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SHORT COMMUNICATION

Measurement the of radon gas concentrations of soil samples in Ishtar residential gleaner at the Tuwaitha nuclear site

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ABSTRACT

Radon irradiated and its solid products are the largest contributors to. Its concentration in soil gas is much greater than that of other sources. Therefore, the total inhalation dose and are harmful to human health it is necessary to measure the concentration of radon in the soil. This study investigated the measurements of radon irradiated ^{222}Rn concentrations at 20 sites of the Ishtar residential gleaner at the Tuwaitha nuclear site using the RADON electronic detector manufactured by RAD7 (Durridge Company Inc., USA). Measurements were carried out at a depth of (10 cm), (A_{10} region) which was equal to (1590±176 Bq/m^3), while the lowest average radon gas concentration was found in (A_{17} region) which was equal to (130±36.6 Bq/m^3), with an average value of (698±162 Bq/m^3), The results obtained from this study indicate .The present results in all areas of study have shown that the radon gas concentrations in soil samples were higher value of the recommended value (200 Bq/m^3) given by (ICRP, 1993).

***Keywords*:** Rad-7 detector, ^{222}Rn gas, Tuwaitha site

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1. INTRODUCTION

Gaseous radioactive ^{222}Rn gas, decay product of ^{226}Ra isotope is present in all the types of rock and soil. ^{226}Ra Ra-226 atoms decays in soil particles, the resulting atoms of ^{222}Rn entering to air filled pores and then transported by advection and diffusion through this space in order to exhale into the atmosphere. Radon (^{222}Rn) is a natural inert radioactive tasteless and odorless gas, whose density is 7.5 times higher than that of air. It dissolves in water and can readily diffuse with gases and water vapor, thus building up significant concentration. ^{222}Rn concentrations in soil gas within a few meters of the surface ground are obviously important in determining radon rates of entry into pore spaces and then into atmosphere. The measurement of ^{222}Rn concentration in soil gas, in principle, can be used as a method of evaluating the potential for elevated indoor ^{222}Rn concentrations. ^{222}Rn gas can diffuse easily out of surface soil into houses or air; it can be trapped in poorly ventilated houses and so its concentration can build up to higher levels. Although soil is considered to be the main source of indoor radon concentration, raw building materials (cement, gravel, especially, etc.) can make a significant contribution to the level of natural radioactivity in closed spaces such as stores and badly ventilated houses. Moreover, the production rate of ^{222}Rn in houses depends on the concentration of ^{226}Ra content in the subsoil, building materials, and porosity as well as that the density of the wall materials. The emission of ^{222}Rn from the building materials is found to be a function of ventilation as well as of the ^{226}Ra content in building materials. The nongaseous ^{222}Rn decay products are partially hanging in air as a mixture of attached and detached fractions and partly deposited on walls and furniture [1-9].

2. EXPERIMENTAL TECHNIQUE

The RAD-7 radon detector uses a solid state detector see Figure (1), This alpha detector is a silicon ion-implanted detector, The semiconductor material converts the alpha radiation from the decay of the radionuclide (e.g. ^{214}Po or ^{218}Po) into an electrical signal, One advantage of a solid state detector in radon or radon progeny detection is the fact that it can electronically determine the energy associated with the incoming alpha particle. In this way, the specific radionuclide can be identified [6]. ^{218}Po with an alpha radiation of 6.00 MeV or ^{214}Po with an energy of 7.69 MeV, The RAD-7 possesses an internal sample cell of about 0.7 liter and has a hemispherical shape as can be observed in Figure (1). The inside of the hemisphere is coated with an electrical conductor and a high voltage power supply charges the inside of the conductor to a potential of about (2000-2500) Volts relative to the detector, This creates an electrical field throughout the cell, The electrical field propels the positively charged particles onto the detector in the periodic-fill cell. A decaying ^{222}Rn atom within the cell leaves behind a positively charged ^{218}Po, which is accelerated onto the detector and sticks to it, The ^{218}Po nucleus has a relatively short half-lifeand when it decays, it will have a 50% chance of entering the detector where it will produce an electrical signal, and the energy of the alpha particle can be identified, The electrical signal recorded from the decay of the radionuclide is then amplified, filtered and then sorted according to its strength, Different modes of functionality of the RAD-7 allow for detection of radon from the ^{218}Po signal, but it can also determine the thoron (^{220}Rn) concentration from the ^{216}Po signal, The ^{218}Po and ^{216}Po

signals arise from the 6.00 and 6.78 MeV alpha decays respectively, and the alpha energies from the other decay products are ignored.

