Measurement of Radioactive Radon Gas Concentrations of Water in the schools for Abu - Gharaq

Khalid Hussain Hatif Mohsin Kadhim Muttaleb Alyaa Hofdi Abass
University of Babylon / Science College /Department of Physics
Kalid.hsen@yahoo.com mam50_24@yahoo.com happy_nawras@yahoo.com

Abstract

This research measuring the radioactive gas radon in samples of drinking water in the schools of Abu- Gharaq in Babylon Governorate Was chosen as the water from 14 schools by using the electronic radon detector $RADH_2O$, where the highest value (0.688) $Bq.L^{-1}$ and the lowest value (0.072) $Bq.L^{-1}$ and effective dose for, human exposure to radon rate from (0.31536) $mSv.y^{-1}$ to (3.01344) $mSv.y^{-1}$.This subject Has been chosen for the importance of water in human life and the lack of previous studies in the study area.

Keywords : Radioactive, Drinking water, RAD7, Radon,Schools, Human life.

الخلاصة

في هذا البحث تم قياس غاز الرادون المشع في عينات من مياه الشرب في مدارس ناحية ابو غرق في محافظة بابل حيث تم اختيار العينات من 14 مدرسة في هذه الناحية باستخدام تقنية جهاز $RADH_2O$ حيث كانت اعلى قيمة $Bq.L^{-1}$ (0.688) وادنى قيمة $Bq.L^{-1}$ (0.072) وقيمة الجرعة الفعالة لتعرض الانسان تراوحت من $mSv.y^{-1}$ (0.031536) الى $mSv.y^{-1}$ (3.01344). وقد تم اختيار هذا الموضوع للدراسة لأهمية المياه في حياة الانسان والحياة , وعدم وجود دراسات سابقة في منطقة الدراسة .

الكلمات المفتاحية: النشاط الأشعاعي، مياه الشرب ، راد7 ، الرادون، المدارس ، حياة الانسان.

1. Introduction

Radon is a naturally occurring, colorless, odorless gas that is soluble in water. It is radioactive, which means that it breaks down to form other elements. The rate of radon's radioactive decay is defined by its half-life, which is the time required for one half of any amount of the element to break down. The half-life of radon is 3.8 days. The source of radon is the radioactive decay of uranium. Therefore, higher radon amounts are commonly detected in areas underlain by granites and similar rocks that usually contain more uranium than do other rock types [Ali, 2015] .The earth's crust contains trace amounts of ^{238}U and ^{232}Th which decay to ^{222}Rn and ^{220}Rn respectively, thus building up significant concentrations from (^{222}Rn) and two of its daughters, (^{218}Po) and (^{214}Po), are alpha emitters, while (^{214}Pb) and (^{214}Bi) are beta gamma emitters, Radon ^{222}Rn which is the daughter of uranium ^{238}U, represents the most important radon isotope [Murtadha, 2014]. The main sources of radon in the middle, the outer two of soil and water, and produces about 80% of radon emanating from the outside to the middle, the upper layer of the earth , moreover the building materials which made from the soil and rocks, such as cement and bricks containing radioactive material with a natural origin such as uranium and radium and thus generate radon [Hadi ,2014].

Radon gas can also dissolve and accumulate in water from underground sources (ground water), such as wells .When water containing radon is used in the home for showering, washing dishes, and cooking, radon gas escapes from the water into the air [Ali, 2015]. Soil is the most important source of radon to the environment, and water

role depends on the nature of the rock layers in contact with groundwater . Radon dissolves with water, depending on the temperature of the water. According to the U.S. Environmental Protection Agency, 10000 pCi / L of radon gas concentration in water increases its concentration in the air by 1 pCi / L in the case of normal use of drinking water at homes [Inaam, 2014], and because water is essential to life as the air breathed by humans. In recent years, a great interest arose towards the natural radioactivity in drinking water. Thus, the presence of natural radioactivity in surface and ground water has been studied by many investigators across the world.

