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RADON CONCENTRATION OF GROUND WATER IN BABYLON GOVERNORATE

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ABSTRACT

Groundwater samples were collected from seven wells from different sites of Babylon governorate, research measured values of concentrations in ground water of Babylon governorate by a radon interpretation technique using utilizing electron radon detector RAD7H$_2$O. The values of the concentration range from (1.70) Bq L^{-1} to (5.83) Bq L^{-1}.

Keywords: *Groundwater, Babylon governorate, electron radon detector RAD7H$_2$O*

INTRODUCTION

^{222}Rn, commonly called radon, is a naturally occurring colorless, odorless, and invisible radioactive gas resulting from the decay of ^{226}Ra in the uranium-series decay chain. It is commonly transported freely via faults and fragmented rocks and soils to the open atmosphere, surface dwellings, underground water and cavities [1].

Radon-222 (222Rn) is a naturally occurring radionuclide; it is a gas which is formed by a series radioactive decay of uranium-238 (238U). Radium -226 (226Ra) is the parent radionuclide of 222Rn in the decay series and 226Ra is found in a wide variety of rocks and soils.

Volcanic rocks in the Rocky Mountain region possess a high 222Rn generating potential. Therefore colluviums and alluvium originated from uranium bearing rocks present moderate to high 222Rn generating potential and they are abundant in Idaho [2]. Radon is the number one cause of lung cancer among non-smokers; overall, radon is the second leading cause of lung cancer and is responsible for about 21,000 lung cancer deaths every year [3]. 222Rn gas generated from the colluviums and alluvium can enter groundwater by dissolution.

Numerous factors such as geology, geochemical properties of parent radio nuclides, hydrological conditions, abundance of parent radio nuclides, and radio nuclides sorbent by the rocks or soils are potential parameters that can affect the concentration of 222Rn in groundwater [4].

The United States Environmental Protection Agency (USEPA) is in campaign to promote Radon testing and mitigation and radon resistance construction practices. The month of January is recognized as National Radon Action Month by the USEPA [5].The USEPA recommended zero concentration of 222Rn in drinking water and this has been proposed as maximum contaminate level goal (MCLG) since 1999 ;however , this limit is anon – enforceable limit [6].

In the Safe Drinking Water Act Amendments of 1996 the USEPA has recommended the maximum level (MCL) for 222Rn in drinking water as 11 Bq/ L (300pCi/L).

This limit should be followed if there is no indoor air multimedia mitigation (MMM) program Implemented for public water treatment and supply system. If a MMM program is implemented, then the limit for 222Rn becomes 148 Bq/L (4000pCi/L) [4,5] Presumably , the

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MMM program would reduce the fugitive 222Rn gas escaped from the drinking water to an acceptable risk level . Although this rule should only be followed by public water suppliers, private wells and water providers should also follow the recommended MCL due to health concerns. Idaho Department of Environmental Quality (IDEQ) neither regulates 222Rn in drinking water , nor does it have any MMM programs for the state .Nevertheless if human health is a priority , 222Rn concentration in the drinking water should be below 11 Bq/L when it is consumed domestically without a MMM program.

Radon from the groundwater can enter our living environment by various routes: such as Rn gas released from water in showering, dishwashing, and laundry [7]. Direct inhalation is probably the most likely mechanism that radon^{222}Rn, enters into our body, although other route such as dermal sorption is possible. High concentrations of 222Rn in water may pose a serious health threat to human as 222Rn is a known carcinogen [5].

Hopke *et al.* [8] have listed inhalation and ingestion risk for 222Rn in water: the authors estimated a lifetime risk of lung cancer for a mixed population that included smokers and nonsmokers in men and women as a result of air exposure to 222Rn generating from 222Rn water with concentration of 0.0009 Bq/L as 1.3 x 10^{-8}. For the same 222Rn water concentration the lifetime risk of stomach cancer was reported as 0.2 x 10^{-8}, the lung cancer risk was more than six times of the stomach cancer risk.

Although these risk factors are relatively low, the aforementioned concentration in water from the report was also orders of magnitude (10,000 times) lower than the 11 Bq/L limit. species in groundwater and the proposed MCL of 11 Bq/L (300 pCi/L) as the reference concentration for our discussions commonly called radon, is a naturally occurring colorless, odorless, and invisible radioactive gas resulting from the decay of ^{226}Ra in the uranium-series decay chain. It is commonly transported freely via faults and fragmented rocks and soils to the open atmosphere, surface dwellings, underground water and cavities [1].

As explained above radon (^{222}Rn) is emitted by the decay of 222Ra, an element of the ^{238}U decay series. Radon-222 decays into a series of other radioactive elements, of which ^{214}Po and ^{218}Po are the most significant, as they contribute the majority of radiation dose when inhaled. Following a number of decay series, ^{218}Po transforms into ^{210}Po and it decays into stable ^{206}Pb.

