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Indoor Radon Measurements in the Dwellings and Multistory Buildings of Basrah Technical Institute (Iraq)

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Abstract

In this study the measurement of radon concentration was carried out in the dwellings and multistory buildings in the campus of Basrah Technical Institute (Basrah-Iraq) by using solid state nuclear track detectors. Measurements were made in 50 dwellings and 6 Multistory buildings in the campus of Basrah technical institute. The polymer track detector LR-115 type II is the solid state nuclear track detector was used to measure the radon concentrations inside the rooms in the winter season. The indoor radon concentrations in the rooms of dwellings and buildings which have been measured are ranging from (13.532) Bq/m^3 to (51.176) Bq/m^3. The variation of radon concentration with height of the floor is also discussed. The observed concentrations of radon inside the rooms of dwellings and buildings of the campus are lower than the maximum allowed value 200 Bq/m^3 which recommended by International Commission on Radiological Protection (ICRP), therefore all measured radon concentrations are within the safety limits.

Keywords: Indoor Radon Concentration, LR-115 type II.

1.Introduction

The inhalation of short-lived radon daughters in dwelling, is one of the most important radiation risks to the human beings. The UNSCEAR reports on natural sources of radiation emphasizes that knowledge of radiation levels in buildings is important in assessing population exposure because people spend most of their time indoors. It is widely accepted that the primary effect is not due to ^{222}Rn as such since inhaled ^{222}Rn is mostly expelled, but from the decay of alpha-activity daughters of radon ^{218}Po and ^{214}Po . These are attached to aerosols which can be lodged in the lungs when inhaled.

The measurements of indoor radon are importance because the radiation dose to human population due to inhalation of radon and its daughters contributes more than 50% of the total dose from natural sources [1]. The three radon isotopes (^{219}Rn, ^{220}Rn, ^{222}Rn) are gaseous and they may be released from the ground, rocks and also from building materials and accumulate with

their short lived daughters in closed spaces, and in particular in dwellings. ^{220}Rn and ^{219}Rn are not important in comparison with ^{222}Rn because of their short half-lifes, therefore the levels of concentration of ^{222}Rn in air which are significant in terms of radiological protection. The dose deriving from the presence in the air of ^{222}Rn is linked to the inhalation of its short-lived daughter, which are deposited in the respiratory organs, if deeply inhaled, emit alpha-particles in direct contact with the bronchial and pulmonary epithelium. For these reasons, the dose deriving from the exposure to ^{222}Rn in closed spaces has been placed in direct relation to the risk of lung cancer [2].

During recent years, several reports have appeared in literature demonstrating the ever increasing interest in monitoring the radon in the dwellings all over the world [3, 4] and the results of the studies show that some countries (e. g. Sweeden, Norway, Hengary and some parts of USA) have high radon concentrations in many of their dwelling [1,5] and even in certain cases doses from this source for some people living in these areas may exceed those received by occupational workers.

The main sources of indoor radon levels are the soil-gas, building materials, tap water and natural gas used for cooking. The topography, house construction type, soil characteristics, ventilation rate, wind direction, atmospheric pressure and even the life style of the people , also significantly influence it [6,7], Which emphasizes in the importance of long-term integrated measurements. Thus indicating the importance of the SSNTD techniques in these measurements.

The polymer cellulose nitrate tracks detectors technique has been used to investigate the radon and radon daughters activity in the dwellings of Basrah city, Karbala city and Thi Qar city in Iraq [8-11]. In this study we used the same technique to measure the levels of Radon in dwellings and Multistory buildings in the campus of Basrah technical institute (Basrah-Iraq).

2.Experimental Method

Experimental methods for radon detection and measurements are based on alpha-counting of radon and its daughters. The plastic track detector (LR-115 type II) is a cellulose nitrate film of 12 μm thickness manufacture by Kodak Path, France. Due to its ruggedness and a fine window for recording alpha particles emanating from radon progeny, it is highly useful for integrated measurements from few days to several months [9]. These plastics films of size 2cm x 2cm were hung in the ceiling at distance 2.5 m above the earth of room. After an exposure time of three months, detector films were removed and etched in 2.5 N NaOH solution at 60 ^{o}C for 80 minutes in a constant temperature bath. These films were washed and dried. The Optical Microscope which was used to see and count the tracks in nuclear detectors is made in Japan, ALTAY mark. The exposed area of the each film was scanned thoroughly and sufficiently, a large number of fields were counted to get an average track density to minimize the uncertainty due to counting errors. The track density is converted to radon concentration in dwelling using a calibration factor 0.021 tracks/cm^2/day =1 Bq/m^3 [12].