Radon is released from the water and mixes with indoor air. Thus, radon from water contributes to the total inhalation risk associated with radon in indoor air [Ali, 2009]. However a very high level of radon in drinking water can also lead to a significant risk of the stomach and gastrointestinal cancer [Laith, 2014].

2. Location of the study area

Hilla is a city in Iraq , south of the capital Baghdad , which has an area of (191 Km^2) and pose of the total area of the province of Babylon (21.8%) , with location of latitude (32 ˚ 36) N, and longitude(44 ˚ 15) E .

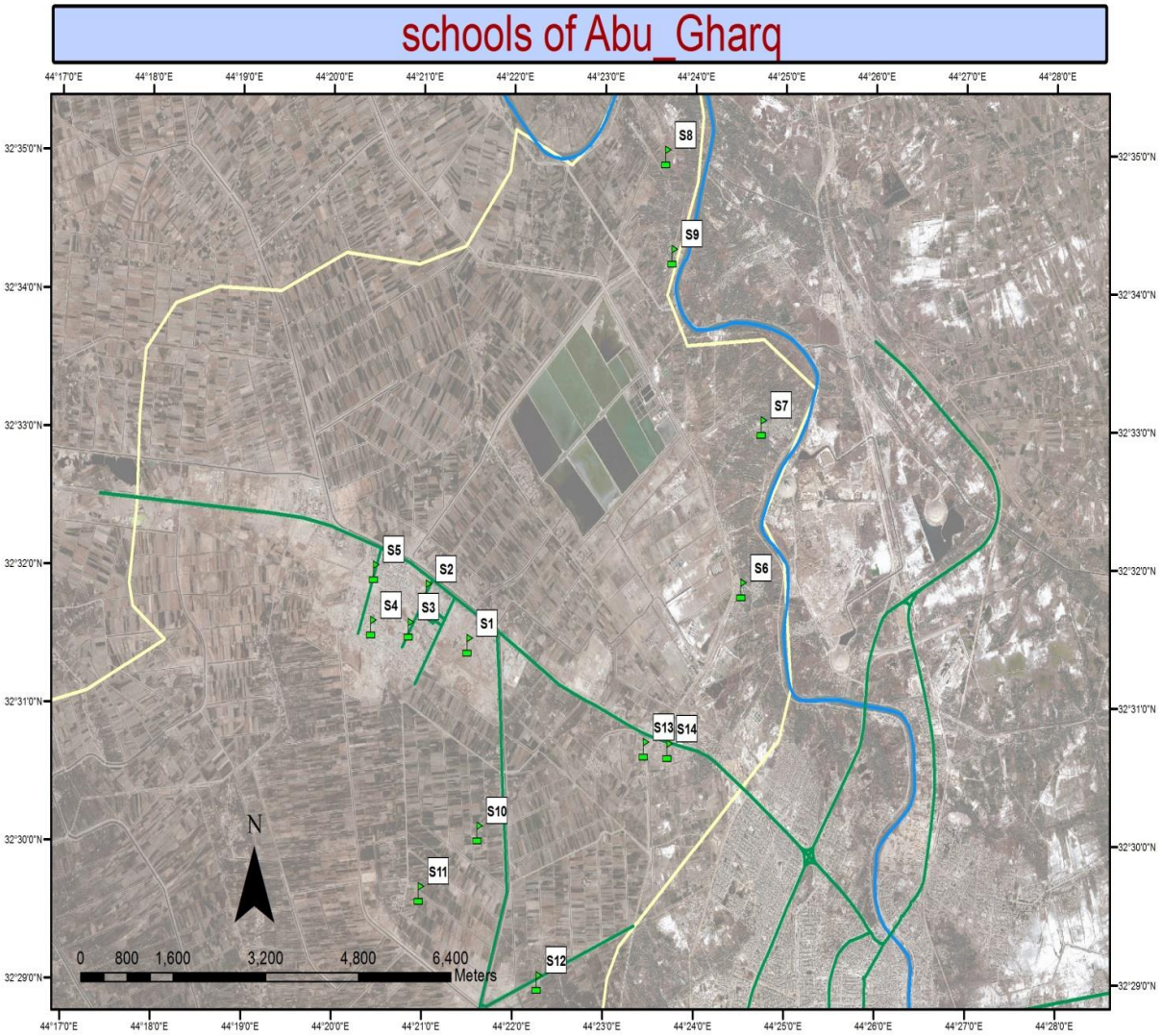


Fig. 1. Sketch map shows locations of study samples in the schools of Abu – Gharaq

