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Indoor Air Radon Concentrations in Clinical Centre University of Kosovo and Faculty of Medicine, University of Prishtina, Kosovo

Ymer Halimi, Besim Xhafa and Albert Januzaj
Faculty of Medicine, University of Prishtina, Kosovo

Abstract: Indoor air radon concentration was measured by exposing track-etch detectors in the Clinical Centre University of Prishtina and Faculty of Medicine, University of Prishtina in the city of Prishtina. Measurements were performed with the radon monitor PRM-145, which uses alpha scintillation cells and serves to determine the current concentration of radon. The results we obtained are in the range between the average values of radon for the interior spaces and values that pose a potential risk for lung cancer. Measuring the concentration of radon was done in total of 22 rooms and came up with values which are between 87 and 294 Bq m^{-3}. In order to reduce the concentration of radon, we have built a ventilation pump, then we performed repeated measurements and finally came with results between 110-125 Bq m^{-3}.

Key words: Radon-222, indoors, concentration, measurements, dosimetry, exposure

INTRODUCTION

Approximately, 85% of radiation comes from natural sources, while about 15% are taken to be from artificial sources. Out of 100% of all radiation in nature, about 50% of radiation comes from radon ^{222}Rn and thoron ^{220}Rn (Nazaroff and Nero, 1988). Today, radon is known as one of the main causes of lung cancer and respiratory organs. The risk posed by Radon so high that only tobacco smoking is a higher cause for lung cancer (Bahtijari *et al*., 2008). This is the main reason we have worked, performed the measurements and monitored the indoor concentration of Radon in the city of Prishtina, which is at an altitude 680 m above the sea level. The results we came up are on the range of 87-294 Bq m^{-3}.

MATERIALS AND METHODS

We only measured the level of radon in public buildings in the city of Prishtina, which are frequented by an average of 8000 people a day altogether, mainly man, women, children.

Measurements are performed in different levels of buildings including: undergrounds, ground floor, first and second floors that have a maximum altitude of 10 m above the surface of the earth. Samples of air within the room are taken up to 1.5 m from floor and 20-60 cm distance from walls. Air was pumped in a cell using a simple manual hand pump as shown in the Fig. 1.

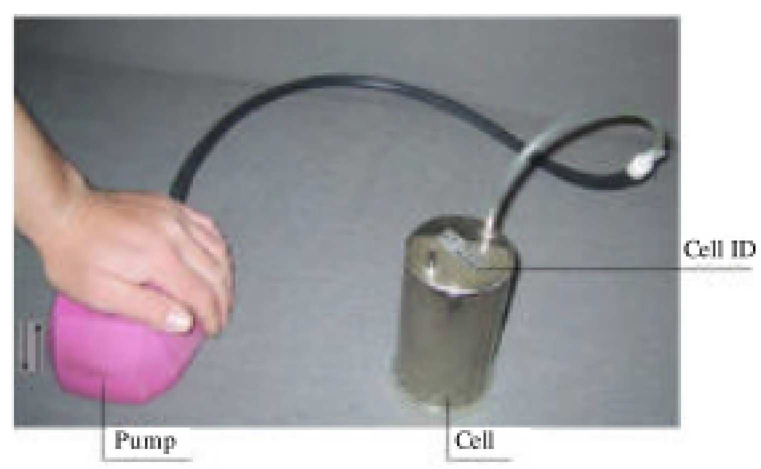

Fig. 1: The process of pumping the air in the scintillation cell

Fig. 2: Portable monitor AMES-PRM 145

Results are calculated using portable monitor of radon PRM-145 shown in Fig. 2. Radon concentration on air was measured with 0.7 dm^3 alpha scintillation cells (Vauputotie *et al*., 1992) and calibration according to the

Corresponding Author: Besim Xhafa, Faculty of Medicine, University of Prishtina, Bulevardi I Deshmoreve P.N., Prishtine, 10,000, Republic of Kosova

Rushing *et al*. (1964)'s procedure using the NIST (National Institute of Standards and Technology, Washington DC, USA) standard $^{226}RaCl_2$ solution 4953D. Cell efficiency is in the range from 0.0019-0.0022 s/Bq/m^3 which gives a lower limit of detection from 10-30 Bq m^{-3} at 30-60 min counting time in a PRM-145 counter (AMES, Slovenia). Radon concentration obtained by exposing track etched detectors (Sutej *et al*., 1988).

Portable monitor has a software program installed which is designed to do the calculations inserted from the user and then displaying the results on the monitor.

The measurements were performed in the following locations: in Nuclear Medicine, Radiology, Radiotherapy, Oncology and Surgery unit, all these are local in Clinical Centre University of Kosovo and three large amphitheatres for student in Faculty of Medicine. Measurements are conducted in basement, ground floors, first and second floors.

After taking the air samples in, we placed cells in a calm environment and waited for three hours prior to putting them into the measuring instrument. Measuring time for each cell, time which cell stays in instrument is 30 min.

