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STUDY OF TIME MEASURED FACTOR ON MEASURING RADON CONCENTRATIONS IN GROUNDWATER

Abstract: *Radon concentration measurements were performed in all 24 samples of ground water at four locations in Al-Haidariya hand in Najaf, Iraq, using active RAD-7 continual radon measuring instruments. The radon concentrations were measured at different time (0, 24, 48, 72, 96 and 120) hour for determining daily correction factor in groundwater samples using the least-squares fitting method.*

The experimental results show that the radon concentration at low and high time of measuring for all location in this study were varied from (1130±220 to 443±96.54) mBq/l at (l location), from (1180±184 to 339±66.14) mBq/l at 2 location, from (1049±166 to 542±90.65) mBq/l at 3 location and from (1270±190 to 625±86.32) mBq/l at 4 location, therefore the radon concentration increased with decrease time of measuring samples. The main finding of the least-squares fitting method investigation is that use present study, experimentally observed, the radon concentration can be determined theoretically by depending on the semprical formula which it was determined at different location.

This study proved that can be determined radon concentrations in water using RAD-7 detector at any day of measurement depending on the daily correction.

Key words: *RAD-7, Daily correction factor, Radon concentration in groundwater and Al-Haidariya hand in Najaf.*

Language: *English*

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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[1] . 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[2] . Radon moves from its source in rocks and soils through voids and fractures. It can enter buildings as a gas through foundation cracks or dissolve in the ground water and be carried to water-supply wells.

Radon-222 concentrations in ground water vary because of variable concentrations of sources in the aquifer materials, emanation rates from mineral sources, aquifer porosity, and permeability.

There are some scientists modernly using RAD7 detector to measure radon concentrations in groundwater[3-6].

The aim of the present work, radon concentration were measured in four a location of

Al-Haidariya hand in Najaf, Iraq at different time (0,24, 48, 72, 98 and 120 hour) using RAD-7 detector. Also study of effected time measurement on radon concentration using the least-squares fitting method and applied to find the parameters necessary to estimate radon at any time of measurement.

Study Area

Najaf is a holy city in Iraq. Najaf is located in southern Iraq near the historic city of Kufa, it is the capital of the province of Najaf. Najaf is away from Baghdad about 160km in southern direction and away from Karbala about 80 km. in the direction of the north west. There are one of the hands in Al-Najaf city Al-Haidariya. Al-Haidariya hand in An Najaf (region) is a town in Iraq - about 82 mi (or 132 km) South of Baghdad, the country's capital city. Its center lies at a latitude of 32.1520200 and longitude of 44.4014200and it has an elevation of 22 meters above sea level. Figure (1) shows the area of study which it is selected the region under study[7-9].

