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Characterization of Radon Exhalation from Building Materials

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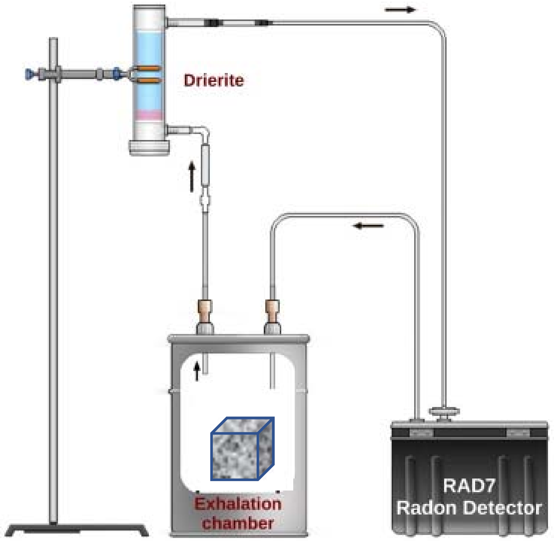
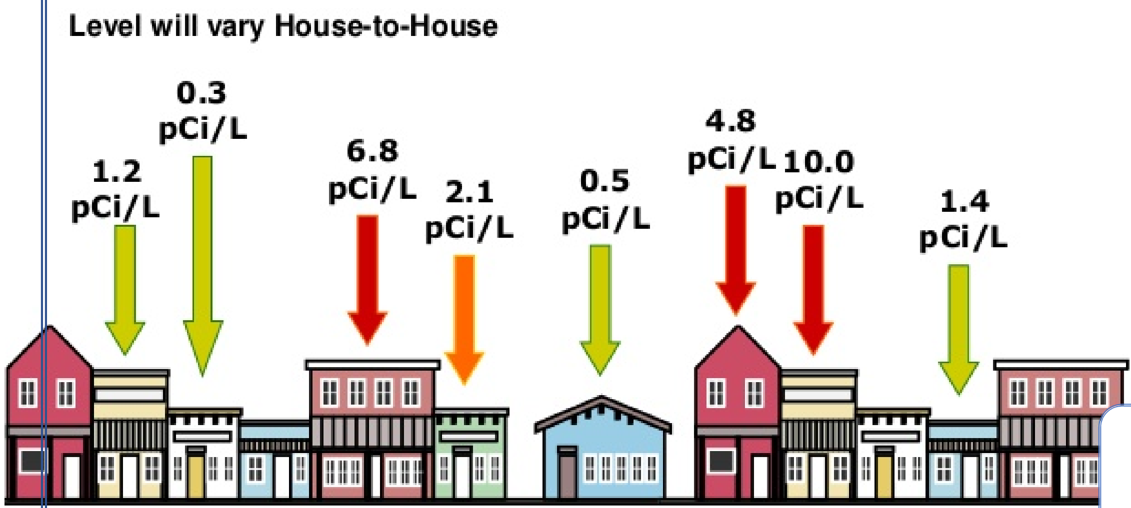
The aim of this study is to measure the radon mass exhalation rate from different coating materials used in building.



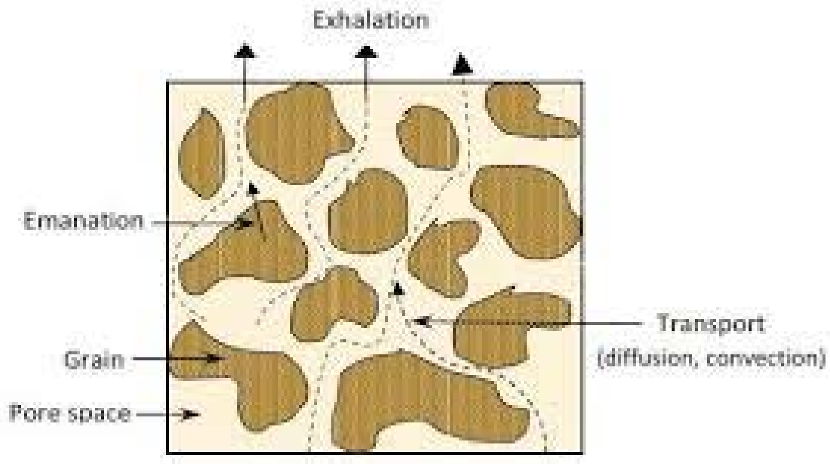
What is radon?

