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Radioactive Measurements by Using Chemical Detectors (CR) and (TLD) in Damascus City

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Abstract: This study is a local study in Damascus City, designed to measure the concentration of chemical gas: " radon" and radiation dose and radiation levels.
This study showed that the average of radon concentration was ((40.2 ±0.3) Bq/m^3), and the average of the radiation dose rate was ((0.0778±0.005) μSv/h) which means that, there is no dangerous radiation.
Key words: Radon gas, Radiation Dose, , detectors, Becquerel, Curie, Sievert.

1. Introduction

Human live existence of natural background of radiation ,cosmic rays and radiation with earth origin. Everything on earth has a natural radioactive materials, the inhaled air, food and drink. The difference of exposure to these existing natural radioactive materials is according to the geographical position, height, the condition of climate and the environment, in addition to eating and drinking habits. But recently the increasing of human activity, the use of radioactive materials, nuclear energy and oil industries which addition to natural radiation background [1] .

We are exposed daily to radiation comes from the surrounding environment. There are three basic sources of radioactivity:

• natural activity.

• cosmic radiation.

• the ground radiation from the rocks [2].

The main part of the radiation exposure earth return to radon gas figure (1). Inhalation of radon and its production is the largest single source of exposure to radiation in the world [2]. Radon gas discovery was by the the chemical scientist Fredrik Dorn (1900), which is the origin of natural inert gas. Radon is produced from the disintegration of the radioactive element radium[3].

There are two possible ways of radon to enter the human body breathing and digestion [4]. In fact, radon gas does not cause the radiation dose because it is an inert gas, but products disintegration cause a dose which is equivalent to (100) double more than the dose of radon gas[5].

Measurement of radioactivity has two units Becquerel (Bq) and Curie (Ci). Becquerel: the disintegration of the nucleus of one per second. Curie: the radioactivity of a sample weighing one gram of radium (^{226}Ra). The relationship between Becquerel and Curie is:

$$1\ Ci = (3.7 \times 10^{10})\ Bq\ [2].$$

The unit of equivalent dose (affecting) which was measured in this study is Sievert (Sv) . The Sievert is a derived unit of ionizing radiation dose in the international System of units. It measures of the health effect of low levels of ionizing radiation on the human body[6].

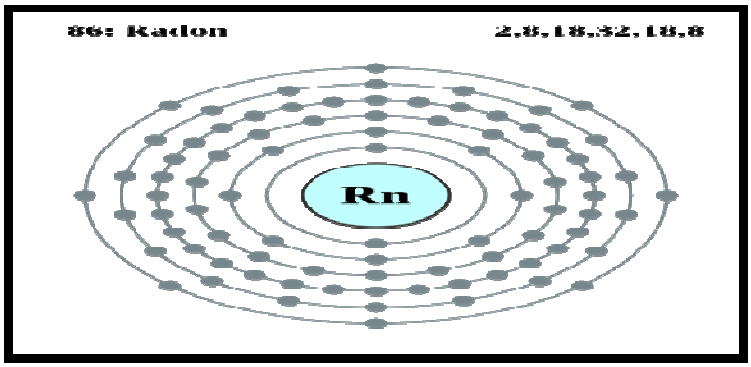


Figure (1) Radon gas

2. The purpose of the study:

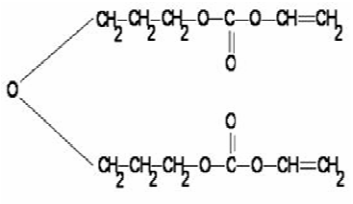
Determining the radiation levels in some buildings in Faculty of Science at Damascus University.

3. The study location:

The city center of Damascus, the capital of the Syrian Arab Republic.

4. Study materials and methods:

We used the complementarily (cumulative) way in nuclear detectors effect type (CR-39) which using to measure radon gas[7].CR _39 is plastic detector . It is solid state nuclear tracks detectors . The chemical formula of the CR-39 detector is ($C_{12}H_{18}O_7$) figure (2) .



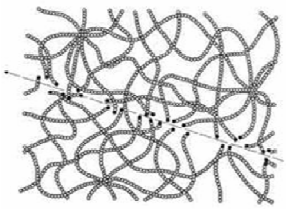


Figure (2) chemical formula of the CR-39 detector[6]

- We used the thermal luminescence detectors (TLD) to measure the beta and gamma rays.
- We put (CR) and (TLD) detectors in small chamber Figure(3)[6].

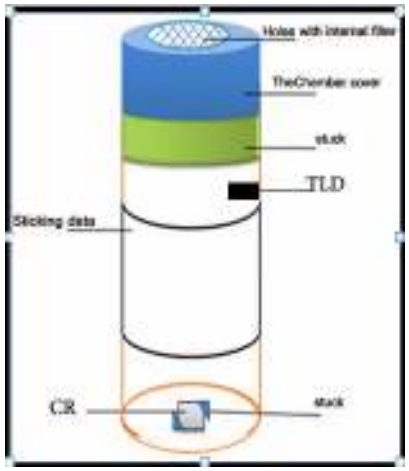


Figure (3) The small chamber

- We used (123) small chambers in two big buildings in Damascus city, the table(1) shows the distribution of detectors.