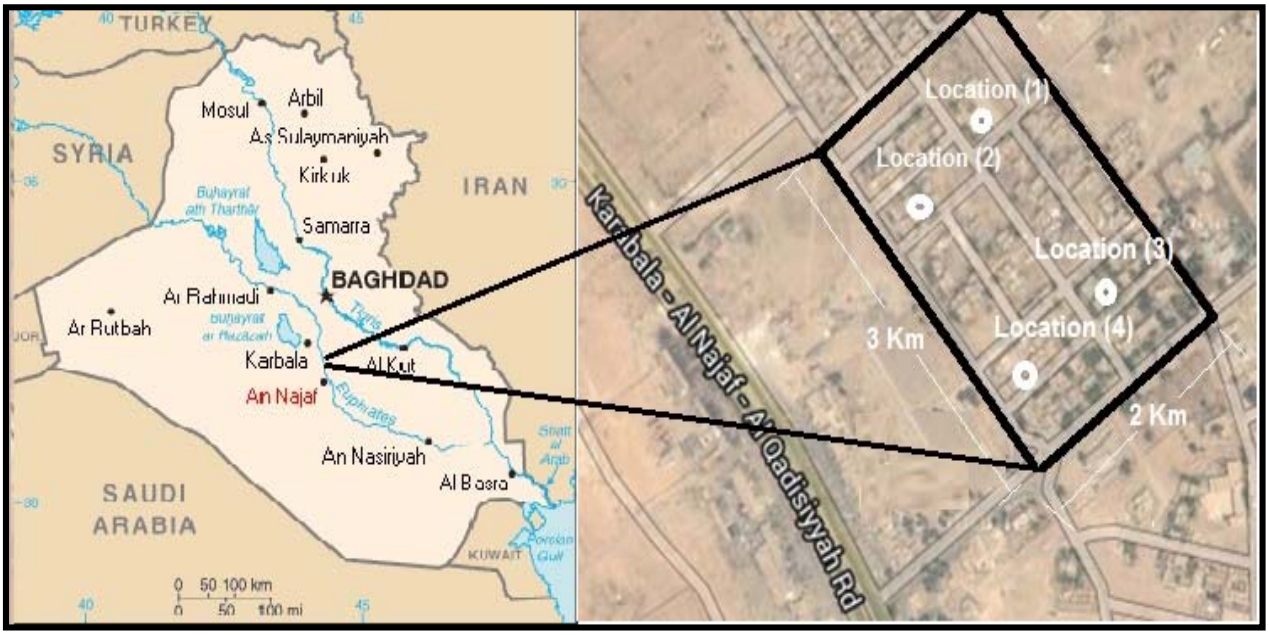

Figure 1 - Map of Al-Haidariya hand.

Material and Method

Location and Collection of the Samples

In the present study (4) location were chosen as fair distribution in Al-Haidariya hand in Najaf, Iraq. The methods which were used to collect the sample is described as follow: Five samples of groundwater are taken for each location at depth about over 10 m and for five time measurement over one week. The samples were kept in plastic container of volume 250 ml. These were measured at location with a portable RAD-7 detector.

Experimental Setup

In the interior of the measurement instrument RAD-7 (from Durridge) is a hemisphere with a silicon solid-state detector. The RAD H_2O is an accessory to the RAD-7 detector that enables the measurement radon in water over a concentration range from less than 30 pCi/L to greater than 105pCi/L. The lower limit of detection is less than 10 pCi/L. The equipment is portable and battery operated, and the measurement is fast. An accurate reading of radon in water within an hour of taking the sample can be read. The RAD H_20 gives results after 30 minutes analysis with a sensitivity that matches or exceeds that of liquid scintillation methods. The setup consists of three components, the RAD-7, on the left, the water vial with aerator. During the five minutes of aeration, more than 95% of the available radon is removed from the water. Fig. (1) shows the RAD-7- H_2o schematic .

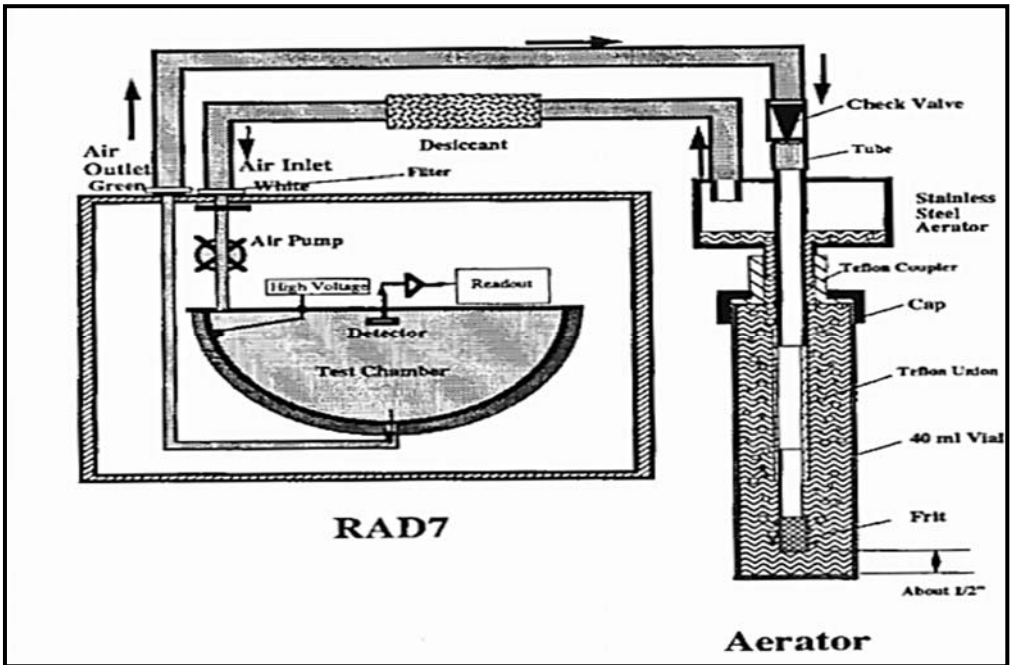

Figure 2 - Schematic diagram RAD-7- H_2o assembly [10].

