POLYMERS TRACK DETECTOR USED FOR RADON SURVEY IN BABIL CITY (AL HILLAH-IRAQ)

I.J.M. AL-KHALIFA
PHYSICS DEPARTMENT, COLLAGE OF EDUCATION
BASRAH UNIVERSITY
BASRAH, IRAQ

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ABSTRACT:

This paper deals with the measurement of ^{222}Rn in dwellings of Babil city for the first time in Iraq, using Solid State Nuclear Track Detectors (SSNTDs). The plastic detectors used in this survey were LR-115 type II.The levels of Radon measured in Babil are ranging from 5 Bq m^{-3} to 35 Bq m^{-3} compared with that in Karbala city 14 Bq m^{-3} [4], as well as in Sweden 100 Bq m^{-3} [6] and Finland 70 Bq m^{-3}. The variation of radon concentration with height of the floor is also discussed.

KEY WORDS: Radon, SSNTDs, Dwelling, Lung cancer.

INTRODUCTION:

The naturally occurring radio nuclides can be divided into two types. The first type occurs singly like those produced by cosmic rays and radio nuclides of terrestrial origin. The second type is those elements found in natural sources and which have an atomic number more than 83 (bismuth), these belong to chains of successive decays of the species in each chain belonging to a distinct radioactive series.The long-lived parent elements are widely distributed in the earth crust and account for much of the radioactivity to which is exposed each of the three chains, there is an isotope of element number 86, $^{222}Rn_{86}$, $^{220}Rn_{86}$ and $^{219}Rn_{86}$. These are radon (Rn, $t_{½}$ 3.82 days), thoron (Th, $t_{½}$ 54 sec) and actinon (An, $t_{½}$ 3.92 sec), respectively, and are isotopes of a noble gas [1]. After their formation in soil, rocks, building materials etc, they can diffuse into the atmosphere. The 3.82 day ^{222}Rn isotope has a greater opportunity to escape into the atmosphere before undergoing decay than thoron and actinon which have lives of 54 sec and 3.92 sec, respectively. Thus, having correspondingly smaller probability of diffusing from their places of origin to the atmosphere.The only series affect human beings in this content arise from radon and thoron and their α emitter descendants from the ^{238}U and ^{232}Th series. The former is usually far more important than the latter from the point of view of radiation dose to the lung. This is because the radon emanation from the materials of building will be far more than thoron and because the short-lived daughters of radon have half-lives in the range of minutes (3-28 min) so most of them will decay in the lung before any clearance can occur while the thoron daughters are separated by a β-emitter daughter (^{212}Pb $t_{½}$ 10.6 hr). For two reasons, firstly long life time among other nuclides and secondly, its gaseous form that diffuse through inspiration to human and animal lungs, the discussion will be confined to ^{222}R and its daughters only.^{222}Rn is the immediate daughter of ^{226}Ra which is distributed in soil, rock, ocean water and sediment. The gas is expected to be present to a greater extent over igneous rocks than over large bodies of water or over sedimentary formations [2].Traces of naturally occurring radioactivity can be found in all substances, living and inanimate. Also, ionizing radiation organization beyond the earth continually bombard its surface and subjects all inhabitants to an additional source of exposure.Studying the radon emanation from building materials with electronic equipment may be difficult and expensive. Lengthy measurements are essential because of the low level

of emanation from the material and very few measurements can be made in a reasonable time. In this investigation a technique was developed using SSNTDs LR-115 type II. These small passive and inexpensive plastic detectors permit many measurements to be made simultaneously and for long term measurements of few months duration without any electronic equipment. This reliable technique for integrated and long term measurements of radon activity inside dwelling have been used [3-5].The results of our investigation of radon and radon daughters activity in the dwelling of Babil city are presented in this paper. Compared of the results with Kerbala city and Basrah city [4,5], as well as several European countries [6,7] is also discussed.

