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Test report 2011012001e

Determination of the radon diffusion coefficient and the radon diffusion length of the dpc-foil „ PM-Mauerwerkssperre “

Sponsor: PMI-Plast GmbH
Bullermannshof 10
D – 47441 Moers

Order: 2011-01-05

Date of test cycle: 2011-01-10 to 2011-01-19

This report includes 7 pages including cover sheet.

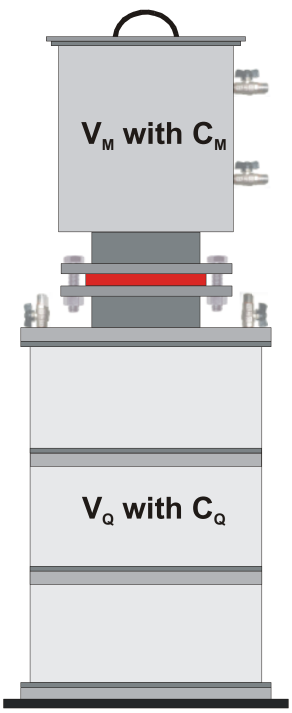
1. Test assignment

The assignment is to determine the radon diffusion coefficient and the radon diffusion length of the dpc-foil „PM-Mauerwerkssperre“. The material was sent to us by the test sponsor, PMI-Plast GmbH, Moers.

According to the written description provided by PMI-Plast, the material is a single-layer LDPE foil (thickness: 0,35 mm). Within the foil a grid of fabric is included. On both sides it has a rhombical stamping.

2. Test equipment

There is no standardized procedure in Germany for the given test. Our testing is carried out in a test system comprising one radon source canister of 200 l volume and one measuring chamber of 50 l volume. The test sample is placed between the boxes, fixed with screws and tightened very carefully with self adhesive aluminium tape. A diagram of the test procedure is presented in the following drawing.



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

V_M = volume of the measuring chamber = 0,05 m^3

C_Q = steady state radon concentration in source chamber (Bq m^{-3})

C_M = steady state radon concentration in measuring chamber (Bq m^{-3})

To find the steady state radon concentrations the following one-dimensional differential equation for radon diffusion has to be solved:

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

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

c(x, t) = c(x) = radon concentration in the material ($Bq\ m^{-3}$),

λ = decay constant of radon-222 ($0{,}0000021\ s^{-1}$).

According to the steady-state radon concentrations and radon fluxes into and out of the membrane in both chambers, the diffusion coefficient for radon in the tested membrane material can be evaluated from the following expression:

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

d = thickness of the material (m)

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

f = radon production rate of the source ($Bq\ s^{-1}$)

The steady state radon concentration in the measuring chamber will be fitted through non linear regression modelling based on the measured radon concentration.

3. Testing

The testing was performed in the laboratory of Kemski & Partner from 2011-01-10 to 2011-01-19. Two samples were analysed, one on a HDF carrier and one on a gypsum plasterboard carrier. The results are shown in figure 1 and 2.

test 1:

carrier material: gypsum plasterboard

Measuring instrument in measuring chamber: RadonScout, calibrated at Bundesamt für Strahlenschutz, Berlin

Measuring instrument for source chamber: AlphaGuard, calibrated at Bundesamt für Strahlenschutz, Berlin

