INDOOR RADON MEASUREMENTS IN DWELLINGS OF GARHWAL HIMALAYA, NORTHERN INDIA

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Measurement of indoor radon and daughters concentration were performed in several houses in Garhwal Himalaya during 1993-95 with solid state nuclear track detector films (LR-115 Type II). The detector films were exposed for a period of three months to one year. The films basically measured total airborne alpha activity but may be calibrated in unite of EEC_{RN} (equilibrium equivalent concentration of radon with equilibrium factor F=0.45) in an environment with known radon and daughters concentrations. A numbers of dwelling in the area exhibited radon daughters concentrations (EEC_{RN}) exceeding the recommended level. The abnormal values are due to typical house construction (mud house) in the area. The houses are constructed with soil and local stone with a thin paste of mud. Behaviour and abnormality of radon in mud houses are discussed in details the corresponding annual effective dose has been calculated.

INTRODUCTION

Nearly one half of the total natural radiation exposure is due to the inhalation of radon and its progeny in air(1) which can result in a significant risk to the general public. The health effect of radon is well known in mine workers (2,3) but recent survey carried out all over the world (4-10) shows high concentration of radon in some dwellings could entail significant health risk. The daughter products of radon, which are solid under ordinary condition, attach themselves to atmospheric dust. During inhalation these particles may deposit in the lung and damage the tissue. It is therefore desirable and possibly necessary to monitor levels of radon in places where people are exposed to radon, particularly at sites where the geological formations are enriched with uranium. This paper presents the results of radon survey carried out in the houses of Garhwal Himalayas using LR-115 type II, plastic track detector.

CALIBRATION OF DETECTOR

The experiment on the calibration of LR-115 type II, plastic track detector was performed at Environmental Assessment Division, Bhabha Atomic Research Centre, Bombay. The detector films (2.5 cm X 2.5 cm) were exposed in bare mode in a calibration chamber of known radon concentration. The condition was kept similar to that in the field measurements. In all 12 samples were exposed and an average value was obtained as 3.12×10^{-2} tracks/cm^{2}d = 1 Bq/m^3.

EXPERIMENTAL TECHNIQUE

Track etch technique has been used for the measurement of radon activity in the dwellings. Small pieces (2.5 cm X 2.5 cm) the LR-115 were fixed on a glass slide which acts as a supporting material and these slides were suspended inside the houses at a height of about 2 meters from ground floor. The detectors are then removed after three months, etched in 2.5 N NaOH solution at 60 °C for two hours and were scanned under an optical microscope for track density measurements. The resulting values of track densities are converted in Bq/m^3 by using the calibration factor as discussed above.

RESULTS AND CONCLUSIONS

The results of indoor radon concentration in Garhwal Himalaya are given in Table 1. The choice of house was random and one room of each house selected for radon measurement. Most of the houses in the area are mud houses, constructed with local stone and soil.

Table 1. Radon concentration and equivalent dose in the dwellings of Garhwal Himalayas.

Place	Average Radon Concentration (Bq/m^3)	EEC_{RN} (Bq/m^3)	Dose (mSv/y)
Padiyargaon	199	90	7.9
KotiColony	122	55	4.8
Tehri	110	50	4.3
New Tehri	119	54	4.7
Nail	119	54	4.7
Chamma	109	49	4.3
Dikholgaon	76	34	3.0
Thanegaon	64	29	2.5
Sabligaon	72	32	2.8
Khanda Srikot	178	80	7.0
Srinagar	75	34	2.9
Chauras	69	31	2.7
Kotdwar	33	15	1.3
Malideval	133	60	5.2
Serain	82	37	3.2
Rajgaon	118	53	4.7
Uppu	48	22	1.9
Dang	54	24	2.1

The results reveal that radon concentration in mud houses are relatively higher than that in the normal buildings. This variation may be due to the building material and mode of construction of the mud houses. The ground floor of such houses allows more radon to diffuse inside the room because of higher porosity of the material used. The emanation of radon from building material (stone and soil) is also higher than the normal building material and may contribute additional radon inside the room. As such high radon concentration is recorded in mud houses.

The radon concentration is expressed in terms of equilibrium-equivalent radon concentration (EEC_{RN}) by using the following relation:

$$EEC_{RN} = F.A_{RN}$$

Where F is the equilibrium factor (F=0.45) and A_{RN} is the measured radon activity. The dose equivalent received by bronchial and pulmonary regions of human lungs have been calculated using a conversion factor 1.0×10^{-5} mSv per $Bq.h/m^3$ (4).

The calculated dose for indoor radon values were found to be four to six times higher than the recommended value (4). The total relative life time risk of lung cancer from inhaled radon and daughter concentration in the study area was calculated as 0.52 per Bq/m^3. This indicates that the lung cancer risk for a population exposed throughout an average life time to the calculated mean EEC_{RN} is more than half of normal lung cancer. These abnormal recorded values in the area finds a scope for the further study in the areas with identical geographical and geological conditions. A detailed study is already in progress in other areas of Garhwal Himalayas.

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