3. Experimental Part

The RAD7 is a highly versatile instrument that can form the basis of a comprehensive radon measurement system. It may be used in many different modes for different purposes and The RAD7 is a rugged and long-lasting piece of equipment. [Sadiq, 2013] . The RAD H2O is an accessory to the RAD7 that measures radon in water with high accuracy, over a wide range of concentrations, capable of obtaining a reading for radon concentration in water within an hour of taking the sample. The RAD H2O makes use of standard, pre-set protocols, built into the RAD7, which furnish a direct reading of the radon concentration in the water sample itself, Figure (1) and, Figure (2) show the device RAD7 and RAD-H2O . The RAD7 detector has the capability to calculate the concentration of radon in water sample by multiplying the concentration of radon in the air loop by a fixed conversion coefficient [Drudge Company Inc., 2015]. A sample of water was taken from the school by tight reagent bottle of 250 mL and uses a glass bulb containing calcium to absorb the moisture; the RAD7 contains a small compartment which acts as scintillator to detect alpha activity. Air was then circulated in a close circuit for a period of 5-10 min until the radon was uniformly mixed with the air and the resulting alpha activity was recorded and it directly gives the radon concentration. The radon concentration of surface water is an important issue from the dosimeter aspect, so it requires a great attention from researchers to control the amount of radiation to which the public is exposed. Radon is soluble in water and this route of exposure is important if high concentrations are found in drinking water [Khalid, 2013].

The annual effective dose to an individual consumer due to intake of radon from drinking water is evaluated using the Eq. (1), as shown in the table (1).

$$Dw = Cw\ CRw\ Dcw \quad \text{..... (1)}$$

where Dw is the annual effective dose (Sv. y^{-1}) , Cw concentration of ^{222}Rn(Bq. L^{-1}) CRw annual intake of drinking water (1095 L y^{-1}), Dcw is the ingested dose conversion factor for ^{222}Rn (4 Sv Bq^{-1}) [Drudge Company Inc., 2015].

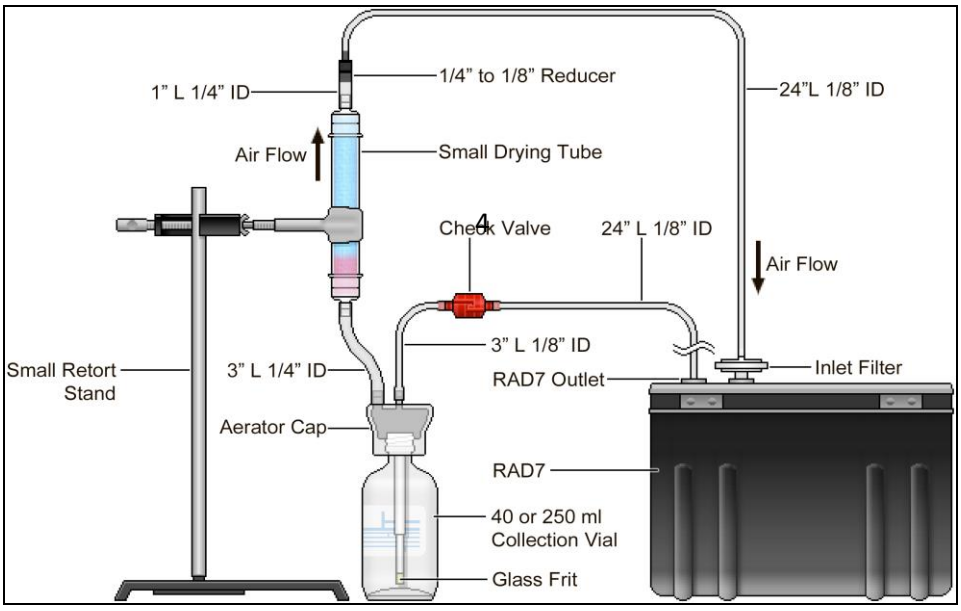
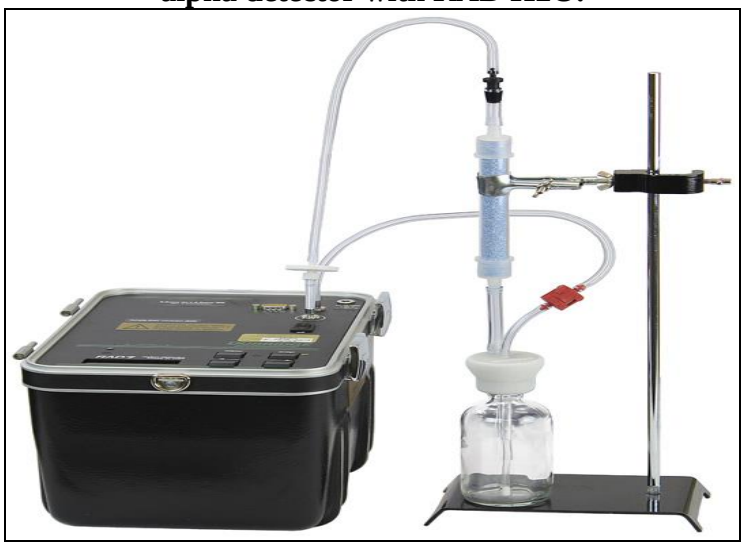


