Scholars Journal of Physics, Mathematics and Statistics **ISSN 2393-8056 (Print)**
Sch. J. Phys. Math. Stat. 2016; 3(2):66-68 **ISSN 2393-8064 (Online)**

Measurement of Radon Exhalation Rates from Soil Samples of Some Villages of Ambala, Haryana

Vimal Mehta*, Deep Shikha
PG Department of Physics, SGTB Khalsa College, Anandpur Sahib, Punjab-140118, India

***Corresponding Author:**
Vimal Mehta
Email: mehta_vimal78@yahoo.co.in

Abstract: The world is naturally radioactive as some of the materials in the nature are radioactive. Uranium is one of them and can be found in trace amount in most rocks and soils. Uranium decays to radium that leads to the decay of radon. Because radon is a noble gas, a large portion of it is free to migrate away from radium. Radon and its progeny are major contributors in the radiation dose received by general population of the world. A sufficient quantity of radon comes out of rock and soil in the environment. The primary sources of indoor radon are soils and rocks source emanations, emanation from building materials, and entry of radon into a structure from outdoor air. Keeping this in mind the study of radon exhalation rate from some soil samples of the villages of Ambala, Haryana has been carried out using Can Technique. The equilibrium radon concentration in various soil samples varied from 30.82 Bqm^{-3} to 84.52 Bqm^{-3} with an average of 49.02± 9.21Bqm^{-3}. The radon mass exhalation rates from the soil samples varied from 1.11 to 3.04mBq/kg/h with an average of 1.76 ± 0.33mBq/kg/h and radon surface exhalation rates varied from 25.09 to 68.83mBq/m^2/h with an average of 39.92 ± 7.50mBq/m^2/h. The radon mass and surface exhalation rates of the soil samples of villages of Ambala, Haryana were lower than that of the world wide average.
Keywords: Radon; SSNTD; Mass exhalation rate; Surface exhalation rate.

INTRODUCTION

Radioactivity in the environment is the biggest concern for the human beings. Natural radioactivity is common in the rocks, soil, water, oceans that make up our planet, and in our building materials because of the presence of radioactive nuclides like uranium, thorium, ^{40}K and ^{14}C etc.Since the distribution of these radionuclides is not uniform in our nature so the knowledge of their distribution and radiation levels due to them in the environment is important for assessing the effects of radiation exposure to human beings. Radionuclides such as ^{222}Rn and ^{220}Rn and their daughter products represent sources of internal radiation exposure to man from inhalation from indoor air. The inhalation of short-lived decay products of radon (^{222}Rn) accounts on average about 55% of the effective equivalent dose on the human being. ^{222}Rn is part of the ^{238}U decay chain and is frequently generated close to it. Due to the serious public health implications of exposure to high levels of radon, the measurement of radon exhalation rates from some soil samples of villages of Ambala, Haryana has been carried out using canister technique. Our earlier work in different parts of Punjab and Haryana shows that the values of indoor radon, thoron and their progeny and radon exhalation rates are within the safe limits [1-8].

MATERIALS AND METHODS

For the measurement of radon concentration and exhalation rates from soil samples the “Canister Technique” [9] used by many groups [2-3, 6, 10-12] has been adapted. The details of the technique are given elsewhere [6]. The can is tightly closed from the top and sealed as shown in Fig. 1. At the end of the exposure time (~100 days), the detectors are removed and subjected to a chemical etching process in 2.5 N NaOH solution at 60±0.5^{0}C for 90 minutes in a constant temperature water bath. The etched detectors are thoroughly washed and then immediately after the completion of washing, the red sensitive layer is stripped for the spark counting.

From the track density (track/cm^2/day), the radon activity was obtained in Bqm^{-3}, using the calibration factor of 0.056 tr. cm^{-2} d^{-1}/Bqm^{-3} obtained from an earlier calibration experiment [13]. The radon mass and surface exhalation rates from the soil sample can be calculated by following relation.

$$E_A = \frac{CV\lambda}{A(T + \frac{1}{\lambda}(e^{-\lambda T} - 1)} \qquad (1)$$

$$E_M = \frac{CV\lambda}{M(T + \frac{1}{\lambda}(e^{-\lambda T} - 1)} \quad (2)$$

Where C is equilibrium radon activity inside the canister, V and A are volume and area of cross-section of the canister, M is the mass of the sample and λ is the radon decay constant, T is the time of exposure.

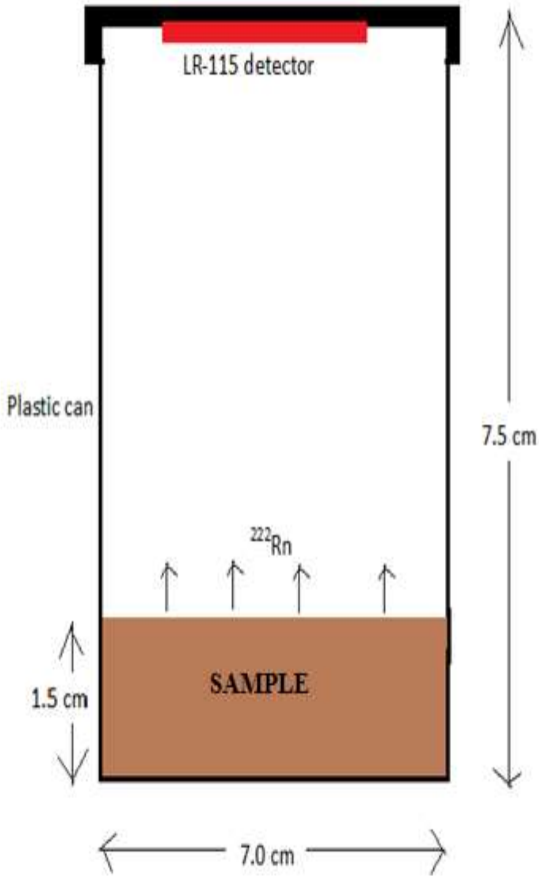

Fig. 1: The plastic can used for the measurement of equilibrium radon concentration and exhalation rates from different soil samples

