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Seasonal variation of radon gas concentration in the waters of Shandiz, Iran

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ABSTRACT

Radon gas with chemical symbol Rn222 is the heaviest element radioactivity, colorless, odorless, tasteless, heavy and noble. Radon naturally in rocks and soils and waters is available and because there is no affinity to plead easily by soil and water molecules into the air and is moving. Radon enters the body with breathing, eating and drinking. Alpha, which is emitted from radon and other nuclear radiations, sent by its daughters nucleus, serious damage to human respiratory and gastrointestinal system brings, so after smoking, the second risk factor in lung cancer is radon radiation. Radon gas density varies due to factors such as temperature, air pressure, humidity and changes in ground layers. As a result, radon gas densities in the seasons are different. In this research, water radon concentration of 10 point Shandiz area in different seasons of the year with the help PRASSI system is measured. Fortunately, the results show that only two samples of drinking water are higher than normal density Bq /l 11.1 in the fall.
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KEYWORDS

INTRODUCTION

Radon, a radioactive element is present in nature and in case of entering the body can be serious damage to human respiratory and gastrointestinal. Human respiratory tract due to radiation, radon and its daughter nucleus after entering the body are exposed to the most damage. Therefore, after smoking, the second factor of lung cancer is radon[1-5]. Measure and analyze sources of drinking water and groundwater is important in health physics and in various countries has been done by researchers[6-12]. Factors such as geography and regional geology, climate zone, geophysical conditions, such as the Earth's crust thickness, and permeability, the temperature of the shell and Earthquake Seismicity, temperature and air pressure affect the concentration of radon gas[12]. Also, the radon gas concentration varies in different seasons. In this study, with the help PRASSI system, radon in water at 10 locations in different seasons has been measured.

MATERIALS AND METHODS

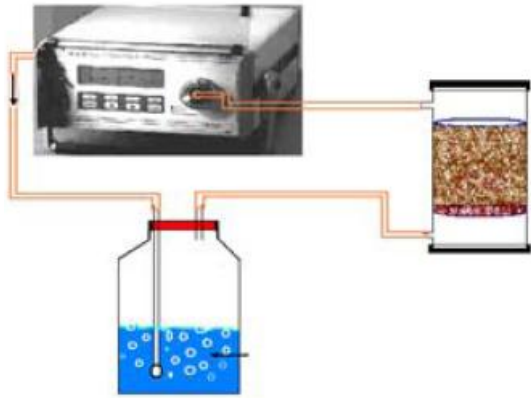In this research, for measuring radon concentration

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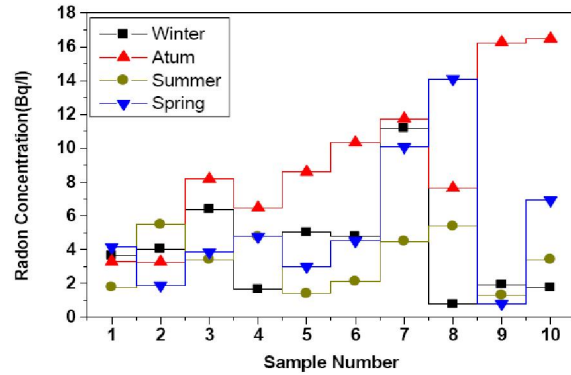**Figure 1 : View from the device to measure radon gas**

Figure 2 : Graphs of radon in water density changes of the 10 samples listed in TABLE 1
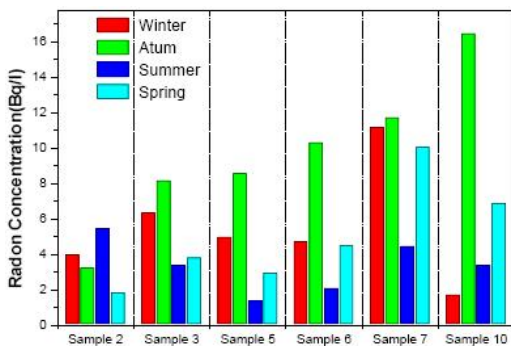