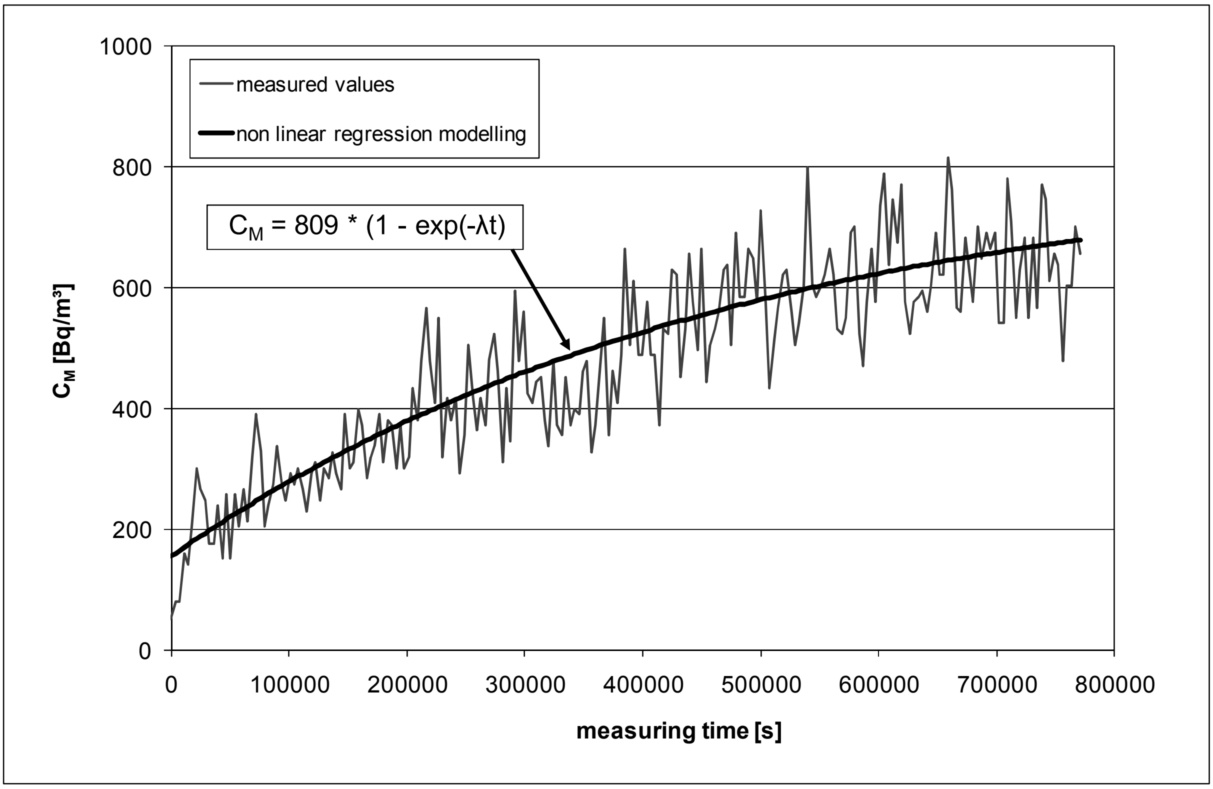


fig. 1: results and curve fitting test 1

C_Q = **125.000 Bq m^{-3}** ± 10 %

C_M = **809 Bq m^{-3}** ± 15 %

L_1 = **0,064 mm** (0,062 – 0,067 mm)

D_1 = **8,67 E^{-15} m^2 s^{-1}** (8,00 – 9,45 E^{-15} m^2 s^{-1})

test 2:

carrier material: HDF

Measuring instrument in measuring chamber: Radim 3A, calibrated at Bundesamt für Strahlenschutz, Berlin

Measuring instrument for source chamber: AlphaGuard, calibrated at Bundesamt für Strahlenschutz, Berlin