EXPERIMENTAL TECHNIQUE:

The cellulose nitrate plastic used here was LR-115 type II, peelable which is manufactured by Kodak-Pathe, France. These consist of thin films of cellulose nitrate 12µm in thickness, with deep red colour coated on a 100µm thick colourless polyster base. Only one side of these films is sensitive – that is coloured red. These films are unaffected by electromagnetic radiations or by electrons.Open naked strips of the film are hung up on threads in the roof of the dwellings for 135 days. More than 100 films were distributed in different buildings chosen randomly in Babil city (AL Hillah-Iraq), (Fig. 1).After exposure the films were chemically etched in sodium hydroxide (6.25 N, 56.5 C°, 1h). The number of registered alpha particles from both radon and radon daughters where energies fall in the interval 1.7-4.1 Mev were reviled [8]. The number of registered alpha particle trackes per film area is manually counted in a light microscope type " Letize " while the plate out effect of radon daughters on the film is reduced [9].

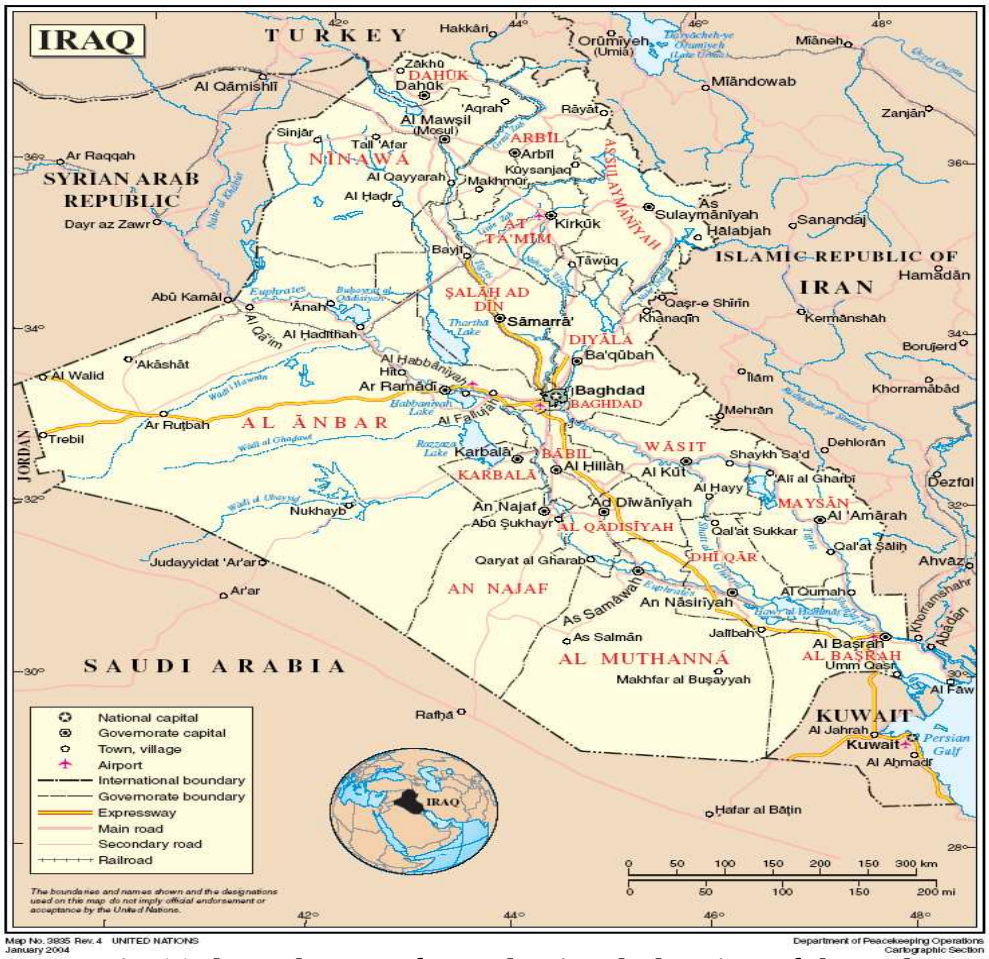

Fig. (1) shows the map of Iraq,showing the locations of the study.

