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Evaluation of natural radioactivity for building materials samples used in Tall Al Ubaid Archaeologist in Dhi-Qar governorate - Iraq

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Abstract

In this study, the levels of natural radionuclide concentrations were measured for radium (^{226}Ra), thorium(^{232}Th) and potassium(^{40}K) in the building materials used in Tall Al Ubaid Archaeologist site of Dhi-Qar Governorate-Iraq. Using one of gamma-ray spectroscopy techniques, which consists of a scintillation detector sodium iodide activated by thallium NaI (Tl) with dimensions of (3"×3"), measurements performed at the laboratory of environmental and radiation pollution research in the department of Physics, College of Science, University of Dhi-Qar. The obtained results for radionuclides in all of building materials samples were analyzed and tabulated against the global average and the allowed limits as recommended by international scientific agencies. The average value of specific radiative activity concentrations values of natural radioactive elements (^{232}Th, ^{226}Ra and ^{40}K) and the equivalent activity of Radium ($Ra_{eq.}$) for samples of building materials are (15.17- 21.47, 11.04-20.92 and 192.75-291.45) Bq/Kg and (49.60-71.78) Bq./Kg, respectively. The absorbed dose rate (nGy/h), annual effective dose (mSv/y), estimated gamma coefficient (Bq/Kg) were calculated. All values in the four studied areas were lower of the allowable limits, all values of the risk index (internal and external) in units (Bq/Kg) in the studied archaeological sites are less than one. All the results indicate that all concentrations of radioactive elements targeted in the study were within the allowable limits despite the differences in the concentration values of these elements according to the samples.

Introduction

Radionuclides in nature can be classified into three general primitive categories. On earth, primordial are residues from the big bang, secondary are radiogenic isotopes formed after primordial radio nuclides decay, and cosmic ones, which continually being formed in the upper atmosphere because of the cosmic rays. Building materials used by humans have the greatest effect in increasing radiation exposure due to the presence of uranium and thorium elements which can be found in the earth's crust, which produces radon and thoron basing on dissolution process of both uranium and thorium chains respectively (which is more concentrated inside buildings than outside, especially for radon), and that they have significant role in increasing human exposure due to building materials [1].

It is generally agreed that humans are exposed to radiation through different mediums such as air, food and water on daily basis. Natural radiation is present in basic elements that make up our planet such as water and soil. Also, it exists in building materials which shape our homes and it is almost existed everywhere on earth [2]. Man is constantly exposed to ionizing radiation produced naturally from radioactive materials, the average of the effective dose (AED) worldwide due to gamma rays of building materials is estimated at (0.4) ml/year and the average activity determined for radium (^{226}Ra) , thorium(^{232}Th) and Potassium(^{40}K) is (30 , 35 and 400) Bq/kg [3]. Natural, industrial and recycled materials from industrial processes and waste are commonly used as raw materials in construction [4]. Usually, people spend 80% of their time in homes or work buildings, which makes them vulnerable to radiation from radionuclides found in building materials [4,5].

However, the saturation rate of the residents depends on other factors such as the type of soil, the nature of the building materials and the nature of living [6]. The current study aims to know the natural radioactivity of some building materials which been used in building process of ancient Sumerian cities that include housing and public buildings. The spectral analysis technique of gamma ray has been selected using the Sodium Iodide activated by Thallium (NaI (Tl)) system to calculate the natural radioactive elements concentrations for Radium (^{226}Ra), thorium(^{232}Th) and Potassium(^{40}K) in samples of some building materials used in the ancient Sumerian civilization (Tall Al Ubaid Archaeologist) In Dhi-Qar governorate, southern of Iraq. The absorbed dose rate (D_{γ}), annual effective dose (AED), estimated gamma coefficient (I_{γ}), specific radiative activity ($Ra_{eq.}$), external (H_{ex}) and internal (H_{in}) risk coefficients were calculated. Also, a database of natural radioactivity was obtained in order to make this study completion for the previous studies and a reference to the future studies.

Area of the study

The Tall Al Ubaid Archaeologist site with coordinates of (30°58′20″N, 46°01′50″E) in Dhi-Qar governorate, southern part of Iraq. It is about (6 km) west of Ur archaeological city located is near Nasiriyah city, As shown in Figures 1 and 2. Also, table 1 show samples of building materials collected from Tall Al Ubaid Archaeologist site.

Fig. 1: Administrative map of Dhi-Qar governorate showing the area covered by the study.

