Australian Journal of Basic and Applied Sciences, 8(8) Special 2014, Pages: 156-160

AENSI Journals

Australian Journal of Basic and Applied Sciences

ISSN:1991-8178

Journal home page: www.ajbasweb.com

Measurement and Study of Radioactive Radon Gas Concentrations in the Selected Samples of water for AL-Shomaly / Iraq

Wasan Mnati Mohammed

Department of Physics, College of Education for Pure Sciences, University of Babylon.

ARTICLE INFO

Article history:
Received 25 April 2014
Received in revised form
18 May 2014
Accepted 28 May 2014
Available online 2 June 2014

Keywords:
radon concentrations, River Hilla, Annual effective dose, RAD7.

ABSTRACT

This research measuring the radioactive gas radon in samples of drinking water in the AL-Shomaly of Babylon (100 Km) south of capital Baghdad Was chosen as the water by 128 sample from 12 regions by using the electronic radon detector RAD7, and the average concentration of radon was (0.29) Bq.L^{-1} , where the highest value (2.146) Bq.L^{-1} and the lowest value (0.036) Bq.L^{-1} , Has been chosen this subject of the current study of the importance of water in human life and living, and the lack of previous studies in the study area.

To Cite This Article: Wasan Mnati Mohammed, Measurement and Study of Radioactive Radon Gas Concentrations in the Selected Samples of water for AL-Shomaly / Iraq. ***Aust. J. Basic & Appl. Sci.,*** *8(8): 156-160, 2014*

INTRODUCTION

Radon is a naturally occurring, chemically inert, alpha particle emitting radioactive gas. This colorless, tasteless and odorless gas is produced by natural radioactive decay of uranium, radium and thorium found in trace amounts everywhere in the rocks and soils of the Earth's crust (Reid, J.M., 1986). The three naturally occurring isotopes of radon are radon (^{222} Rn) is produced from the decay of ^{238}U having natural abundance of about 99.3% of the total uranium within the Earth's crust, thoron(^{220}Rn) is produced in nature during the decay of ^{232}Th and action(^{219} Rn) is formed during the decay of ^{235}U (Gillmore, G.K. and N. Jabarivasal, 2010). The most stable and abundant isotope of radon is(^{222} Rn) which has a half-life of 3.8 days. It decays by emitting an (α) particle of (5.49 MeV) and creates radioactive daughters. (Reid, J.M., 1986; Gillmore, G.K. and N. Jabarivasal, 2010).

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. (This is similar to carbonated soda drinks where carbon dioxide is dissolved in the soda and is released when you open the bottle) (Nour, S., *et al*., 2008). Some radon stays in the water. Radon generally is not a concern in water that comes from lakes, rivers, and reservoirs (surface water), because the radon is released into the air before it reaches the tap (Gillmore, G.K. and N. Jabarivasal, 2010; Nour, S., *et al*., 2008).

Radon is the major source of naturally occurring radiation exposure for humans Exposure occurs via the ingestion of radon dissolved in water and the inhalation of airborne radon. According to EPA (Khattak, N.U., *et al*., 2011), ^{222}Rn is the second leading cause of lung cancer in the U.S, smoking being the first. The nature of building materials, soil, and water used for drinking and other domestic applications can make variable contributions to the radon level in indoor environment (Khattak, N.U., *et al*., 2011).

Location of The Study Area:

Study area is located in the province of Babylon (100 Km) south of the capital Baghdad, where the city of Hilla, which has an area of (49.816) km^2 on both sides of the River Hilla (a branch of the Euphrates River), at Latitude(29´ 32˚) north, longitude (26´ 44˚) east ,as shown in Fig. (1). Geographical location (of the River Hilla) is located in the center of the province of Babylon approximately between longitudes (15´ 44˚) and (44˚ 50´) east and the constituencies of latitude (32˚ 15´) and (32˚ 44´) north (Bashar fuad Abbas Maroof, 2008) and a length of the study area (17.673) km.

Corresponding Author: Wasan Mnati Mohammed, Department of Physics, College of Education for Pure Sciences, University of Babylon.

