(Translation from German Language)

Dr. Joachim Kemski
Publicly appointed and sworn by IHK Bonn/Rhein-Sieg
Expert for Radon

Dr. Kemski Sachverständigenbüro Euskirchener Straße 54 D-53121 Bonn

Euskirchener Straße 54
D-53121 Bonn

Phone: 0228 96292-41
Fax: 0228 96292-49
eMail: kemski@kemski-bonn.de

Test report 2019021901d

on

the determination of the radon diffusion coefficient and the radon diffusion length of a liquid plastic sealing, product name „WIDOCRYL-Detail"

client: Widopan Produkte GmbH
Ostereichen 3
21714 Hammah

order of: 7 Jan 2019

process term: 31 Jan 2019 until 14 Feb 2019

This test report consists of 5 pages including the cover sheet.

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WIDOCRYL-DETAIL
19 Feb 2019

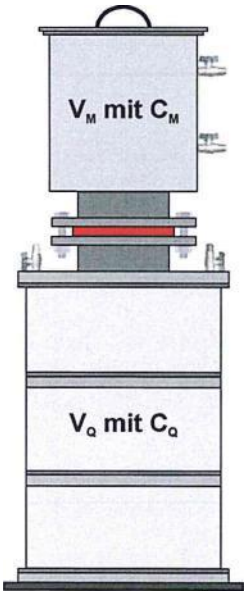
1. Sample description

We speak about a crack bridging liquid plastic sealing, consisting of a foundation, uranium-modified polymethyl methacrylate (PMMA) and a polyester grid fleece. The client provides flat elements of the material, which were cut suitable for the application in the a.m. measuring device. The thickness amounts to 2.3 mm.

2. Methodics

The testing is executed according to the Technical Specification ISO/TS 11665-13 (Measurement of radioactivity in the environment - Air: radon 222 - Part 13: Determination of the diffusion coefficient in waterproof materials: membrane two-side activity concentration test method; 2017). The material is placed between two chambers, whereas in the radon resource chamber a radon source cares for a permanent production of radon gas; and in the measuring chamber, the change of radon concentration by a potential radon flue through the material would be measured.

The adjoining outline of the principle shows the used measuring arrangement.



Hereby, the following parameters are valid:

V_Q = Volume of the source chamber = 0,2 m^3

V_M = Volume of the measuring chamber = 0,006 m^3

C_Q = balance radon activity concentration in source chamber

(Bq m^{-3}, measured)

C_M = balance radon activity concentration in measuring chamber (Bq m^{-3}, calculated from measured radon increase)

Under „steady state"-conditions, for test assembly, the following one-dimensional equation would be valid according to the 2nd Fick's Law:

$$\frac{\partial c(x,t)}{\partial t} = D\frac{\partial^2 c(x,t)}{\partial x^2} - \lambda c(x,t) = 0$$

with

D = Radon diffusion coefficient ($m^2\ s^{-1}$),

c(x, t) = c(x) **=** Radon concentration im sample material (Bq m^{-3}),

ƛ= decay constant of Radon-222 (0.0000021 s^{-l}).

With the marginal conditions of constant Radon activity concentrations in the reservoir and the measuring chamber as well as with a balance between Radon flow and Radon decay in both chambers the equation to be solved as follows:

$$\cosh\left(\frac{d}{L}\right) = \frac{C_Q}{C_M}\left[1 - \frac{1-\left(\frac{C_M}{C_Q}\right)^2}{\frac{V_Q}{V_M}\left(\left(\frac{f}{\lambda V_Q C_Q}-1\right)+1\right)}\right]$$

with

d = sample thickness (m)

L = diffusion length (m) with *l* $\sqrt{\frac{D}{\lambda}}$

f = Radon source production rate (Bq s^{-1})

The necessary balance concentration calculates from the time-resolved measurement curve of the Radon activity concentration in the measuring chamber by a nonlinear regression.

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3. Measurement and results

For the measurements, measuring devices calibrated by the Federal Office for Radiation Protection (BfS) such as (AlphaGuard, RadonScout) were used.

We found the following Radon concentrations with the measurement device-related uncertainties, (calculation of uncertainties for L and D on this basis):

Source chamber	$C_Q{}^{=}$ 132 000 Bq m^{-3} ± 10 %
Measuring chamber	C_M = 160 Bq m^{-3} ± 15 %

The following parameters to be calculated from this:

Radon diffusion coefficient **D = 2.04 E^{-13} m^2 s^{-1}** (1.91 E^{-13} – 2.19 E^{-13} m^2 s^{-1})

Radon diffusion length **L = 0.31 mm** (0.30 — 0.32 mm)

With respect to the „Radon tight" of „WIDOCRYL-Detail" country-specific regulations should be observed.

In **Germany,** according to works of G. Keller, University of Saarland, we use a convention that defines materials as ***radon tight***, when their thickness d is larger than the threefold diffusion length L (d $\geq$ 3 L).

For **„WIDOCRYL-Detail"** applies: d = 2.3 mm > 3 L (= 0.93 mm).

According to G Keller, therefore the material can be defined as radon tight.

4. Remarks

The examinations were made based on the samples provided by the client. We took the measurements under standardised laboratory conditions. Thereof, statements about the conditions when using in construction cannot be deviated.

The test results can be transferred only to materials, which are identical with the provided and tested samples. Deviations with respect to thickness, composition and age of the material might lead to invalidity of the Test Certificate. We cannot accept a liability for the general correctness and validity.

For the large-area use of the material, the appropriate processing of the material at joints, penetrations and detailed seals play an essential role for the function as radon diffusion blocker. You should possibly take and observe the appropriate indications from the respective technical data sheet resp. from the processing requirements for the material. The examination of these detailed solutions had not been a subject of the test.

This Test Report should be transmitted only in full and without any changes. Extractions or shortenings need the authorisation of the issuer of the report. The Certificate is valid for five years starting from the examination date. Bonn, 19 Feb 2019

("signature J. Kemski")

Dr. Joachim Kemski (seal: "Dr. rer.nat. Dipl.-Geol. Joachim Kemski, Radon Expert")

For the translation into English

Barbara Kempt

Barbara Kempt
Interpreter/Translator for Russian and English
Certified and authorised by the President of the Regional Court of Potsdam