Peculiarities of Radon – levels will vary:

- ✓ Geographic location
- ✓ Type construction
- ✓ Type mechanical systems
- ✓ Time of day
- ✓ Weather conditions
- ✓ Occupant lifestyle
- ✓ Time of year – seasonal changes
- ✓ Other factors

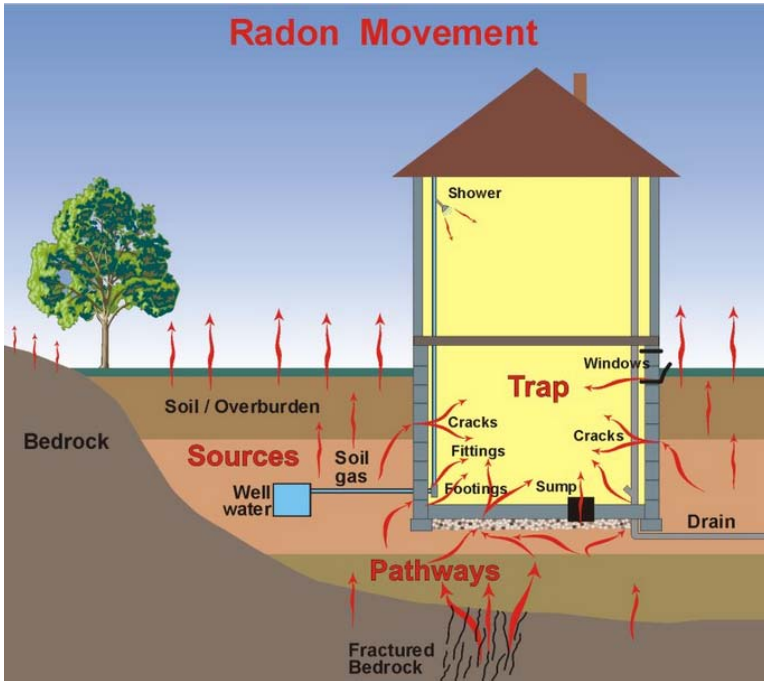


Part of the ^{222}Rn emanates from the soil grains into the air and diffuse to the atmosphere.



Outdoors, radon quickly dilutes to very low concentrations and is generally not a problem. However, indoors, ^{222}Rn concentrations are higher, and can be a hazard.

There are many ways how ^{222}Rn enters a house.



Most of the radon in indoor air comes from soil underneath the home.

As uranium breaks down, radon gas forms and seeps into the house.

Radon is the most important natural radioactive factor that harmful influence the human population and the environment.

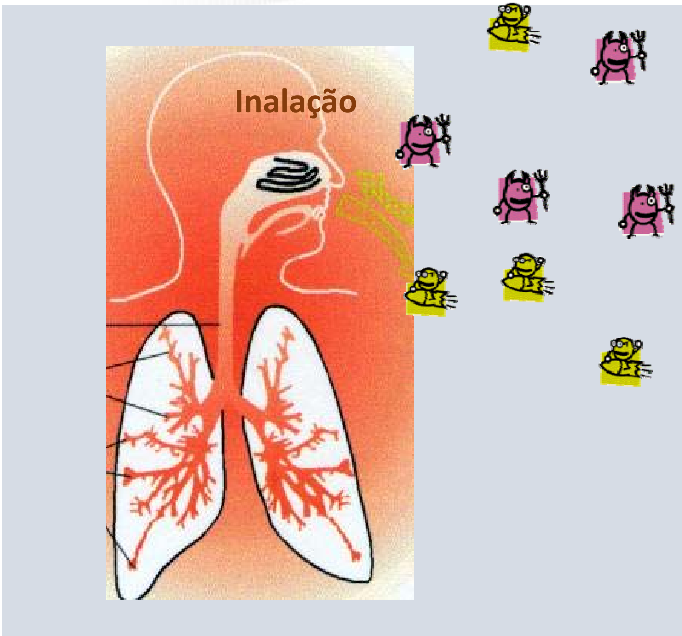
Natural occurring radionuclides enter the human body, mainly by **inhalation**, of ^{222}Rn and ^{220}Rn gases, and by **ingestion**, of primordial radionuclides and their progeny.

One of the challenges of studying radon concentration, in soil and indoors, is the fact that radon-generating rocks are not necessarily underground.

