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A pilot survey on indoor radon and thoron progeny in Yangjiang, China

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Abstract. A pilot survey on indoor radon and thoron progeny concentration was carried out in five villages in HBRA of Yangjiang and one village in the controlled area(CA) in March 2004. Totally 26 adobe houses and 29 brick houses in HBRA were investigated. A portable 24-h integrating monitor with CR-39 detectors was adopted for progeny measurements, and the average equilibrium equivalent ^{222}Rn and ^{220}Rn concentrations (EEC_{Rn} and EEC_{Tn}) were obtained. Rather high levels of EEC_{Rn} and EEC_{Tn} with an average of 57.1 ± 33.3 and 12.6 ± 9.5 $Bq\cdot m^{-3}$, respectively, were observed in adobe houses. In addition, ^{222}Rn/^{220}Rn concentrations and exhalation rate were also measured by an Electrostatic-Radon-Sampler (ERS-2) monitor. © 2004 Published by Elsevier B.V.

Keywords: Radon; Thoron; Progeny; High Background Radiation Area; Yangjiang, China

1. Introduction

Yangjiang, located in the very southern part of China mainland, is well-known as a high background radiation area (HBRA), and an epidemiological study has been carried out for several decades. It is noticed according to previous research that the ^{232}Th content of soil in HBRA is rather high; the average value is 206 ± 92 Bq kg^{-1} [1]. Therefore, the evaluation of the contribution from thoron (^{220}Rn) progenies should be necessary and important from the viewpoint of internal exposure. Measurements on both radon (^{222}Rn) and ^{220}Rn gas have been performed, but data of ^{222}Rn and ^{220}Rn progenies was very limited until now. For the purpose of the evaluation of dose contribution from those progenies, direct and integrating measurements are desirable.

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Table 1
Indoor EEC_{Rn} and EEC_{Tn} in HBRA (Bq m^{-3})

Dwelling types	Dwelling numbers	EEC_{Rn}			EEC_{Tn}		
		Range	Mean	S.D.	Range	Mean	S.D.
Adobe houses	26	1.2–128.2	57.1	33.3	1.2–37.0	12.6	9.5
Brick houses	29	3.6–88.8	41.8	26.0	0.6–29.6	4.7	5.5

2. Materials and methods

2.1. $^{222}Rn/^{220}Rn$ progeny integrating measurements

To simultaneously measure both ^{222}Rn and ^{220}Rn progeny concentrations, a new type of portable integrating monitors with etched track detectors (CR-39) was developed by Dr. Zhou [2] and adopted in our survey. The monitor sampled ambient air at a flow rate around 1 L min^{-1} for 24 h continuously, and then the average equilibrium-equivalent ^{222}Rn and ^{220}Rn concentrations (EEC_{Rn} and EEC_{Tn}) during the sampling intervals were obtained through etching and calculating.

2.2. Measurements of ^{222}Rn and ^{220}Rn gas concentrations and exhalation rates

A set of Electrostatic-Radon-Sampler (ERS-2, Tracerlab Instruments, Germany) was adopted to measure both ^{222}Rn and ^{220}Rn gas concentrations as well as exhalation rates from the surface of typical walls and ground.

3. Results and discussions

A pilot survey of 64 dwellings in five villages of the HBRA and one village in the control area was conducted in a typical spring season, March 2004. The main results of HBRA are shown in Table 1.

EEC_{Tn} seemed more sensitive to ventilation conditions than that of EEC_{Rn}. Indoor EEC_{Rn} and EEC_{Tn} also showed a good correlativity with field γ dose rate. The ranges of ^{222}Rn and ^{220}Rn exhalation rate from the surface of adobe wall were 22.5–42.9 and 2111–4012 mBq/m^2 s, respectively. For the surface of brick wall, the ranges of ^{222}Rn and ^{220}Rn exhalation rate were 11.1–26.4 and 317–1022 mBq/m^2 s, respectively. Both $^{222}Rn/^{220}Rn$ concentrations were measured with 1-h cycle in five adobe and brick houses; the range of the average concentrations of each measured room was 152–412 Bq m^{-3} for ^{222}Rn and 82–403 Bq $m^{-3}$for ^{220}Rn (5 cm from the ground and far from the wall).

4. Conclusion

Rather high levels of EEC_{Rn} and EEC_{Tn} with a wide and varied range were found in both adobe and brick houses as well. High ^{220}Rn exhalation rates from the surface of adobe walls suggested that the adobe walls were the sources of the high EEC_{Tn} concentrations indoors. Investigations in detail were needed in the future.

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