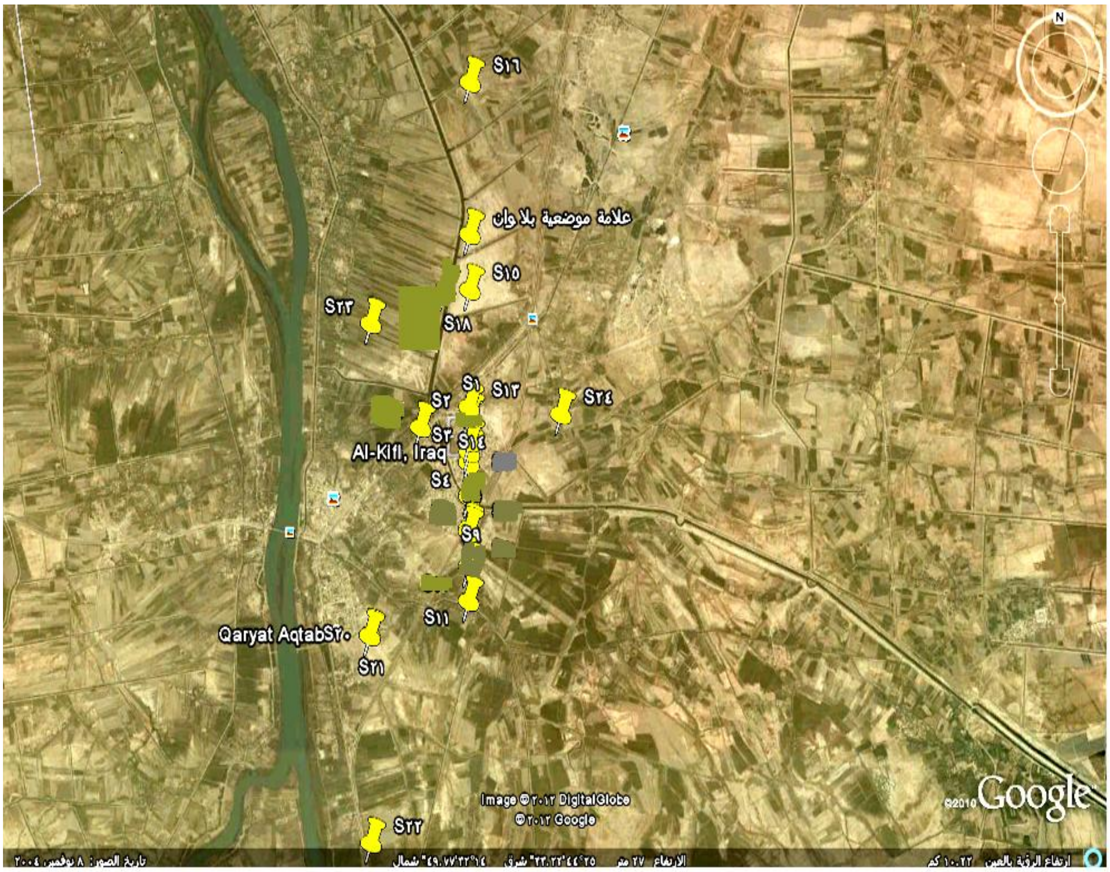
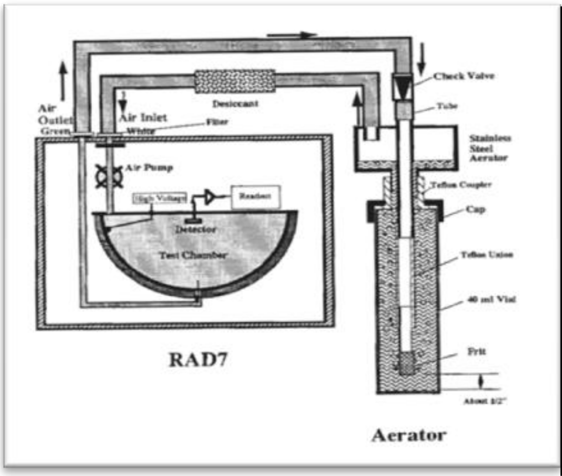


Fig. 1: Map of drinking water of showing sampling locations (Visual artificial lunar satellite Landsat 7, 2005) Where S refers to the Sample

Experimental Part:

RAD7 a radon-in-air monitor of Durridge Company of USA was used for monitoring radon concentration in 88 water samples collected from 22 regions different locations within River Hilla and adjoining area using the RAD H_2O technique (Durridge Company Inc., 2012). The RAD H_2O 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 (Durridge Company Inc., 2012). The RAD H_2O 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. 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. For a 250 mL vial of water sample conversion coefficient of 4 has been derived from the volume of the air loop, the volume of the sample and the equilibrium radon distribution coefficient at room temperature. The method makes use of a closed loop aeration design in which the air volume and water volume are kept constant and are independent of the flow rate (Durridge Company Inc., 2012).