Figure 3 : Histogram changes of radon concentration in drinking water samples
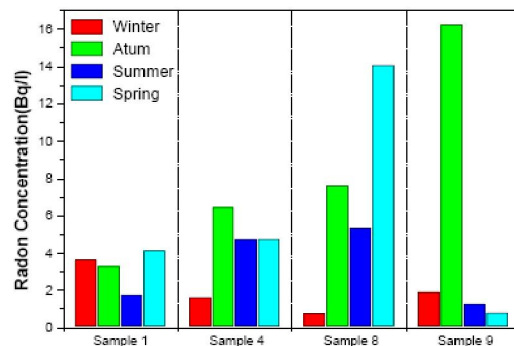

Figure 4 : Histogram radon concentration changes in river water samples

in the Shandiz region's water resources, the PRASSI system model Mod 5s was used. This system, a lightweight and portable device and has ability to measure radon concentration in water, soil and air. A schema of PRASSI system, including bubble blower and moisture is shown in figure 1. Numbers shown by the device is based on Bq/m^3. Radon gas density with using the relationship (1) is calculated based on Bq/l.

QPRASSI raw value recorded by the device and the total volume of air connections is Vtot.

$$Q_{Rn}(\frac{Bq}{L}) = Q_{PRASSI} \times \frac{Vtot(m^3)}{V(lit)} \times \left[exp(\frac{Ln2}{3/8 \times 24})t \right] \quad (1)$$

V sample volume is measured, and within the brackets is a correction factor in the delay measurement.

Measurement results and their analysis

We have measured radon concentration of 10 water samples from Shandiz region in four seasons. To reduce error, each measurement was repeated three times and the average was recorded as the final value. Radon concentration in different seasons is shown in

TABLE 1.

Radon density chart of water in 10 local chapters of Shandiz region in figure 2 also is shown. We can see that the radon concentration in different seasons for some of the samples had fluctuated only slightly, but some of the samples have had many changes.

In figure 3, a Histogram radon concentration changes in six samples of drinking water is presented. We note that the minimum changes is related to drinking water sample no.2, Shandiz Square with average density 4.42±0.97, and most changes is related to the drinking water samples no. 10, Zshk average density 7.14 ± 6.59. And the average radon concentration in drinking water of Shandiz in the fall has been larger than in other seasons and this can be due to reduced water sources and prolonged period of no rainfall. The Histogram of radon concentration changes for four river water samples from the region is presented in figure 4. We can see that the minimum changes related to sample No. 1, River 1.5 km after Zshk with average concentration 3.21 ± 1.02, and most changes related to the

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TABLE 1 : Radon concentration in water samples of Shandiz in different seasons

Sample no.	Water	Spring	Summer	Fall	Winter
1	River 1.5 Km after Zshk	4.147	1.776	3.279	3.563
2	Drinking water of Shandiz Square	4.881	5.481	3.265	4.033
3	Drinking water of Lower Abrdh	3.844	3.412	8.189	6.380
4	The river 2 km from Abrdh	4.756	4.759	6.472	1.644
5	Drinking water at the end of Upper Abrdh	2.985	1.387	8.603	5.004
6	Drinking water beginning Upper Abrdh	4.508	2.115	10.343	4.768
7	Drinking water mosque Zshk	10.080	4.488	11.748	11.175
8	The river 1 km from Abrdh	14.101	5.377	7.639	0.774
9	The river 3 km from Abrdh	0.081	1.296	16.256	1.930
10	Drinking water of Zshk	6.913	3.412	16.479	1.747

sample No. 9, river 3 km from Abrdh with average concentration 4.89 ± 7.62. Average radon concentration in low rainfall seasons i.e. summer and autumn is higher than in winter and spring; although there are exceptions.

CONCLUSION

Measuring radon concentration in drinking water of the region in four seasons, the results show that only two water samples from drinking are more than normal density 11.1 Bq / l in autumn. This limit is defined by United States Environmental Protection Agency, as normal[5]. Radon concentration in samples of river water is too low, which indicates a low density of radium in soil and water in the Shandiz.

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