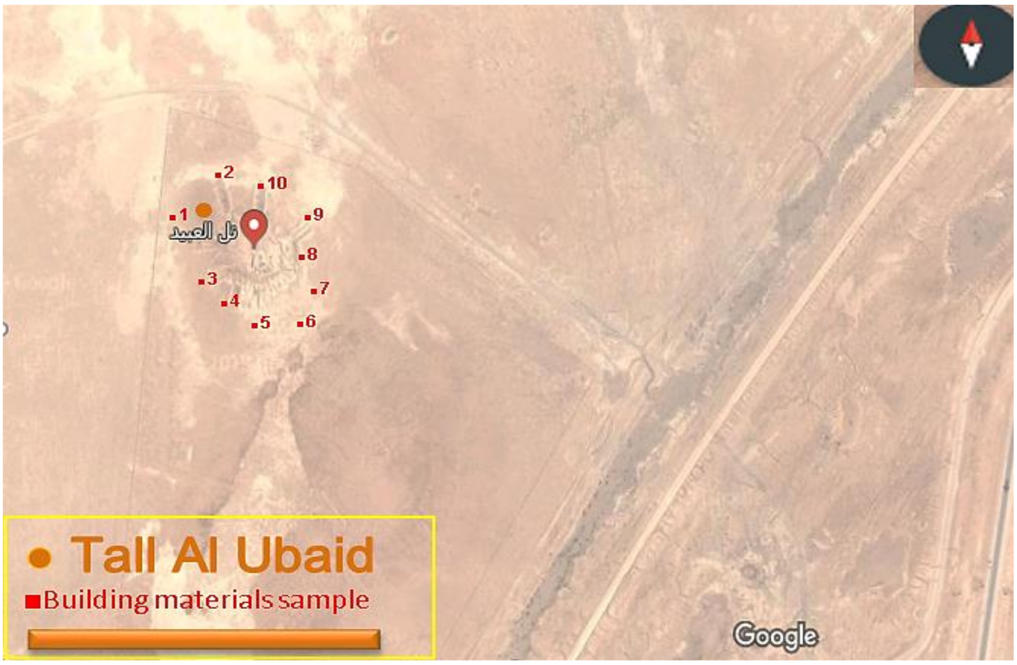

Fig.2: Tall Al Ubaid Archaeologist site [Google Earth].

Table 1 : Samples of building materials collected from Tall Al Ubaid Archaeologist site .

NO	Sample Name	Sample ID	Type of sample*
1	Tall Al Ubaid Sample1	TU 1	Mud - Brick
2	Tall Al Ubaid Sample 2	TU 2	Brick
3	Tall Al Ubaid Sample 3	TU 3	Mud - Brick
4	Tall Al Ubaid Sample 4	TU 4	Stone
5	Tall Al Ubaid Sample 5	TU 5	Mud - Brick
6	Tall Al Ubaid Sample 6	TU 6	Brick
7	Tall Al Ubaid Sample 7	TU 7	Mud - Brick
8	Tall Al Ubaid Sample 8	TU 8	Brick
9	Tall Al Ubaid Sample 9	TU 9	Stone
10	Tall Al Ubaid Sample 10	TU 10	Brick

* The samples include many types of building materials (Mud – Brick: clay bricks sun-dried, Brick : brick dried in oven at certain temperatures, Stone).

Samples Preparation

Ten samples of building materials were collected, stored in airtight plastic boxes, and transferred to the laboratory of environmental and radiation pollution research, department of Physics, College of Science, University of Dhi-Qar, Iraq. In order to remove moisture, the samples were processed and dried in an electric oven at temperature of 110 °C for 24 hours. After drying, the samples were grinded into a granular size of 1000 microns and prepared for measurement using 1 kg standard size marinelli beaker for each sample. The samples tightly sealed and stored for one month to obtain an acceptable radiative equilibrium for the natural radioactive elements targeted in this study.

Samples Measurement

A gamma-ray spectroscopy system with a 76 mm x 76 mm Teledyne isotope (NaI (Tl)) scintillation detector having resolution of (7.5%) KeV at the (661.76) KeV Cs-137 source was used. The detector was shielded with a low-level background lead shield. The (NaI (Tl)) system was calibrated using two reference materials. The first is thorium oxide (ThO2-S7) from British laboratory equipment company PANAX. The certified activity of thorium is (3570 ± 20) Bq /kg. The second reference material is (1) kg of potassium chloride (KCl) which contain (0.52307) kg of potassium, and for natural potassium (K) there are (0.0117%) of potassium (^{40}K), then the rate of (^{40}K) at natural potassium is (6.1199) gm of (^{40}K) which mean the activity of (^{40}K) in (1) kg of (KCl) is (600.12) Bq/kg .The third reference material is radium, an isotope generator kit was used as a standard radioactive reference. The energy transitions of the thorium (^{232}Th) daughters table 2, and the single energy (1460.8 KeV) for (^{40}K) were used to determine the efficiency calibration curve.

Minimum Detectable Activity

The calculation of minimum detectable activity *(MDA)* is very crucial if low concentration radioactive elements such as naturally occurring radioactive materials (NORM) are detected. The sample count rate is often the same as the radiation background count. Radiation background without the sample should be measured with the same measurement conditions and preferably at the same measuring time of sample. (MDA) is dependent on the detection limit level (LLD) and the counting efficiency of the detection system. The (LLD) detection limit level of the detector system can be calculated from the following Eq. [7]:

$$LLD = (4.66x\sigma_b) + 3 \qquad (1)$$

The minimum effectiveness of (MDA) detection can be calculated from the following Eq. [7]:

$$MDA = \frac{LLD}{\varepsilon(E_\gamma).I_\gamma(E_\gamma).W.t} \qquad (2)$$

Or as follows:

$$MDA = \frac{(4.66x\sigma_b)+3}{\varepsilon(E_\gamma).I_\gamma(E_\gamma).W.t} \qquad (3)$$

Where (σ_b) is the standard deviation of the radiation background ,(t) is the measurement time of the radiation background , $\varepsilon(E_\gamma)$ is the efficiency of the detection system , $I_\gamma(E_\gamma)$ is the abundance of the element under measurement and (W) is the weight of the sample measured in Kg . The (MDA) was calculated in the current study using eq. (3) as shown in table 2.

