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Measurement of Soil –Radon Gas in Al-Mahaweel Areas of Iraq using Nuclear Track Detector CR-39

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ABSTRACT

The health hazards of the radioactive gas radon on overall public are well know . In order to understand the level and distribution of ^{222}Rn concentrations in soil-gas in Al-Mahaweel areas, we have measured the radon gas concentration in soil samples of different areas in Al-Mahaweel areas (AL-Mahaweel Center , Al-Imam district , Al-Mashroua district , Al-Nile district)via using alpha-emitters registrations which are emitted since radon gas in nuclear track detector (CR-39). The obtained results have shown that the highest average radon gas concentration in soil sample was found in Al-Mahaweel (Al-camp district)samples ,which was (75.957±0.005Bq/m^3) ,while the lowest average radon gas concentration in soil samples was found in Al-Imam district (ferry district) sample , which was (15.991±0.002Bq/m^3).The present marks shown that radon gas concentration in all soil samples is under the acceptable limit from (International Commission of Radioactivity Protection)(ICRP) agency.

Key words : Radon , Soil Samples , Al-Mahaweel , Nuclear Track Detector CR-39.

1.INTRODUCTION

Radon is a naturally occurring odorless , colorless , tasteless , inert gas which is imperceptible to our sense . It is produced continuously from the decay of naturally occurring radionuclide such as ^{238}U, ^{235}U, ^{232}Th. The isotope ^{222}Rn,produced from the decay of ^{238}U,is the main source (approximately 55%)of the internal radiation contact to human life[1,10]. Radon comes from the natural decay of Uranium that is found in near all soils . It typically moves up through the ground to the air above and into homes through cracks and other holes in the foundation[1].Since all structure materials contain different amounts of mainly natural radionuclides of the Uranium (^{238}U)and Thorium(^{232}Th) series, and the active isotope of potassium (^{40}K), those radionuclides are sources of the outside and the inside radiation exposures in dwellings. Radon (half life:3.824d) is active gas formed by the disintegration of ^{226}Ra, which is a deterioration product of ^{238}U.The inhalation of radioactive inert gases radon (^{222}Rn,a daughter product of ^{226}Rn), and heir short-lived products may be deposited on respiratory tract tissues when inhaled. Subsequent alpha decays may damage cells near the deposition site , contributing to an increased risk of lung cancer , and in the same time it helps in the treatment of malignant tumors (medical applications of radon)[2-4]. Consequently, building material is considered to be the second main source of radon in our house after soil . After radon generated from radium deterioration in the solid grains it emanated to pore gases or fluids and then migrate a significant distance form the site of generation in rock , soil or building materials into the atmosphere before undergoing radioactive deterioration in an exhalation process [2,5-6]. The exhalation rate provides a measure of the liberation of radon from inside a sample to outside the sample .Its value depends on emanation and on the concentration gradient between pore and ambient air [2,8] . While the plastic detector CR-39 or LR-115 and Gamma Spectroscopy can used to estimate Radon concentration in soil [7,8]. The aim of the present work is to determine the radon concentration in soil gas at a specific depth within the soil . To do the , CR-39 used to determine alpha emitters form radon gas .

2.MATERIALS AND METHODS OF WORK

2.1 Samples Collection and Preparation

In this study , Soil samples were collected from the study area that included Al-Mahaweel areas (Al-Mahaweel Center , Al-Imam district , Al-Mashroua district , Al-Nile district)deeply (30cm) and the samples were dried at a temperature (50C°) using a thermal oven , and they were sifted to get rid of foreign bodies and a hand grinder , and prepared samples with certain specifications to find radon concentration .

2.2 Irradiation Process

We prepared chips from the nuclear effect detector (CR-39)with an approximate area (1×1cm^2)with samples of soil powder for the study areas and the irradiation time (60days) was the best time period to obtain better results , as shown in the figure 1.

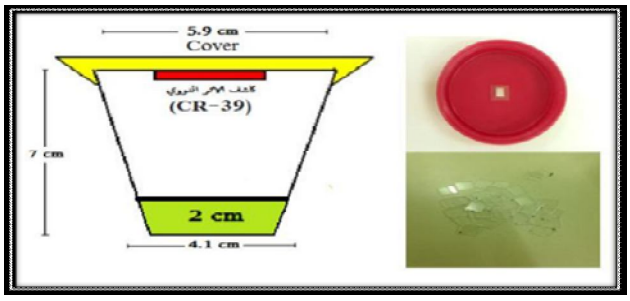

Figure 1: Schematic representation of the plastic container showing the position of the CR-39 detector and the sample tested.

