INTEGRATING MEASUREMENTS OF RADON IN DWELLINGS IN SOME REGIONS FROM ROMANIA

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INTRODUCTION

Many epidemiological studies especially made on different cohorts of uranium miners clearly showed the influence of radon and radon progeny in lung cancer diseases (1).

At present, about ten important epidemiological studies regarding indoor radon concentration and lung cancer risk are in the world under observation (2).

The indoor radon concentrations are strongly dependent on the meteorological factors, the ventilation conditions and on the radon soil potentiality. In some earth areas the radon generated in upper part of the lithosphere or in the wall material may produce high radon concentrations in dwellings (3).

In Romania have been performed measurements in uranium and nonuranium mines (4) also in some country centres (5) by Kusnetz's method. The Kusnetz's method being an instantaneous method for indoor radon concentrations may not provides a correct estimation for average indoor radon content. In some cases, if the measurements are made in determined conditions (after a few hours of the windows and doors closing) it is possible to obtain a certain average value for indoor radon concentration more or less deviated from the real value (6).

Therefore, for a good estimation of the average indoor radon content, the measurements may be made for 3-6 months period, that is integrating determinations. Such measurements usually performed by track method or by electret detectors in the last years (7) are used for the radon indoors in dwellings.

Beginning from 1994 under collaboration with Gent University (Belgium) and NRPB (England) financed by CEC in Romania were started the first integrating measurements of radon in dwellings.

This work presents these measurements in three regions of Romania. In the first two, respectively the Bihor and Cluj districts also an epidemiological pilot study in connection with the lung cancer risk due to radon was started. The third region is the Herculane Spa area where also many radon determinations in different environmental factors exist (8).

EXPERIMENTAL METHOD

The Karlsruhe radon diffusion chambers using makrofol electrochemical etched track detectors were used (9). After a previous chemical etching (0.5 hours) at 25 °C using a 6N KOH solution follows the electrochemical etching performed in the same solution applying an effective voltage of 800 V at 2 kHz during 3 hours (Gent conditions) (10).

The makrofol detectors were exposed for 3 months period in different buildings. The indoor radon concentrations were also performed by the Kusnetz's method using the scintillation flasks of 0.5l which were calibrated with romanian $RaCl_2$ standard solution.

RESULTS AND DISCUSSION

Table 1 presents the average values and the standard deviation for three areas from Romania. For the first two areas (Cluj-Napoca and Oradea cities) the measurements have been made in the <u>cold season</u>

and for the Herculane Spa region the measurements were made measurements both in cold season and warm season. For comparison in the last column of this table we present the measurements for indoor radon obtained by the Kusnetz's method. The values of 76 $Bq.m^{-3}$ and 115 $Bq.m^{-3}$ in each town represent the mean value of 30-35 dwellings and in each dwelling these were measured twice a year in cold and in warm season. These values are smaller than integrating measurements made only in cold season when the ventilation is smaller.

A rather high value was find for ^{14}C-laboratory (1d) and for the cave of one author (1e).

The measurements made in Herculane Spa show an average value for the cold season (185 $Bq.m^{-3}$) of two times greater than the average value for the warm season. Figure 1 also shows the indoor radon distribution for the cold and warm season.

Table 1. Integrating measurements of radon in three areas of Romania.

No.	Place	Number of dwellings	Average indoor radon ($Bq.m^{-3}$)	Standard deviation ($Bq.m^{-3}$)	Time period	Kusnetz's method (5,6) ($Bq.m^{-3}$)
1	Cluj-Napoca city a) houses-downstairs	11	182.6	102	10.12.94 to 10.03.95	76
	b) block flats	8	125.7	20	idem	
	c) University-downstairs	4	127.3	21	idem	(annual
	d) ^{14}C laboratory (ITIM)	1	282	-	idem	average)
	e) author cave	1	1060	-	idem	
	f) Dej (town in Cluj district) houses-downstairs	2	100	15	06.12.94 to 06.03.95	
2	Oradea city houses-downstairs	5	124	15	06.12.94 to 06.03.95	115 (annual average)
3	Herculane Spa a) buildings-downstairs in warm season	15	98.2	82	16.04.94 to 16.07.94	
	b) the same dwellings in the cold season	15	185.1	68	20.11.94 to 20.02.95	-
	TOTAL COULD SEASON AVERAGE (without 1e and 3a) 161 $Bq.m^{-3}$					

The mean value in the cold season (161 $Bq.m^{-3}$) obtained for all measurements from Table 1 is high enough but many integrating determinations are necessary for configuration of this value.

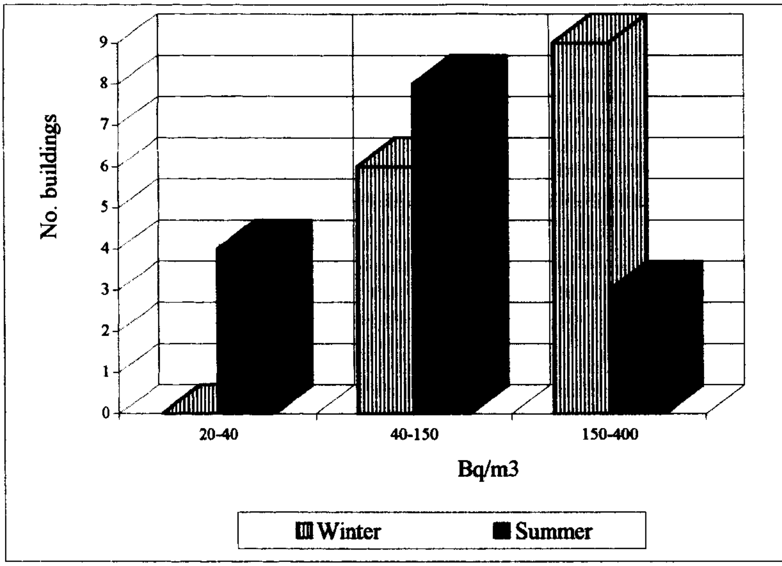

Figure 1. The distribution of indoor radon concentrations in Herculane Spa .

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