Table 2: Minimum detection activity (MDA) of measurement system used to determine the radioactivity concentrations of targeted Elements in samples.

Nuclide	$E_\gamma(KeV)$	$I_\gamma\%$	$\varepsilon(E_\gamma)$	*MDA* (Bq/Kg)
$^{226}_{88}Ra(^{214}_{83}Bi)$	609.3	46	0.071895	1.9041
$^{40}_{19}K(Natural)$	1460.8	10.6	0.017991	12.1073
$^{232}_{90}Th(^{208}_{81}Tl)$	2614.5	99	0.007159	2.8622

Radioactivity Concentration

The concentration of the specific radiation activity can be defined as the activity of each unit of mass of the radioactive material, it can be measured in Curies per gram or Bq/Kg. The activity concentration (A) for each radioactive element in (Bq/kg) can be calculated using the following Eq. [8]:

$$A(Bq/Kg) = \frac{N}{t.I_\gamma(E_\gamma).\varepsilon(E_\gamma).m} \pm \frac{\sqrt{N}}{t.I_\gamma(E_\gamma).\varepsilon(E_\gamma).m} \qquad (4)$$

Where ($\frac{\sqrt{N}}{t.I_\gamma(E_\gamma).\varepsilon(E_\gamma).m}$) It represents the error rate, (N) is the net area under the gamma-ray peak measured for the spectrum after subtraction of the radiation background in (Bq/Kg), (t) is the measurement time in (sec), $I_\gamma(E_\gamma)$ is the intensity of the measured gamma ray energy E_γ (KeV), $\varepsilon(E_\gamma)$ is the efficiency of gamma ray energy line in (KeV) and (m) is the weight of the sample in (Kg). The figure 3 shows the energy spectrum which obtained through measuring process of sample (TU4), which been used later to obtain peak energies and to calculate radioactivity concentrations of radium, thorium and radium .

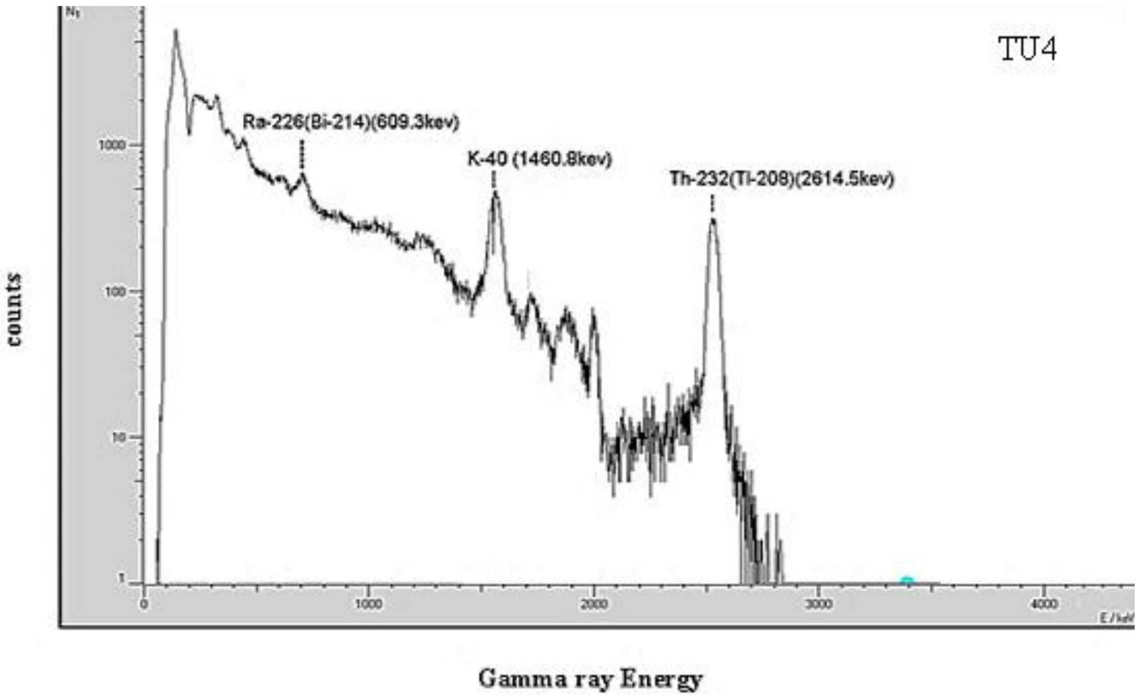

Fig.3: *Energy spectrum of Sample (TU4).*

Radium Equivalent Activity $(Ra_{eq.})$

The equivalent concentration value of the radium element $(Ra_{eq.})$ which is used to estimate the hazards associated with substances containing radium (^{226}Ra), thorium (^{232}Th) and potassium (^{40}K) radionuclides, the calculated $(Ra_{eq.})$ should be less than the allowable concentration of (370) Bq/kg for radium (^{226}Ra), which produces the same dose of gamma rays. The equivalent radium efficiency $(Ra_{eq.})$ can be calculated using the following Eq. [9]:

$$Ra_{eq.}(Bq/kg) = A_{Ra} + 1.43\ A_{Th} + 0.077\ A_K \qquad (5)$$

Where A_{Ra} , A_{Th} and A_K are radioactivity concentrations of ^{226}Ra, ^{232}Th and ^{40}K respectively, measured in Bq/Kg.