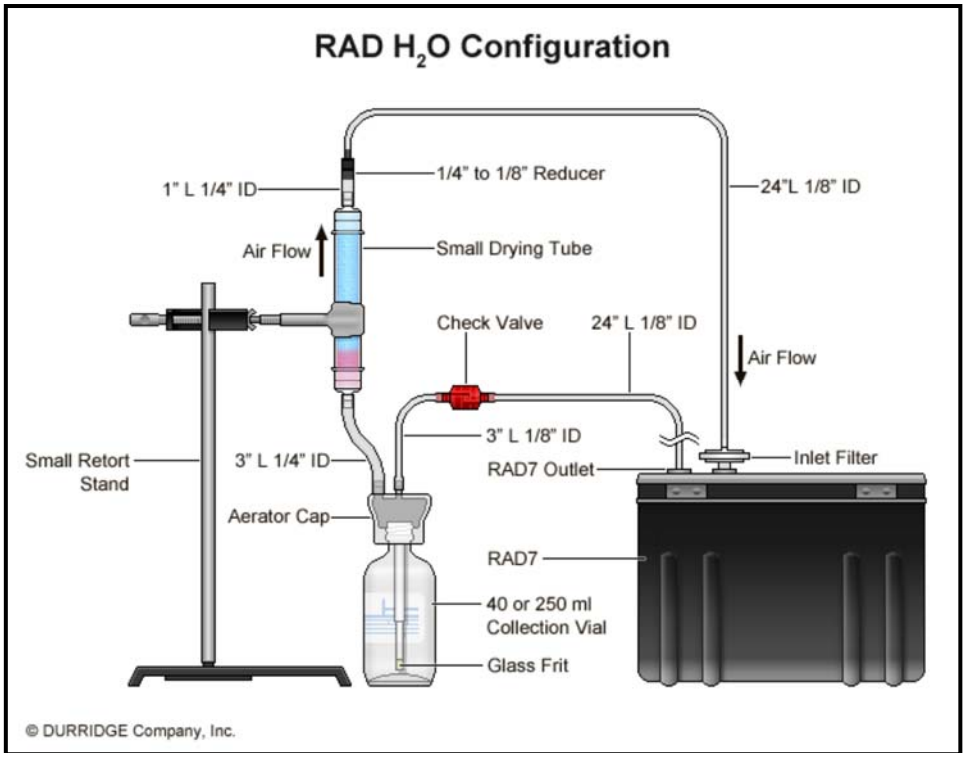

Figure 3 – Experimental laboratory set-up for Radon-in-water activity concentration measurements with Radon-in-air analyzer RAD7 plus the RADH2O accessory. Courtesy by Durridge, Inc. [11].

Theory of the least-squares fitting

The least-squares fitting are distinctive in the way that the solution is interpreted. the least-squares fitting problems usually incorporate some assumptions about the errors in the model. In this study the function is not linear because the radon gas decay as exponential carve so we using the nonlinear least-squares formulation method by math lab simulation program. The nonlinear least-squares formulation to fit a nonlinear model to data. This

method is defined as an equation that is nonlinear in the coefficients where the nonlinear models are more difficult to fit than linear models because the coefficients cannot be estimated using simple matrix techniques. This method is known as the method of least squares because the idea is to make the squares of the errors as small as possible. It is a method very widely used in statistics[12-14].

Result and Discussion:

Table (1) show the experimental results of average of radon concentration for unit (mBq/l) of ground water in four locations of Al-Haidariya hand in Najaf in different times (0, 24, 48, 72, 96 and 120) hour. Table (2) show the theoretical value of the radon concentrations in sample of groundwater at same time measured (0, 24, 48, 72, 96 and 120 hour) that it are calculated using the least-squares fitting method.

