IAF - Radioökologie GmbH

Radionuclide Laboratory | Radiation Safety | Radiological Consultants

Determination of the Radon Diffusion Coefficient and Radon Diffusion Length of a test specimen

Client:	DOYMA GmbH & Co Dichtungssysteme Brandschutzsysteme Industriestraße 43-57 28876 Oyten
Project:	Determination of the Radon Diffusion Coefficient and Radon Diffusion Length of a test specimen consisting of acrylonitrile butadiene rubber (NBR)
Project number:	180213-11
Contractor:	IAF-Radioökologie GmbH
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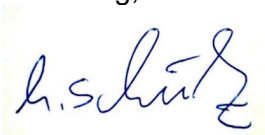
The accreditation is valid for the measurement results of the radon concentration indoors (SOP 4-02, 2018-11). The assessments made are based on this measurements results.

Radeberg, 07. June 2018



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1 Task

According to the order issued by DOYMA GmbH & Co from 02/08/2018, the Radon Diffusion Coefficient of the test specimen consisting of acrylonitrile butadiene rubber (NBR) has to be determined by the IAF-Radioökologie GmbH (IAF) and an assessment has to be made regarding the "radon tightness" of the material. To determine the radon diffusion values the client provided a test specimen with an area of 900 cm² and a material thickness of 20 mm.

2 Methodological framework

In order to determine the radon diffusion values, the specimen was installed in a two chamber measuring system in such a way that radon can migrate from chamber 1 into chamber 2 only if it traverses the sealing system as a result of a diffusion process. The radon concentration developing in chamber 2 is recorded at one-hour intervals. Depending on the radon tightness of the sealing system, the increase in radon concentration in chamber 2 varies, resulting in a plateau value, which forms a steady state between radon migration from the radon reservoir (chamber 1) through the sealing system and radon decay in the measuring chamber (chamber 2) and thus determines the radon diffusion coefficient D, measured in [m²/s]. The diffusion length L_D of the specimen is given by

$$L_D = \sqrt{\frac{D}{\lambda_{Rn}}},$$

with $\lambda_{Rn} = 2{,}1 \cdot 10^{-6} / s$ being the radon decay coefficient. The radon diffusion length L_D is the average length a radon atom passes through the test specimen during its half-life. A sealing system is to be rated as “radon-tight” if the material thickness (d) is at least three times its radon diffusion length L_D.

$$R = \frac{d}{L_D} \geq 3,$$

Otherwise the material is rated as “not radon tight”.

3 Results and assessment

The radon diffusion length calculated from the measurement results and the results of the "radon tightness" are summarized in Table 1.

Table 1: Results of the test for radon tightness

Sealing material	Material thickness of the specimen [d]	Diffusion coefficient [D]	Diffusion length [L_D]	Test parameter R = d/L_D	Result
acrylonitrile butadiene rubber (NBR)	20 mm	$3.44 \cdot 10^{-11}$ m²/s	4.04 mm	4.94	**R > 3, radon-tight**