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## RADON AND ITS PRESENCE IN THE INDOOR AIR

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### **Introduction**

Radon is an odorless and colorless radioactive gas that is formed by the radioactive decay of earth uranium. Radon can accumulate in rooms, homes, schools, hospitals or office buildings, especially in rooms that are not anti-radon insulated and ventilated. The establishment of an average annual reference level for the residential radon concentration is 100 Bq/m<sup>3</sup>, but if this level cannot be reached under country specific conditions, the reference level should not exceed 300 Bq/m<sup>3</sup>. The World Health Organization (WHO) recommended 100 Bq/m<sup>3</sup> the maximum limit of radon concentration inside buildings, although the European Commission established a maximum threshold of 300 Bq/m<sup>3</sup>. Romania, as a Member State, choosing this limit. This paper aims to assess the concentration of radon in indoor air taking into account certain factors that influence the evolution of radon levels in rooms.

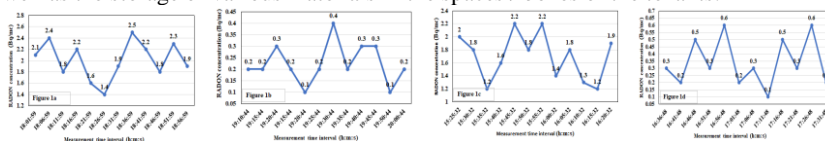
### **Materials and methods**

Measurements were performed in different locations, especially in points in the basement of the buildings and ground floor, where the effect of radon emission from different environments determines the values of the concentration in the indoor air. The Pylon AB6 / AB6A Portable Radiation Monitor equipped with Lucas model Pylon scintillating cells for radon measurement was used. The equipment cells have high sensitivity of detection which are unaffected by changes in temperature and humidity as well as insensitive to beta and gamma radiation. The detection limit for the cell / detector used respectively 600A was 0.037 Bq/m<sup>3</sup>. The determinations of the radon level were performed in locations / buildings located in different areas and districts of Bucharest. The first location was an apartments building in Berceni-Luica area district 4; the second location was a apartments building in the Basarab-Calea Grivitei area, district 1; the third location was the building of INCD ECOIND in Giulesti area, district 6. It should also be noted that the age of the buildings where the measurements were performed shows great differences in the year of construction. Therefore, the building in the first location was built in 1975, the second was built in 1972, and the third was built in 2011, so that different construction materials manufactured in different years were used with different manufacturing technologies (old technology - use in combustion - to reach the sintering temperature - of coal brought from great depths) and with raw materials extracted from different quarries of limestone, clay or marl.

Radon level measurements were performed as follows: i) in the basement and ground floor of the two stairs of Berceni-Luica apartments building; ii) in the ground floor and basement at the only staircase of Basarab-Calea Grivitei apartments building; iii) in the basement of INCD ECOIND reserch institute. It is worth mentioning that, not only the construction materials but also the depth of the enclosures were different, such as: the basement of Berceni-Luica area was at 5 m depth with concrete walls and brick walls, the basement of Basarab-Calea Grivitei area was at 3 m depth and the INCD ECOIND basement enclosure was at 1.5 m. The measurements were performed in an interval of 60 minutes over 12 periods of 5 minutes / period.

### Results and conclusions

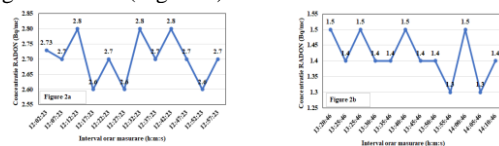
The level of radon measured at Berceni-Luica apartments building basement was of 2.5 Bq/m<sup>3</sup>, while the maximum value from the ground floor was of 0.6 Bq/m<sup>3</sup> (Figure 1). The variation of radon concentration depends on the age of the construction, the materials used (concrete and brick), the depth of the location, the soil and the emanation from the soil of radon over the years, or unventilated space as well as the storage of various materials in the spaces / boxes of the tenants.



**Fig.1.** Radon concentration at Berceni-Luica apartments building: a) staircase 1 basement; b) staircase 1 on the ground floor; c) staircase 2 basement; d) staircase 2 on the ground floor.

For the values detected on the ground floor, there was observed a reduction of radon level, first of all due to the ceiling between the basement and the ground floor and the ventilation, being in the vicinity of the entrance door to the location.

At the second location, Basarab Calea Grivitei apartments building, the radon level varied between 2.8 Bq/m<sup>3</sup> in the basement and 1.5 Bq/m<sup>3</sup>, the value detected in the ground floor (Figure 2).



**Fig.2.** Radon concentration at Basarab Calea Grivitei apartments building: a) basement; b) ground floor.

As mentioned, the radon level varies based on the construction age, the materials used (brick), the soil and depth of location as well as the level of space ventilation.

In the ground floor, the reduction of radon level was due to the ceiling between the basement and the ground floor, but the ventilated space, being in the vicinity of the entrance door.

In case of INCD ECOIND building, the radon concentrations were below the detection limit of 0.037 Bq/m<sup>3</sup> (PYLON 600A cell / detector). This fact may be attributed to relatively recent building (2011), no building materials or different types of fuels are stored inside and the spaces are frequently ventilated.