3.Results And Discussion

The results of indoor radon concentration measured in dwellings and Multistory buildings in the campus of Basrah technical institute carried out to fifty rooms for the dwelling and fourteen rooms for the Multistory buildings, the results are reported in the Tables(1), Tables(2) and Table(3) respectively. The observations have been taken in winter (from December 2010 to February 2011). From Table (1) we noted that the dwellings show radon concentrations between (20.087 - 51.176)

Bq/m3 as shown in the figure(1). The variation in the indoor radon concentration are happened

Table (1): The indoor radon concentration in the dwellings of Basrah Technical Institute campus (Iraq).

Dwelling Number	Radon Concentration in Bq/m^3	Dwelling Number	Radon Concentration in Bq/m^3	Dwelling Number	Radon Concentration in Bq/m^3
1	21.012	18	32.0542	35	51.1759
2	23.7547	19	37.6237	36	47.8878
3	24.7657	20	38.7288	37	41.9749
4	20.0774	21	37.8023	38	40.8637
5	22.7238	22	33.9763	39	36.5726
6	29.3549	23	32.0634	40	39.868
7	26.0365	24	31.2712	41	42.0856
8	25.7879	25	34.9982	42	45.2533
9	24.3192	26	35.2372	43	38.9649
10	23.3673	27	38.2721	44	38.686
11	21.9652	28	37.2333	45	36.3725
12	20.0873	29	28.3458	46	40.0763
13	29.8202	30	27.1811	47	39.2164
14	30.2546	31	24.7232	48	49.0282
15	27.8746	32	32.7111	49	38.9927
16	31.8743	33	29.5878	50	40.2542
17	30.0675	34	30.3737		

because of many reasons like the different ventilation rate, nature of the soil underneath, the building materials and particular geological considerations. The results in table (2) and table (3) are shown in the figure(2) and figure(3) respectively, from this figures we noted the radon concentration in the rooms of the ground floor is higher than for the other floors above the ground floor because of the radon is heavy gas and not go up to high floors and the radon concentrations in the rooms of this floors have a convergence values and there is no clear relation between the reduction of radon concentration value with height of the floor above the ground floor because of the different in there ventilation rates.