Fig.(2) Schematic diagram of RAD7, solid state, ion implanted, planar silicon alpha detector with RAD H2O.



Figure(3). RAD7H2O [Sadiq. H. L,2013].

4. Results and Discussion

Table (1) shows the results were obtained in this study where the : (Mean) represents the value of average concentration, (SD) represents the value of the standard deviation, (High) highest value, (Low) is lower value of the average radon concentration and are all measured in ($Bq.L^{-1}$). The last column represents a sample Location using GPS**.**

Table (1) Radioactive radon gas concentrations in samples from the schools.

Schools	Sample	Mean ($Bq.L^{-1}$)	High ($Bq.L^{-1}$)	Low ($Bq.L^{-1}$)	Effective dose($mSv.y^{-1}$)	Samples location
Hassan Shehata	S1	0.072	0.145	0.00	0.31536	N 32º,31′, 27.10 ″ E 44º,21′,31.172″
Al-Nasser	S2	0.145	0.29	0.00	0.6351	N 32º,31′,49.9″ E 44º,21′,3.35″
Al-Soquor	S3	0.072	0.288	0.00	0.31536	N 32º,28′, 10. 1″ E 44º,20′,52.0.9″
Kawkaba	S4	00.253	0.435	0.00	1.10814	N 32º, 29′, 26. 0″ E 44º, 20′, 40.98″
Batalat Karbela	S5	0.181	0.435	0.00	0.79278	N 32º,31′, 57. 22″ E 44º,20′,28.14″
Wasit	S6	0.072	0.290	0.00	0.31536	N 32º,31′, 50. 96″ E 44º,24′,30.96″
Fass	S7	0.217	0.579	0.00	0.95046	N 32º,33′, 1.7 7″ E 44º,24′,45.34″
Al-Shaheed Satar	S8	0.072	0.145	0.00	0.31536	N 32º,35′, 0. 88″ E 44º,23′,41.22″
Al-Tathamon	S9	0.144	0.432	0.00	0.63072	N 32º,34′, 15. 35″ E 44º,23′,45.08″
Al-Moujahid	S10	0.145	0.290	0.00	0.6351	N 32º,30′, 3. 88″ E 44º,21′,37.67″
Fatima Bint Huzam	S11	0.144	0.288	0.00	0.63072	N 32º,29′, 37. 6″ E 44º,20′,58.45″
Al-Toofof	S12	0.688	1.160	0.288	3.01344	N 32º,29′, 0. 146″ E 44º,22′,19.37″
Babylon	S13	0.072	0.145	0.00	0.31536	N 32º,30′, 41. 23″ E 44º,23′,27.33″
Hamaim Al-Salam	S14	0.145	0.290	0.00	0.6351	N 32º,29′, 0. 146″ E 44º,23′,43.96″