Table(1) shows the distribution of detectors

Number of chambers	*Building*
63	*The First*
60	*The Second*

- The distribution of the chamber was according to these Standards:

1. Trying to cover all the floors in the building, and avoiding the parts which have repairing operations.
2. Considering the height of the floors.
3. We select where there are no losses to the detector.
4. We Left the detectors for three months starting from 1st of February 2012 to the 30 of April 2012.
5. We put the information in a special form.

5. Discussion and Results :

After the ending of the exposure, we sent detectors (TLD) to the Syrian Atomic Energy Commission to get the results. We calibrated (CR) detectors. After that we have chemical scratching by using sodium hydroxide (6.25 mol/l) and temperature ($70C^0$) for seven hours. Then we washed the detectors by using distilled water, then we counted by light microscope. We counted the average concentration effects on each of them ,then we drew a diagram concentration effects (Tr/cm^2) in terms of the exposure multiplied concentration of radon hard time ($KBq.h/m^3$) to get a straight line [6](Figure 4).

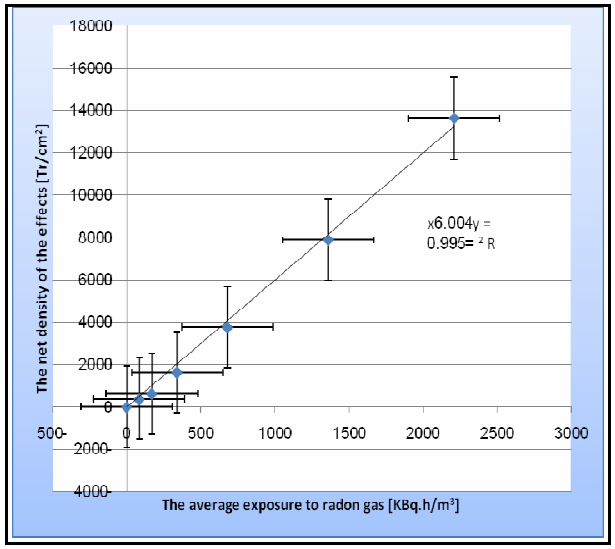


Figure (4) Calibration curve the tendency is: [m=6.004 [$(Tr.cm^{-2})/(KBq.hm^{-3})$]]

We used the tendency to calculate the concentration of radon in buildings.

We compared the results with the following standards:

- Syrian Arab Republic standards for levels of radon is ($200Bq/m^3$))[7].

- The exposure of the general public dose is (1 mSv per year) [3], where the value of the natural background dose rate in the Syrian Arab Republic is (0.09 µSv / h).

Notice: After getting results, We took the average results of each floor.

5.1. The results of the first building:

5.1.1Radon of Gas Results figure(5):

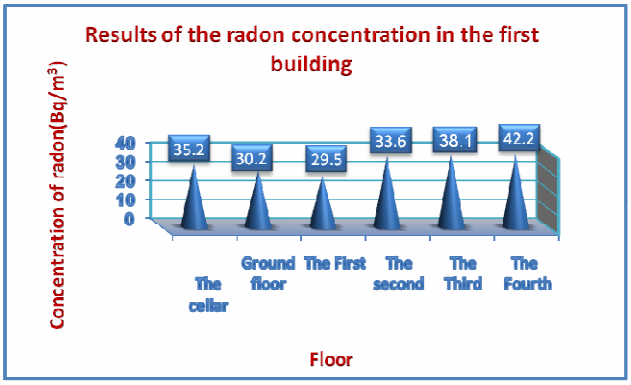
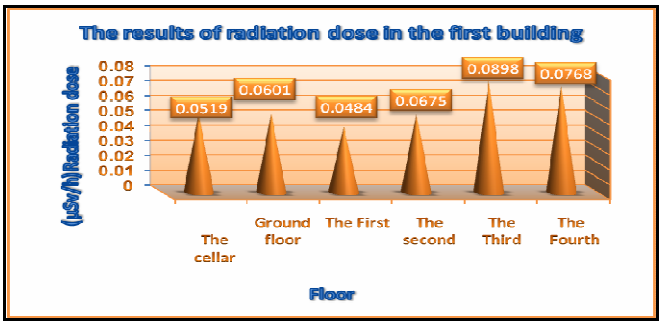


Figure (4) Results of the radon concentration in the first building

Radon concentration was the highest in the fourth floor, it is surprising. This floor contains the air-conditioned rooms, the windows of these room was not opened because the people did not refresh the room air, which made the radon gas accumulates in that room.

