A study of environmental for sensing and detection with the radiation pollutants in limited depths from the soil at elected regions in Salah Al-din Governorate by using CR-39 detector

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Abstract:-
This study detected about the existence of depleted uranium in soils samples taken from limited depths to various regions in Salah Al-din province. The determination of uranium concentration in these samples determined through radioactive Radon (Rn^{222}) gas emanated from the samples. The present investigation carried out by using CR-39 which indicated that these regions are exposed to remarkable DU .

Introduction:-

During the military actions of Gulf wars (1991 and 2003) various weapons were employed including prohibited weapons mainly those include depleted uranium (DU). As a result the human and environment were exposed to severe damages which in turn created various types of pollution, this matter induced many researchers to study its reflections intensively. [1- 5].

In investigating radon and DU levels in dwellings, scientists (Al-Kofahi et al., 1992; Knizhnik et al. 1992; Zikoysky, 1991; Golovchenko, 1991) used active and passive dosimeters with different types of solid state nuclear track detectors (SSNTDs)[6].

The active dosimeter generally records only those alpha-disintegrations caused by the collected radon daughter nuclei on a filter , after forcing certain amount of air to pass through, the passive dosimeter is normally used for long term measurements and it records alpha-particles emitted into the air. Furthermore, the passive CR-39 detectors are found to be the most appropriate for our study because they are more sensitive to alpha-particles. They can detect alpha-particles with energies form 0.1 MeV to 20 MeV [7].

Labbate N et al studied showed that the indoor radon pollution in houses in the Apulian region in Italy, is a significant problem as it is one of the main causes of lung cancer [8,9]. Hubin and Boice reported a meta-analysis of the case control studies that summarized the current weight of evidence data from eight studies conducted in the United States, Canada, Finland and China, were used these three programs had shown a statistically significant association between radon and DU exposure and lung cancer. [9]. The importance of the problem of indoor radon for the public was emphasized in September (1980) when the Environmental Protection Agency (EPA) and the centers for disease control jointly recommended that nearly all houses in the United States should be tested for radon.

Studies of miners have shown using lung cancer risk as cumulative exposure to radon decay products increases [9]. Since along period, plastic track detectors have been used for the measurement of indoor radon, using (CR - 39) alpha sensitive solid state nuclear track detectors, which have proved to be a very economical and reliable method [6][10-12].

Calculation of radon concentrations.

In order to measure the radon concentration with CR-39 technique, it is necessary to determine the rate of tracks density (D) to the following equation: -[13,14]

$$D = \rho / T = K.C \quad \ldots\ldots\ldots(1)$$

Where : D: track density (tr/cm^2).

(tr/cm^2). the range of track : ρ

T: irradiation time in seconds.

K: diffusion constant.

C:the radon concentration (Bq/cm^3).

But for the daughters Po^{214}, Po^{218} (α- particles emitters) which deposit on the walls of irradiation chamber we employ the equation :-[15]

$$D_{Po^{218}} = D_{Po^{214}} = \frac{C}{4} r[\frac{h}{r+h}]Cos\theta_c \quad \ldots\ldots\ldots(2)$$

From R_α according to the equation :- [15]

$$R_\alpha = (0.005E_\alpha + 0.285)E_\alpha^{3/2} \quad \ldots\ldots\ldots(3)$$

Where E_α : Alpha partical energy in MeV .

R_α : The Alpha partical range in the air and equal to(4.15)cm.

The radon concentration in sample can be determined by using the equation :- [15]

$$C_s = \lambda_{Rn} C_a ht / L \quad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where C_s: radon concentration (Bq / m^3) in the samples.

C_a: radon concentration (Bq / m^3) in the air room .

λ_{Rn} : decay constant of Radon (0.1814 / day).

h: height of air room (9.5 cm).

L: the sample Thickness (1.5).

t: irradiation time (60 day approximately).

The irradiancy activity (A) of radon produced from the used samples in (Bq) units can be determined by the relation:- [15]

$$A_{Rn} = C_s.V \quad \ldots\ldots\ldots\ldots(5)$$

$$V = \pi r^2 L \quad \ldots\ldots\ldots\ldots(6)$$

Where V: the sample volume in (m^3) unite.

r : the radius of irradiation chamber (1.19cm).

Uranium concentration calculation

To determine the uranium concentration, the number of uranium atoms must be evaluated by applying the ideal radiation equilibrium . The number of Uranium atoms in the sample is given by: [15]

$$\lambda_U . N_U = \lambda_{Rn} . N_{Rn} = A_{Rn} \quad \ldots\ldots(7)$$

N_{Rn}: the number of radon atoms.

Where λ_U : decay constant of DU ($4.9 \times 10^{-18} \sec^{-1}$). Thus to find DU concentration in the samples (ppm) we use the relation: [15]

$$C_U\,(ppm) = \frac{W_U}{W_s} \quad \ldots..(8)$$

Where W_s: sample weight.