Construction materials are sources of indoor airborne radioactivity and external radiation from the decay series of uranium in buildings.

Building and industrial materials can contribute to environmental radioactivity in two ways:

- ✓ By **gamma** radiation mainly ^{226}Ra, ^{232}Th, ^{40}K and their **progenies** to a **whole body dose** and in some cases by **beta** radiation to a **skin dose**.
- ✓ By releasing radon, its radioactive daughters, which are **deposited** in the human **respiratory tract**.



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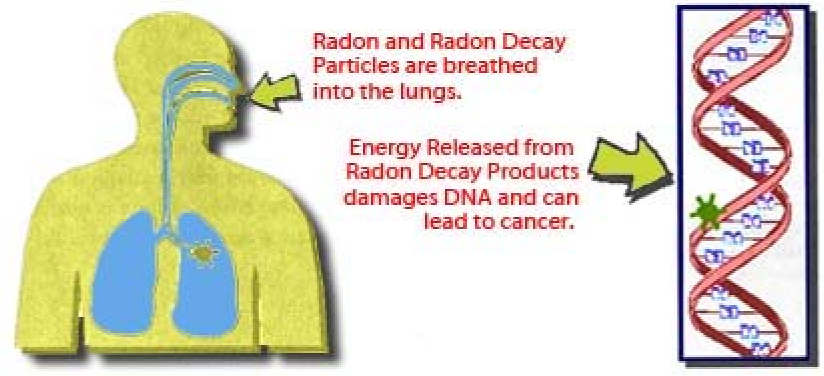
RDPs attached to microscopic dust particles are inhaled and emit alpha particles, which effectively cause biological damages to the lung cells.



The continuous damage produced by alpha particles emitted from radon in lungs may cause cancer.

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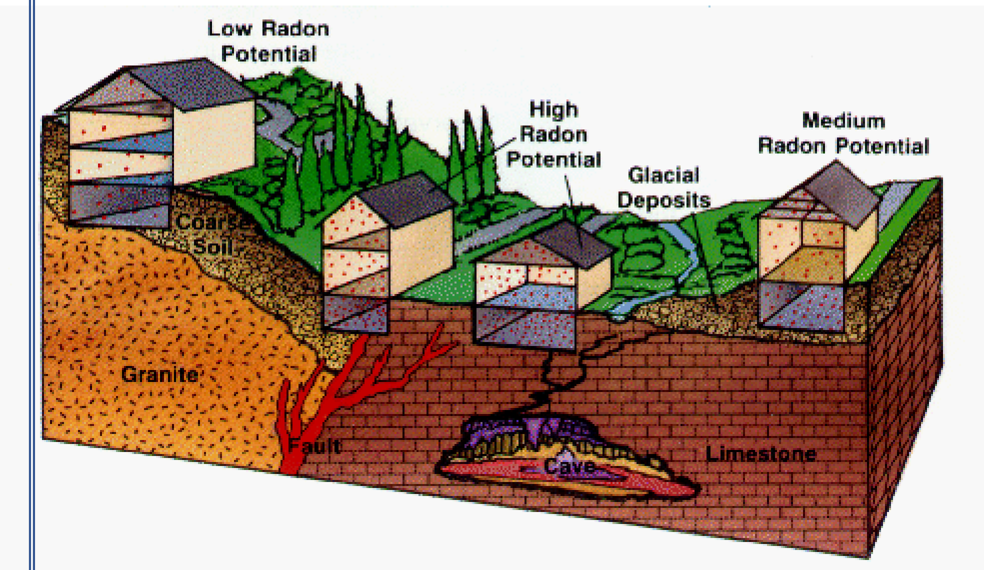
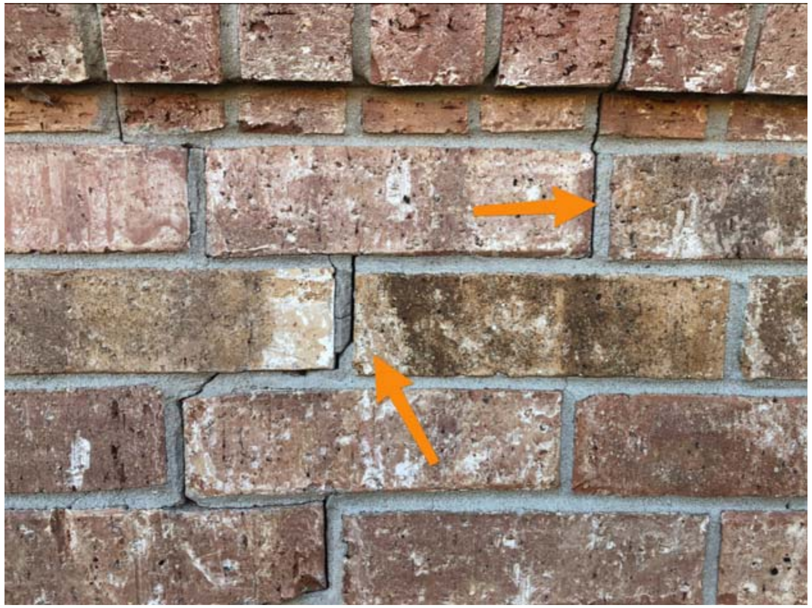
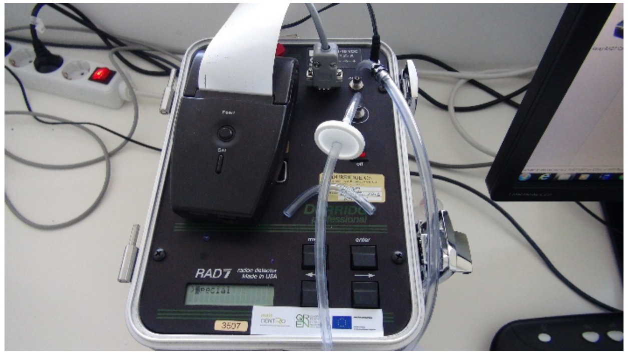
Radon concentration can reach **high levels** in dwellings depending **not only** on the building material used like concrete, bricks, phosphogypsum or granite, but also on **natural materials** incorporated in structural elements or decorative materials.



