Mausam, (1989), 40, 1, 101-106

Letters to the Editor

550.835.24 : 551.50 (549.3)

VARIATION OF RADON DAUGHTER CONCENTRATIONS WITH METEOROLOGICAL PARAMETERS IN BANGLADESH

1. The air concentrations of short-lived radon daughters RaA, RaB and RaC were determined and working level were computed.

It reveals from the results that there is a strong dependence of air concentrations of radon daughters with relative humidity, rainfall and temperature.

2. Radon-222 and its short-lived daughter products are among the natural radioactive constituents of earth's atmosphere and may constitute a health hazard. This hazard is largely due to the daughter products rather than radon itself.

Concentrations of radon daughter products have been evaluated from the measurement of alpha activity collected on filters and converted to working level. The working level expresses the concentration or burden of radioactivity in a given environment and is defined as any combination of short-lived radon daughters in one litre of air that represents 1.3×10^5 MeV of potential alpha energy (Holiday *et al.* 1957).

The main aim of this research work is to determine the level of air-borne radon daughter concentrations and to observe their variation with meteorological parameters.

3. *Methods and materials* — The methods for RaA, RaB and RaC concentration measurements have been given by many investigators (Jonassen and Hayes 1973, Martz, *et al.* 1969, Raabe and Wrenn 1969, Tsivoglou *et al.* 1953, Thomas 1970, 1972). These three nuclides are almost always determined by collecting air samples on a filter at a constant flow rate and then analyzing alpha activity. The total count method have been used in this work. The total No. of alpha counts $[I(T_a, T_b)]$ occurring from T_a and T_b minutes after the end of sampling can be determined from the work of Thomas (1970, 1972). We have determined the equations for the air concentrations of RaA, RaB and RaC for three different time interval sets (1- 5), (6- 20) and (21- 30) minutes after the end of sampling and sampling time of five minutes.

The equations in terms of atoms/l are as follows :

$$Q_1=(0.2357645\ I_1-0.1590806\ I_2+0.1561233\ I_3)/EYV$$
$$Q_2=(0.0016773\ I_1-0.0454563\ I_2+0.1087879\ I_3)/EYV$$
$$Q_3=\frac{-0.0319368\ I_1+0.0709045\ I_2-0.0818600\ I_3}{EYV} \qquad (1)$$

where,

Q_1, Q_2 and Q_3 are the air concentrations of RaA, RaB and RaC respectively: atoms/l ;

I_1, I_2 and I_3 are the net alpha counts in the chosen counting time interval sets;

E is the efficiency of the filter;

Y is the efficiency of the detection system;

V is the volume flow rate, /m.

The equations for air concentrations of RaA, RaB and RaC in $P^{ci/l}$ are as follows :

$$Q_1=(0.1062002\ I_1-0.0716579\ I_2+0.703258\ I_3)/EYV$$
$$Q_2=(0.0007555\ I_1-0.0204758\ I_2+0.0490035\ I_3)/EYV$$
$$Q_3=(-0.0143859 I_1+0.0319389 I_2-0.0368738 I_3)/EYV \qquad (2)$$

The standard deviations of Q_1, Q_2 and Q_3 in units of P^{ci} are determined from the Eqn. (3), if we assume that E, Y, V and coefficients of I are constants,

$$S(Q_1)=(a^2I_1+b^2I_2+c^2I_3)^{1/2}/EYV$$
$$S(Q_2)=(d^2I_1+e^2I_2+f^2I_3)^{1/2}/EYV$$
$$S(Q_3)=(g^2I_1+h^2I_2+j^2I_3)^{1/2}/EYV \qquad (3)$$

where, a, b,............, j are the coefficients of I after determining air concentrations of RaA, RaB and RaC in terms of atoms/l by using Eqn. (1), the radon daughter working level is computed from the following Working Level (WL) formula (Homgren 1974, Raabe and Wrenn 1969) :

