Proc. XIth Nat. Symp. SSNTD
Oct. 12-14, 1998, Amritsar, pp. 259-262
Surinder Singh (Ed.)

INDOOR LEVELS OF RADON/THORON DAUGHTERS IN SOME DWELLINGS OF PUNJAB

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ABSTRACT

Radon/Thoron survey has been carried out in indoor air of dwellings in some districts in Punjab under BRNS:DAE Coordinated National Project. Passive track-etch technique using LR-115 II has been utilised for time integrated measurerment. The detectors were exposed in twin chamber dosemeter cups. The measuerements were carried in form of quarterly cycles covering all the four seasons of the year. The present paper reports the concentration levels of radon/thoron progenies in indoor air of dwellings. The present measurements give geometric mean values of 0.94mWL & 11.32mWL of exposure level from ^{222}Rn and ^{220}Rn daughters. The corresponding values of radon and thoron are 15.4 Bq/m^3 and 5.2 Bq/m^3 respectively.

1. INTRODUCTION

Air borne ratioactivity is well known for its hazardous effects on human beings Gaseous elements, radon and thoron are most important components of air borne radioactivity. There is sufficient evidence to show some correlation between between radon exposure and some type of cancer. (Archer et al., 1973; Edling et al., 1986; Sevc et al., 1988). Also it has been recognised that the real culprit is not radon but its short lived daughters . The radon daughter mainly responsible for natural radiation exposure are Po-218, Pb-214, Bi-214 and Po-214. The available data for India shows that dose from radon daughters ins nearly 25 times higher than from radon. (Mishra et al., 1997).

Radon, once released in open environment leads to buildup of short lived radon daughters. These daughters get attached to dust particles thereby forming a radioactive aerosol. Because of low solubility in body tissue and its inert nature the radiotoxicity of inhaled radon is relatively small compared with inhaled non-gaseous radionu clides such as radon daughters. On the other hand, the radon daughters due to their short half life decay in respiratory tract, giving rise to radiation dose to bronchial epithelium, once inhaled (ICRP, 1986).

2. EXPERIMENTAL TECHNIQUES

Track-etch technique using SSNTD is considerded to be one of the best techniques available for passive integrated measurements (Frank & Benton, 1970). We have utilized this technique using 12μm thick cellulose nitrate film commonly known as LR-115

Type II as detector and twin chamber dosemeter cups as per standard protocol of DAE. Details of this technique are available elsewhere (Prasad, 1994, Virk et al., 1998).

In order to measure the concentration of radon and thoron separately, the detectors were exposed in twin chamber dosimeter cups obtained from Environment Assessment Division, BARC, Trombay. These cups have two chambers each with a height of 4.5 cm and diameter 6.2 cm. The detectors were fixed at the bottom of each chamber and the mouth of one chamber is covered with glass fibre filter paper and the other with a semi permeable membrane (NWSUR, 1994). These cups also have provision for exposing the detector in bare also on outer side of the cup. The detector in the chamber covered with membrane records alpha tracks due to Radon (^{222}Rn) only as membrane allows only radon to pass through it. The other chamber detector, covered with filter paper records track due to alpha from radon and thoron both. Bare detector records tracks due to alpha particles from radon, thoron and their progeny and is used to determine radon and thoron concentration mWL. From this data the inhalation dose due to radon, thoron and their progeny can be calculated. These cups were exposed in 90 dwellings at a height of about 2.5m from the ground. Exposure period of one year was covered in the form of two three month surveys and one six month survey. These exposed detectors were etched under standard conditions (2.5N NaOH solution at 60°C for 80 min.) and counted for track density measurements using a spark-counter. Then using the calibration factors and the software developed at BARC, Trombay the track densities were converted to radon and thoron concentrations and other factors, i.e., dose rate, equilibrium factors and progeny concentrations were calculated. The methodology for calculation of dose is that a ventilation dependent parameter is computed by correlating bare track density with gas and progeny concentration. Then using this parameter and dose conversion coefficient of UNSCEAR(1993), the inhalation dose rates are calculated.

3. RESULTS AND DISCUSSIONS

The data obtained showed log-normal distribution hence the G.M. and G.S.D. values are calculated. The results of measurement of gas and progeny concentrations are summarised in Table 1. Indoor radon concentration varies from a minimum value of 6.4 Bq/m3 to a maximum value of 59.1 Bq/m^3 with annual geometric mean concentration of radon as 15.4 Bq/m^3 and a G.S.D. value of 1.6. The average value of radon for winter season (Oct. 1997-March 1998) is 17.7 Bq/m^3 while for summer (Mar. 1997-June 1997), it is 9.8 Bq/m^3. Obviously, a difference of factor two in the winter and summer radon concentration is attributable to reduced ventilation and increased exhalation in winter. The average value of radon for rainy season (Jun. 1997-Sep. 1997) is 11.6 Bq/m^3 with a G.S.D. value of 1.8.

The average value of thoron concentration varies from 0.2 Bq/m^3 to 26.4 Bq/m^3 with an annual geometric mean value of 5.2 Bq/m^3 and a G.S.D. value of 2.4. The average value for winter season is 6.1 Bq/m^3 while for summer it is 3.3 Bq/m^3. As in the case of radon, thoron value for winter is also almost double than the summer value.

From the table 1 it can be seen that radon daughter concentration varies from a minimum value of 0.1 mWL to a maximum of 4.8mWL with yearly average GM value of 0.94mWL while daughter concentration for thoron varies from 0.1mWL to 175mWL with year average GM value of 11.3mWL. Using dose conversion coefficients of UNSCEAR (1993), the inhalation dose due to radon gas is calculated to be 2.6nSv/h while dose due to radon daughters is 31.35nSv/h. similarly the inhalation dose due to thoron gas is 0.57nSv/h while that due to thoron daughters is 99.44nSv/h. The collective dose due to both gases and their daughters taking into account the spatial profiles of thoron comes out to be 0.18μSv/h.

Table 1. Measured $^{222}Rn/^{220}Rn$ gas and progeny concentration in Punjab (Average of 90 dwellings)

	Radon Conc. (Bq/m^3)	Radon Progeny Conc. (mWL)	Thoron Conc. (Bq/m^3)	Thoron Progeny Conc. (mWL)
Minimum	6.4	0.1	0.2	0.1
Maximum	59.1	4.8	26.4	175.2
Annual Average	15.3	0.94	5.2	11.3

Table 2. Dose rates due to radon / thoron and their progenies

Dose rate				
Radon Gas (nSv/h)	Thoron Gas (nSv/h)	Radon Progeny (nSv/h)	Thoron Progeny (nSv/h)	Collective Dose (μSv/h)
2.60	0.57	31.35	99.44	0.18

CONCLUSION

From the above discussion it can be seen that dose due to radon daughters is about 17 times higher than radon gas. In the case of thoron, dose due to progeny is about 170 times of that from parent gas which can be assumed as an over estimation upto some extent. But even then it is clearly established that dose due to progenies is several times higher than that from parent gases. So the correct estimation of progeny levels is very important for correctly estimating exposure to local population. As the progeny concentrations are strongly dependent on equilibrium factors, which again is depandant on ventilation in a particular house, so the seasonal variation of gas and progeny concentration is an important factor to be considered for correctly estimating the dose.

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