From Table (1) for all samples were found that the maximum value of radon concentration for all samples at different time measured is lower than the recorded values of radon concentration in groundwater which it is the safe limit of 11 Bq/l recommended by the US Environmental Protection Agency (USEPA)[15]. Also from Table (1), Table (2) and Figure (2), we are found that the radon concentration decreasing with increasing time measured. The reason for decreasing in radon concentration duo to the relation between radon concentration with time measured is decayed, therefore may be found the semprical formula (determined by the least-squares fitting) depending on experimental and theoretical results as the bellow equations:

$$\boldsymbol{Radon\ Concentrations(Exp.)}\left(\frac{mBq}{l}\right) = 1167.1e^{-0.007 \times Time\ Measured} \quad (1)$$

$$\boldsymbol{Radon\ Concentrations(Theo.)}\left(\frac{mBq}{l}\right) = 1155.5e^{-0.007 \times Time\ Measured} \quad (2)$$

From equations (1) and (2), we found that must factor be added the correction when it is measured Radon concentrations in water samples by RAD-7 detector at different times measured. Because the half- life of radon gas is 3.8 day and take samples in glass duo to escape of radon from the water sample.

Table 1

Experimental results of Radon concentrations in groundwater in Al-Haidariya Hand.

Time (hour)	Average of Radon Concentrations in (mBq/l)				
	Location 1	Location 2	Location 3	Location 4	Mean
0	1130±210.230	1180±207.001	1049±185.771	1270±189.076	1157.25±92.889
24	953±135.657	964±123.322	914±124.453	1102±125.448	983.25±87.175
48	792±101.765	770±90.078	807±106.670	960±110.980	832.25±98.869
72	667±98.980	587±84.879	712±92.098	832±89.903	699.5±110.622
96	553±90.901	4482±88.804	625±92.306	732±78.093	588±117.913
120	443±87.412	339±78.521	542±88.706	625±75.678	487.25±120.648

Table 2

Theoretical results of Radon concentrations in groundwater in Al-Haidariya Hand.

Time (hour)	Average of Radon Concentrations in (mBq/l)				
	Location 1	Location 2	Location 3	Location 4	Mean
0	1136.74	1183.198	1046.848	1269.573	1159.09
24	947.21	928.505	919.6	1104.597	974.978
48	789.28	728.637	807.82	961.059	821.699
72	657.68	571.792	709.627	836.174	693.818
96	548.03	448.71	623.369	727.516	586.906
120	456.65	352.121	547.597	632.978	497.337

