Preliminary ^{222}Rn Concentration Study Using CR-39 Detector in Some Houses of Garmat Ali, Basrah Governorate, Iraq

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Abstract: An indoor radon study was carried out in carefully chosen houses in the city of Garmat Ali. The cutting approach evaluated the density of alpha radiation emitted by the gas and its offspring using the CR39 nuclear route detector. In the bedroom and living room of each house, the dosimeters were fixed at head height. The houses with food pantries were also considered for interlinking purposes. Dosimeters were installed in the food pantry, on the first floor, and on the ground level of these houses. Radon was exposed to each dosimeter over the course of three months. Following exposure, CR-39 detectors were etched for 16 hours at 81 degrees Celsius in 4 M NaOH, and the results were counted using an optical microscope. Using a calibration value of K=0.1880±00433 Tr/cm2.d per Bq/m3, the obtained track densities were then linked to radon concentration levels. For Garmat Ali regions one and two, the measured indoor radon concentration levels were found to range from 16 Bqm^{-3} to 30 Bqm-3 and from 24 Bqm^{-3} to 28 Bqm^{-3}, respectively. The radon levels recorded in this investigation are lower than the ICRP limit.

Keyword : Radon gas, CR39, Cement blocks, Food pantry, Track.

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Introduction

Natural radionuclides are present in all raw materials and minerals. Naturally Occurring Radioactive Material (abbreviated "NORM") is a term used to describe elevated levels of human exposure to ionizing radiation caused by naturally occurring radionuclides and/or human activities [1-4]. This phrase is more specifically used to describe any NORM when human actions result in more radiation exposure than would otherwise be the case, such as coal burning, the use of pesticides and fertilizers, and the production of gas and oil. One NORM that can be managed by ventilation is the radon in the air around us [1,5]. When uranium-238 breaks down, it releases radon, a noble radioactive gas that originates from nature. The radon isotope that needs the most attention is ^{222}Rn, which has a rather lengthy half-life of 3.82 days. There has long been knowledge of the harmful effects of mine gases and vapors on human health [6-8]. The International Agency for Research on Cancer has recently determined that radon causes cancer in humans [9]. There are usually very low concentrations of radon in outdoor air. But it can accumulate at higher concentrations indoors when it cannot disperse [10,11]. Radon indoor monitoring has received a great deal of attention in recent decades. 50% to 55% of the typical annual dose from natural background radiation is thought to be caused by only ^{222}Rn [12]. Because ^{222}Rn and its decay products can accumulate to quite high levels, their effects are of concern. High radon sources or concentrations in structures with inadequate ventilation [13,14]. Numerous investigations into the origins and means of transmission of ^{222}Rn have been conducted as a result [11,15]. Radon is assumed to be present everywhere, but its concentration is higher in rocks and soils that are enriched with radium and uranium[16]. In this scientific field, semiconductor nuclear track detectors (SSNTD) have been frequently utilized [8,17-20]. This article has been carried out in the city of Garmat Ali, Basrah, Iraq with measurements of indoor radon concentration levels in the city of Garmat Ali. In this investigation, a method for identifying the nuclear route utilizing a CR39 film was used.

Materials and Methods

The majority of the houses in the study region had two stories. Few of those residences had basements. The homes under study were constructed over a period of at least ten years using concrete, cement blocks, and bricks. Sandalized mortar and cement were used to cover the interior walls of the homes. These homes' foundations were built with a cement and sand combination that was around 2–5 cm thick as the first layer, followed by a 3–4 cm layer of pottery or granite. It is anticipated that these materials will make a significant contribution to indoor radon sources. Every house has a decent amount of front and back yard space. There were variations in both the size of a house and the number of rooms it had from one town to the next and even within a hamlet.

A sectional (Cup mode) dosimeter was installed in 20 detached houses with numerous stores and deferred construction styles. These houses were selected for this investigation from the two mentioned regions, illustrated on the map of Garmat Ali in Basrah governorate as in Figure 1.