5.1.2 Results of radiation dose figure (5):



Figure(5):The results of radiation dose in the first building

Radiation dose was the highest in the third floor. This floor has lab that use some educational radioactive sources.

5.2. The results of the second building:

5.2.1Radon of Gas Results figure(6):

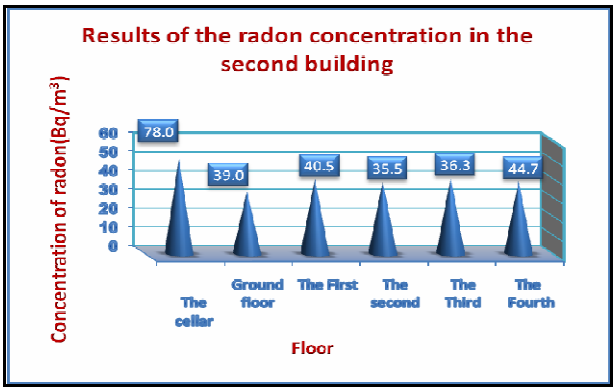
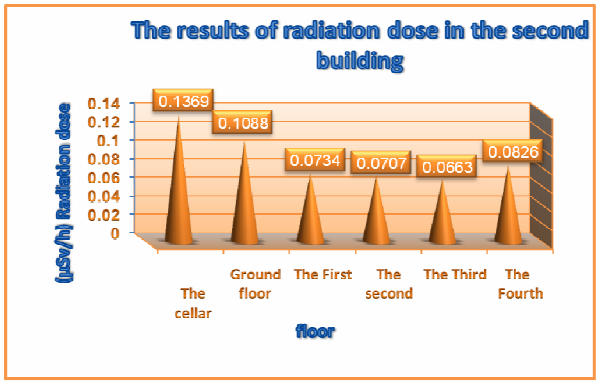


Figure (6) Results of the radon concentration in the second building

Radon concentration was the highest in the cellar, it is not surprising. The fact, radon is frequently in cellars. In addition to the presence of cabinets which contain different types of rocks as volcanic stones belonging to the Department of Geology, and there is not ventilation.

5.2.2 Results of radiation dose figure (7):



Figure(7):The results of radiation dose in the second building

The radiation dose was the highest in the cellar.

5.3. Comparison between the two buildings:

5.3.1.Comparison between the two buildings in terms of radon concentration figure (8):

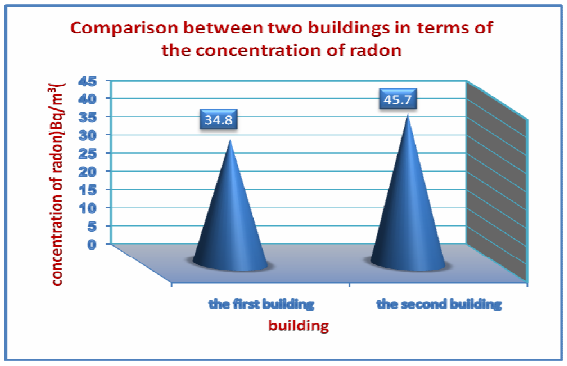


Figure (8) Comparison between two buildings in terms of the concentration of radon

Radon concentration was the highest in the second building.

5.3.2. Comparison between two buildings in terms of radiation dose figure (9):

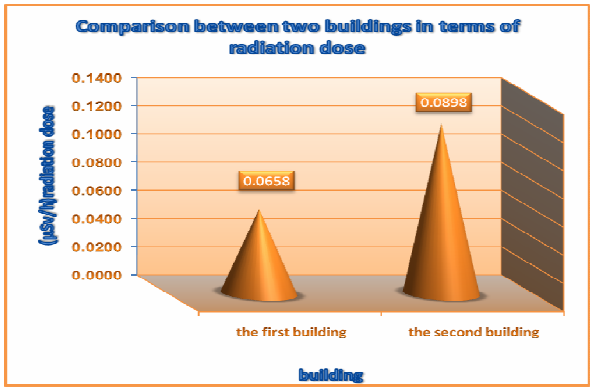


Figure (9) Comparison between two buildings in terms of radiation dose

The radiation dose was the highest in the second building.

The average of radon concentration was ((40.2 ±0.3) Bq/m^3), and the average of the radiation dose rate was ((0.0778±0.005) μSv/h) according to this study, there was no dangerous radiation.

In a previous study of the concentration of radon in the Syrian homes had an average concentration (44 Bq/m^3) [8], comparing the result of our research with this previous study, we found that the value of radon concentration came close.

The value of the dose of radiation dose in our study were in the allowable values guardian.

6. Recommendations:

We advised to ventilate the air-conditioned rooms on the fourth floor of the first building.

We advised to install the ventilation system in the cellar of the second building.

7. References:

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