

SZ Innovation AB
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Determination of radon transmittance

(2 appendices)

Work requested

RISE was requested to measure the radon transmittance through a membrane in accordance with SP Method no. 3873.

The material sample

The client delivered their product which was named EcoZmart Ice Elite to RISE Research Institute of Sweden on 2018-02-16. There were no signs of visible damage to the material on arrival. The material thickness was 25.9 mm measured by RISE according to SS-EN 823:2013. The material was tested without joints. See Appendix 2 for a picture of the material.

Method of testing

Radon transmittance was tested in accordance with SP Method no. 3873. The material was mounted between two stainless steel boxes, the lower of which (the source box) contained a radon source. The perimeter was sealed very carefully, in order to ensure gas-tight joints between the boxes and the material, and also between the boxes themselves. The radon concentrations on each side of the test material was measured using an Atmos 33 instrument.

Results

Material	Thickness (average) d , m	Radon transmittance P , m/s	Radon permeability k , m ² /s	Radon resistance Z , s/m
EcoZmart Ice Elite	0.0259	$1.9 \cdot 10^{-8}$	$4.9 \cdot 10^{-10}$	$5.3 \cdot 10^7$

Note that the test results shown above apply only to the particular sample of material that was tested. Detailed results, including uncertainty of measurement, are given in Appendix 1.

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Appendices

Test results

Photographs of the tested material

Appendix 1

Test results

Client	SZ Innovation AB
Sample for testing	EcoZmart Ice Elite
Date of testing	volume, source box, V_I :
Test data	0.027 m³ Free volume receiver box, V_2: 0.026 m³ Total free volume, V: 0.053 m³
Equipment	Atmos 33 (SP no. 202266) for measurement of Polonium-218 concentration. Most recently calibrated 2018-02-03, by Swedish Radiation Safety Authority
Radon source	Lightweight concrete emitting Radium Rn-222, with Po-218 as the first decay product.
Ambient temperature	23 ± 3 °C
Ambient RH	50 ± 10 %
Uncertainty of measurement	The increased uncertainty of measurement was estimated as ± 21 %, including a coverage factor of $k = 2$. Uncertainty of measurement for temperature was ± 2 °C, and that for relative humidity was ± 5 % in the test chamber.
Observation	No changes in the test material were observed during the tests.
Miscellaneous	The test results given in this report relate only to the particular samples of material that were tested.

The following results have been calculated under the conditions as shown in the table below:

Material, name	EcoZmart Ice Elite
Radon transmittance P , m/s	$1.9 \cdot 10^{-8}$
Radon resistance Z , s/m	$5.3 \cdot 10^7$
Radon permeability k , m ² /s	$4.9 \cdot 10^{-10}$
Effective radon sink λ_1 , s ⁻¹	$3.7 \cdot 10^{-6}$
Radon exhalation Φ , Bq/s	$2.7 \cdot 10^{-3}$
Exposed area of test material A , m ²	0.25
Thickness of test material d , m	0.0259
Radon concentration at start C_0 , Bq/m	14

Appendix 1

Theory

Emission of radon from the radon source results in an increase of radon concentration in the source box, leading to a difference in concentration between the source box and the receiver box. This difference causes a flow of radon by diffusion through the test material. Only radon gas (Rn) passes through, and not its decay products (RnD). Radon transmittance is measured by measuring the change in radon concentration on both sides of the test material. Figures 1 and 2 show how the radon concentrations build up in the two boxes.