The ^{222}Rn and its decay products are reported as major causes of lung cancer (UNSCEAR, 2000a, b; ICRP, 1987), especially when they are inhaled attached to dust particles in the air. The ^{222}Rn exists in soil and water, and propagates into the atmosphere from these natural sources. Meteorological parameters such as temperature, pressure differences, and humidity also affect indoor^{222}Rn concentrations. Levels of ^{222}Rn can also be modified by the ventilation conditions, heating cooling systems and the life style of inhabitants [9, 10].

It is believed that average concentration of uranium in earth's crust is about 4 mg/kg. This radioactive element decays into numerous other radioactive isotopes including ^{222}Rn [11].

EXPERIMENTAL PART

In this research, samples were collected from seven wells **(2-2.5)** m depth from different sites of Babylon Governorate. The measurements achieve by RAD7H20as in figure (1) shows the concentrations of radon in ground water in some sites in Babylon Province and (fig.2) shows theRAD7H2O instrument .

Table 1. The concentration of radon in ground water of Babylon

Sequence	*1st Reading*	*2nd Reading*	*3rd Reading*	*4th Reading*	*Mean Bq L^{-1}*	*±S. D*
1	5.360	5.50	6.08	6.37	5.830	0.479
2	3.91	3.48	2.32	2.61	3.08	0.742
3	2.75	3.04	2.17	2.750	2.68	0.365
4	2.32	3.62	6.81	5.650	4.60	0.464
5	2.03	2.46	1.880	1.59	1.99	0.362
6	2.030	1.880	2.460	1.390	2.000	0.362
7	1.160	2.030	0.1300	2.320	1.700	0.559

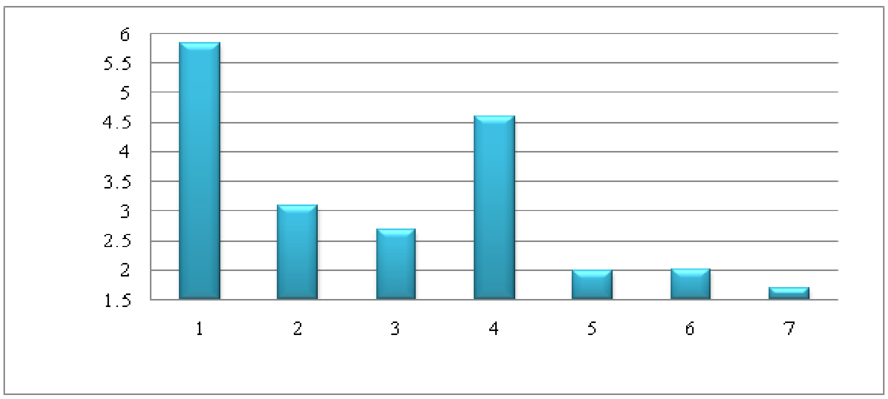

Figure 1. The concentrations of radon in ground water in some sites in Babylon Province

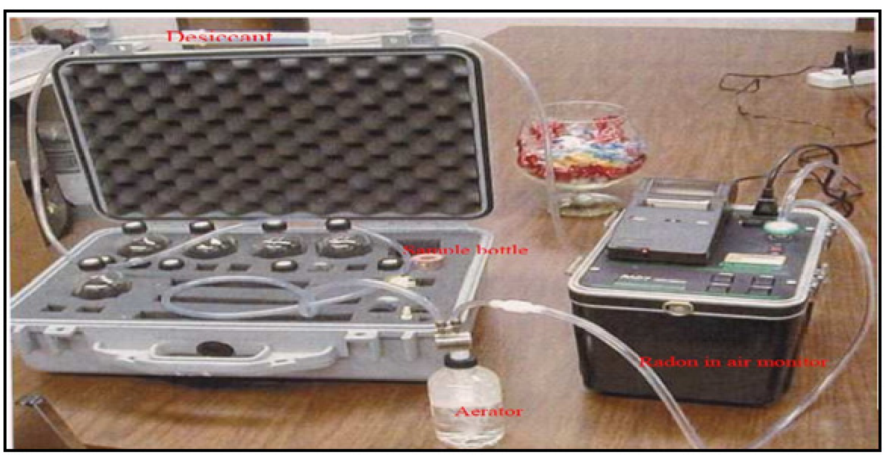

Figure 2. RAD7H2O

CONCLUSION AND DISCUSSION

The results in the above table can be appearance the overall radon concentration level, it can be seen that radon activity varies from (1.70)Bq L^{-1} to (5.83) Bq L^{-1} with an average value of (3.126) Bq L^{-}

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[1]The result sample within the US Environmental Protection Agency Maximum Contaminant Level of 11.1 Bq. L^{-1}

The spatial variation in radon concentration could be a function of the geological structure of water, depth of the water source and also differences in the climate and geo-hydrological processes that occurs of area.

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