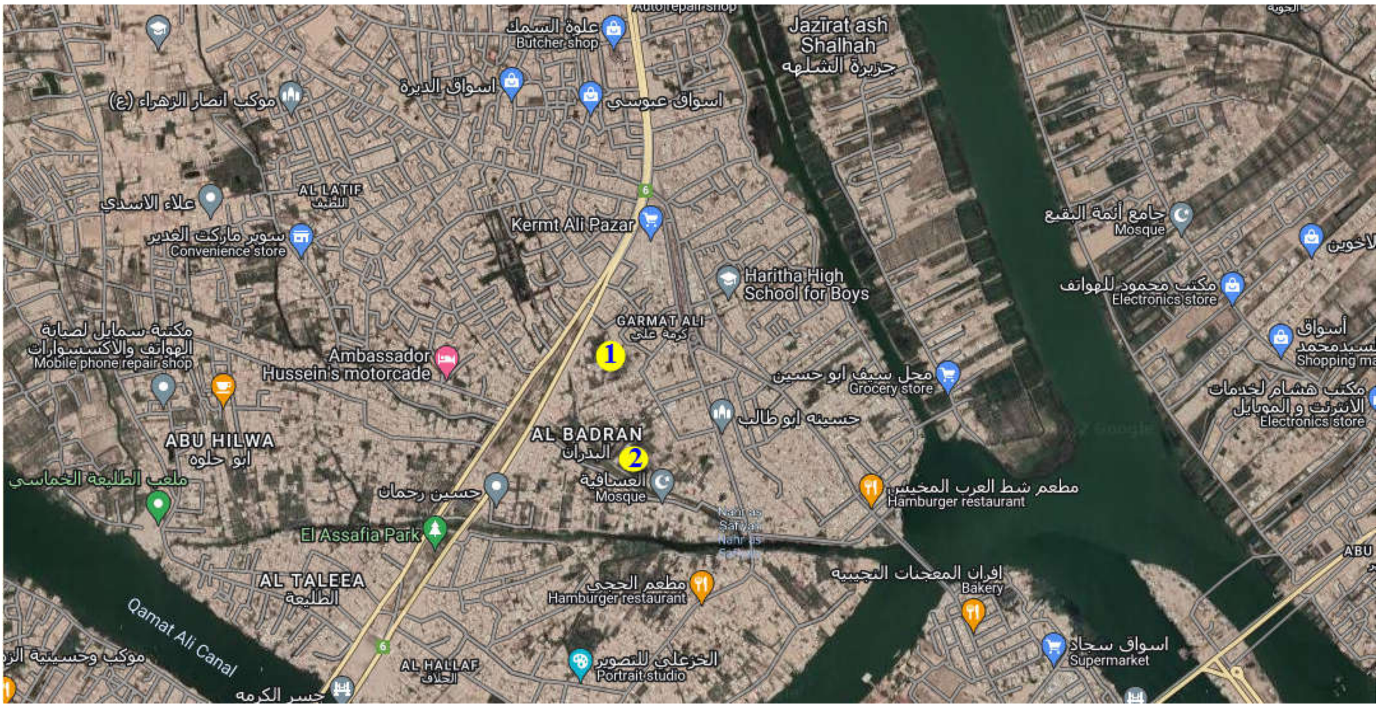

Fig.1. Map of the Garmat Ali city.

Radon levels in homes were measured using solid state nuclear track detectors (CR-39). From Page Mouldings Ltd. UK, standard grade CR-39 detectors with a thickness of 500 µm were acquired. The NRPB radon dosimeter holders were then fitted with little pieces of 1.5 cm 1.5 cm CR-39 that had been cut from large sheets. The holders were listed and given numbers. The detector has the number inscribed on it as well. This dosimeter assembly is designated by the National Radiological Protection Board as a diffusion cup (UK).

For this study, a total of 20 homes were chosen, and 40 dosimeters were placed at head height in living rooms and bedrooms in basements, on the ground floor, and on the first floor. Three months of radon exposure to the detectors was permitted. After being chemically etched for 16 hours in 6 M NaOH at 80 °C, CR-39 detectors were optically counted. By adopting a calibration factor of 2.7 tracks cm^{-2} h^{-1} $(kBqm^{-3})^{-1}$, the measured track densities were correlated to activity in Bqm^{-3} [16].

Results and Discussion

The results for the radon levels in the Garmat Ali regions are shown in Tables 1 and 2. The radon concentration indoors, which is expressed in Bq/m^3, and the track density, which is picked up by a CR-39 detector operating in cup mode. The average track values per unit were calculated using the average track number per unit.

Table 1. Track density and radon concentration in Garmat Ali region 1

House No.	Ground floor living rooms		First floor bed rooms	
	Track density Tr/cm^2	Radon concentration Bq/m^3	Track density Tr/cm^2	Radon concentration Bq/m^3
1	490	23	270	18
2	520	30	215	12
3	383	16	245	17
4	518	23	211	8
5	429	17	130	7
6	422	21	69	5
7	497	24	102	11
8	461	19	312	21
9	511	20	294	20
10	515	27	330	24
Avr.	474	22	217	14

Table 2. Track density and radon concentration in Garmat Ali region 2

House No.	Ground floor living rooms		First floor bed rooms	
	Track density Tr/cm^2	Radon concentration Bq/m^3	Track density Tr/cm^2	Radon concentration Bq/m^3
1	437	26	122	8
2	412	25	280	16
3	406	24	317	18
4	455	28	156	9
5	423	25	266	13
6	459	25	313	19
7	567	28	261	15
8	505	25	325	19
9	524	26	101	8
10	467	25	220	12
Avr.	465	25	236	13