$$\text{WL}=\frac{13.68\ Q_1+7.68\ (Q_2+Q_3)}{1.3\times10^5} \qquad (4)$$

A Karl Kolb model FH 422 portable dust sampler was used. The air flow rate of the sampler is 466.6 l/m and the filter efficiency is 35%. The air samples collected were counted with a PT-72 scaler in combination with a polon alpha scintillation probe. The counting efficiency of the detection system was determined by a calibrated ^{241}Am alpha reference source and was found to be 31%. The counter background was determined to be 0.6 cpm. We collected all samples at noon from the same place at a height of 7 metres from the ground. The soils underlying and around our sample collecting point are comprised of the smooth relief phase of grey, strongly mettled brown, strongly acid, sandy loams, seasonally intermittently wet, which are surrounded by the steep hills of brown, strongly acid, loams to clay loams. The relative humidity, temperature were recorded

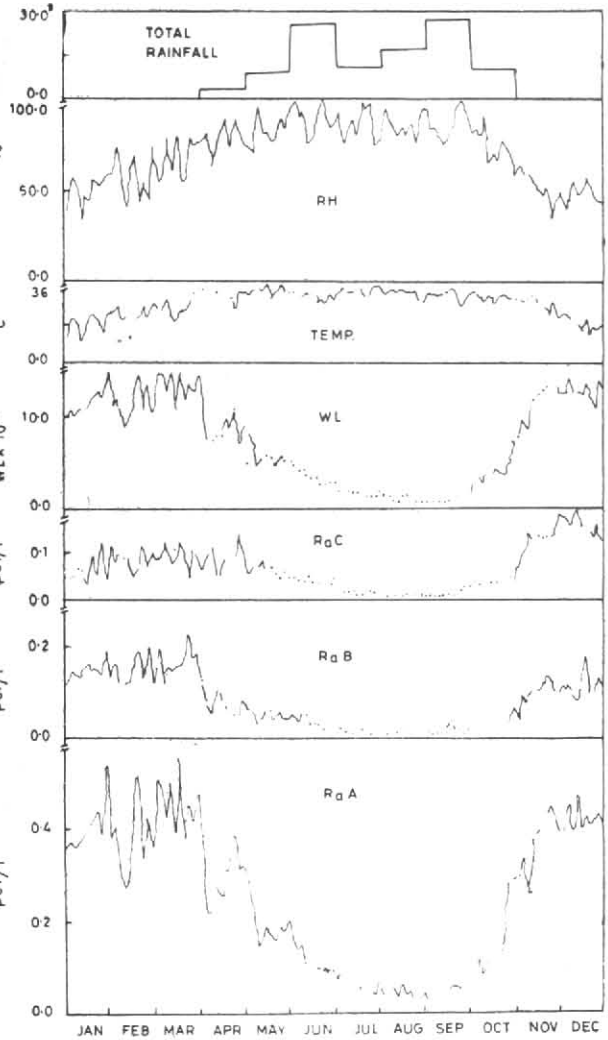

Fig. 1

on all days of sample collection date throughout the year and total rainfall for the months were collected from Meteorological Department.

4. *Results and discussions* — The results obtained for RaA, RaB and RaC in units of Pci/l and computed value of working level are plotted for one year shown in Fig. 1. They represented the activity of air samples collected throughout the year. In Fig. 1, the curves for temperature, relative humidity and total rainfall in twelve months of the same year are also shown.

From the figure, we observed that higher value of radon daughter concentrations appeared in the months from November to April, and in these months relative humidity and rainfall are very low. A lower value of radon daughter concentrations obtained in the months from June to September and in these months the relative humidity and total rainfall are maximum. From these results, it would be concluded that there is a strong dependence of radon daughter concentrations on relative humidity and rainfall. It decreases with the increases of both relative humidity and rainfall.

One can determine the burden of radio activity due to air-borne radon daughters from the curve of working level in Fig. 1.

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8 March 1988