External (H_{ex}) **and Internal** (H_{in}) **Hazard Indexes**

External risk factor is used to determine the external hazard caused by gamma radiation, it estimates the expected gamma dose which someone can be exposed to through external direct contact with materials contain gamma radiation. The internal risk factor determines the dose limits received by individuals in working environment containing normal radiation activity, which can be obtained internally by swallowing or inhaling.

Both of external (H_{ex}) and Internal (H_{in}) hazard indexes can be calculated using the following Eqs [10,11]:

$$H_{ex} = \frac{A_{Ra}}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \le 1 \qquad (6)$$

$$H_{in} = \frac{A_{Ra}}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \le 1 \qquad (7)$$

Where A_{Ra}, A_{Th} and A_K are radioactivity concentrations of ^{226}Ra, ^{232}Th and ^{40}K respectively, measured by Bq/Kg.

Absorbed gamma ray dose (D_γ)

The absorbed dose is the absorbed energy in the mass unit of the body exposed to radiation. This term is used for all types of radiation, energies, and all objects and materials. The rates of the absorbed doses due to gamma ray radiation of a naturally occurring radionuclide (^{226}Ra ، ^{232}Th , ^{40}K) calculated based on the recommendations of International Commission on Radiological Protection (ICRP) , using the following Eq. [12]:

$$D_\gamma = 0.462A_{Ra} + 0.604A_{Th} + 0.0417A_K \qquad (8)$$

The conversion factors used to calculate the absorption rate of gamma rays for each radioactivity concentration of (1Bq/Kg) are compatible with radium(^{226}Ra) (0.462) nGy/h, (0.604) nGy/h for thorium (^{232}Th) and (0.0417) nGy/h for potassium (^{40}K).

Gamma Representative level Index (I_γ)

This factor can be used to assess the level of gamma radiation risk associated with natural radioactive materials in the measured samples, the factor that representing the Organisation for Economic Co-operation and Development (OECD) index can be calculated from the following Eq. derived by the (OECD) [13]:

$$I_\gamma = \frac{A_{Ra}}{150} + \frac{A_{Th}}{100} + \frac{A_K}{1500} \qquad (9)$$

Where A_{Ra}, A_{Th} and A_K are radioactivity concentrations of ^{226}Ra,^{232}Th and ^{40}K respectively, measured by Bq/Kg.

The Annual Effective Dose (AED)

In order to calculate the effective annual dose (AED), the conversion factor of the absorbed dose (AD) to the effective dose must be considered, to calculate the effective dose, UNSEAR2000 has been depended to select the conversion coefficient, which is (0.7) Sv/Gy as a conversion factor from the (AD) in air to the (AED) received by adults [13]. The calculations considered that (80%) of the person life time spent in buildings and (20%) of time spent outdoors. From these data, the annual effective dose was calculated as follows [14]:

$$AED_{in}\,(mSv/y) = D_\gamma(nGy/h) \times 10^{-6} \times 8760h/y \times 0.8 \times 0.7\,Sv/G \qquad (10)$$

$$AED_{out}(mSv/y) = D_\gamma(nGy/h) \times 10^{-6} \times 8760h/y \times 0.2 \times 0.7\,Sv/G \qquad (11)$$

Where the number (8760) is the number of hours per year.

Results and Discussion

The specific radiative activity concentrations were calculated of natural radioactive elements for each thorium (^{232}Th), radium (^{226}Ra) and potassium (^{40}K) by using the Eq.(4), for building materials samples collected from Tall Al Ubaid Archaeologist site. Results are presented in the table 3, the results showed that the concentrations of (^{232}Th, ^{226}Ra and ^{40}K) are ranged between (15.17 - 21.47) Bq/kg with an average of (18.20) Bq/kg , (11.04 -

20.92) Bq/ kg with an average of (16.25) Bq/kg and (192.75-291.45) Bq/kg with an average (231.93) Bq/kg respectively.

It can be noticed that the levels of concentrations of specific radioactivity of the natural radioactive elements of each thorium (^{232}Th), radium(^{226}Ra) and potassium (^{40}K) in the measured samples were in the allowable limits which recommended by the specialized international organizations and authorities.

Table 3 also showed that the value of the equivalent concentration of radium($Ra_{eq.}$) for all samples, which ranged between (49.60-71.78) Bq/kg with an average of (60.13) Bq/kg, which is calculated from the Eq. (5), where these Eq. depend on the concentration of (370) Bq/kg of Radium (^{226}Ra) which gives the same radiation dose of gamma radiation, which is also represent the highest permissible limit for the equivalent activity concentrations. The calculated equivalent concentrations are within allowable range, which is recommended by ICRP and UNSCEAR.

It can be stated that the lowest value of the equivalent concentration of ($Ra_{eq.}$) is (49.60) Bq/Kg that recorded for (TU10) sample. The highest value is (71.78 Bq/Kg) which was detected from (TU3) sample. Figure 4 shows the values of radiative activity concentrations for each (^{232}Th, ^{226}Ra , ^{40}K) and the equivalent concentration of radium ($Ra_{eq.}$) .

Table 3: Natural radioactivity concentrations values of (^{232}Th, ^{226}Ra , ^{40}K) and ($Ra_{eq.}$) for samples of building materials collected from Tall Al Ubaid Archaeologist site.