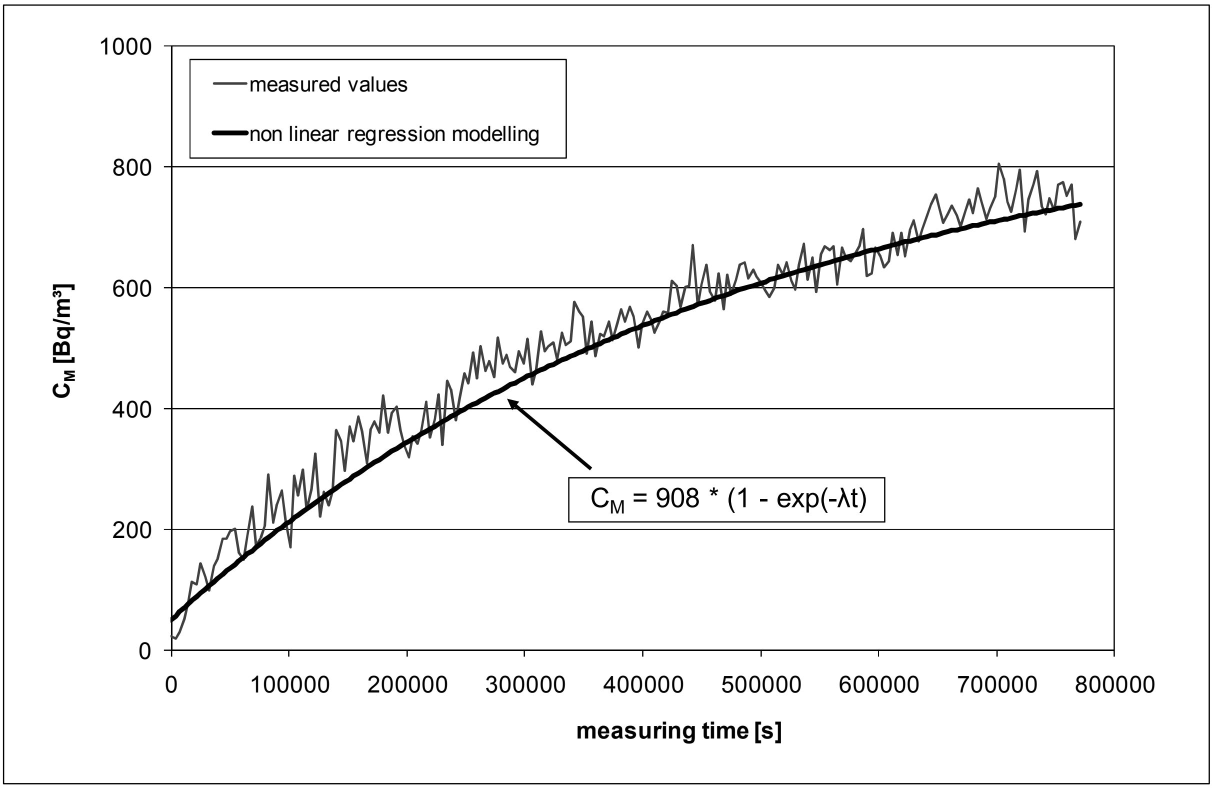


fig. 2: results and curve fitting test 2

C_Q = **45.000 Bq m^{-3}** ± 10 %

C_M = **908 Bq m^{-3}** ± 15 %

L_2 = **0,081 mm** (0,077 – 0,086 mm)

D_2 = **1,39 E^{-14} m^2 s^{-1}** (1,25 – 1,54 E^{-14} m^2 s^{-1})

As test result (mean value of both measurements) the following can be declared:

radon diffusion coefficient **D = 1,13 E^{-14} m^2 s^{-1}**

radon diffusion length **L = 0,073 mm**

Due to these values the "PM-Mauerwerkssperre" will act as an effective passive radon barrier.

Consequently this radon resistant product is suitable for use in protection of buildings from the ingress of radon gas.

Local regulations have to be considered in different countries.

4. Comments

The results are only valid for the tested specimen. The specimen are no longer usable. The measurements were conducted under normal laboratory conditions. The testing was performed according to the specifications made byPMI -Plast GmbH.

This certificate shall remain valid for five years from date of issue so long as

- the specification of the product is unchanged,
- no new information becomes available, which would preclude the granting of the certificate,
- the product continues to be manufactured in accordance with the given description.

This certificate does not comprise installation instructions and does not replace the manufacturer's directions.

This certificate does not include, that the manufacture or installation of the certified product will satisfy any regulation, any current or future common law duty of care owed by the manufacturer or the certificate holder.

Bonn, 2011-01-20

Dr. Joachim Kemski

von der Industrie- und Handelskammer Bonn/Rhein-Sieg • öffentlich bestellt und vereidigt •
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