Concentration Of Radon In The Rain Falls In Salah-Din Province / Iraq

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Abstract:

Five regions in Salah -Din province Iraq were chosen to the study, concentration of radon in the rainwater falls in 2016. by using long-term technique for alpha particles emission with solid state nuclear track detector (SSNTD) CR-39, which have been used to determine the above radioactive isotopes concentrations in the samples. The results show the presence of some radioactivity on the area of Bieja refinery and it was measured to be (2.606) $Bq.L^{-1}$, the min average in Balad was (1.006) $Bq.L^{-1}$, in general we found that radon ^{222}Rn concentration, in the studied water samples, was less than the allowed permitted limit which is about 18 $Bq.L^{-1}$, and it has no danger on human being life.

Keywords: Concentration of radon , Radon , Rain falls

1. Introduction

There is increasing concern worldwide about the quality of drinking water. Due to the importance of water for human life, its quality must be strictly controlled. For this reason, studies of groundwater for human consumption must be performed to guarantee that they have a low level of radioactivity. The earth contains numerous radioactive elements; their origin, for part of them, dates to the formation of our world. While others are continuously produced through nuclear reactions in the universe. Among the former elements, the most abundant are potassium-40 and the radioisotopes of the natural series of uranium and thorium including the parent nuclei ^{238}U and ^{232}Th and the decay products from the successive alpha or beta decays [1]. ^{222}R has a radioactive gas with a half-life of 3.824 days. It is the immediate progeny of radium ^{226}Ra, in the decay series of uranium (^{238}U) and thorium (^{232}Th). The half-life of thoron (^{220}Rn; radon isotopes) is 55.6 sec which is much shorter than that of radon. Because of such a short half-life of Thoron. Its emanation from building materials, as well as its infiltration from the ground and further migration is restricted to only a few centimeters [2]. Alpha particles emitted from radon and the products of dissolution of heavy and charged particles, they occur when collisions with the atoms of the constituent cells of the tissues and organs of the body effects and major disorders in them, as well as chemical effects at the molecular level. The average length of the alpha particle pathway in the soft tissue is estimated to be 40 mm. [3,4]. Its ionic energy is more than 1,000 times the capacity of beta particles and thus is more destructive to human tissues, hence the risk of exposure to the ^{222}Rn radon and its degradation products. In addition, part of the annual effective equivalent dose for people in an environment with a typical radiation background of 2msv.y $^{-1}$ is human inhalation of the ^{222}Rn radon at 0.8msv. y^{-1} [5]. Levels of radon concentration in water depends on some factor such as geologic nature for the area including the study and weather [6]. Radiation pollution in the water takes major role when the pollution water drops lead to pollute populated area and poison than animals' plants in the areas for that the final result led to poison the human [7]. Radon exhalation rates in the areas where uranium deposits and phosphate rocks are significant, and this is the main source of exposure to uranium. Radiation hazards may represent one of environmental crises affecting in Gaza district of Palestine and received no serious study in the past. Long-term exposure to elevated levels of radon increases one's risk of

containing lung cancer [8]. Nevertheless, the contribution of the natural radioactivity in the ground water and its spatial-temporal variations induced by the water-rock interaction and the hydrological properties of the grano sasso aquifer has never been considered. The measurements of the neutron flux made during years at the LNGS-INFN revealed differences of orders of magnitude [9]. We have started a program of measurement of radon concentration in the country since no serious study. Certainly, this study will provide the basic data for any future study and project planning from the environmental point of view [10,11,12, and 13]. Many countries have carried out surveys of prevailing indoor radon levels [14]. Many scientists believe that the alpha particle radiation dose from long-term exposure to elevated levels of radon and radon progeny (break-down products) in air increases your chance of getting lung cancer. The greater your exposure to airborne radon, the greater your chance of developing lung cancer [15,21]. The aim of the study is to gather information about natural radiation and to evaluate the radon concentration throughout. This is motivated by the concern about the possible consequences of long-term exposure to higher concentration radon in rain falls and its short-lived product in air. Since, it is known that radon through its radioactive progeny can cause lung cancer, and thus has become a public health concern.