Sample ID	^{232}Th (Bq/Kg)± *Err*	^{226}Ra (Bq/Kg)± *Err*	^{40}K (Bq/Kg)± *Err*	$Ra_{eq.}$ (Bq/Kg)
TU 1	18.12 ± 0.30	18.20 ± 0.14	265.74 ± 2.20	64.58
TU 2	15.17 ± 0.27	13.89 ± 0.12	198.23 ± 1.90	50.84
TU 3	20.69 ± 0.32	19.75 ± 0.14	291.45 ± 2.30	71.78
TU 4	15.59 ± 0.28	17.39 ± 0.14	192.75 ± 1.87	54.52
TU 5	21.37 ± 0.32	16.55 ± 0.13	231.37 ± 2.05	64.93
TU 6	18.61 ± 0.30	11.04 ± 0.11	247.41 ± 2.12	56.70
TU 7	19.28 ± 0.31	20.92 ± 0.15	254.02 ± 2.15	68.05
TU 8	21.47 ± 0.32	18.56 ± 0.14	225.85 ± 2.03	66.65
TU 9	16.02 ± 0.28	15.09 ± 0.13	203.18 ± 1.92	53.64
TU 10	15.67 ± 0.28	11.08 ± 0.11	209.27 ± 1.95	49.60
Average	18.20 ± 0.30	16.25 ± 0.13	231.93 ± 2.05	60.13
Max.	21.47 ± 0.32	20.92 ± 0.15	291.45 ± 2.30	71.78
Min.	15.17 ± 0.27	11.04 ± 0.11	192.75 ± 1.87	49.60
*Wor. ave.[3]	30	35	400	370

*Wor. ave. : World average

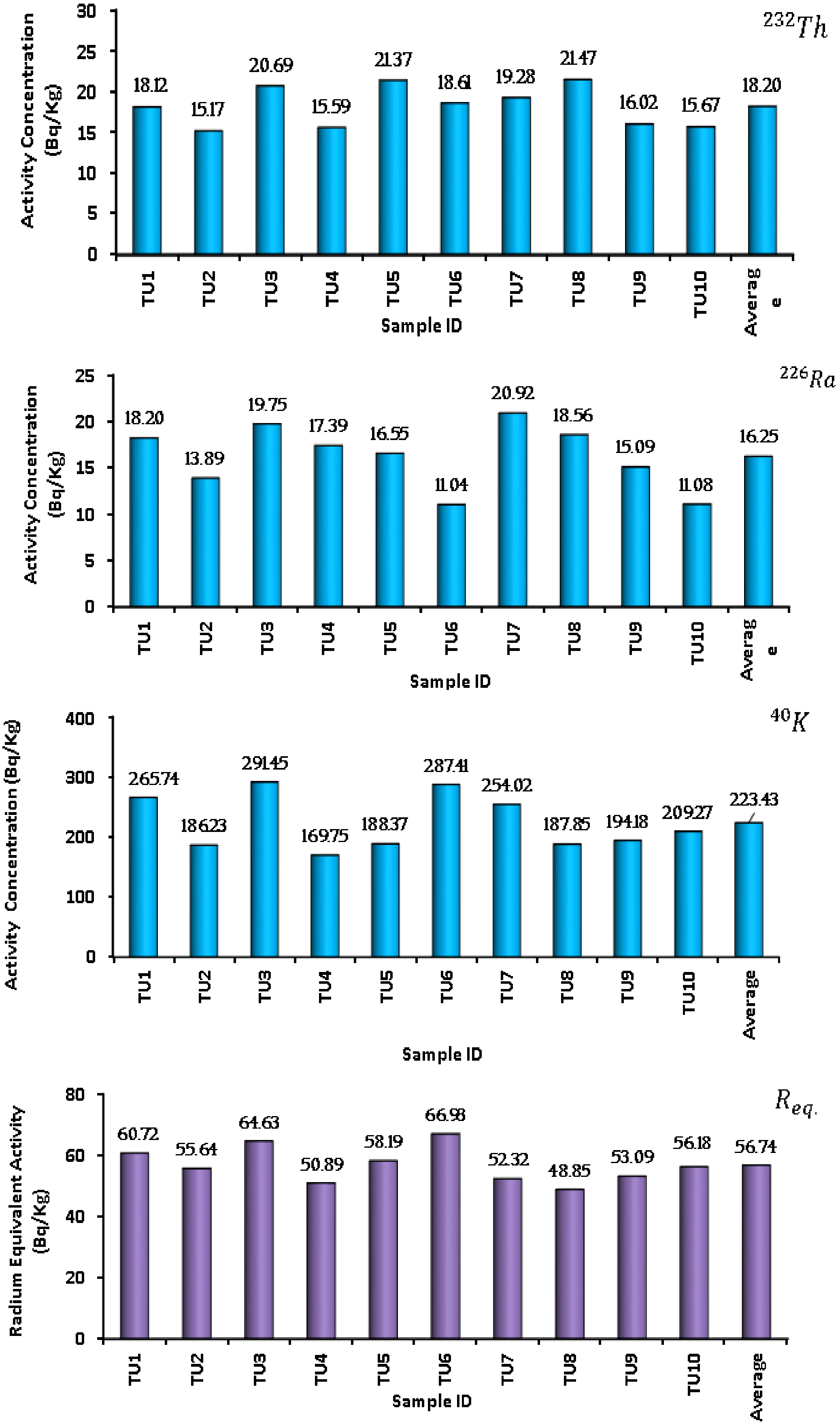

Fig. 4: Radiative activity concentrations for each (^{232}Th, ^{226}Ra , ^{40}K) and the equivalent concentration of radium $Ra_{eq.}$ for all samples**.**