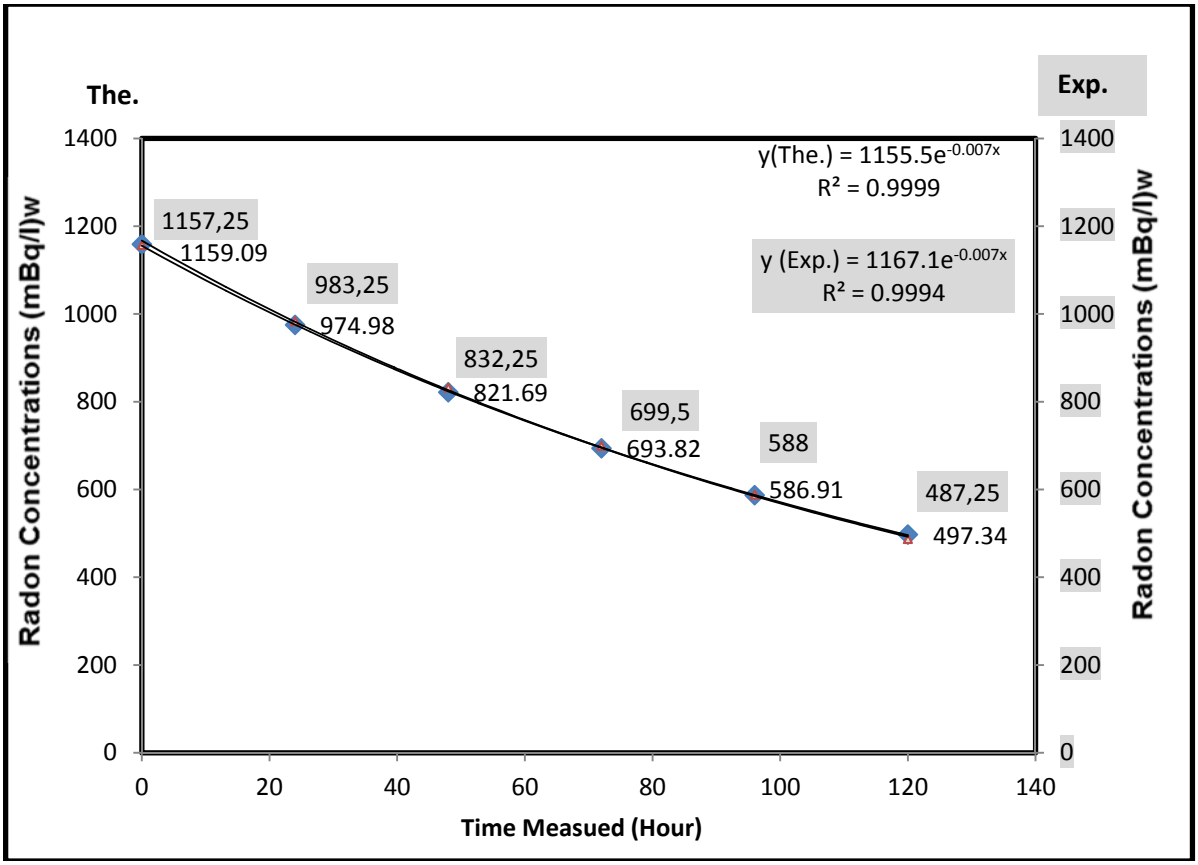

Figure (4) Relation between the average of Radon concentrations and time measured experimentally and theoretically.

From Figure (4) , we found perfect agreement between experimental and theoretical method for radon concentrations in groundwater samples, therefore, we can be found the radon concentrations for any time measured by theoretical method if we determined only the radon concentration at zero of time measured.

Conclusion:

The Radon concentrations in natural ground water of Al-Haidariya hand in Najaf, Iraqi district the water samples were collected are measured by RAD-7 technique at different times. All the Radon concentrations were observed that were well below the prescribed dose limit of the US Environmental Protection Agency (USEPA). The semprical formulas were found experimentaly and theoreticaly studies for determining the concentrations of Radon gas in groundwater at different time of measured. Also, we can be found the Radon concentrations for any time measured by theoretical method if we determined only the radon concentration at zero of time measured.

References:

1. Hem JD (1985) Study and interpretation of the chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, p.263.
2. Faure G (1986) Principles of isotope geology: New York, John Wiley and Sons, Inc., 589 p.
3. Surinder Singh, Arvind Kumar, Bikramjit Singh Bajwa, Sandeep Mahajan, Vinod Kumar and Sunil Dhar (2010) "Radon Monitoring in Soil Gas and Ground Water for Earthquake Prediction Studies in North West Himalayas, India", Terr. Atmos. Ocean. Sci., Vol. 21, No. 4, 685-695, August 2010.
4. Ali A. Al-Hamadwi, Abdulhussan A. Al.Bayati and Asia H. Al.Mashhadani (2012) Radon and Thoron Concentration measurement of Ground Water in Kufa City by using RAD7 detector", J. of kufa– phy., Vol.4, No.2, 44-49 ,2012.
5. Ali A. Abojassim (2013) Radon Concentrations Measurement for Drinking

Water in Kufa City /Iraq Using Active Detecting Method", Advances in Physics Theories and Applications, Vol. 26, 30-35, 2013.

6. Vikas Duggal, Rohit Mehra and Asha Rani (2013) Determination of ^{222} Rn levels in groundwater using RAD-7 detector in the bathinda district of Punjab,INDIA", Radiation Protection Dosimetry, Vol.18, 1–7, 2013
7. Jump up^ Nakash, Yitzhak (2003) The Shi'is of Iraq. Princeton University Press. Retrieved 2009-09-13.
8. Jump up^ Yitzhak Nakash (1994) The Shi'is of Iraq (Princeton: Princeton University Press, 1994) p. 16
9. Toynbee Arnold J (1935) Survey of International Affairs 1934. London: Oxford University Press. pp. 120–122.
10. (2012) DURRIDGE, RAD7 RADON DETECTOR. Owner's Manual (Bedford, MA.), 2012, USA.
11. (2012) DURRIDGE, RAD7 RADH20 Radon in Water Accessory. Owner's Manual (Bedford, MA.), 2012, USA.
12. K.Madsen, H.B. Nielsen and O. Tingleff (2006) Methodes for non-linear least squares problem", infomatics and mathematical modeling technical university of Denmark, 2nd Edition, non-linear time series", J. arxiv math. Phy. Vol.19, 2006.
13. M. Sari (2012) "An improved method of fitting experimental data to the Hoek-Brown failure criterion", Engineering Geology, No.127, pp.27-35.
14. (1991) United States Environmental Protection Agency (USEPA). Federal Register 40 Parts 141 and 142: national primary drinking water regulations; radionuclides: proposed rule. U.S. Government Printing Office.