In all measuring locations, we had an agreement with room coordinators so they lock all the doors and windows 12-14 h prior to taking the air samples, usually in the morning. In order to keep the error late as low as possible, mainly caused by instrument, as preferred, we performed two series of measurements. After performing all these procedures, we have gained the results for indoor concentration of Radon in the air. Series of measurements were performed during April and May 2009. The total average value for all buildings was 152.02 Bq m^{-3}. Average values of the premises, it thus appears that these values are smaller than the values allowed by the ICRP. But if we take the values of indoor radon through each room we have a result that several rooms exceeds the value 200 Bq m^{-3} of radon, according to the ICRP should not be passed value 200 Bq m^{-3} for the closed space (Meleq *et al*., 2006).

Average values were calculated both independently from each other and also a total average value was derived for all buildings together. Average value of nuclear medicine, 181.30 Bq m^{-3}, in radiotherapy the average value is 148 Bq m^{-3}, in radiology the average value is 157 Bq m^{-3}, in surgery unit is 133.05 Bq m^{-3} and in the three amphitheatre the average value is 140 Bq m^{-3} (Table 1).

The total average value from all five buildings is 151.86±14 Bq m^{-3}. If we compare the average values of the premises, it thus appears that these values are smaller than the values allowed by the ICRP. But if we take the values of indoor radon through each room we end up having several rooms that exceed 200 of Radon. According to the ICRP should not be passed value 200 Bq m^{-3}.

The main purpose of these measurements was do determine the concentration of radon in the buildings but especially in room of gamma camera, room for command of gamma camera, warm room with isotope of technetium (Tc-99). In the mammography room, in CT room, we can see that the results is >200 Bq m^{-3} (Table 2 and Fig. 3).

Table 1: Building average concentration value

Buildings	Average concentration value in (Bq m^{-3})
Nuclear medicine department	181.30
Radiotherapy	148.15
Radiology	157.22
Surgery department	133.05
Faculty of medicine	140.31

Table 2: Indoor air radon concentration in closed buildings

Departments	Rooms	Flours	C_{Rn} 222 (Bq m^{-3})
Nuclear medicine	Corridor	B	107.13±12.46
	Kitchen	B	159.04±7.8
	Patients room	B	163.10±11.01
	Laboratory for blood testing	B	132.18±16.01
	Room of Gamma camera	B	257.15±13.04
	Control room for gamma camera	B	215.19±14.02
	Warm room with isotope of technetium (Tc-99)	B	294.94±14.92
	Medical Doctors office	1	121.68±14.44
Radiotherapy	Ultrasound room	1	187.82±16.32
	Mammography room	B	235.12±15.23
	Medical doctors office	1	109.89±9.12
	Corridor	2	95.89±10.21
Radiology	CT room	B	215.14±13.39
	Control room for CT	B	185.16±11.40
	Corridor	2	87.31±16.63
	Patients room	1	105.64±17.21
Surgery	Corridor	1	94.58±12.21
	Surgery room (I)	1	169.86±12.53
	Surgery room (II)	1	134.73±14.56
Faculty of medicine (Amphitheatre)	Amphitheatre I	1	145.64±15.12
	Amphitheatre II	2	128.14±11.25
	Amphitheatre III	1	149.10±.15

B = Basement, 1: First floor, 2: Second flour

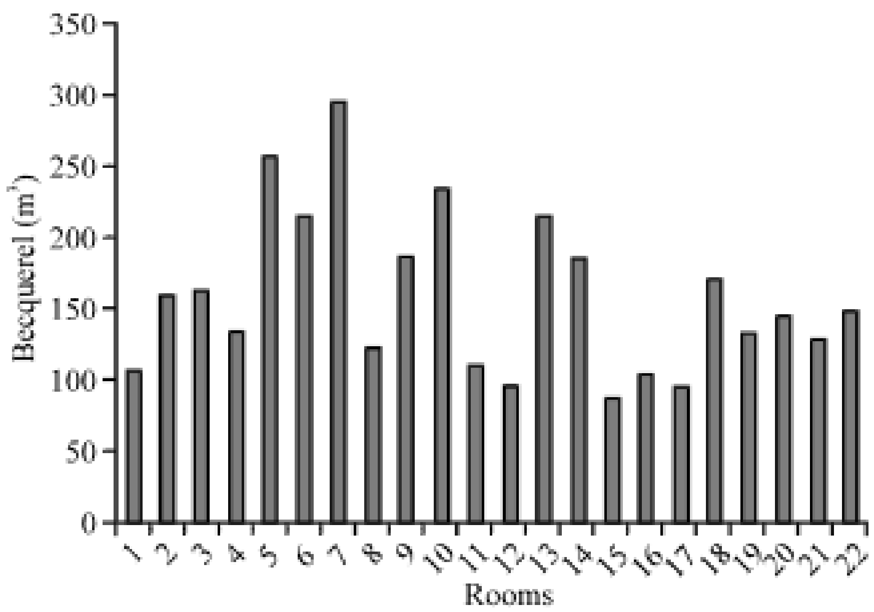

Fig. 3: The distribution of radon concentration in closed buildings-Prishtina

Due to the fact that prior to installing a ventilation pump the concentration of radon was 400 Bq m^{-3}, whereas after the ventilation the concentration dropped between 130 and 145 Bq m^{-3}.

CONCLUSION

In this study, all of rooms with value >200 Bq m^{-3} are located in the basement of this building, where workers spend a good amount of time at these jobs. It was essential to let the hospital and university staff now about these values and steps they needed to take to prevent any health complication.

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