Table 4 includes the results of calculations with regard to the Absorbed gamma ray dose (D_γ), which was calculated using Eq. (8), the obtained value ranged between (23.31-33.78) nGy.h^{-1} with an average of (28.17) nGy.h^{-1}. Figure 5 shows the calculated values of the Absorbed gamma ray dose (D_γ) for all samples . Also, table (4) include the calculated values of the annual effective dose rate for outdoor ($AED_{out.}$) and indoor ($AED_{in.}$) basing on Eq. (10) and (11) respectively. Values for ($AED_{out.}$) ranged between (0.029-0.041) mSv.y^{-1} with an average value of (0.035) mSv.y^{-1}. On the other side, ($AED_{in.}$) values ranged between (0.114-0.166) mSv.y^{-1} with an average (0.138) mSv.y^{-1}. Figure 6 shows values of the annual effective dose rate for outdoor ($AED_{out.}$) and indoor ($AED_{in.}$).

Furthermore, gamma representative level index (I_γ) was calculated using Eq. (9) which is approved by the Organisation for Economic Co-operation and Development (OECD), the obtained value ranged between (0.370–0.533) Bq/kg with an average (0.445) Bq/kg, figure 7 shows the calculated values of the gamma Representative level Index(I_γ). In addition, external (H_{ex}) and internal (H_{in}) hazard index were calculated and ranged between (0.134-0.194) Bq/kg for external (H_{ex}) and (0.164-0.247) Bq/kg internal (H_{in}) with an average of (0.162) Bq/kg and (0.206) Bq/kg respectively. Figure 8 shows the comparison of external (H_{ex}) and internal (H_{in}) hazard index values.

Table 4: The Absorbed gamma ray dose (D_γ), the annual effective dose (AED) outdoor ($AED_{out.}$) and indoor ($AED_{in.}$) , gamma representative level index (I_γ) and the external (H_{ex}) and internal(H_{in}) hazard index for the building materials samples.

Sample ID	D_γ ($nGy.h^{-1}$)	AED ($mSv.y^{-1}$)		I_γ (Bq/Kg)	H_{ex} (Bq/Kg)	H_{in} (Bq/Kg)
		AED_{out}	AED_{in}			
TU 1	30.44	0.037	0.149	0.480	0.174	0.224
TU 2	23.85	0.029	0.117	0.376	0.137	0.175
TU 3	33.78	0.041	0.166	0.533	0.194	0.247
TU 4	25.48	0.031	0.125	0.400	0.147	0.194
TU 5	30.20	0.037	0.148	0.478	0.175	0.220
TU 6	26.66	0.033	0.131	0.425	0.153	0.183
TU 7	31.90	0.039	0.157	0.502	0.184	0.240
TU 8	30.96	0.038	0.152	0.489	0.180	0.230
TU 9	25.12	0.031	0.123	0.396	0.145	0.186
TU 10	23.31	0.029	0.114	0.370	0.134	0.164
Average	28.17	0.035	0.138	0.445	0.162	0.206
Max.	33.78	0.041	0.166	0.533	0.194	0.247
Min.	23.31	0.029	0.114	0.370	0.134	0.164
Wor. ave.[3]	55	≤1	≤1	≤1	≤1	≤1

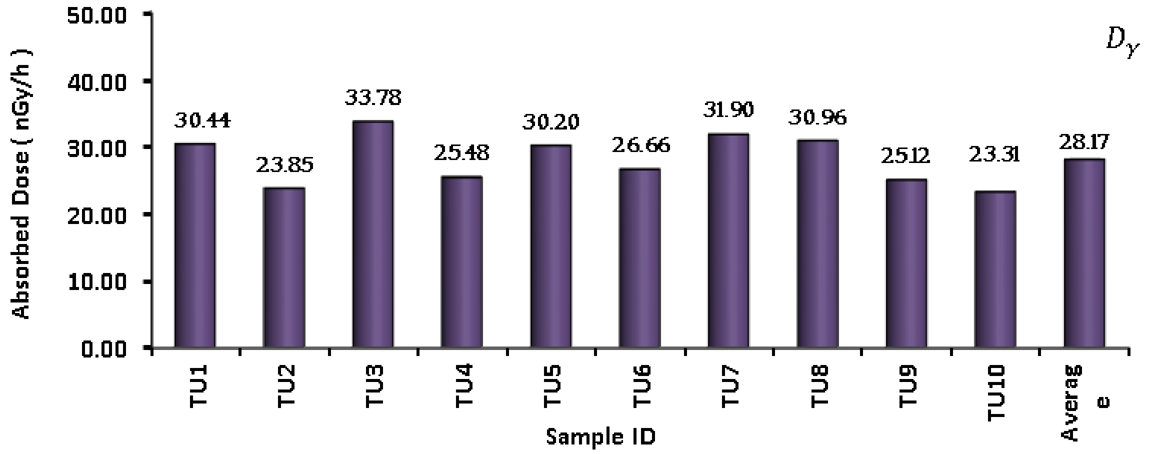

Fig. 5: Show values of Absorbed gamma ray dose (D_γ) for all samples.