The RAD H_2O setup consists of three components, namely, (Durridge Company Inc., 2012) (a) the RAD7 radon monitor, on the left, (b) the water vial with aerator, in the case near the front, and (c) the tube of desiccant, supported by the retort stand above as shown in Fig.(2). Diagrammatic illustrations of the radon-monitor, RAD7with RAD H_2O accessory for measuring radon in water samples has been shown in the Fig.(3). Care must be taken in taking the water sample such that it has never been in contact with the open air. A choice of selection among two different protocols (Wat 40 and Wat 250) is available in the setup of RAD7 for a user enabling him to calculate radon concentration in vials of two different (40 or 250 mL) supplied with the equipment. In our case we used vials of 250 mL capacity (Durridge Company Inc., 2012).



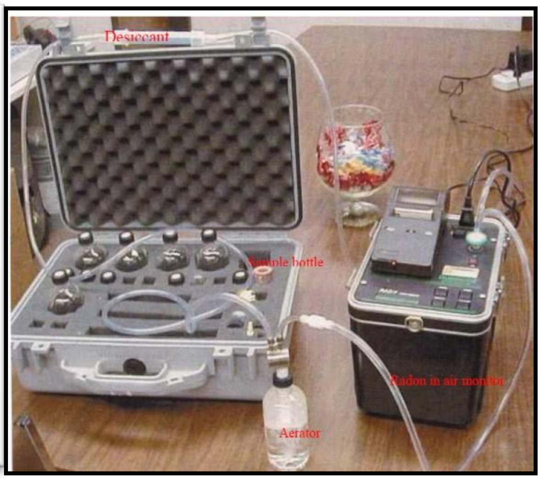


Fig. 3: Schematic diagram of RAD7, a solid state, ion implanted, planar Silicon alpha detector with RAD H2O assembly in (Durridge Company Inc., 2012)

Fig. 2: Diagram showing arrangement of apparatus for measuring radon content water sample in a 250 mL vial (Durridge Company Inc., 2012)

A water test in a pre-set Wat 250 protocol is normally completed in 30 min time. At the beginning of a test the inbuilt pump of RAD7 starts running automatically for 5 min duration, aerating the sample and delivering the degassed radon to the RAD7 measuring chamber. During the 5 min of aeration, more than 94% of the available radon is removed from the water. After 5 min operation the pump stops automatically and the system then wait for a further 5 min interval. After that the system then starts counting. After 5 min, the system prints out a short-form report for a 5 min cycle (Khattak, N.U., *et al*., 2011; Durridge Company Inc., 2012). The same thing happens again5 min afterward, and for two more 5-min periods after that. At the end of the run (30 min after the start), the RAD7 prints out a summary, showing the average radon concentration in four counted cycles each of 5 min duration, a bar chart of the four readings, and a cumulative spectrum. The radon concentration shown is that of the water, and is calculated automatically by the RAD7 (Durridge Company Inc., 2012; Somashekar, R.K. and P. Ravikumar, 2010).

The annual effective dose to an individual consumer due to intake of radon from drinking water is evaluated using the Eq. (1) (Somashekar, R.K. and P. Ravikumar, 2010), as shown in the table (1).

$$D_w = C_w \, C_{Rw} \, D_{cw} \quad (1)$$

where D_w is the annual effective dose (Sv y^{-1}) , C_w concentration of ^{222}Rn(Bq. L^{-1}) C_{Rw} annual intake of drinking water (1095 L y^{-1}), D_{cw} is the ingested dose conversion factor for ^{222}Rn (4 Sv Bq^{-1}). (Durridge Company Inc., 2012; Somashekar, R.K. and P. Ravikumar, 2010).

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($Bq.L^{-1}$).