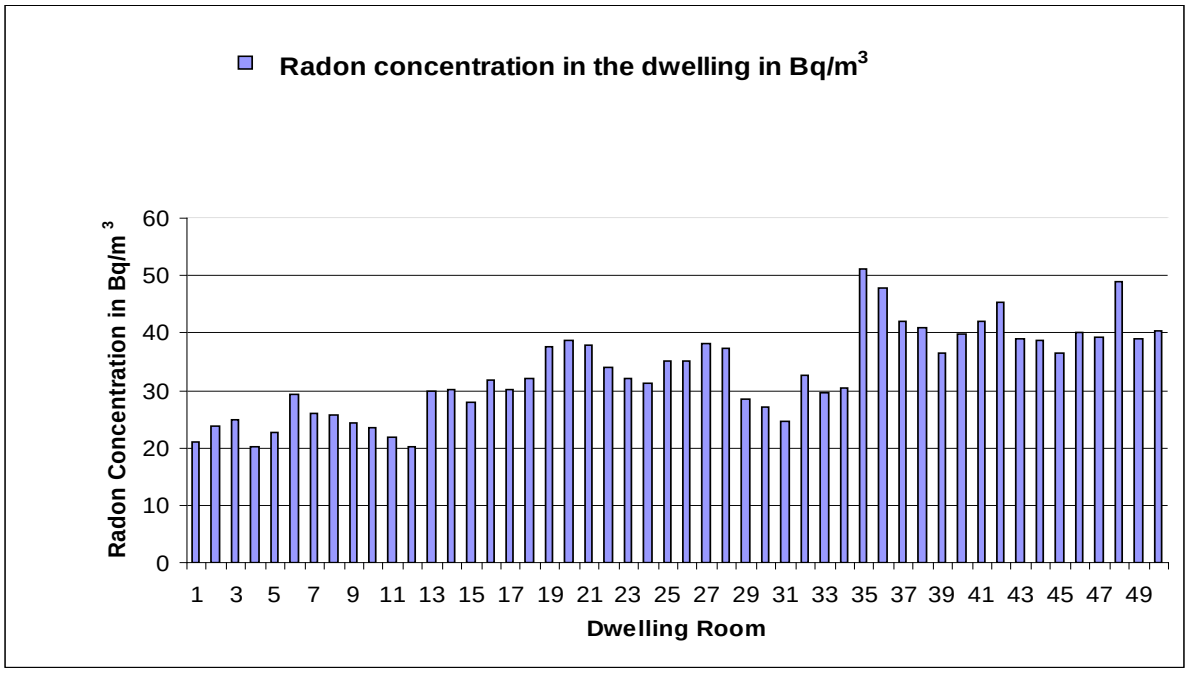
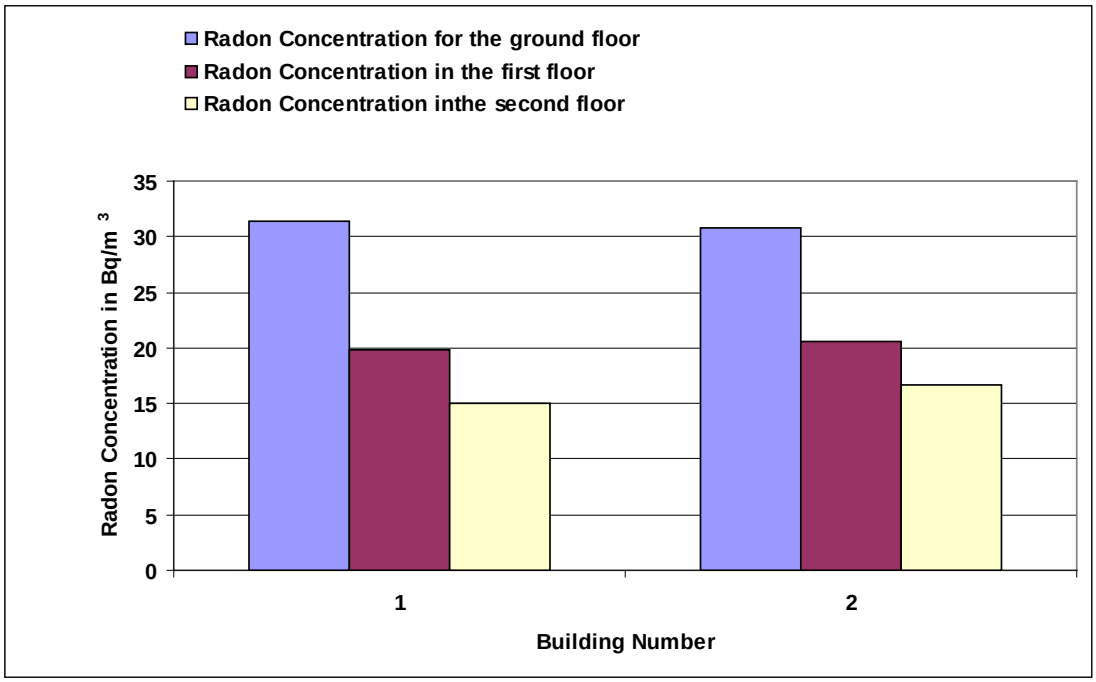


Figure (1): The indoor radon concentration in the dwellings of Basrah Technical Institute campus (Iraq).

Table (2): The indoor radon concentration in the three stories buildings of Basrah Technical Institute campus (Iraq).

Building Number	Radon Concentration in Bq/m^3 for the ground floor	Radon Concentration in Bq/m^3 for the first floor	Radon Concentration in Bq/m^3 for the second floor
1	31.456	19.763	15.003
2	30.762	20.534	16.746



Figure(2): The indoor radon concentration in the three stories buildings of Basrah Technical Institute campus (Iraq).

Table (3): The indoor radon concentration in the two stories buildings of Basrah Technical Institute campus (Iraq).

Building Number	Radon Concentration in Bq/m^3 for the ground floor	Radon Concentration in Bq/m^3 for the first floor
1	28.322	13.532
2	25.651	16.876
3	24.452	15.537
4	23.537	14.643