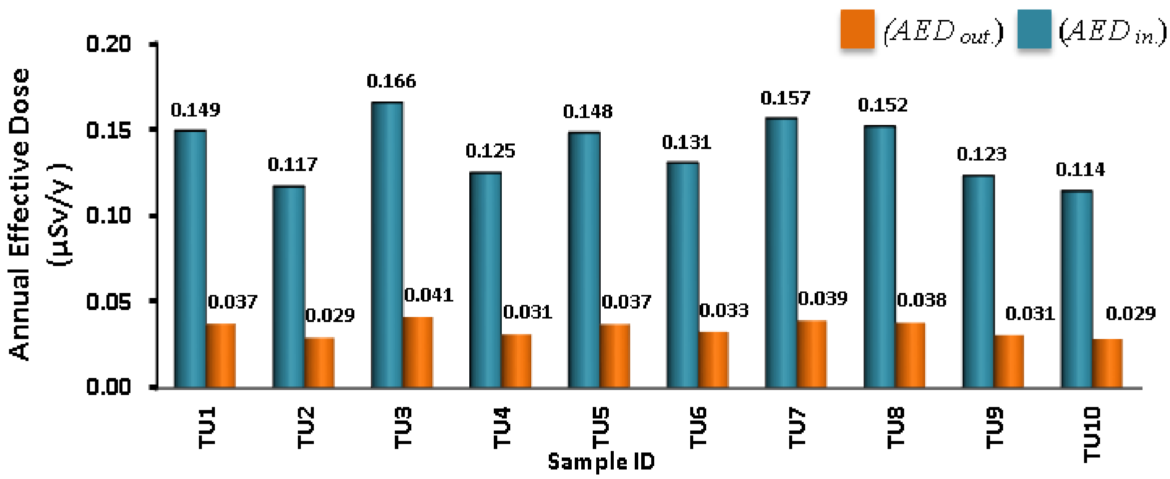

Fig. 6: Show values of the Annual Effective Dose for outdoor (AED $_{out.}$) and indoor (AE$_{Din.}$) for all samples.

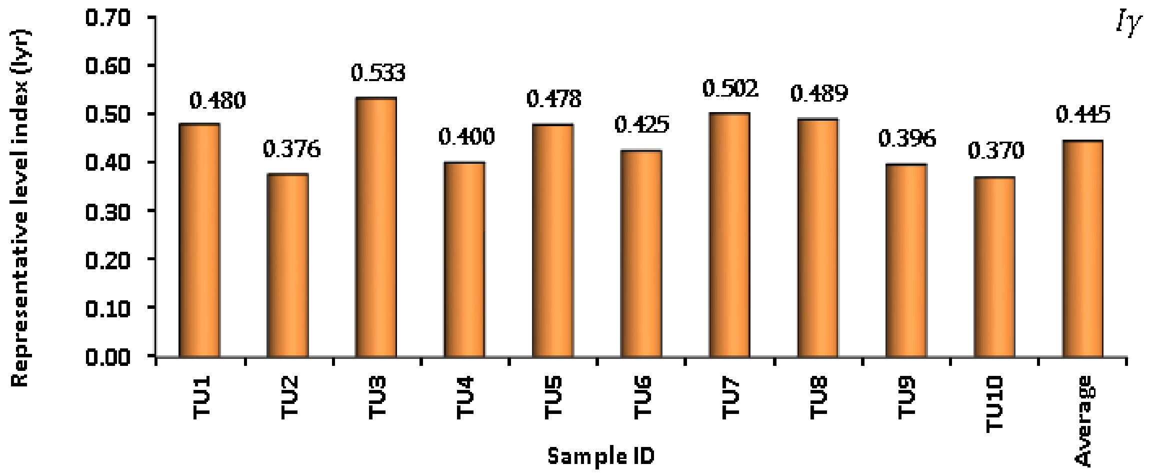

Fig. 7: Show values of gamma representative level index (I_γ) for all samples

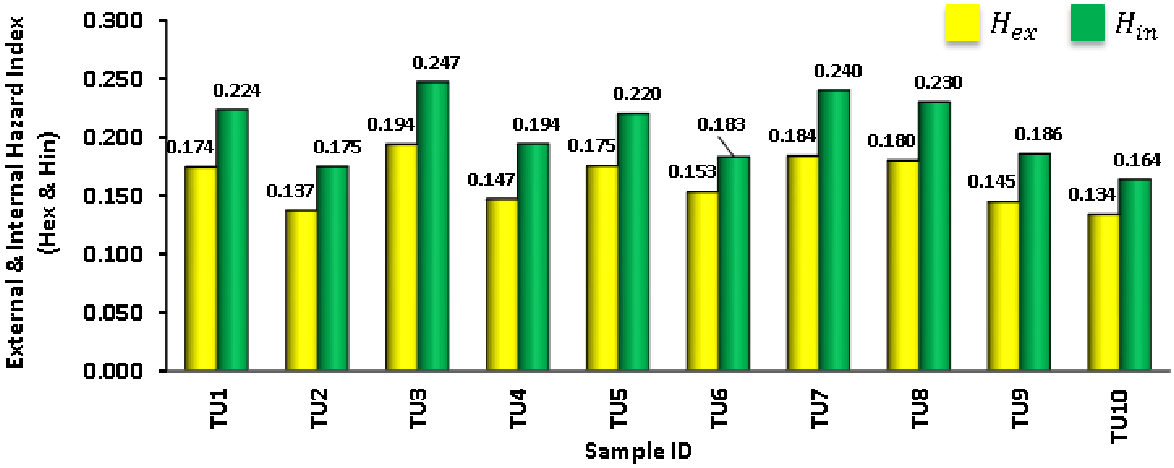

Fig. 8: Show values of hazard indices (external (H_{ex}) and interna l (H_{in})) for all samples