RESULTS AND DISCUSSION:

Little information has been reported in the literature about the variation of the radon concentration with the height of the floor. Fifty measurements were carried out in similar rooms on different floors in two high-rise buildings. The study sites represented by three and five storey buildings. The results are shown in Table -1- for three storey and Table -2- for five storey.From these two tables, there is no clear relation between the reduction of Rn concentration value with height of the floor above the ground floor. It seems clear that there is no effect from the sub soil to the room above the first floor, and because the rooms are identical in their value, on the side of the building and probably in their concentration and painting, the only source of variation is expected to be due to the difference in their ventilation rates, but is not due to their height above the ground. In these two cases the means of concentration are higher than the other previously quoted means for Karbala and Dhi Qar [4,10]. As a result, the reduction of concentration of radon values with height is not shown clearly in these similar rooms. Therefore, the exposure of the radon to the people living in high rise buildings is less than the exposure to the people living in the houses or flats near the ground surface.Fig. 2 shows the frequency distribution as a function of radon concentration in different houses in Babil city (Iraq). From this figure we can see that most of the houses have radon concentration between 15 Bq m^{-3} and 20 Bq m^{-3}, while very few of them have high concentration 35 Bq m^{-3}, this high value maybe due to different building materials.

Floor No.	Radon concentration (Bq m^{-3})
1	22 ± 3
2	18 ± 2
3	20 ± 1

Table -1- shows the results of measurements in three storey buildings.

Floor No.	Radon concentration (Bq m^{-3})
1	24 ± 4
2	16 ± 2
3	28 ± 4
4	18 ± 2
5	20 ± 3

Table -2- shows the results of measurements in five storey buildings.

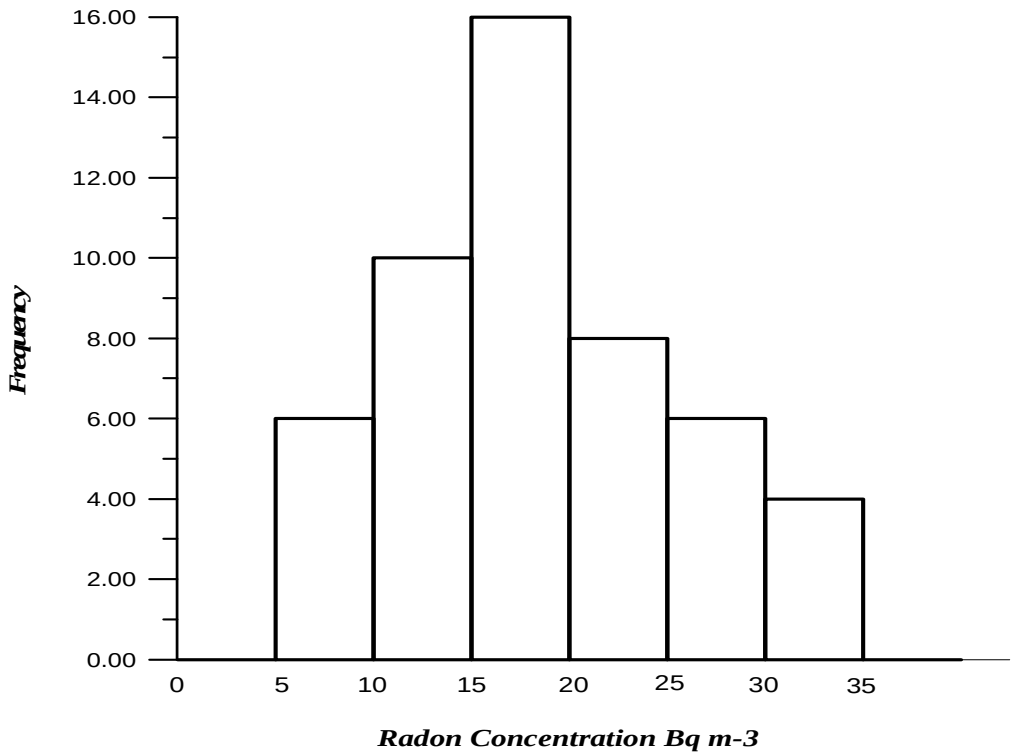

Fig. (2) shows frequency distribution as a function of radon concentration in Babil city houses.