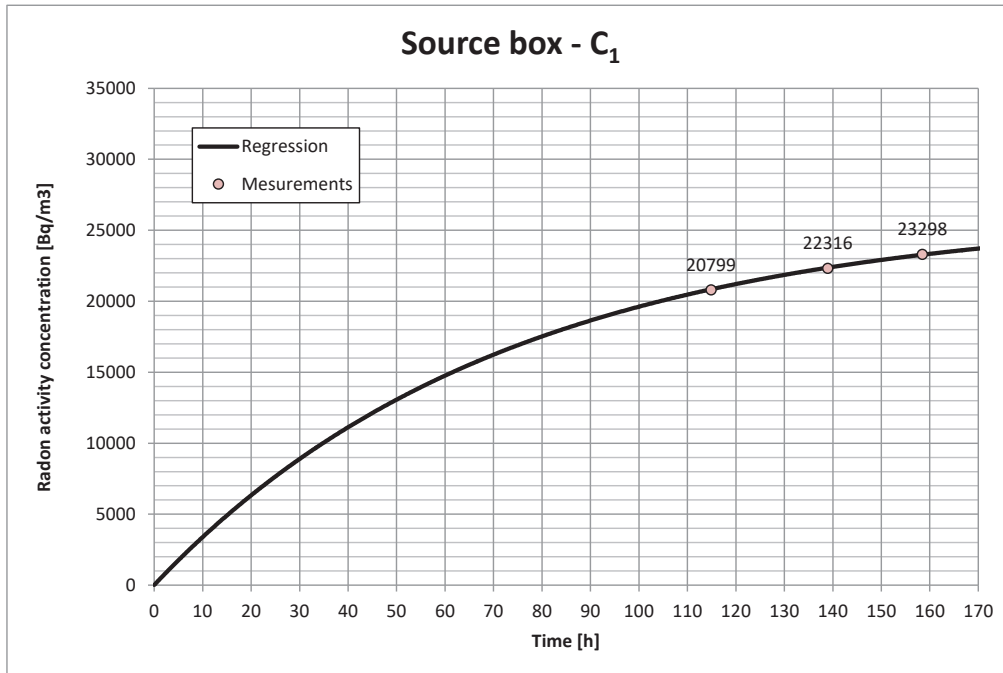


Figure 1 Radon concentration in the primary box: measured daily average values and the regression curve.

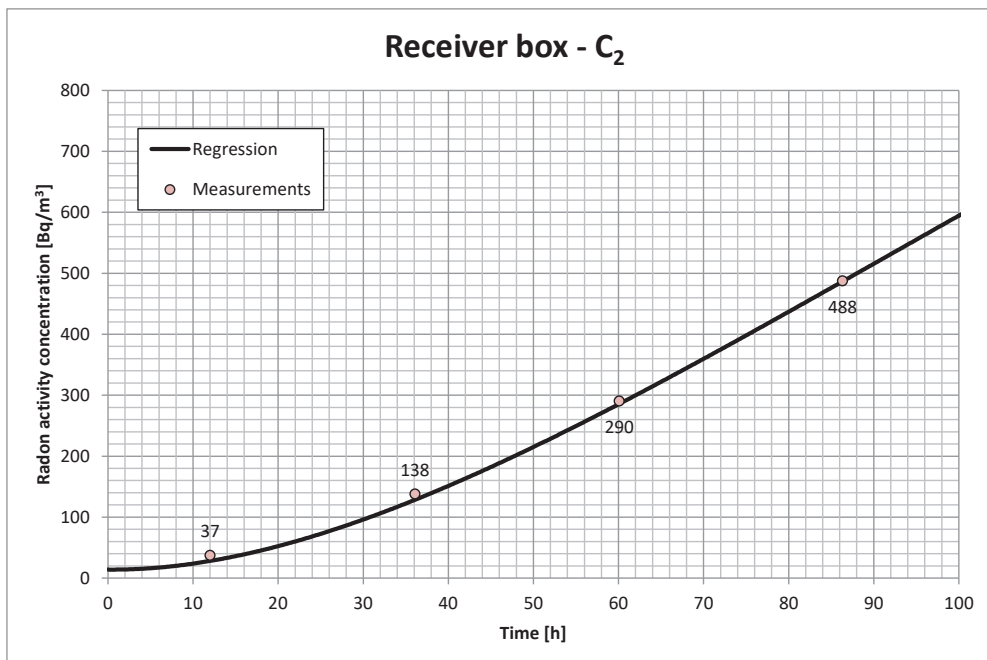


Figure 2 Radon concentration in the secondary box: measured daily average values and the regression curve.

Appendix 1

For test specimens made of homogenous materials radon permeability can be determined

$$k = \frac{d}{Z} P d$$

where k = radon permeability (m²/s)
 d = test specimen thickness (m)

Thickness measurement

The test specimen was used to measure thickness of the material according to SS-EN 823:2013.

Appendix 2

Photographs of the tested material

EcoZmart Ice Elite