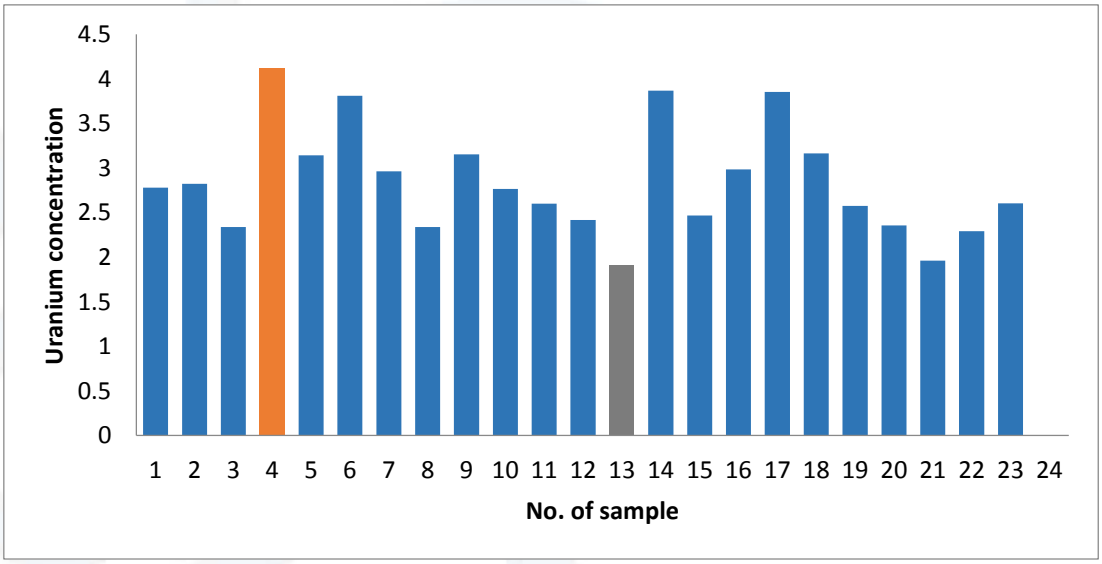

Figure (3): Concentration of uranium in sediment samples different parts of the southern part of the Shatt al-Arab as a function of the number of the station by using SSNTDs

4. CONCLUSION

The results showed that the concentrations of uranium obtained in 23 samples were less than the permissible limit (11.7 parts per million). As the highest concentration obtained is 4.120 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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