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PRELIMINARY RESULTS ON INDOOR RADON CONCENTRATIONS IN THE BUILDINGS OF UNIVERSITY ALEKSANDËR MOISIU, DURRËS (ALBANIA)

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Abstract. *Indoor radon concentrations were measured in the main buildings of the two campus sites of the University Aleksandër Moisiu, Durrës. The measurements were performed using the passive method based on solid-state nuclear track detectors (CR-39) in two seasons' winter and summer, which cover almost the entire period of an academic year. In a few cases, the active method was used to check on diurnal variations of indoor radon concentrations. The average indoor radon concentrations measured in the autumn-winter season (67 measurements in 49 locations) and discussed in this preliminary analysis were found to range from 14 up to 98 Bq m^{-3}. All the measurements were found to be under the reference level of Albanian legislation for indoor radon concentration in workplaces. No significant differences in radon concentrations were found among buildings and between various floors. The preliminary average effective dose was calculated by using ICRP recommendations considering the standard exposure period was found to be 0.6 mSv/year.*

Keywords: *University Aleksandër Moisiu, indoor radon, workplaces, effective dose*

1. INTRODUCTION

People are unambiguously exposed to natural radiation, when it was recognized that long-term exposure to high levels of radon gas can pose health hazards [1, 2]. Based on the European basic safety standards, the reference level of indoor radon concentration in the Albania was set 300 Bq m^{-3} for both dwellings and workplaces [3, 4]. Numerous studies were conducted in many countries in order to monitor radon levels and study the factors affecting concentration levels, such as underlying geology, meteorological conditions or building characteristics, while paying particular attention to public buildings as schools and kindergartens [5, 6, 7]. This study reports the results of indoor radon (^{222}Rn) concentrations in Aleksandër Moisiu University campus in Durrës. These data are used to calculate the annual effective dose due to exposure to radon gas in the workplace and assess the radiological health risks.

2. MATERIALS AND METHODS

Aleksandër Moisiu University is a public institution located in the city of Durrës, comprised of three buildings: one on the Currila campus and two on the Spitallë campus. Long-term measurements of indoor radon activity concentrations in the three buildings were conducted using CR-39 passive radon detectors (SSNTD - Solid-State Nuclear Track Detectors) from the Protex Italia laboratory. Throughout the autumn-winter period, 67 detectors were installed in laboratories, libraries, and offices (49 sites) across various floors at heights of roughly 1 and 2 meters above the ground and as distant as possible from windows and doors. A second survey will be carried out at each site during the spring-summer period, with detectors deployed for about three months. The measurements were performed following the guidelines outlined in UNI standard [8]. First exposed detectors were etched and then rinsed with distilled water to reveal the "latent tracks" produced by the alpha decay of radon gas. The number of "latent tracks" was examined with an optical microscope, and the radon concentration was determined using equation (1):

$$C\left(\frac{Bq}{m^3}\right) = \frac{radon\ exposure\left(\frac{Bq\,h}{m^3}\right)}{duration\ of\ exposure\ (h)} \qquad (1)$$

where the radon exposure was calculated as the ratio between the background corrected track density and the calibration factor.

3. RESULTS AND DISCUSSION

The measured indoor radon concentration in the three buildings vary between 9 and 113 Bq/m^3. Table 1 presents the average indoor radon levels measured at 49 sites within the Aleksandër Moisiu University

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campus. The Kolmogorov-Smirnov test confirmed that the transformed data do not differ significantly from normal distribution, showing a p-value of 0.5 confirming the null hypothesis. The findings indicate that radon activity concentrations do not exceed 300 Bq/m^3 at any location, which is the reference level of Albanian legislation for workplaces. The arithmetic mean was found to be 45±20 Bq/m^3, while the median was 42 Bq/m^3.

Table 1. Statistical analysis of the average radon concentration

Statistical data	Aleksandër Moisiu University campus
No. measurements	49
Range (Bq/m^3)	14-98
Mean (Bq/m^3)	45
Median (Bq/m^3)	42
Standard deviation	20
Skewness	1.0
Curtosis	0.8

No significant differences in radon concentrations were found among buildings or between various floors. The libraries (both located on similar floors) in different buildings on the Currila campus and Spitallë campus display slightly higher levels of radon (average indoor radon concentration are shown in Figures 1 and 2). The relatively higher concentration of indoor radon in libraries could be due to the low ventilation of these locations.

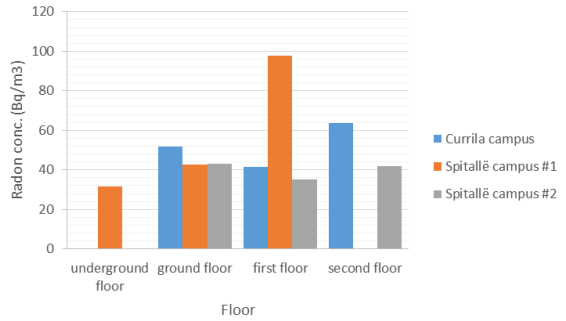

Figure 1. Distribution of the average indoor radon concentration in building floors

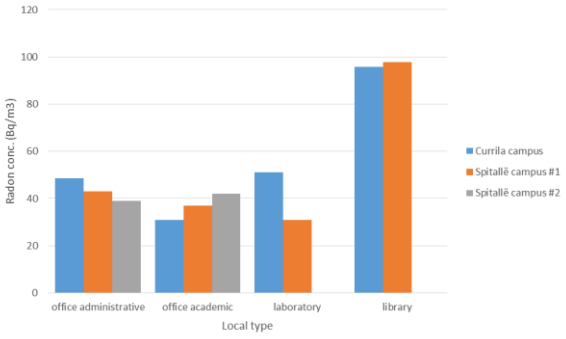

Figure 2. Distribution of the average indoor radon concentration in building locations

The average effective dose due to exposure to radon gas in the dwellings and workplaces has been estimated based on the recommendations of the European Commission and ICRP recommendations using equation (2):

$$E\left(\frac{mSv}{y}\right) = C_{Rn} \times T \times DCF \qquad (2)$$

where C_{Rn} is the radon concentration, T is the occupancy time 2000 hr for workplaces and DCF (equivalent to 6.7 nSv per Bq hm^{-3} using an equilibrium factor of 0.4) is the dose conversion factor [9, 10]. The average effective dose rate due to indoor radon concentrations was calculated to range from 0.2 to 1.3 mSv/y with an arithmetic mean of 0.6 ± 0.3 mSv/y. These findings suggest there was no significant radiological health risk, as the observed concentration levels were below the reference level of 300 Bq/m^3 set in the Albanian legislation for workplaces.

4. Conclusion

The typical indoor radon activity levels at the University Aleksandër Moisiu campus in Durrës vary between 14 and 98 Bq/m^3. The average concentration observed across various buildings and floors shows no significant difference. In any case, the radon activity levels were found to be below the reference level of 300 Bq/m^3. The average dose from indoor radon exposure was estimated to be 0.6 mSv/y (calculated during autumn-winter seasons). These findings suggest there was no significant radiological health risk, as the observed activity levels were below the reference level set in the Albanian legislation for workplaces.

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