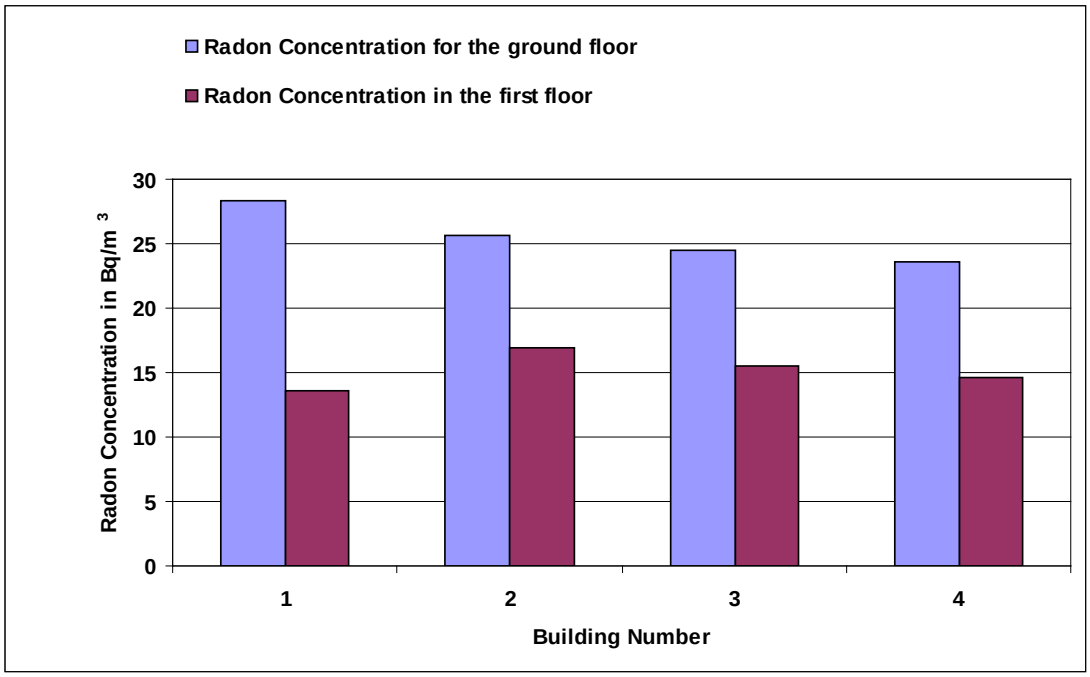


Figure (3): The indoor radon concentration in the two stories buildings of Basrah Technical Institute campus (Iraq).

4.Conclusion

It is obvious from our results that the radon activity depends on ventilation and the nature of the hosted materials. There seems to be clear indication of appreciable variation in radon concentration with height from the ground level. Also we can concluded from the study that the ground floor concentrations are much higher than that on the other floors and must be mainly due to the emanation from the ground. The radon concentration in dwellings and multistory buildings in Basrah technical Institute campus was lower than the ICRP recommended values.

References

[1] UNSCEAR. Sources, **(1988)**, *"Effects and Risks of Ionizing Radiation"*, United Nations Reports, New York, USA.

[2] ICRP Publication 50, **(1987)**, *"Lung cancer risk from indoor exposure due to radon daughters"*. Annals of the ICRP 17(1) (Oxford: Pergemon).

[3] Abu-Jarad F. and Fremlin J. H., **(1981)**, *"A working level monitor for radon measurements inside houses"*. Radiat. Prot. Dosim., 1, 221-226.

[4] Kellar G. and Folkerts H. H., **(1984)**, *" Radon-222 concentration and decay product equilibrium in dwelling and in the open air"* . Health Physics, 47, 385-398.

[5] Swedjemark G. A. and L Magones., **(1984)**, *"Radon and radon daughter concentrations in Swedish homes"*. Radiat. Prot. Dosim. 7, 341-345.

[6] Stranden E., Berteig L. and Ugletveit F., **(1979)**, *"A study on radon in dwellings"*. Health Phys.,36, 413-421.

[7] Abu-Jarad F. and Fremlin J H., **(1983)**, *" Effects of internal wall covers on radon emanation inside houses "*. Health Phys., 44, 243-248.

[8] Al-Khalifa I.J., Hasan A. I. and Al-Hindas A.R.A., **(1993)**, *"Radon survey in Karbala (Iraq) dwelling using LR-115 type*

Solid State Nuclear Track Detector ". J. Basrah Researches, Vol.9, Part!, 47-54.

[9] Al-Khalifa I.J., Al-Hindas A.R.A. Saad and Bakr H., **(1998)**, *"Indoor Radon measurements in Basrah city (Iraq) using Solid State Nuclear Track Technique "*. J. Basrah Researches, Vol.16, Part 1, 5-11.

[10] Al-Khalifa I.J.M., **(2005)**, *"The Use of The Polymer LR-115 Open Track Films For ^{222}Rn-Measurements in Dwellings of Dhi Qar City (An Nasiryah-Iraq)"*. Iraqi J. Polymers, Vol. 10, No.1, 75-78 .

[11] Al-Khalifa I.J.M. **(2006),** "*Polymers track detector used for Radon survey in Babil city (Al-Hillah-Iraq)"*. J. Basrah Researches (Sciences) Vol. 32, Part. 2, 26-30.

[12] . Mishra U. C and Ramachandran T.V., **(1997)**, *"Indoor radon levels in India "*, A review. Rare Gas Geochemistry (ed.H.S. Virk) Guru Nanak Dev University Press, Amritsar, 310-3109.