2. Study Area

Salah Alden governorate lies in the middle of Iraq and forms the governorate in Iraqi region (fig. 1). It confines with Kirkuk and Nineveh from the north, Alanbar from the west, Diyala province from the east, and Baghdad governorate from the south. It is a part of the mountain and semi-mountain that orientated from west to east, in physiographic diversity from the middle and south of Iraq. The governorate has been divided into the following eight districts: - Tikrit, Bieja, Dour, Samara, Shrqat, Tuz, Balad, and Dujaeil. The climate of the region for semi-arid type, designated as continental and subtropical. The elevation is quite different ranging from lower than 10 to more than 150 meters above sea level. During the summer, the average temperature does not normally exceed 45 °C at its peak and drop below 5 °C in winter. The geological formations consist of limestone, red beds of silt, hard clay stone with some siltstone , conglomerate and formation of well bedded chalky, partly dolomite limestone with thin beds of yellowish-green marl. Soil Quality: the area is generally characterized by thick sedimentary cover and well-marked folds of asymmetrical anticlines and broad synclines. The area is entirely located within the low folded zone. This soil throughout investigation is classified as soil of a very low permeability,

moisture of sediment of depth from (5 to 10cm). All the natural water resources come from rain, grounds waters and superficial water to present the actual water sources of Salah-Din province. Superficial water has been considered the main source to the governorate. Most of the irrigated lands at the bottom of the valleys are irrigated by rivers, streams and springs. However, small diesel pumps are used to lift water from the existing streams to strips of lands along these streams[22].

3. Method and Material

The samples of rainwater have been taken from height above 50cm than the surface of earth to prevent pollute with dusts and soil for measuring water pollution that caused by dusts and soil in atmosphere. In this study long term measurement with solid state nuclear track detector (SSNTD) to record effect of alpha particles that emitted from ^{222}Rn which considered as a natural product for deluge ^{238}U. Eight subsamples are taken from each sample. The weight of each sample is $250mL^{-1}$ then placed in rooms for radiating. We use the reagent (CR-39) with equal dimension (1x1 cm^2).The radiation room consists of plastic cup with (radius=3.2cm) and depth (d=5.3cm) The upper cover was with hole of 0.9cm, the internal cover with piece of sponge has dimensions of (2x2cm) area and thickness 0.5cm, of this arrangement is very necessary to preserve the standard condition of calibration and preventing non-gas daughters of radon from and the thoron (Rn^{222}) to enter into cup while allowing to radon gas to pass through (Fig. 2). NaOH (sodium hydroxide) 98% and temperature $70\pm 1C^0$ have been used to show the traces that formed on pieces of the reagents that face the samples and consider to be the favorite solution to show the traces in plastics reagent. The process of etching occurs when we sink the pieces of radiated reagent in the etching solution inside cups with water path under etching condition that mentioned above. To prevent evaporation the covers of the cup must be closed tightly to have a constant concentration in etching processes which takes four hours later the reagent pieces remove from solution and washed with distill water to remove any precipitates comes from solution and then dry by using smooth paper to begin microscopic tests and measuring the density of traces that formed. The samples are collected from areas and regions in Salah-Din province to measure radioactivity in rainwater we select 5 regions as shown in (Table 1), (Figs. 3 and 4) show the spectral shapes in two selected region i.e, Bieja and Balad.

The following equation is used to calculate the concentration of radon in rainwater with units of BqL^{-1} [16] :

$$C_a = \frac{C_0\, t_0 \rho}{t\, \rho_0}$$

C_o: concentration radon in activity calibration room equal to (90 $kBq.m^{-3}$).

t_o: calibration time dose (48 hr.).

ρ: density of trace on radioactivity face.

t: radiation time (1440 hr.).

ρ_o: density of trace on detector face.

4. Results and discussion

Table (1) demonstrates the results that obtained from rain waters that falls on five selected regions, it shows that the mean or average concentration of radon in rainwater varies between (2.606 BqL^{-1} and 1.006 BqL^{-1}) where the region of Bieja refinery has higher mean concentration of radon because there are many radiation element lost in it [17].

Table (1) The demonstrates minimum and maximum values as means of radon concentration in rainwater in Salah Alden province.

Location	Sample number	Min. BqL^{-1}	Max BqL^{-1}	Average BqL^{-1}
Refinery Bieja	8	1.904	3.3.212	2.606
Bieja city	8	1.611	1.977	1.729
Tikrit city	8	1.422	1.731	1.609
Shrqat city	8	1.755	1.989	1.832
Balad city	8	0.832	1.265	1.006

In this area the nature of earth types of granite rock (the rock contains radon gas in its structure) the lower value for main concentration of radon was in Balad which might be due to sedimentary nature of the earth without any radioactivity, for Tikrit, Shrqat and Bieja cities the result were very close. If we compare this study with one study in mosul on many types of water [18], The present study is higher by 40% for refinery and for Balad less than 35% but in Tikrit, Shrqat and Bieja the values are very closed to this study where the concentration for Salah Alden governorate is 1.756 BqL^{-1} and this values are still within the allowed international value of 18 BqL^{-1} [19].