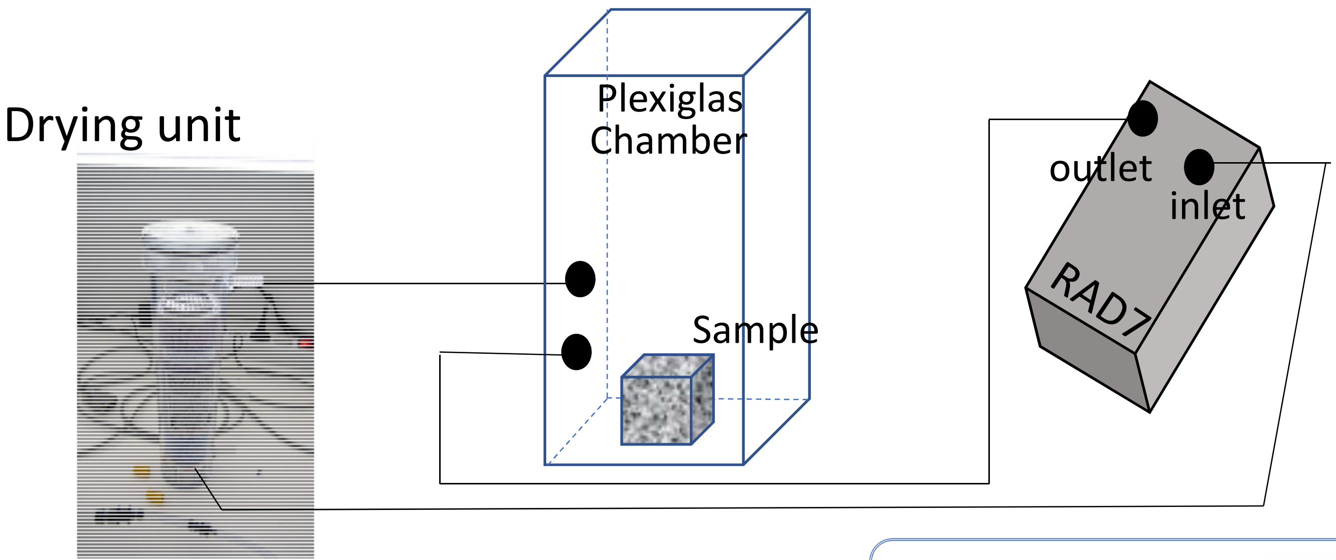


The ^{222}Rn concentration measurements were performed using the RAD7 DURRIDGE detector at the LabExpoRad laboratory, Covilhã – Portugal.



