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# Assessment of Indoor Radon in Some Areas of Northern Punjab Using Plastic Track Detector

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**Abstract**
Using LR-115 type II plastic track detector, 140 dwellings of 28 locations belonging to Amritsar, Gurdaspur and Pathankot areas of Punjab, India, were studied for evaluation of indoor radon in air. This work was carried out for health considerations. The indoor radon concentration in the studied area varies from 42.74 $Bqm^{-3}$ to 437.21 $Bqm^{-3}$, which is well within the recommended action level. The average radon concentration in few dwellings 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. Out of the three areas, Pathankot region recorded the maximum value of average indoor concentration.

**Keywords**
Indoor Radon; LR-115 type II Plastic Films; Dwellings

## I. 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 Amritsar, Gurdaspur and Pathankot districts of Punjab. The indoor radon study was carried out in the dwellings for a period of three months. About 28 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].

## II. Experimental Technique

In the present investigations the indoor $^{222}Rn$ concentration has been studied in 140 dwellings of 28 villages of the study 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°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 + 0.002 tracks $cm^{-2}$ $d^{-1}$ /Bq $m^3$ ) [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 [13] reveals that the contribution from $^{220}Rn$ and its progeny in the dwellings is in the general about 10% of that of 222Rn 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.

## III. Results and Discussion

The average indoor radon concentration levels recorded in 28 villages of districts Amritsar, Gurdaspur and Pathankot, Punjab are given in Table 1.

| S. No. | Sample Location | No. of dwellings studied | Radon Concentration (Bq $m^{-3}$) ±S.E.* |
|---|---|---|---|
| Amritsar area | | | |
| 1 | Lahori gate | 5 | 81.78±32.19 |
| 2 | Maan Singh gate | 5 | 83.63±10.91 |
| 3 | Region Dhaki | 5 | 48.32± 15.23 |
| 4 | Katra Ahloowalia | 5 | 83.63±13.17 |
| 5 | Gol bag | 5 | 48.33±17.52 |
| 6 | Kashmir Avenue | 5 | 126.38± 20.24 |
| 7 | College road | 5 | 102.83±23.18 |
| 8 | Jawahar Nagar | 5 | 42.74±11.89 |
| 9 | Ram Nagar | 5 | 89.21±5.84 |
| 10 | Vijay Nagar | 5 | 61.34±23.42 |
| Gurdaspur area | | | |
| 11 | Dhir | 5 | 135.02±24.31 |
| 12 | Aliwal | 5 | 202.53±22.67 |
| 13 | Batala | 5 | 265.21±16.67 |

| | | | |
|---|---|---|---|
| 14 | Kotla | 5 | 250.72±15.56 |
| 15 | Dyalgarh | 5 | 221.82±10.02 |
| 16 | Ghumni | 5 | 289.33±12.36 |
| 17 | Dhariwal | 5 | 347.21±10.71 |
| 18 | Gurdaspur | 5 | 163.95±22.25 |
| Pathankot area | | | |
| 19 | Targar | 5 | 250.70±32.19 |
| 20 | Bharoli khurd | 5 | 294.15±25.31 |
| 21 | Sujanpur | 5 | 163.91±23.18 |
| 22 | Mamun | 5 | 337.51±17.43 |
| 23 | Dalhousie | 5 | 168.72±24.71 |
| 24 | Kot | 5 | 405.05±35.42 |
| 25 | Shahpur Kandi | 5 | 308.62±23.18 |
| 26 | Doongh | 5 | 437.21±36.13 |
| 27 | Dhaner | 5 | 281.35±18.75 |
| 28 | Nauni | 5 | 226.33±47.21 |

*S.E. (Standard Error) = SD/√N
Where SD is the standard deviation,
N represents the number of measurements in each village

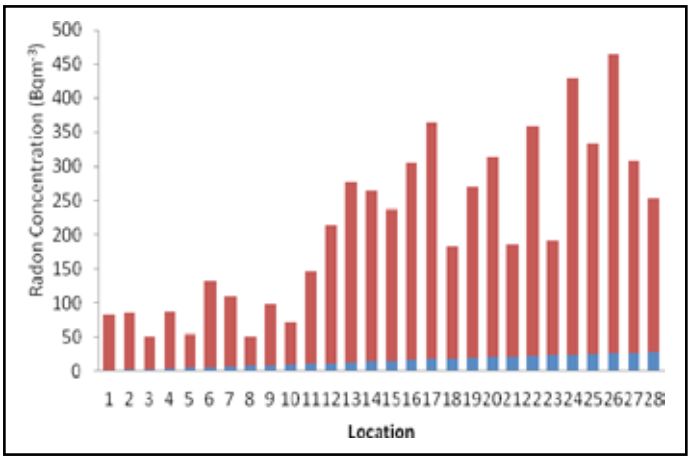


Fig. 1: Distribution of Radon Concentration in 28 Locations of Amritsar, Gurdaspur and Pathankot Districts of Punjab, India

From the table we find that the average indoor radon concentration varies from42.74±11.89 $Bqm_{-3}$ of in Jawahar Nagar of Amritsar area to 437.21+35.42 Bqm-3 in the village Doongh of Pathankot. The error shown in the results is the standard error calculated on the basis of number of measurements of radon level in each village. The present average radon concentration is more than the world average of 40 $Bqm^{-3}$ [13] but these values are well below (except for few locations) the recommended reference level (200-600 $Bqm^{-3}$) [11]. The indoor radon values obtained in the present investigations of Amritsar and Gurdaspur area are lower as compared with some area of district Pathankot. This may be due to the difference in the concentration of radioactive elements viz. uranium and radium in the soil and building materials of the study area. The values are comparatively lower than those reported in some dwellings of Hamirpur [14] , Kullu [15] and Una [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 values of Amritsar and Gurdaspur area of Punjab are comparable to the values reported for Malwa regions of Punjab [18-19].

The high levels of indoor radon concentration in some dwellings of Pathankot may be due to the fact that this area lies in the vicinity of Himachal Himalayas, which is known for Uranium Mineralization [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. The Indoor radon concentration may also depend on the soil gas radon beneath the dwellings and the environmental conditions.

Fig. 1 shows the variation of radon concentration of 28 villages (140 dwellings) of the study area. It is also observed from the fig. 1, the increasing trend of radon concentration has been observed from Amritsar to Pathankot. The difference in the values of radon concentration may be due to the different ventililation conditions , the nature and type of the building materials and the variation of the radioactivity level in the soil beneath the dwellings. Few houses have the average radon concentration lies between the action level (200-600 $Bqm^{-3}$) [11] and most of the houses have values below the action level (<200 Bq $m^{-3}$).

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