2.3 Chemical Skimming and Microscopic Viewing

Chemical skimming of the reagents was performed after the irradiation stage using sodium hydroxide solution (NaOH) standard (6.25N) and temperature (70C°).The reagent was suspended(CR-39) to be placed inside the skimming solution for five hours and after completion of the skimming period the detecter is taken to wash with distilled water and dried . then is detected on the effects using a light microscope by selecting the appropriate magnification and counting the effects per unit area , then divides the average number of effects ($N_{ave.}$)of the model (X)by the calculated area (A) to get the effects of the effects(ρ_x),figure 2 shownthe effects of fission fragments in the detector nuclear impact CR-39.

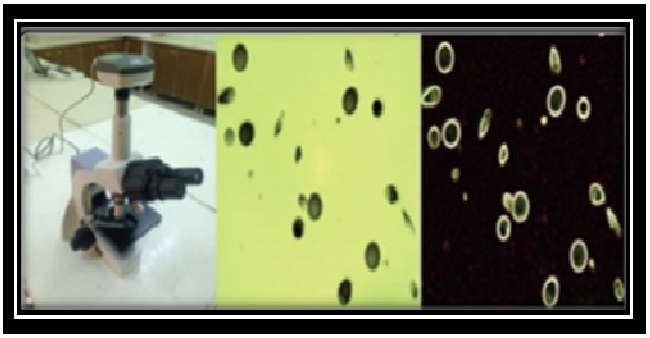

Figure 2 : The effects of alpha particles chemical etching as seen at 400X by optical microscope.

2.4 Blace of Study

Al-Mahaweel is one of the districts of Babil Governorate , as shown on the map , in the north Baghdad Governorate and Wasit Governorate , while the southern boundary ends with the Al-Hashemite district , while the Wasit Governorate is from the east , while the Hilla district and Mussayab district represent the western (32°)and (32° 51')Type equation here. in the north and in Qusi in length(44°19′) and(45°03′) in the east and the Mahaweel district extends over an area of (1667)$Km^2$and the administrative district consists of three areas :(Al-Imam district, Al-Mashroua district, Al-Nile district)[9],as shown in the figure 3.

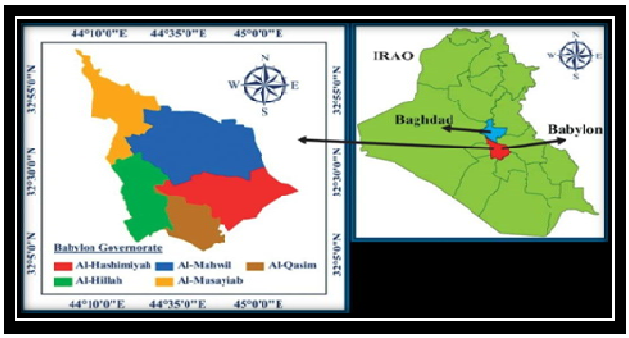

Figure 3 : The map showing the Al-Mahaweel area surveyed during the present investigations.

2.5 Practical Part

The density of the tracks ρ in the detectors was calculated according to the following equation [10].

$$\rho = \frac{N_{average}}{A} \qquad (1)$$

Where , ρ is track density (Track/m^3),N is an average of total tracks (Track)and A is an of a field view (m^2) .Radon concentration (C_{Rn})in Bq/m^3unit are calculated by the following equations [11,12].

$$C_{Rn} = \frac{\rho}{K\,T} \qquad (2)$$

Where , K: is the calibration factor in terms of (track.cm^{-2}/Bq.d.m^{-3})which is the same value as reported in many works [11-14].T is the exposure time (d).

The value for radon activity (A_{Rn})and specific radon activity ($S.A_{Rn}$) can be found based on radon concentrations , volume of container(V)and massof a sample(m) as it follows:[15-17]

$$A_{Rn} = C_{Rn}\mathrm{v} \qquad (3)$$

$$s.A_{Rn} = \frac{C_{Rn}}{m} (4)$$

3.RESULTS AND DISCUSSION

To calculate the average value of radon for sixteen different soil samples taken from different areas of Al-Mahaweel areas (Al-Mahaweel Center , Al-Imam district , Al-Mashroua district , Al-Nile district)as shown in the table1,2 and the extent of the radon gas concentration in these areas and found that the radon sample elected for Al-Mahaweel (Al-camp district)(75.957±0.005Bq/m^3)and density effects rate (125.329±11.195Track.m^2)and specific radon activity rate(198±1.622×10^{-5}Bq/kg),and the concentration of radon to sample the Al-Imam district(ferry district) of focus is the (15.991±0.002Bq/m^3) and the density rate effects (26.385±5.136Tarck . m^2) and specific radon activity rate (0.061±9.001×10^{-5}Bq/kg), as shown in the figure 4,5.