The recorded radon concentrations in water samples from 14 different regions in schools of Abu- Gharaq were found to vary from (0.072) $Bq.L^{-1}$ at S1 to high value (0.688) $Bq.L^{-1}$ at S12, shown in table (1) that there is a difference in measurement results for water according to locations samples as shown in Fig. (4) the reason is attributed to the difference in the geological nature of each region of the earth and environmental conditions and seasons of the year and to the movement of water and change it constantly, which leads to the deposition of radionuclides so the presence of high concentrations of radon in the surface waters is small compared to groundwater [Khalid, 2013], When the measured radon concentration values are compared with the allowed maximum contamination level for radon concentration in water which is 11 BqL^{-1}, proposed by the US Environmental Protection Agency[Mehra, 2010], it can be seen that present value is well below this recommended value.

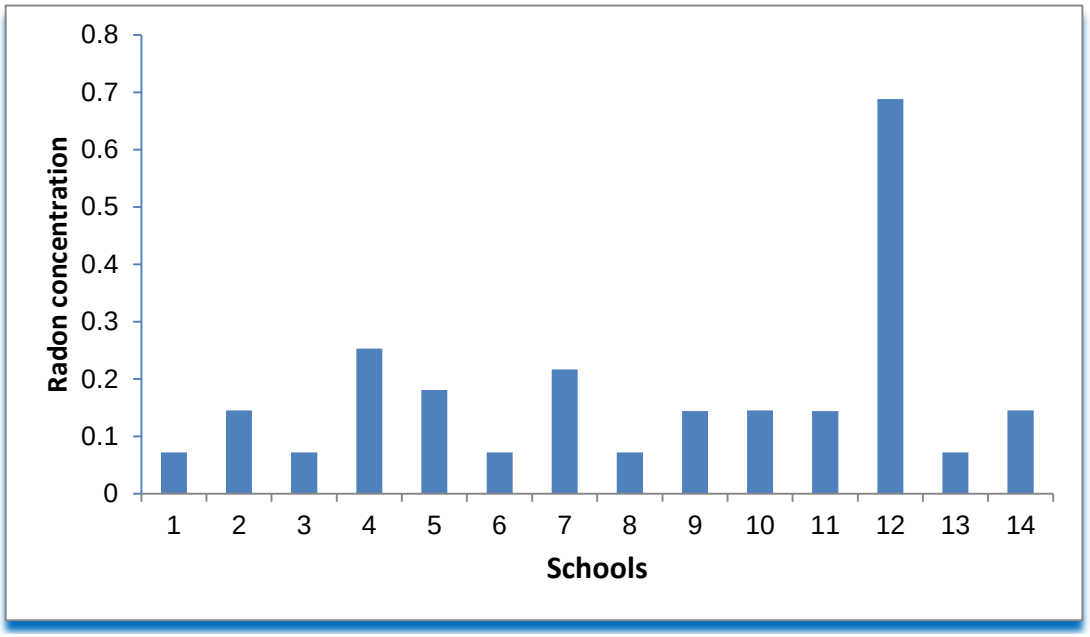


Fig.(4) Bar diagram showing variation in radon concentration of the water samples.

5. Conclusion

The present study reveals that the radon concentrations in the water of the schools are well below the recommended safe limit value, These results have shown variations of radon concentration in water due to different locations of the samples was taken, nature and geological physiographic region .Mmost of these schools have a source of water which is not piped water, but of tanks (tankar) in areas that have been studied and are using this water by students for drinking and washing .This research was done in order to determine the effect of this gas , also natural waters contamination is a worldwide problem which deserves large attention not only due to its environmental hazards but also for the risks to the human health as well as the economical damages. Between the wide diversity of pollutant affecting water resources occurrence of these ions receives particular concern considering their strong toxicity even at low concentrations.

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