

Evaluation of Radon Concentration in Groundwater in Moradabad, Uttar Pradesh, India



Physics

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ABSTRACT

Radon is a product of the natural radioactive decay of uranium, which occurs naturally in the earth's crust, to radium and then to radon. As radium decays, radon is formed and is released into small air or water-containing pores between soil and rock particles. If this occurs near the soil surface, the radon may be released to ambient air. Radon may also be released into groundwater. If this groundwater reaches the surface, most of the radon gas will quickly be released to ambient air, but small amounts may remain in the water. Evaluation of radon concentration in ground water in Moradabad city of Uttar Pradesh has been carried out using Lucas scintillation cell. Radon concentration in ground water varies from 13 Bq/L to 84 Bq/L with an overall average of 34.81 Bq/L. Radon concentration in ground water varies in summer season from 13 Bq/L to 53 Bq/L with an average of 30.80 Bq/L, during rainy season radon concentration varies from 19 Bq/L to 84 Bq/L with an average of 42.21 Bq/L, during winter season radon concentration varies from 17 Bq/L to 72 Bq/L with an average of 37.83 Bq/L and during autumn it varies from 14 Bq/L to 49 Bq/L with an average of 28.40 Bq/L.

Introduction

Radon is a colorless, odorless gas and radioactive by product of radium. It has half life of 3.825 days. It is like carbon-14 gas, is completely natural. Over the course of several days, a radon atom becomes a lead atom. It is produced as a result of α -decay of radium. It is the most harmful gas present in atmosphere. It is present in atmosphere, environment, soil, ground, water, oil and gas deposits, indoor and outdoor. Since it has half life of 3.8 days and therefore has a much better chance of escaping from material in which it was formed. Hence it reaches the indoor environment as a soil gas from the ground and also from walls, ceilings etc. and other building materials used in construction of human dwellings. In some countries, the radiation dose to man caused by inhaled radon daughters constitutes more than 50% of the total dose (UNSCEAR; 2000, Lubin; 1993). The groundwater radon concentration is expected to reflect not only in chemical form but also in structural properties of rock in an aquifer (Y Sasaki; 1995). The second most important contributor to outer radon is emanation from ground water sources. Ground water in contact with rustle rock penetrates into the pores and voids present in the rocks and soils and dissolves radon that emanates into these spaces following 226Ra decay. Radon is very soluble in water (Misdagetal.2000).

In most cases, the movement of radon in water is governed by water transport rather than diffusion. Various investigation is have been made to correlate 222Rn concentration in water supplies with indoor radon levels in typical homes (Lamresh, J.R., 1983).

Experimental Methods The measurements of radon in ground water have been carried out by using Lucas scintillation cell. Brief descriptions of these techniques are given below:

Radon measurement in groundwater

For the measurements of radon in ground water, a radon tight reagent bottle of one liter capacity holds 750 ml water was taken. The water samples from the ground water were collected. The sample bottle was connected in a closed circuit with Lucas Cell, hand operated rubber pump through a bubbler. The air was circulated in a closed circuit for a period of 15 min until the radon forms a uniform mixture with the air. After sampling the Lucas cell connected to detector and resulting counts were recorded. The observed counts then converted to Bq/l by using the calibration factor.

1 count/min = 0.0663 Bq/L

These calibration factor obtained in the form of a computer programme developed by the Environment Assessment Division of Bhabha Atomic Research Center, Mumbai for the use of various Indian radon research group under collaborated research programme of the Department of atomic Energy (Ramchandran1998, Ramola et.al., 1996: 2005).

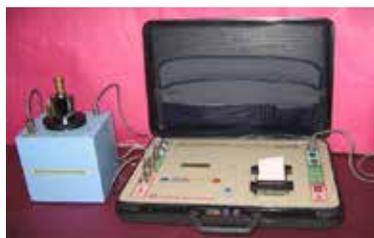


Figure 1: Emanometer and detector with Lucas cell

Results and Discussion

The measured values of radon concentrations in groundwater in different seasons are shown in Table 1 and its variation shown in Figure 2.

Table 1: Radon concentration (Bq/L) in groundwater

Location	Summer			Rainy			Winter			Autumn		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Lodhipur	13	21	17.25	23	32	27.75	19	28	23.50	14	20	17.00
Pakwara	22	26	23.66	27	44	35.66	17	42	32.75	19	25	21.75
Mangupura	13	24	19.00	29	45	35.00	29	42	33.33	25	30	27.00
Prem Nagar	23	32	26.66	38	53	46.66	26	37	31.75	16	34	26.50
Gulabbari	18	35	27.25	31	48	40.33	34	46	39.00	25	37	30.00
Petal Basti	22	36	29.60	36	53	43.75	38	56	46.25	19	32	26.00
Sita Puri	23	49	35.33	36	54	44.00	28	42	35.00	24	30	26.75
Mandi Chawk	23	37	29.60	37	58	47.50	33	40	37.33	18	32	27.00
Ram Ganga Vihar	28	45	35.00	48	76	59.75	42	62	49.50	19	30	25.66
Ram Ganga River	53	53	53.00	84	84	84.00	63	63	63.00	34	34	34.00

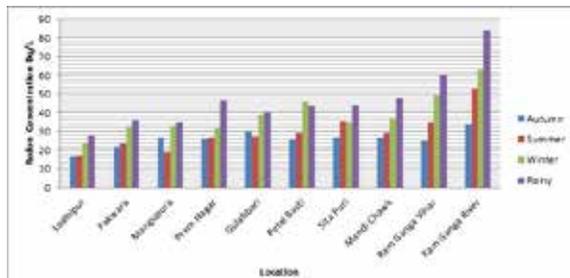


Figure 2: Seasonal variation of radon concentration in groundwater

The radon concentration in groundwater it was found to vary from 13 Bq/L to 84 Bq/L with an average of 34.81 Bq/L. In summer season the radon concentration in groundwater varies from 13 Bq/L to 53 Bq/L with an average of 30.80 Bq/L, In rainy season radon concentration in groundwater from 19 Bq/L to 84 Bq/L with an average of 42.21 Bq/L, In winter season radon concentration in groundwater from 17 Bq/L to 72 Bq/L with an average of 37.83 Bq/L, In autumn season radon concentration in groundwater 14 Bq/L to 49 Bq/L with an average of 28.40 Bq/L.

Radon concentration higher in ground water. In rainy season flow of water through rivers and canals come to the ground and increase the level of water, Because of

this the radon kept low in other seasons flow upwards with water level and hence a slight increase in the radon concentration is observed. At the same time flow of radioactive atoms from hilly region reach to the planes of Moradabad, which is one of the reason in the increase of concentration in water. In groundwater the radon concentration found least in autumn while highest in rainy.

Conclusion

Considering that about 50% of natural exposure of people is from radon gas and it is the leading cause of cancer patients suffering respiratory and gastrointestinal systems, and the highest percentage of radon that enter the human body is from drinking water and breathing, especially when is bathing, the measuring of radon gas in underground water in this region is done. The range of the radon concentration in India was reported 4.6 Bq/m³ to 147.3 Bq/m³ (BARC). But it is not very high and the amount of radon exist in water is not a serious hazard risk threaten the region. So for more attention to public health community and reducing the risks of radon gas, it is recommended that the drinking water must be kept in the open pools, or at least moved as a cascade to moving out radon gas.

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