The minimum annual effective dose for a person when drink 1 liter of water varies between higher value 9.09 $\mu sv.y^{-1}$ in sample of rainwater within Baijee refinery area and lower value 4.66 $\mu sv.y^{-1}$ from rainwater of Balad. Inhalation 5.28 $\mu sv.y^{-1}$ that considers higher value and 2.55 $\mu sv.y^{-1}$ that represents lower value. The mean of annual effective dosage in studied rainwater in Salah-Din province is 6.83 $\mu sv.y^{-1}$ in case of drinking and 3.25 $\mu sv.y^{-1}$ in inhalation which is lower than normal range that equal 20 $\mu sv.y^{-1}$ [20]. In (table 2) we give the average effective dose of present study compared to the world data [23].

Table (2) The average effective dose compared to the world data. [23]

Country	Effective dose rates ($mSvy^{-1}$)
Pakistan	0.041
Nigeria	0.39
India	0.11
Nigeria	0.069
Turkey	0.055
Egypt	0.05
Iraq (present study)	0.00683
World average value	0.5

5. Conclusion:

Therenclude that the radon concentration ^{222}Rn in rainwater samples in Salah Alden governorate equal to (1.006-2.606 BqL^{-1}) with mean equal to 1.756 BqL^{-1} for the used samples there are some percent of pollution in the air of Bieja refinery area, while annual effective dose was with a little effect.

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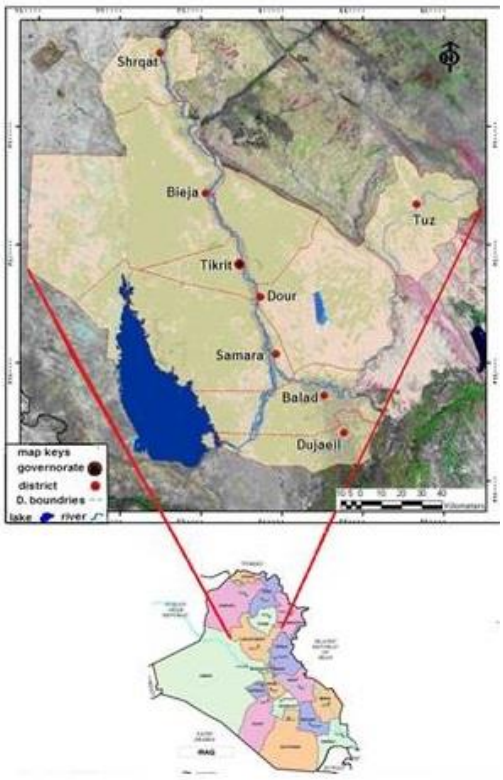

Fig (1) shows the region of study

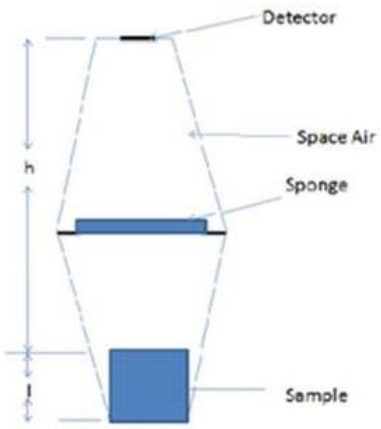

Fig (2) the structure of the Dosimeter

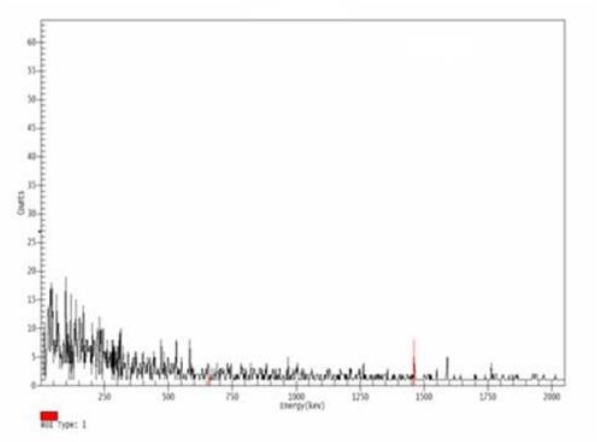

Fig (3) shows the spectral shape in Baijee Refinery

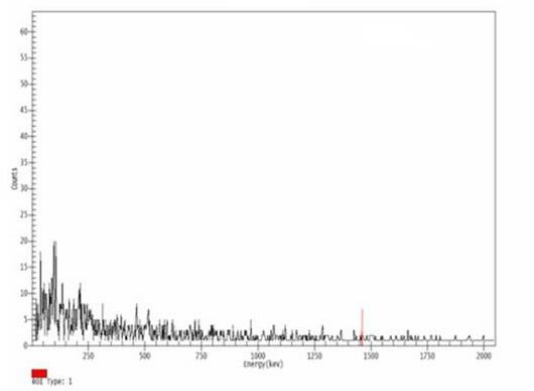

Fig (4) shows the spectral shape in Balad Refinery