Optimal conditions for usage of the RAD7 is at 22 ^{0}C for the air temperature and RH of less than 6%.

The rates of radon exhalation from the different samples were estimated by placing the samples in a chamber with a closed loop arrangement: the chamber was connected through two vents to the inlet and outlet of RAD7 device.



A simplified scheme of the experimental setup

We tested four **granite samples** used for countertops and fireplaces, one without any coating and three coated with different materials, normally used over natural rock, namely varnish, hidrorepealent and liquid silicone.

The coatings selected are normally used over natural rock either to improve waterproofness or indoor performance namely comfort and desegregation of the natural rock limiting the particle loss.

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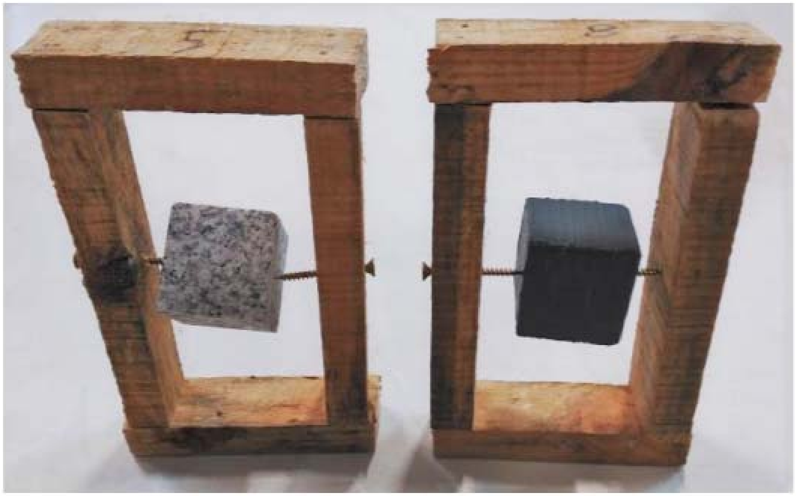
The coat was applied to the samples using a wood mold for homogeneous painting of the samples.



Cube of granite with 5 cm of edge.

Before and after coating application.

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After the determination of the radon concentration, the mass exhalation rate was calculated using the equation:

$$ER(Bq\ kg^{-1}h^{-1}) = \frac{C\ V\ \lambda}{M\ T_{eff}}$$

Where C is the radon concentration, V is the effective volume of the chamber, λ is the radon decay constant, M is the mass of the sample and T_{eff} is the effective exposure time.

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The measured **radon concentration** values and the determined **radon mass exhalation rate** (ER)

[^{222}Rn] (Bq/m^3)	**Sample**	**ER** (mBq/Kg.h)
340.88	**Varnish**	41.41
356.67		**43.33**
332.38		40.38
254.22	**Hidrorepealent**	**30.88**
257.75		31.31
242.86		29.50
192.11	**Liquid silicone**	23.34
199.25		24.21
200.67		**24.38**
500.88	**Rock not covered**	**60.85**
485.88		59.03
492.63		59.85

The higher values found were 60.85 mBq/kg.h , for the sample not covered and 43.33 mBq/kg.h, 30.88 mBq/kg.h and 24.38 mBq/kg.h for varnish, hidrorepealent and liquid silicone, respectively.

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Conclusions

This is a preliminary study.

The obtained results are interesting, but the work as to be improve.

Although the radon mass exhalation rates from the granitic samples analyzed have relatively low values, this study can be used as a reference information.

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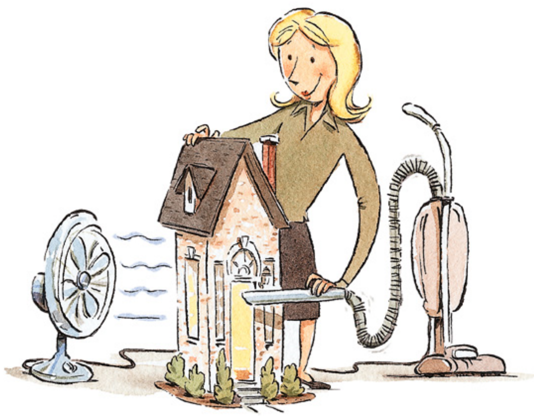

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