Table 1: Radioactive radon gas concentrations in samples from the water for AL-Shomaly

Sample Point	Mean ($Bq.L^{-1}$)	High ($Bq.L^{-1}$)	Low ($Bq.L^{-1}$)	Samples location
S1	0.072 ±0.07	0.145	0	N 32º,32′, 17. 0″ E 44º,24′,39.3″
S2	0.036 ±0.07	0.145	0	N 32º,31′, 22. 0″ E 44º,24′,53.2″
S3	0.108 ± .13	0.288	0	N 32º,31′, 10. 35″ E 44º,25′,23.9″
S4	0.072 ±0 .08	0.145	0	N 32º,31′,00. 4″ E 44º,25′,52.6″
S5	0.43 ± 0.2	0.579	0.144	N 32º,30′, 17. 2″ E 44º,26′,12.1″
S6	0.036 ± 0.07	.145	0	N32º,29′, 27. 6″ E 44º,26′,00.6″
S7	0.144 ± 0.11	0.288	0.0	N 32º,30′, 55. 8″

				E 44º,26′,12.7″
S8	0.145 ± 0.12	0.288	0.0	N 32º,28′, 02. 6″ E 44º,26′,29.4″
S9	0.144 ± 0.19	0.290	0.0	N 32º,28′, 43.2″ E 44º,26′,21.9″
S10	0.072 ±0.08	0.145	0.0	N 32º,28′, 02. 8″ E 44º,26′,21.2″
S11	0.072 ±0.083	0.145	0.0	N32º,29′, 41.3″ E 44º,25′,54.1″
S12	2.146 ± 0.63	2.46	1.95	N32º,29′, 12. 1″ E 44º,26′,23.2″

The results of the examination of water samples for Shomaly shown in the table (1) that there is variation in the measurement results for models of water in different locations as shown in Figure (4) , so were found to vary from (2.146± 0.626) $Bq.L^{-1}$ to (0.036± 0.07) $Bq.L^{-1}$ with an average the concentration of radon (0.29±0.05) $Bq.L^{-1}$, where shows that the highest average in the value of S12 (2.146) $Bq.L^{-1}$ and then followed by the value of S5 (0.43) $Bq.L^{-1}$ and then S8 (0.145) $Bq.L^{-1}$ and both S7, S9 (0.144) $Bq.L^{-1}$,S3 (0.108) $Bq.L^{-1}$ and the other samples ranged between (0.0362, 0.072) $Bq.L^{-1}$.and 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 high concentrations of radon in the surface waters be small compared to groundwater (Gillmore, G.K. and N. Jabarivasal, 2010; Maged, A.F. 2009; Jonsson, G., 1991).

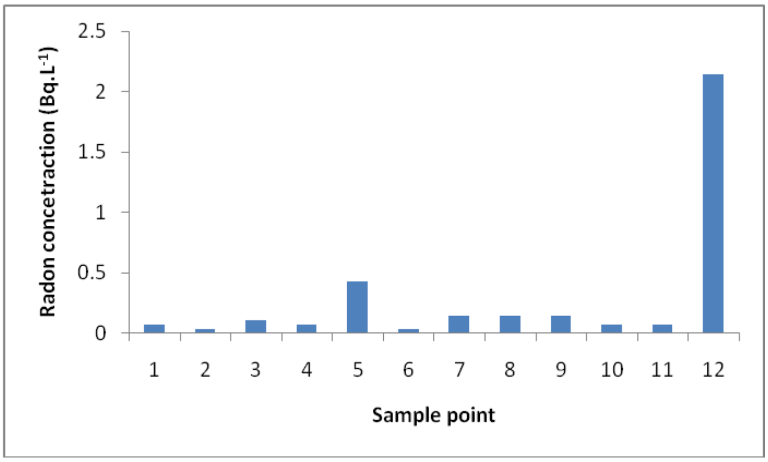


Fig. 4: Bar diagram showing variation in radon concentration of the water samples

By comparing the results of this study with the studies described in the table (2), we find that the average concentration of radon in water lower as compared with these studies :

Table 2: shows the average of radon concentration in the water for some countries compared to the present research

country	Radon concentration average	
Iraq- Nenava	Sabah Yousif Hassan Ukla, 2004	1.133 $Bq.L^{-1}$
present study	Iraq-Alshomaly 0.29 $Bq.L^{-1}$	
Turkey	Canbazoğlu, C., *et la.*, 2012	0.091 $Bq.L^{-1}$
Kuwait	Maged, A.F. 2009	0.74 $Bq.L^{-1}$
Syria	Jonsson, G., 1991	13 $Bq.L^{-1}$
Iran	Behtash, A., *et al.*, 2012	(0.21-3.89) $Bq.L^{-1}$
Jordon	Al-Kazwini, A.T. and M.A. Hasan, 2003	3.9 $Bq.L^{-1}$
Khartoum	Sam, A.K., H. Idriss and I. Salih, 2011	59.2 $Bq.L^{-1}$
Algeria	Amrani, D., 2002	7 $Bq.L^{-1}$

