Measurement of radon concentration in dwellings belonging to some areas of Pathankot District, Punjab using solid state nuclear track detectors

Ajay Kumar*, Savita Sharma

PG Department of Physics, DAV College, Amritsar-143001, India

E-mail: ajay782@rediffmail.com

Abstract

Indoor radon studies have been carried out in the environs of some areas of Pathankot district, Punjab, India using LR-115 type II plastic track detector. The area lies in the vicinity of Himachal Himalayas known for uranium mineralization. The work has been undertaken for the health risk assessments. The indoor radon concentration in 10 different villages of the area is found to vary from 163.91 Bqm^{-3} to 437.21 Bqm^{-3}. The average radon concentration in dwellings in most of the villages falls in the action level (200-600 Bqm^{-3}) recommended by International Commission on Radiological Protection (ICRP). The values are also found to be higher in poorly ventilated houses compared with the well ventilated houses.

Keywords: Indoor radon; LR-115 type II Plastic films; Dwellings

***Corresponding author:**
E-mail: ajay782@rediffmail.com

1. Introduction

Naturally occurring radioactive gas ^{222}Rn resulting from the radioactive decay of ^{226}Ra, the fifth daughter of ^{238}U. The measurement of radon in man's environment is of interest because of its alpha emitting nature. Radon decays with a half life of 3.82 days into a series of short lived daughter products out of which ^{218}Po and ^{214}Po emit high energy alpha particles which are highly effective in damaging tissues. The fact that radon, when inhaled during breathing can cause lung cancer in human beings is known since a long time ago [1,2]. On the other hand ^{222}Rn has been used as an excellent tool for tracing many environmental and geophysical processes such as gas exchange across the air-sea surface [3, 4]. The main sources of radon in dwellings are the soil or the rock underneath, the building materials and the public water supplies.

The work on the measurement of radon concentration levels and its short lived decay products in different countries have been published in the recent years [5-10]. In India many research workers are engaged in the measurement of indoor radon levels in dwellings for health risk assessments and its control.

Keeping in view the health hazardous effects of radon, the survey has been carried out for the measurement of ^{222}Rn in the indoor environment in some areas of Pathankot district, Punjab. The indoor radon study was carried out in the dwellings for a period of three months. About 10 villages and few houses in each village were chosen for the studies. The radon concentration has been assessed in the light of guidelines given by the International Commission on Radiological Protection [11].

2. Experimental Technique

In the present investigations the indoor ^{222}Rn concentration has been studied in 50 dwellings of 10 villages of the area. The houses were chosen randomly in such a way that the dwellings constructed with different types of building materials such as soil, bricks, cement, marble, concrete, wood in different localities of the village are covered. The track etch detector technique has been used to measure the

level of indoor radon concentration in the dwellings. The LR-115 type 2 (Pelliculable) plastic track detectors having a size of about 1.5 cm x 1.5 cm fixed on micro glass slides were suspended at the centre of the room in the bare mode for a period of three months. All the measured dwellings have a single floor level (ground floor). The exposed detectors were etched in 2.5 N NaOH solution for 90 minutes in a constant temperature bath (60^{o}C). After etching the detectors were thoroughly washed and scanned manually for track density measurements using Carl Zeiss binocular optical microscope at a magnification of 400X. The track density so obtained was converted into the units of Bqm^{-3} using the calibration factor (0.020 $\pm$ 0.002 tracks cm^{-2} d^{-1} /Bq m^{3}) determined experimentally by Eappen *et al* (2001) [12] which satisfies the conditions prevailing in the Indian dwellings. The average background track density for the unexposed films of LR-115 type 2 detector was found to be 35 tracks cm^{-2} and this value was subtracted from the observed values.

In the bare mode technique some contribution can be from ^{220}Rn also. However, the recent report by UNSCEAR (2000) [13] reveals that the contribution from ^{220}Rn and its progeny in the dwellings is in the general about 10% of that of ^{222}Rn and its progeny. So this component can be neglected from the point of view of inhalation dose particularly in an area which is not known for thorium mineralization.

3. Results and Discussion

The average indoor radon concentration levels recorded in 10 villages of district Pathankot, Punjab are given in Table 1. From the table we find that the average indoor radon concentration varies from 163.91$\pm$23.18 Bqm^{-3} in Sujanpur village to 437.21$\pm$35.42 Bqm^{-3} in the village Doongh. The error shown in the results is the standard error calculated on the basis

Table 1. Indoor radon levels in the dwellings of some areas of Pathankot District, Punjab

S. No.	Location	No. of Dwellings	Radon activity (Bqm^{-3}) ±S.E.*
1	Targar	5	250.70±32.19
2	Bharoli khurd	5	294.15±25.31
3	Sujanpur	5	163.91±23.18
4	Mamun	5	337.51±17.43
5	Dalhousie	5	168.72±24.71
6	Kot	5	405.05±35.42
7	Shahpur Kandi	5	308.62±23.18
8	Doongh	5	437.21±36.13
9	Dhaner	5	281.35±18.75
10	Nauni	5	226.33±47.21

*S.E. (Standard Error) = SD/$\sqrt{N}$

Where SD is the standard deviation,

N represents the number of measurements in each village

of number of measurements of radon level in each village. The indoor radon values obtained in the present investigations in some area of district Pathankot are comparatively lower than those reported in some dwellings of Hamirpur (660-1060 Bqm^{-3}, Kumar *et al.*, 1994) [14] , Kullu (156-635 Bqm^{-3}, Singh *et al.*, 2001) [15] and Una (235-970 Bqm^{-3}, Singh *et al.*, 2002) [16] districts of Himachal Pradesh.

The higher indoor radon values in these areas are explained due to the presence of uranium mineralization in the area [17].

The high levels of indoor radon concentration in the dwellings of village Doongh may be due to the fact that most of the houses in village Doongh are built of mud, wood and unfired clay bricks. Moreover the houses are poorly ventilated. This may be the reason for high values of indoor radon concentration in dwellings and hence the highest annual average radon concentration of the village. All the houses in Sujanpur village are cemented and well ventilated. So these houses have comparatively low values of indoor radon activity which leads to lowest average radon concentration of the village. The Indoor radon concentration may also depend on the soil gas radon beneath the dwellings and the environmental conditions.

Figure 1 shows the variation of radon concentration in the area of district Pathankot, Most of the houses have the average radon concentration which lies between the action level (200-600 Bqm^{-3}) [11] and few of the houses have values below the action level (<200 Bq m^{-3}).

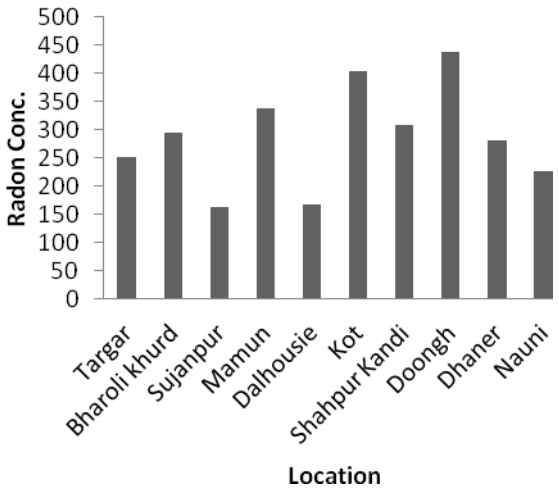

Fig. 1 Radon concentration vs location

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5. References

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