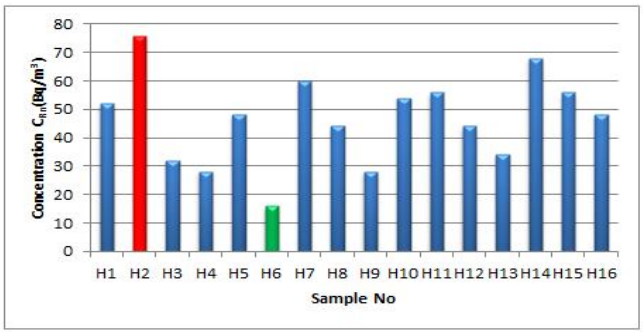

Figure 4 :Radon Concentration in Soil Samples .

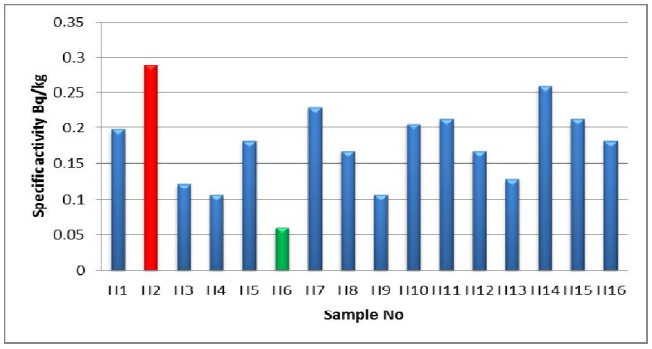

Figure 5 :Specific Radon activity in Soil Samples.

Table 1 :Explain density effects rate**(**ρ(Track /m^2).

Sample code	Area name	(Track /m^2)
H_1	Al-Mahaweel (Al-Jumhuri district)	85.751±9.260
H_2	Al-Mahaweel(Al-camp district)	125.329±11.195
H_3	Al-Mahaweel(Al-Baalwan district)	52.770±7.264
H_4	Al-Mahaweel (coral district)	46.174±6.795
H_5	Al-Imam district (Al-Muftiyah district)	79.155±8.896
H_6	Al-Imam district (ferry district)	26.385±5.136
H_7	Al-Imam district (Abu Tammuz)	98.944±9.947
H_8	Al-Imam district (Al-Prince district)	72.559±8.518
H_9	Al-Mashroua district (Tunis region 1)	46.174±6.795
H_{10}	Al-Mashroua district(Tunis region 2)	89.051±9.260
H_{11}	Al-Mashroua district(Al-Mansouri area 1)	92.348±9.609
H_{12}	Al-Mashroua District (Al-Mansouri area 2)	72.559±8.518
H_{13}	The Nile district (Al-mond district)	56.068±7.487
H_{14}	Al-Nile district (Al-Sayyah district)	112.137±10.589
H_{15}	The Nile district (Al-Prince district)	92.348±9.609
H_{16}	The Nile district (Al-Mortada district)	79.155±8.896

Table 2 :Explain concentration of radonC_{Rn}(Bq/m^3) and specific radon activity rate$S.A_{Rn}$ (Bq/kg) .

Sample code	C_{Rn}(Bq/m^3)	$S.A_{Rn}$ (Bq/kg)
H_1	51.970±0.004	0.198±1.622×10^{-5}
H_2	75.957±0.005	0.290±1.961×10^{-5}
H_3	31.982±0.002	0.122±1.273×10^{-5}
H_4	27.984±0.003	0.106±1.190×10^{-5}
H_5	47.973±0.004	0.183±1.559×10^{-5}
H_6	15.991±0.002	0.061±9.001×10^{-5}
H_7	59.966±0.004	0.229±1.743×10^{-5}
H_8	43.975±0.003	0.168±1.492×10^{-5}
H_9	27.984±0.003	0.106±1.190×10^{-5}
H_{10}	53.969±0.004	0.206±1.653×10^{-5}
H_{11}	55.968±0.004	0.213±1.684×10^{-5}
H_{12}	43.975±0.003	0.168±1.492×10^{-5}
H_{13}	33.980±0.003	0.129±1.312×10^{-5}
H_{14}	67.961±0.004	0.259±1.855×10^{-5}
H_{15}	55.968±0.004	0.213±1.684×10^{-5}
H_{16}	47.973±0.004	0.183±1.559×10^{-5}

4. CONCLUSLON

Form the present work, it can be concluded that the highest average radon gas concentration in soil samples was found in Al-Mahaweel (Al-camp district) samples, which was (75.957±0.002Bq/m^3), while the lowest average radon gas concentration in Al-Imam district (ferry district)soil samples was found in samples, which was (15.991±0.002Bq/m^3).The present results show that the radon concentration in all soil samples , is below the allowed limit from ICRP agency (International Commission of Radiation Protection).

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