Conclusions:

The study of radon in water showed all samples tested had radon activity concentrations well below the recommended EC (2001) action level of 1 $MBq.m^{-3}$ the related by organizations as the maximum allowable concentration of radon in water (11$Bq.L^{-1}$) (As defined by the Environmental Protection Agency EPA) (Environmental Protection Agency, 2009) and the effective dose in the River Hilla was 0.45 $mSv. y^{-1}$. This study is the first of its kind in the province of Babylon necessitating larger and more comprehensive studies of all areas of the province

REFERENCES

(European Commission Recommendation) E.C., 2001.On the protection of the public against exposure to radon in drinking water supplies. Official Journal of the European Communities, L344: 85-88.

Al-Kazwini, A.T. and M.A. Hasan, 2003.“Radon Concentration in Jordanian Drinking Water and Hot Springs”. Institute of Physics Publishing, J. Radiol. Port., 23: 439-448.

Amrani, D., 2002." Natural radioactivity in Algerian bottled mineral waters", Journal of Radioanalytical and Nuclear Chemistry, 252(3): 597-600.

Bashar fuad Abbas Maroof, 2008." The Influence of Human Activity in the Temporal and Local Variation of AL – Hilla River Water Pollution", M .Sc., University of Babylon, College of Education.

Behtash, A., A. Jalili-Majareshin and D. Rezaei-Ochbelagh, 2012. "Radon concentration in hot springs of the touristic city of Sarein and methods to reduce radon in water", Radiation Physics and Chemistry, 81: 749-757.

Canbazoğlu, C., M. Doğru, N. çelebi and G. Kopuz, 2012."Assessment of natural radioactivity in Elazıg region eastern Turkey", Journal of Radioanalytical and Nuclear Chemistry, 292: 375-380.

Durridge Company Inc., 2012. Manual CAPTURE version 4.7.5.

Durridge Company Inc., 2012. RAD7 RADH$_2$O Radon in Water Accessory. Owner's Manual.

Durridge Company Inc., 2012. RAD7 Radon Detector. User Manual.

Environmental Protection Agency, 2009. United States Environmental Protection Agency. A citizen’s guide to radon.

Gillmore, G.K. and N. Jabarivasal, 2010. " A reconnaissance study of radon concentrations in Hamadan city, Iran", Natural Hazards and Earth System Sciences, 10: 857-863.

Jonsson, G., 1991. "Solid State Nuclear Track Detector in Radon Measurement Indoor and Soil". Nucl. Tracks Radiat. Meas., 25: 335-338.

Khattak, N.U., M.A. Khan, M.T. Shah and M.W. Javed, 2011." Radon concentration in drinking water sources of the Main Campus of the University of Peshawar and surrounding areas, Khyber Pakhtunkhwa, Pakistan", Journal of Radioanalytical and Nuclear Chemistry, 290: 493-505.

Maged, A.F. 2009."Estimating the radon concentration in water and indoor air ", Environ Monit Assess, 152: 195-201.

Nour, S., H. Kurosaki, K. Inn, J. La Rosa, L. Lucas, P. Volkovitsky and Outola K. Koepenick, 2008." Investigation of radioactivity in selected drinking water samples from Maryland ", Journal of Radioanalytical and Nuclear Chemistry, 277(1): 155-159.

Reid, J.M., 1986. " The Atomic Nucleus", (Manchester University Press), second edition.

Sabah Yousif Hassan Ukla, 2004. " Determination of Radon, Uranium and Other Radioactive Isotopes Concentration In Different Types of Natural Water In Nenava Governorate", M .Sc., University of Mosul.

Sam, A.K., H. Idriss and I. Salih, 2011." Study of radon in ground water and physicochemical parameters in Khartoum state", Journal of Radioanalytical and Nuclear Chemistry, 290: 333-338.

Somashekar, R.K. and P. Ravikumar, 2010. "Radon concentration in groundwater of Varahi and Markandeya river basins, Karnataka State, India", Journal of Radioanalytical and Nuclear Chemistry, 285: 343-351.

Visual artificial lunar satellite Landsat 7, 2005. Packages (1,2,3), Landsat .gsfc.gov.