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STUDY OF INDOOR RADON LEVELS USING SSNTDs

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ABSTRACT

Solid state nuclear track detectors are extensively used in various fields including radiation dosimetry, high energy particle physics and laser-fusion physics. These detectors have also been used for the measurement of low level radiation in the environment, detection of fast neutron and radiation dosimetry in radiation protection.

This study pertains to the measurement of indoor radon levels in the villages of Gallote and Nukhel, in vicinity of areas known for uranium mineralization in Himachal Pradesh. The indoor radon concentration measurements were carried out using the plastic track detector (LR-115 type II). These concentrations were found to be varying with the building materials amd mode of construction of the house. In some dwellings of these villages the indoor radon levels are above the ICRP recommended values and there is a specific need for epidemiological studies to assess the health hazard to general public in these areas.

1. INTRODUCTION

Exposure of persons to high concentrations of radon and its short-lived progeny for a long period leads to pathological effects like the respiratory functional changes and occurrence of lung cancer (Biological Effects of Ionising Radiation, 1972). According to an estimate, radon gas may be the major source of public radiation exposure, perhaps accounting for between 5-20% of lung cancer deaths (Myers et al., 1979; Borak and Johnson, 1988). Now it has been established that prolonged inhalation of radon and its progeny may lead to lung cancer in many cases (Lundin et al., 1971; Sevc et al., 1976; Ramachandran et al., 1998a). During recent years, several reports have appeared in the literature demonstrating the ever increasing interest in monitoring the radon in the dwelling all over the world (Abu-Jarad & Fermlin, 1981; Keller and Folkerts, 1984; Ramachandran et al., 1986; Mishra & Ramachandran, 1997; Marx & Toth, 1997, Nazaroff & Doyle, 1985, Khan et al., 1997) and the result of the studies show that some countires (eg. Sweeden, Hungary, UK and USA) has high radon concentrations in many of their dwellings (Swedejemark and Majones, 1984; UNSCEAR, 1988). In the present investigations the SSNTDs (LR-115 type-II) has been used to study the indoor radon levels of the dwellings in the villages of Nukhel and Gallote which are located in the vicinity of uranium mineralised pockets of Hamirpur district of Himachal Pardesh.

2. EXPERIMENTAL TECHNIQUES

The measurements of radon levels inside the dwellings were carried out using the plastic track detectors (LR-115 type II). These plastic track detectors of size 2 cm x 2 cm were fixed on glass slides and then these slides were mounted on the walls of different dwellings at a height of about 2 m from the ground with their sensitive surface facing the air, taking due care that there was nothing to obstruct the detectors. After an exposure time of three months, detector films were removed and etched in 2.5N NaOH solution at 60° C for 80 minutes in a constant temperature bath. Then these films were washed, dried and scanned under a Carl Zeiss binocular microscope for track density measurements. The exposed area of the each film was scanned thoroughly and a sufficiently large number of graticules were counted to get average track density and to minimize the uncertaintly due to counting errors. The track density is converted to radon concentration in dwellings using a calibration factor 0.021tr/cm^2/d=1Bq/m^3 (Ramachandran, 1998b).

3.RESULT AND DISCUSSION

The results for the indoor radon concentrations in the dwellings of the villages of Nukhel and Gallote, Hamirpur district, Himachal Pradesh are presented in Table 1 & 2 respectively. The radon levels in these villages has been found to be varying from 197-508 Bq/m^3 and 302-917 Bq/m^3 respectively. The average concentration for this period of measurement (3 months) in these villages is 332 Bq/m^3 and 557 Bq/m^3 respectively, where as for the same period the radon levels in the locality of Amritsar (Table 3) has been found to be varying from 40-93 Bq/m^3 with an average radon concentration of 73 Bq/m^3. Thus clearly showing that the average concentration in dwellings of the uranium mineralised zones have been quite higher than a normal nonmineralised area. Some dwellings of the village Gallote, where uranium has been extracted by AMD, shows as high as 900 Bq/m^3 of radon concentrations.

The high values of radon levels in the dwellings of the villages of Nukhel and Gallote as compared to a non-uranium mineralized area, is clearly due to the presence of uranium prospects beneath the soil of this area and also be due to high radium content in the building material like stones, bricks, mud etc. Since in the village Gallote in particular the local radioactive rocks has been used for construction of houses, so the quite high radon levels in this village is due to the radon contribution by soil as well as by these rocks which have been used for the construction work.

The quite low values of radon levels in Amritsar is not only due to non-uranium mineralised area, but also has been considerably reduced due to their pucca floors which slows down the flow of radon from the ground to the interior of the houses. It may also be due to low emanations from cement and bricks constructions as comapred to the local rocks used for construction in Gallote village showing quite high radon levels.

International and national recommendations for radon limitation vary. US federal authorities recommended 150 Bq/m^3 for existing houses (USEPA, 1986). In federal republic of Germany, a value of 250 Bq/m^3 has been recommended for existing and future homes (FRG, 1988). In UK, a value of 200 Bq/m^3 has been recommended for existing homes (NRPB, 1990). The International Commission on Radiological Protection (ICRP, 1994) has recommended the interventies level for the buildings to be 200-600 Bq/m^3. Since the values of radon level in almost all the dwellings of the Nukhel and Gallote villages lying in the vicinity of uranium-mineralogical zone, are higher than the internationally recommended safety limits, and even these values are much higher than the national average, so the measures should be taken to reduce those below the intervention levels.

Table 1. Track etch radon concentration for the village Nukhel for an exposure of three months. (4th Dec. - 6th March)

House No.	Graticule Counted	Tracks Obsereved	Tracks/cm²	Tracks/cm²/d	Radon Conc. Bq/m³
N1	1608	841	832	8.94	426.02
N2	1030	428	672	7.23	334.29
N3	1800	594	528	5.68	270.48
N4	1830	441	384	4.13	196.67
N5	1015	314	496	5.33	253.81
N6	1973	1235	992	10.67	508.11

Table 2. Track-etch radon concentration for the village Gallote for an exposure of 3 months. (6th Dec. - 7th march)

House No.	Graticule Counted	Tracks Obsereved	Tracks/cm²	Tracks/cm²/d	Radon Conc. Bq/m³
G1	2013	735	584	6.35	302.38
G2	1924	1263	1050	11.41	543.34
G3	1220	1351	1771	19.25	916.68
G4	1830	1015	887	9.64	459.34

Table 3. Track-etch radon conc. for Dashmesh locality of Amritsar for exposure period (10th Dec.1997 - Mar. 1998)

House Code	Graticules Counted	Tracks Observed	Track Density T/cm²/d	Radon Conc. (Bq/m³)
A5	335	35	1.79	85.2
A6	347	39	1.95	92.9
A7	435	45	1.79	85.2
A9	395	19	0.83	39.5
A11	219	17	1.34	63.8

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