W_u: uranium weight.

Field Work

1- Soil Sampling:-

In the current study, four locations in Salah Aldin province had been chosen in which several military actions happen and bombed with depleted uranium projectiles in 2003. These locations are: post office in Beiji, post office in Hammad Shihab village (15km north Tikrit) Al-Qadasia village in Samarh and Almmah Zone which includes the storages of post.

The samples are collected from various areas at depth 20 ↔ 25 cm , then these samples are grinded and cleaned to be homogenous samples.

2- Irradiation process

Here we are using CR-39 detector, for a long term measurement and track recording of α- particles produced from decay of uranium and the release of radon gas from the samples .The CR-39 detector is a sliced has 275 μm thickness into equal areas of ($1cm^2$), then exposed to the soil samples with value 5 gram for each samples; which detained (the samples) in radiation chamber that consisted of a cylindrical test tube named diffusion chamber of diameter 2.38 cm. as show in fig.1:

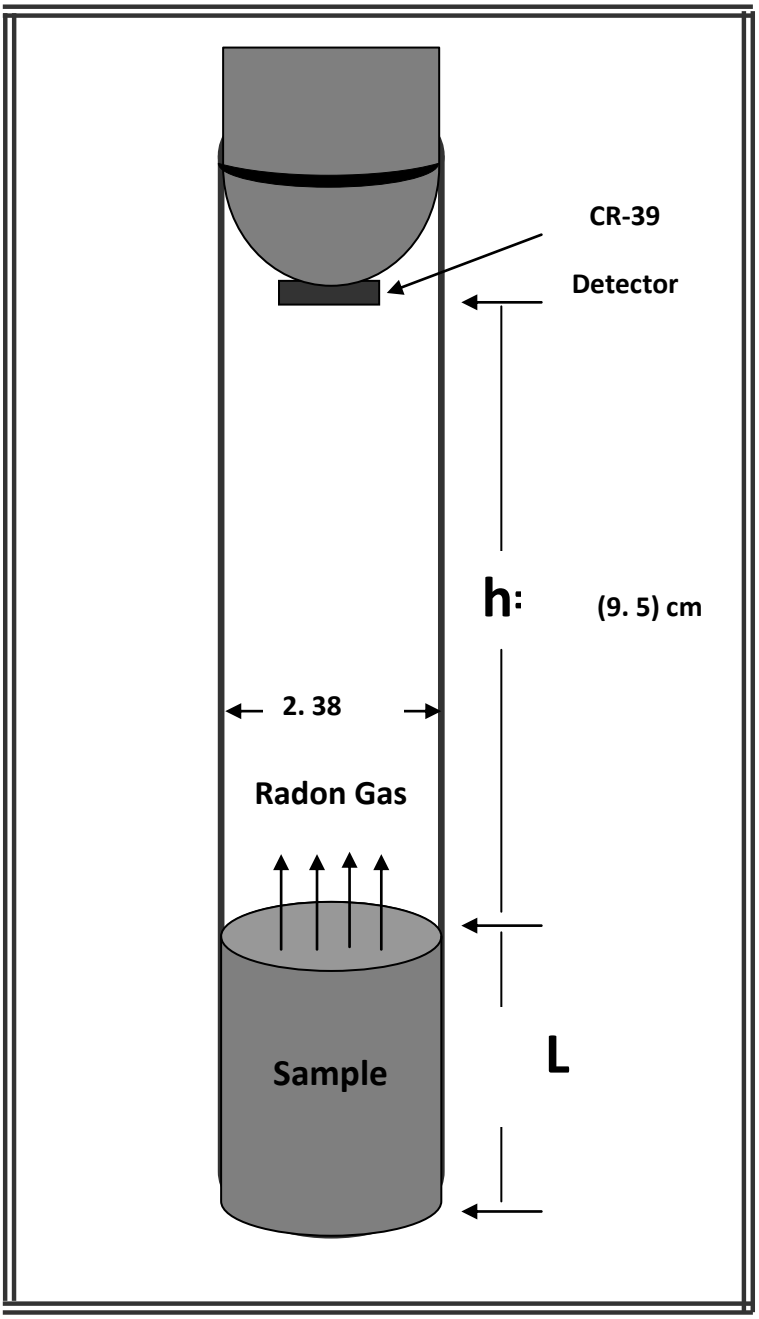

Fig.1: illustrates the circulation compartment .

These chambers locked with rubber stopcock , in the same time the distance from the sample bottom and selector surface is kept constant about (9.5 cm) [15]. All samples are leaved for 22 days in order to reach state of equilibrium of 98% between Radium and its daughters of other Radon isotopes; after 22 days over, the stopcock removed quickly and replaced with a new one connected with CR-39 in its bottom strictly, so as not any exchange of radon gas with its surroundings occurs. While the sample- detector distance is still 9.5cm. after that the detector was placed inside the chamber for about 60 days (exposure time) then the detector was removed to begin the etching process by using NaOH (purity 98% at 71°C) for 4 hours to observe the tracks. The following step is to dry the sliced detectors after washing them with distilled water.