This table shows that the indoor radon concentration level in living rooms ranges from 16 to 30 Bqm-3, while it varies from 5 to 25 Bqm-3 in bedrooms. In living rooms on the first floor and bedrooms on the ground floor, the average radon levels for Garmat Ali area 1 were 22 Bq/m3 and 14 Bq/m3, respectively. Maximum, minimum and average values of radon concentrations were obtained in the same manner for

Garmat Ali region 2. These data ranged between 24 Bq/ m^3 and 28 Bq/m^3 for ground floor living rooms, with average value of 25 Bq/m^3, while changed from 8 Bq/m^3 to 19 Bq/m^3 for first floor bed rooms with average value of 13 Bq/m^3.

The average radon level in living rooms and bedrooms is lower than the global average (40 Bqm^{-3}) [21]. This table shows that there is a significant difference in the indoor radon concentrations in different homes. In some homes, living rooms with higher radon concentrations than bedrooms were discovered. The ventilation of the rooms may be mostly to blame for this discrepancy.

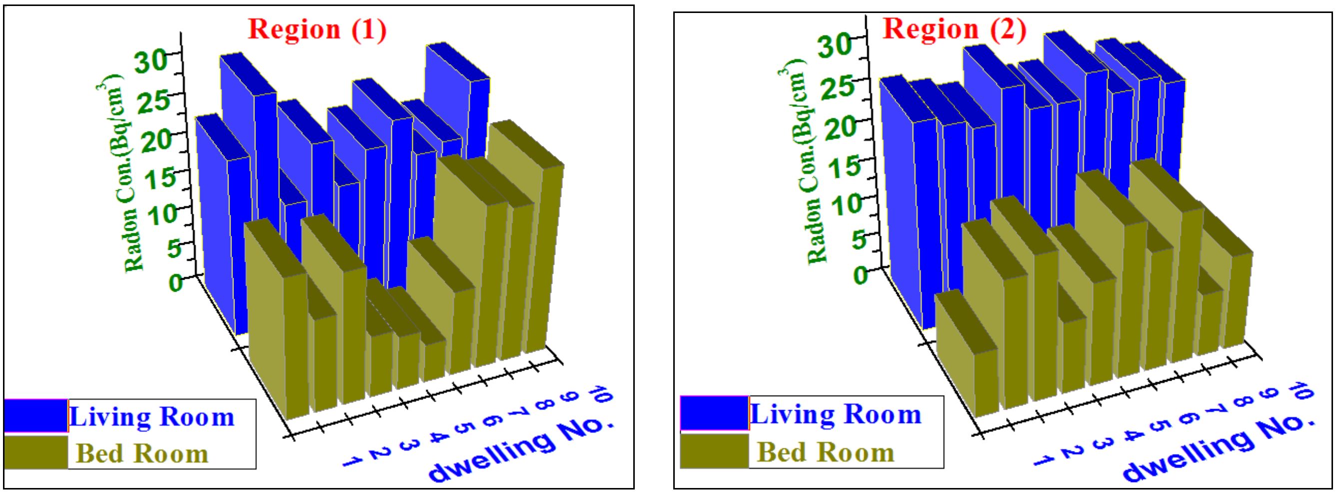

Fig. 2. Radon concentrations in Garmat ali region (1 and 2) dwellings.

The results obtained showed a decrease in the mean radon concentrations with the increase in the floor level, as shown in Figures (3 and 4) for the two regions studied. This disproportion can be attributed to (how near or how far) the soil as regards the base, because the soil represents the considerable provenance of domestic gas. In addition to some other causes, for instance the famous truth (upper floors are finest aerated with respect to lower floors) which has subjected to dust, aerosols, and other types of contamination. These findings are consistent with those of other researchers and can be attributed to the naturally radioactive components of building materials [5,22]. Additionally, cement contains a high concentration of 222Rn, which is consistent with previous researchers' findings. The existence of 226Ra may be the source of these results [16].

Conclusion

A preliminary radon concentration study was conducted in 40 houses in the Iraqi city of Garmat Ali, Basrah governorate. CR-39 detectors were etched in 25% NaOH at 81 °C for 16 hours after being exposed to radon. From the radon concentration that was measured. Sector 1 (region 1) has the highest observed radon levels, whereas Sector 2 has the lowest (region 2). We draw the conclusion that the city of Garmat Ali exhibits low indoor radon concentration from the study of these results (i.e. below the US EPA action limit). The average indoor radon concentrations were found to be lower than the global average of 40 Bqm^{-3}. Radon levels have been shown to vary she ventilation systems of individual homes as well as the usage of various building material significantly in bedrooms and living rooms on the ground and first floors.

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