P – 22

Intermittent and Continuous Measurement of Radon Progeny in Indoor Air

Tsuneo KOBAYASHI

Department of Physics, School of Medicine, Fukushima Medical University

Introduction

Investigations have been made on radon (^{222}Rn) progeny in indoor air. Generally, annual effective dose equivalent of a human body in natural environment is known to be about 2 mSv, and about half of which is due to internal exposure to ^{222}Rn and ^{220}Rn progeny. Therefore, clarifying the behavior of these decay products is an issue of wide importance to radiation protection, etc. Intermittent and continuous measurement for ^{222}Rn progeny was performed from October 1997 to April 1999 at the campus of the author's university located in the northeastern part of Japan (37 °45′N,140 °28′E, 67.4 m above sea level).

Materials and Method

Intermittent measurement of ^{222}Rn progeny employed a filtration method with alpha spectroscopy [1], using membrane filters (pore size, 0.8 μm) and a self-contained alpha spectrometer. After 10 minutes sampling (20 L min^{-1}) of the progeny in air, decay of the activity on the filter was detected for 50 minutes. Concentrations of ^{218}Po, ^{214}Pb and ^{214}Bi were obtained from the decay data. The equilibrium equivalent radon concentration (EC_{Rn}) was calculated from these concentrations. Lower detection limit was 0.1 Bq m^{-3}.

Continuous measurement system for radon progeny (Pylon, WLx) recorded potential alpha energy concentration in unit of WL every one hour. The pump (0.5 L min^{-1}) and counter were set to continuous operation. The counts obtained were grouped in time intervals of 60 minutes. Minimum detectable level written in the manual was nominally 1 mWL (3.7 Bq m^{-3} in EC_{Rn}).

Intermittent measurement was made (from 10:55 to 11:05) every day except holidays, whereas the continuous monitor worked all day. Air was sampled in a room of the author's office, which is on the fourth floor of a five-storied building. The office adopts ventilation system that draws (from 7:30 to 23:30) outdoor air into indoor through some filters. Due to this ventilation system, indoor ^{222}Rn progeny level is lower than that of outdoor, and the equilibrium factor, F-value, is around 0.2 [3]. The dominant origin of indoor ^{222}Rn progeny is considered to be the outdoor ^{222}Rn gas drawn into indoor [1]. The college building was built in 1988.

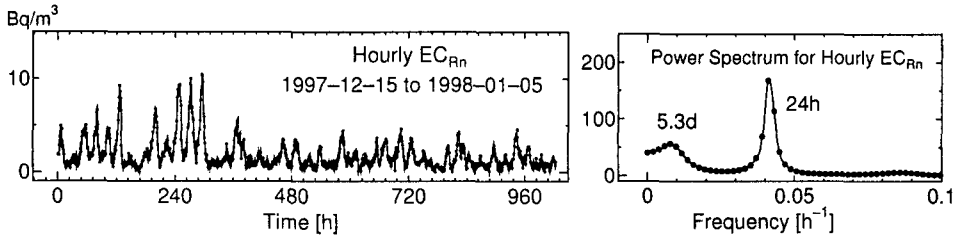
Results and Discussion

Intermittent data exist only for 11:00, while continuous data are from 0:00 to 23:00. Correlation analyses between these data indicated that intermittent data were signifi-

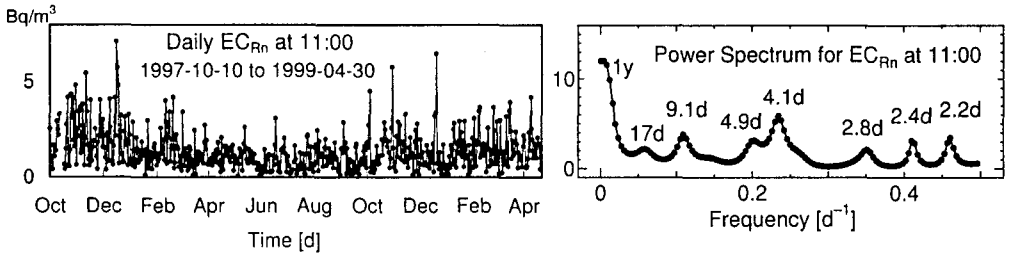
cantly correlated with each 24 group of continuous data (significance level, 0.001%). The highest value of Pearson correlation coefficient was 0.854 for 11:00 data.

To check the well-known log-normal distribution, Lilliefors examination was performed for intermittent data at 11:00 and 24 continuous data at 0:00 to 23:00. Most groups of data passed the examination except 4:00 to 7:00 groups (significance level, 5%).

Time series analysis with autoregressive model [4] was made on progeny concentration, EC_{Rn}, using data of continuous method. Typical power spectrum for hourly data indicated the periodicity of 24 hours and 5.3 days.



To compare the continuous data with intermittent ones, daily data at 11:00 were picked out from continuous data. Continuous data indicated the temporal variation with period such as 17, 9.1, 4.1, 2.8 and 2.2 days. The period of 5.3 days from hourly data and 9.1 to 2.2 days from daily data is probably attributed to the meteorological phenomena such as passage of air masses. Instead of 20 to 40-day peak (often found for outdoor air [2]), 17-day peak was observed. One year period was also clear, which corresponds to seasonal variation (high concentrations in winter). Intermittent data revealed essentially the same results as continuous ones.



References

[1] Kobayashi, T. and Takaku, Y.: Intermittent measurements of ^{222}Rn and ^{220}Rn progeny in air for four years. RADIOISOTOPES, **46**, 603-614, 1997.

[2] Kobayashi, T. and Takaku, Y.: Comparisons of natural radiation at new and old campus of Fukushima Medical College. Hoken Butsuri, **26**, 117-122, 1991. (In Japanese)

[3] Continuous radon gas measurement along with intermittent radon- and thoron-progeny measurement for one year. "Radon And Thoron In The Human Environment" (ed. by Akira Katase and Michikuni Shimo), World Scientific Publishing Co. Pte. Ltd., Singapore, pp. 418-423, 1998. ISBN 981-02-3443-0

[4] Akaike, H.: Annals Inst. Statist. Mathem., **21**, 243-247, 1969.