Conclusion

The current study is performed by using spectral analysis technique of gamma ray using the sodium iodide activated by thallium (NaI (Tl)) with dimensions of (3'' × 3'') to analyze the levels of the natural radioactivity in some building materials which been collected from ancient Sumerian sites. The study showed the radiation levels in the selected samples were included in the allowable levels, the highest detected radiation levels for Potassium(^{40}K) in (TU3) sample was (291.45 ± 2.3) Bq/kg. For radium (^{226}Ra) and thorium (^{232}Th), the highest detected levels of radiation were (20.92 ± 0.15) Bq/kg in (TU7) sample and (21.47 ± 0.32) Bq/kg in (LC9) sample respectively.

The equivalent radiation activity value of radium is in the allowable range, where the highest reading of radium equivalent concentration ($R_{eq.}$) was (71.78) Bq/Kg, which is less than the maximum limit (370) Bq/ Kg. Also, the maximum recorded absorbed dose is (33.78) nG.h^{-1} which falls in the safe range. For the Outdoor (AED_{out}) and Indoor (AED_{in}) Annual Effective Dose, the readings are (0.041) mSv.y^{-1} and (0.166) mSv.y^{-1} respectively, the obtained values are in the allowable range.

For gamma representative level index (I_γ) which is used to evaluate the risk that could be caused by gamma radiations, was obtained with a value less than unit, which is (0.582 Bq/Kg). For the External(H_{ex}) and internal (H_{in}) risk coefficients, the values were (0.219) Bq/Kg and (0.582) Bq/Kg respectively, both were in the safe range. There is a variation in radiation values due to the geological nature of the soil used as a base in building materials, in spite all the detected radiation levels are in the allowable range. It is noticed that the studied archaeological site can be classified as an area with a varied nature with regard to radiation due to variation in the radiation that in some samples were high and where others are low, but both were below the allowable limits.

The specific radioactivity concentration for natural radioactive elements including radium (^{226}Ra), thorium (^{232}Th) and potassium (^{40}K) are acceptable in compare with results obtained globally, and all radiation levels are included in safety range basing on recommendations of specialized international organizations. Also, the studied archaeological site can be considered as a safe with regard to radiation for workers, explorers, researchers, and tourists. It can be stated that spectral analysis technique of gamma ray using the sodium iodide activated by thallium (NaI (Tl)) with dimensions of (3'' × 3'') is efficient in measuring radiation levels in building materials, the current study didn't neglect any detected values for individual's safety purposes.

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تقييم النشاط الإشعاعي الطبيعي لعينات من مواد البناء المستخدمة في تل العبيد الاثري في محافظة ذي قار - العراق

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البحث مستل من رسالة الباحث الأول

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الكلمات المفتاحية:

مطياف أشعة جاما، النشاط الإشعاعي الطبيعي، مواد البناء، كاشف Na (Tl) .

الخلاصة:

شملت الدراسة قياس مستويات تراكيز النويدات المشعة الطبيعية لكل من الراديوم $^{226}_{88}Ra$، الثوريوم $^{232}_{90}Th$ والبوتاسيوم $^{40}_{19}K$ في مواد البناء المستخدمة في تل العبيد الاثري في محافظة ذي قار، العراق. استخدمت منظومة مطيافية أشعة كاما ممثلة بكاشف أيوديد الصوديوم المنشط بالثاليوم NaI (Tl) بأبعاد "3×"3 عالية الكفاءة وجرت القياسات في مختبر وحدة ابحاث التلوث الاشعاعي والبيئي في قسم الفيزياء، كلية العلوم، جامعة ذي قار. النتائج التي تم الحصول عليها للنويدات المشعة ($^{232}_{90}Th$، $^{226}_{88}Ra$ و $^{40}_{19}K$) في عينات مواد البناء تم تحليلها وجدولتها بالمقارنة مع المعدل العالمي والحدود المسموح بها كما أوصى بها من قبل وكالات علمية دولية. وكان معدل قيم تراكيز الفعالية الاشعاعية النوعية للعناصر المشعة الطبيعية والنشاط المكافئ للراديوم ($^{226}Ra_{eq}$) لعينات مواد البناء هي Bq/Kg $(15.17 - 21.47$، $11.04 - 20.92$ و $291.45 - 192.75)$ و $(49.60 - 71.78)Bq/Kg$ على التوالي. كما تم حساب معدل الجرعة الممتصة بوحدة (nGy/h) والجرعة الفعالة السنوية بوحدة (mSv/y) ومعامل كاما التقديري بوحدة (Bq/Kg) وكانت كل القيم هي أقل من الحدود المسموح بها. كذلك كل قيم مؤشر الخطر (الداخلي والخارجي) بوحدة (Bq/Kg) كانت أقل من واحد. ان جميع النتائج تشير إلى أن جميع تراكيز العناصر المشعة المستهدفة في الدراسة كانت ضمن الحدود المسموحة رغم التباين في قيم تراكيز هذه العناصر حسب العينات.