RESULTS AND DISCUSSION

The values of exhalation rates found were tabulated in Table 1. The radon concentration in various soil samples of Ambala, Haryana varied from 30.82 Bqm^{-3} to 84.52 Bqm^{-3} with an average of 49.02 ± 9.21 Bqm^{-3}. The radon mass exhalation rates from the soil samples varied from 1.11 to 3.04 mBq/kg/h with an average of 1.76 ± 0.33 mBq/kg/h and radon surface exhalation rates varied from 25.09 to 68.83 mBq/m^2/h with an average of 39.92 ± 7.50 mBq/m^2/h.

Table 1: Equilibrium radon concentration, radon mass and surface exhalation rates from soil samples of Ambala, Haryana

Sr. No.	Location	Equilibrium Radon conc. (Bqm^{-3})	Mass exhalation rate (mBqkg^{-1}h^{-1})	Surface exhalation rate (mBqm^{-2} h^{-1})
1	Vill. Mullana	43.54	1.57	35.46
2	Vill. Mithapur	84.52	3.04	68.83
3	Vill. Saha	44.76	1.61	36.45
4	Vill. Kalpi	30.82	1.11	25.09
5	Vill. Barara	41.46	1.49	33.76
AM ± SE		49.02±9.21	1.76 ± 0.33	39.92 ±7.50

AM(arithmetic mean); SE (standard error) = σ/√ N, Where σ is SD (standard deviation) and N is the no. of observations

CONCLUSION

The radon exhalation rates of soil sample collected from the study area are nearly the same having not much difference. The radon exhalation rates from soil samples are less than the world wide average [14].The measurements indicate normal levels of natural radioactivity in soil samples of the study area.

REFERENCES

1. Mehta V, Singh SP, Chauhan RP, Mudahar GS; Measurement of indoor radon, thoron and their progeny levels in dwellings of Ambala district, Haryana, Northern India using solid state nuclear track detectors.Rom. J Phys., 2014; 59(7-8): 834.
2. Kumar A, Chauhan RP, Mehta V, Kant K;Radon, exhalation rates of concrete modified with fly ash and silica fumes. ISST J App. Phys., 2014; 5(2): 92.
3. Mehta V, Chauhan RP, Mudahar GS; Radon Exhalation Rates from Some Soil Samples of Nangal, Punjab.Int. J IT Know. Mgmt., 2014: 225.
4. Mehta V, KumarA, Singh SP, Chauhan RP, Mudahar GS; Measurement of indoor radon, thoron and their progeny levels in dwellings of Union Territory Chandigarh, India: correlation with radon exhalation rates.Indoor Built Environ.,2015; 24(6): 833-842.
5. Mehta V, Kumar A, Chauhan RP, Mudahar GS; Radon, thoron and their progeny levels in some dwellings of Union Territory Chandigarh, India using SSNTDs. ISST J App. Phys., 2014; 5(2): 33.
6. Mehta V, Singh TP, Chauhan RP, Mudahar GS; Radon exhalation rates from some soil samples of Kharar, Punjab. AIP Conference Proceedings, 2015; 1675: 030172.
7. Mehta V, Chauhan RP, Mudahar GS; Monitoring of radon, thoron, their progeny concentration in dwellings and radon exhalation rates of soil/sand of Rupnagar district, Punjab, India. Envir. Earth Sci., 2015; 74(5):4145-4155.
8. Mehta V, Singh SP, Chauhan RP, Mudahar GS; Study of indoor radon, thoron, their progeny concentration and radon exhalation rate in the environs of Mohali, Punjab, Northern India. Aerosol Air Qual. Res.,2015; 15(4):1380-1389.
9. Abu-Jarad F; Application of nuclear track detectors for radon related measurements. Nucl. Tracks Rad. Meas.,1988; 15(1-4): 525.
10. Chauhan RP, Chakarvarti SK; Radium concentration and Radon exhalation measurements in the water around thermal power plants of north India, Indian J. Pure &Appl Phys., 2002; 39: 491.
11. Gupta M, Saini M, Chauhan RP;Measurement of alpha radioactivity in some building construction materials.Asian J. Chem., 2009; 21(10): S052.
12. Khan AJ, Tyagi RK, Prasad R; Measurement of radon exhalation rate from some building materials. Nucl. Tracks Radiat. Meas.,1992; 20: 609.
13. Singh AK, Jojo PJ, Khan AJ, Prasad R, Ramachandran TV; Calibration of track detector and measurement of radon exhalation rates from soil sample. Radiat. Prot. Environ., 1997; 20: 129.
14. UNSCEAR: Sources and Effects of Ionizing Radiation. Report to the General Assembly with Scientific Annexes, United Nations Scientific Committee on the Effects of Atomic Radiation, New York 2000.