Next, the tracks that result from α- particles incident on the interface in front of the sample used are concentrated. In addition to that, the background radiation of the detector measured which is positioned in empty test tube and closed strictly for 60 days , the background radiation was 217 tracks / cm^2. The values are subtracted from all the measured data in order to obtain the actual track density that results from α- particles of the samples. These tracks are observed by using optical microscopic Olympus 4oox.

Results and discussion:

Through the results which are show in table (1) the obtained damaged region and the values cache from tracks density of Alfa particles and the radon gas concentration in the samples and the air space, in addition the DU concentrations for the tracks density , the table shows larger value of (730) track / cm^2 at Hammad Shihab region and a small value was found in Balad (Almmah region).

For the concentrations of radon in the air space at the test tube are appear from (350.25) $Bq.m^3$ at Tikrit region as a large value and lower value it equals to (259.09) $Bq.m^3$ at Almmah region.

So much for that concentrations of the radon, the samples were between (24.14)x 10^3 $Bq.m^3$ in Tikrit region sample as a large value and lower value in Almmah region sample it equals to (17.86)x 10^3 $Bq.m^3$.

However there are noticeable DU concentration about (2.598) ppm as a large value in Tikrit region and lower value in Almmah region (1.920)ppm. In this case seen as increase of DU concentration in Tikrit region above of the natural level which had been measure for the back ground that had been measure in the lab and above of the value which had been take from the sample of the quarry of cement in Badoosh and Sinjar in Al-mousl town which is between (0.2 – 1.2)ppm [16]. From all the past peach we are clarify the volume of the environmental injury which the Iraqi environmental is suffer from it. At that the DU concentration arrived in Iraq south between four to nine twice above the natural level [17,18] and which had been refer to the bombardment which happened over there. And as refer to the quality and momentousness of the munition which were used in that interim. As shown in table (1) DU concentration at Albehji location was lower in comparison with its concentration in Tikrit location whereas A.M. Obaid [2] fond (in case superficiality layer) that the results are turned .

Table (1): the casualty regions , the tracks density, radon concentration in the samples and the air space and DU concentration

Region name	Tracks density Track/cm^2	Radon concen. in the air space (Bq/m^3	Radon concen. in the samples ($Bq.m^{-3}$ $x10^3$	DU concen. (ppm)
Behji town/Al-bahdala	٧٢٠	٣٤٥,٤٦	٢٣,٨١	٠,٠٩٤ ± ٢,٥٤٩
Balad town/Almmah region	٥٤٠	٢٥٩,٠٩	١٧,٨٦	± 0.082 ١,٩٢٠
Tikrit town/Hammad Shihab region/Albahdala	٧٣٠	٣٥٠,٢٥	٢٤,١٤	٠,٠٩٦ ٢,٥٩٨ ±
Samara town/Alqahdisia region	٦٧٠	٣٢١,٤٧	٢٢,١٦	± ٠,٠٩١ ٢,٣٧٢
Back ground	٢١٧	١٠٤	٧,٢	٠,٧٧٥ ± ٠,٠٥

The conclusion:

After appearance the clear results in the earlier table (1) therefore become clear the volume o harm which happen to this regions. consequently we can infer the following :

1-the DU concentration rates from Almmah region in Balad town was (1.920)ppm and it increases to arrives to the value (2.598) ppm in Tikrit town (Hammadi Shihap exactly).

This increase is an altitude double to more of two doubles above the back ground and the natural level that is accomplish [0.2-1.2]ppm, and that refer to being a pollution in the environment has been study.

2-Throw the comparison between DU concentration in up on and lower the surface and to more than region we are deduce that is not find any relation between an altitude and decrease the DU concentration level with the depth difference in case different of regions .

3-Its possible to find out the Uranium concentration according to the test tube technique in the samples directly by placing the detector in touch with sample (when h=o cm).

4-The tube technique can be employed to determine the Radon content in soil (even when h= 0cm)

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دراسة بيئية للتحسس والكشف عن التلوث الاشعاعي في أعماق محددة من التربة و لمناطق مختارة من محافظة صلاح الدين بإستخدام الكاشفCR-39

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الملخص

كانت هذه الدراسة حول الكشف والتحسس بوجود اليورانيوم المنضب في نماذج من التربة التي أخذت من أعماق محددة ولمناطق متنوعة من محافظة صلاح الدين. أما عن حساب تراكيز اليورانيوم في هذه النماذج فقد إستُخرجت من نشاط غاز الرادون (Rn^{222}) المنبعث منها. هذا البحث قد أُنجز بإستخدام الكاشف CR-39 الذي أشار بأن هذه المناطق إحتوت على تراكيز من اليورانيم منضب فوق الحد الطبيعي .