CONCLUSION:

The following points are concluded from the study:

1. LR-115 Type II is a good tool for measuring the radon and radon daughter in dwellings.
2. The ground floor concentration is much higher than that on the other floors and must be mainly due to the emanation from the ground. The high value of concentration in 3rd floor for two buildings may be due to closed windows and it needs more investigation.
3. The concentration in houses of Babil is less than observed in European countries Sweden [6], 100 Bq m^{-3} and Finland [7], 70 Bq m^{-3}.
4. It is obvious that the activity depends on the ventilation rate more than on the floor height.

REFERENCES:

1. R.L. Fliescher, P.B. Price and R.M. Walker, Nuclear Tracks in Solid; Principle and applications Univ, California Press, Berkleley, California, (1975).
2. L. Sesana, G. Polla, U. Facchini; ^{222}Rn concentration in the atmosphere in Milan and in the plane around. Il Nuovo Cimento, 27, 6, (2004).
3. M. Karpinska, Z. Mnich, J. Kapata; Comparison of radon hazard to inhabitants of the Augustow Plane sandr and inhabitants of the Suwalki region of fluvioglacial sands and gravels. Nukleoika, 48(4), 197, (2003).
4. I.J.M. Al-khalifa, A.I. Hasan and A.R.A. Al-saad Al-hindas; Radon survey in Karbala (Iraq) dwelling using LR-115 Solid State Nuclear Track Detector. J. Basrah Researches, 10, 5, (1993).

5. I.J.M. Al-khalifa, A.R.A. Al-saad Al-hindas and H. Baker; Indoor radiation measurements in Basrah city (Iraq) using Solid State Nuclear Track Teqchnique. J. Basrah researches, 10, 5, (1998).
6. F. Abu-Jarad, Fazal-ur-Rehman, M. I. Al-Jarallah and A. Al-Shukri; Indoor radon survey in dwelling of nine cities in the Eastern and the Western provinces of Saudi Arabia. Radiat Prot. Dosimetry, 106(3), 227, (2003).
7. M. I. Al-Jarallah and Fazal-ur-Rehman; Anomalous indoor radon concentration in a dwelling in Qatif city, Saudi Arabia. Radiation Protection Dosimetry, 117(4), 408, (2005).
8. S.A. Durrani and P. Green; The effect of etching condition on the response of LR-115 Nucl. Track. Radiat. Meas., 8, 12, (1984).
9. T. Domanski, A, Wojda, W. Chruscielewski and A. Zorawski; Plate- out effects in the passive track detectors for radon and its daughters, Nucl. Track. Radiat. Meas., 9, 1, (1984).
10. I. J. M. Al-khalifa; The use of Polymer LR-115 open track films for ^{222}Rn measurements in dwelling of Dhi Qar city (An Nasiriyah-Iraq). Paper accepted for poplication in J. of Iraqi Polymers (2006).

الخلاصة:

تم في هذا البحث لأول مرة في العراق دراسة تركيز ^{222}Rn (الرادون) في الدور والمباني السكنية لمركز محافظة بابل (الحلة) في العراق باستخدام تقنية الكواشف الأثر الصلبة النووية (SSNTDs). وقد استخدم الكاشف LR-115 في هذا الدراسة.وقد وجد بأن مستوى الإشعاع للراد ون في مركز المدينة يتغير من $5\ Bq\ m^{-3}$ إلى $35\ Bq\ m^{-3}$ وقورنت هذه النتائج مع نتائج محافظة كربلاء $14\ Bq\ m^{-3}$ والسويد $100\ Bq\ m^{-3}$ وفنلندة $70\ Bq\ m^{-3}$. وقد نوقشت أسباب تغيير تركيز الرادون مع ارتفاع طوابق البنايات السكنية.