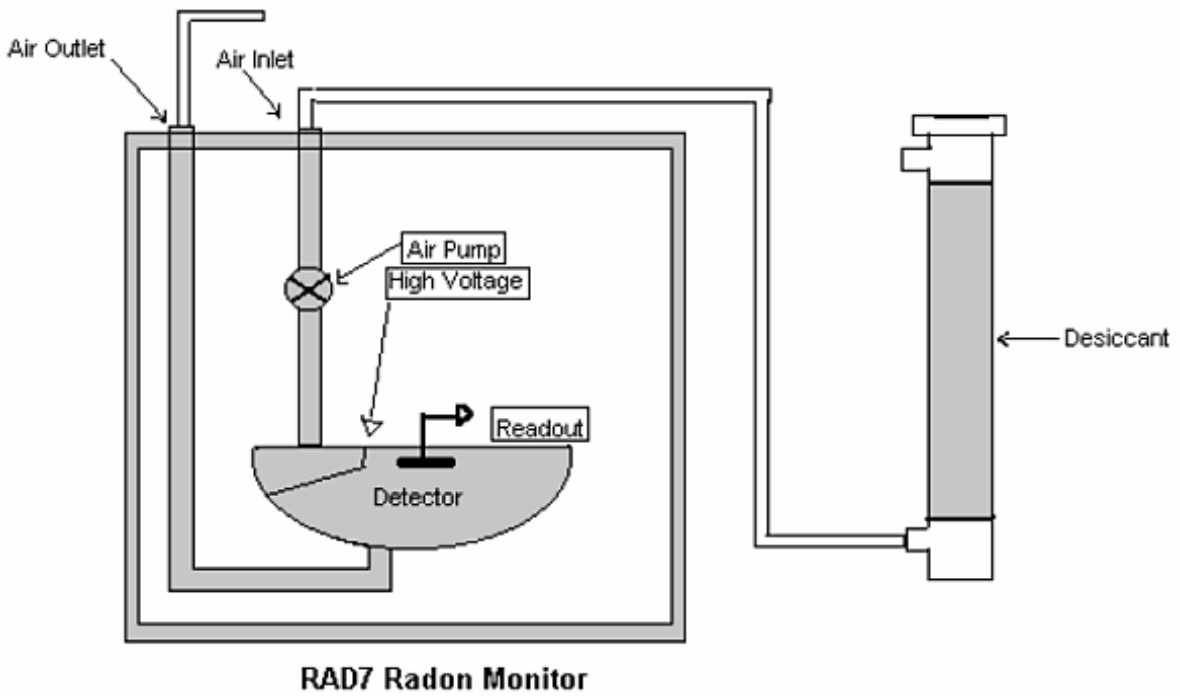

Figure 1. Schematic of the RAD-7. Special emphasis is put on the hemispherical shaped periodic-fill cell, the high voltage power supply inside the detector as well as the air pump that samples the air to be analyzed.

3. DESCRIPTION OF STUDY AREA

Figure 2. Sketch map showing locations for the studied sites in Ishtar residential gleaner.

Tuwaitha Nuclear Research Center covers an area about 1.3 km^2 and is located approximately 1 km east of the Tigris River 18 km south of Baghdad., there are number of sites in Iraq which have been used for nuclear activities and which contain potentially significant amounts of radioactive material. The principal nuclear site is Al Tuwaitha nuclear research center which contains about 18 facilities including Research reactors, hot cells, waste treatment and storage facilities. Al Tuwaitha site considered as unique case most of its facilities suffer substantial physical damage during the Gulf Wars and have been subjected to subsequent looting. Despite the long history of nuclear programs at Al Tuwaitha no significant radioactive contamination as a result of normal operations has been officially reported for the site or surrounding communities Radionuclide's are present in the environment and within the remaining structures. Location of these facilities are shown in Figure (2).

Table 1. Sample name, mean of radon gas concentration soil samples, temperature for depth (10 cm) in Anbar governorate.

Sample name	Coordinates		Mean of Radon Concentration ($Bq.m^{-3}$)	Temperature °C
	N	E		
A1	**33.192953**	**44.534839**	517±123	19.1
A2	**33.190758**	**44.529786**	1290±304	21.0
A3	**33.192725**	**44.533486**	698±237	17.0
A4	**33.193100**	**44.533947**	130±62.5	19.1
A5	**33.192550**	**44.531794**	520±137	22.5
A6	**33.192953**	**44.532114**	153±64.9	27.7
A7	**33.193631**	**44.533119**	793±67.0	20.4
A8	**33.190906**	**44.530739**	609±150	24.0
A9	**33.192153**	**44.532047**	288±123	22.8
A10	**33.192217**	**44.530694**	1590±176	20.4
A11	**33.192119**	**44.534133**	383±167	17.6
A12	**33.191808**	**44.533447**	266±46.9	24.3
A13	**33.191524**	**44.532692**	1100±240	27.4
A14	**33.191786**	**44.531461**	1550±405	15.5
A15	**33.191369**	**44.531964**	627±188	20.0
A16	**33.192644**	**44.531247**	618±184	23.1
A17	**33.190937**	**44.531219**	130±36.6	21.0

A18	**33.191514**	**44.529475**	1380±278	24.6
A19	**33.192842**	**44.533025**	282±42.1	18.8
A20	**33.192648**	**44.532362**	1040±204	18.8
Max.			1590±176	
Min.			130±36.6	
Ave.			698±162	

4. RESULTS AND DISCUSSION

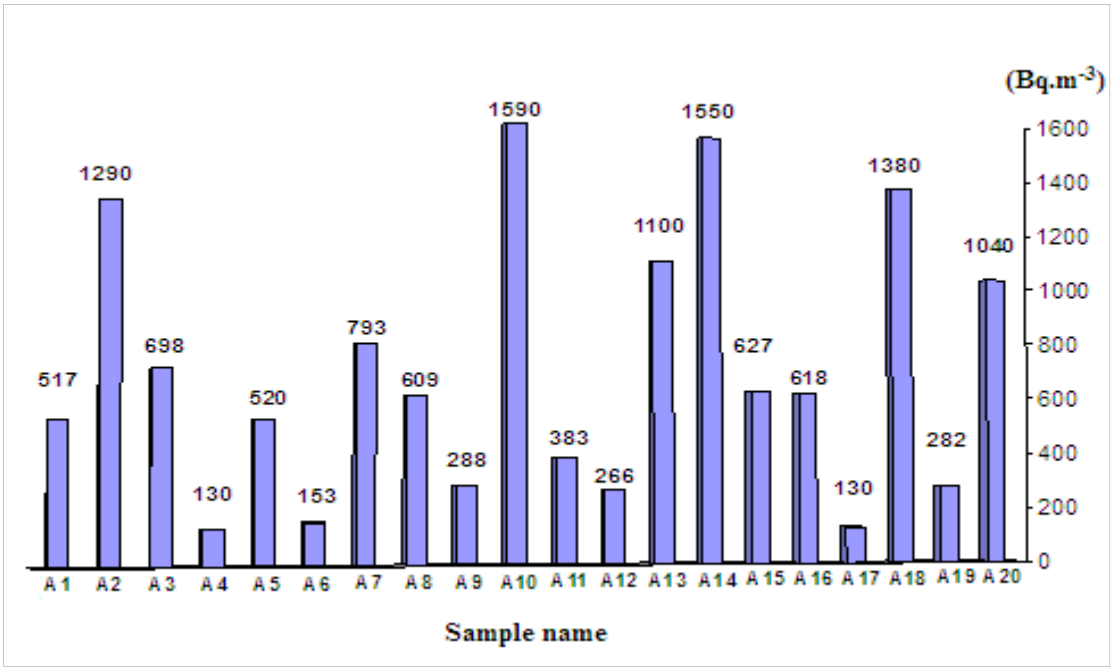

Figure 3. Radon gas concentration in soil samples for all regions studied in Ishtar residential gleaner.

Table (1) presents the radon gas concentrations in soil samples for depth (10 cm) for selected regions in ishtar residential gleaner at the Tuwaitha nuclear site. It can be noticed that, the highest average radon concentration in soil samples was found in (A_{10}) which was equal to (1590±176 Bq/m^3), while the lowest average radon gas concentration was found in (T A_{17} region) which was equal to (130±36.6 Bq/m^3) see Figure (3), with an average value of (698±162 Bq/m^3), The present results in all areas of study have shown that the radon gas concentrations in soil samples were higher value of the recommended value (200 Bq/m^3) given by (ICRP, 1993). The difference in soil radon gas concentrations in the studied areas might be due to the difference in the underlying bedrocks and the geology of the studied areas. The most important parameter of the soil radon gas concentration might be the type of

bedrock beneath the soil. It was found that, the variety of rocks that contain radionuclide concentrations plays important roles in radon concentration. In most cases, rocks with high ^{226}Ra concentrations develop soils with high radon concentrations. Not only the ^{226}Ra or ^{238}U concentrations of a soil controlled by the type of bedrock, but also the gas permeability of a soil, that determines the migration distance which depends on the bedrock type.

5. CONCLUSIONS

In this article, The results obtained from this study indicate .The present results in all areas of study have shown that the radon gas concentrations in soil samples were higher value of the recommended value (200 Bq/m^3) given by (ICRP, 1993), finally, we would like to mention that the present study is considered to be very important and vital because it is concerned with people health and safety in the first place.

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