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Test Report

Determination of the Radon Diffusion Coefficient on
"Sulfiton Profi Tight"

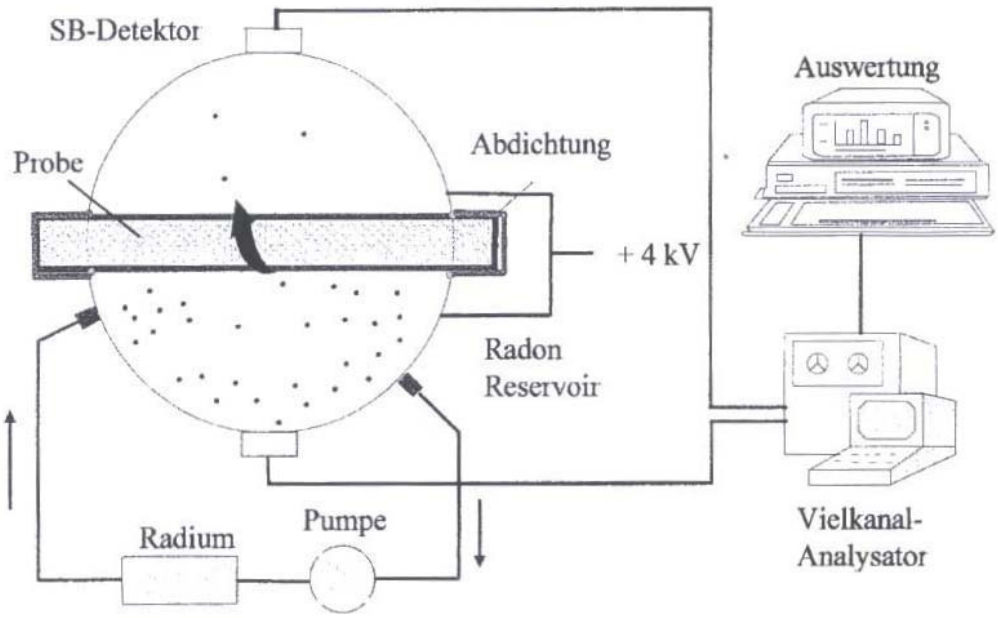
In compliance with your order dated March 9, 2005, radon diffusion measurements were carried out on a plastic modified, bitumen thick coating called "Sulfiton Profi Tight", Art. No. 0886.

a) Measuring Method

The method for determining the exhalation rate of radon and thoron is based on the electrostatic precipitation of the first daughter atoms on the surface of a semi-conductor detector. In this manner, advantage is taken of the fact that polonium-218 and polonium-216 ions that result during alpha disintegration are positively charged (stripping effect). The electrodes of the electrical field are formed by a metallic hemisphere and a metallic lattice on the bottom of the hemisphere, both on high positive potential, as well as a surface barrier layer detector on earth potential. When the exhaled radon and thoron atoms reach the chamber where they disintegrate, a part of the first daughter products (polonium-218 and polonium-216) is deposited on the detector because of the electric field that has been set up. The exhalation rate of radon and thoron from the sample is determined by evaluating several consecutive alpha spectrums of polonium-218 or polonium-216 determined during the course of the concentration of radon and thoron activity in the chamber. To determine the diffusion coefficients of building materials, the sample is placed on a container and sealed with silicone. With the aid of a pump, radon is led from a dry source of radium-

226 into the container and continuously mixed with the air in the container. After a constant concentration gradient between the air in the container and the "free" side of the sample, the flux density towards the "free" side can be measured with the method for determining the exhalation rate. The theory of diffusion gives the corresponding diffusion coefficient for the geometric form of the sample. Illustration 1 shows the set-up of the diffusion and exhalation method as a diagram. The record(s) of the measurements is (are) found in the enclosure.

The diffusion coefficients D are independent from the thickness of the material. The diffusion coefficient D can be linked to the diffusion length (relaxation length) R through the disintegration constant Z; therefore: $R^2 = D/Z$



(SB-Detektor = SB detector, Probe = sample, Abdichtung = seal, Radium = radium, Pumpe = pump, Auswertung = evaluation, Vielkanal-Analysator = multichannel analyser)

Ill. 1: Measuring method for determining the radon and thoron exhalation rates and radon diffusion coefficients

There is no standard that defines when a material can be designated "radon tight". According to our scientific knowledge and experience, a material can be designated relatively "radon tight" if its thickness is at least three times the diffusion length. The

material is not radon tight if the thickness of the material is less than three times the diffusion length. With the normal thickness of the sample specimens of several millimetres, diffusion coefficients of $D = 1 \cdot 10^{-14} m^2/s$ can be determined with this highly sensitive measuring arrangement (for thicknesses in the cm-range, $D \approx 1 \cdot 10^{-12} m^2/s$). For smaller diffusion coefficients that are no longer detectable, only a minimum thickness can be given at which the material can be deemed "radon tight".

b) Results of Measuring

Sample no.	Designation of sample	Thickness (mm)	Diffusion coefficient (m^2/s)	Diffusion length (mm)	Result
1	Sulfiton Profi Tight Art. No. 0886	4.5	< MDL	< MDL	Radon tight

MDL: minimum detectable level

c) Notes on the Measured Results

The delivered sample can be designated as radon tight.

[Signature]

Professor Dr. Gert Keller [SEAL of the University of Saarland]

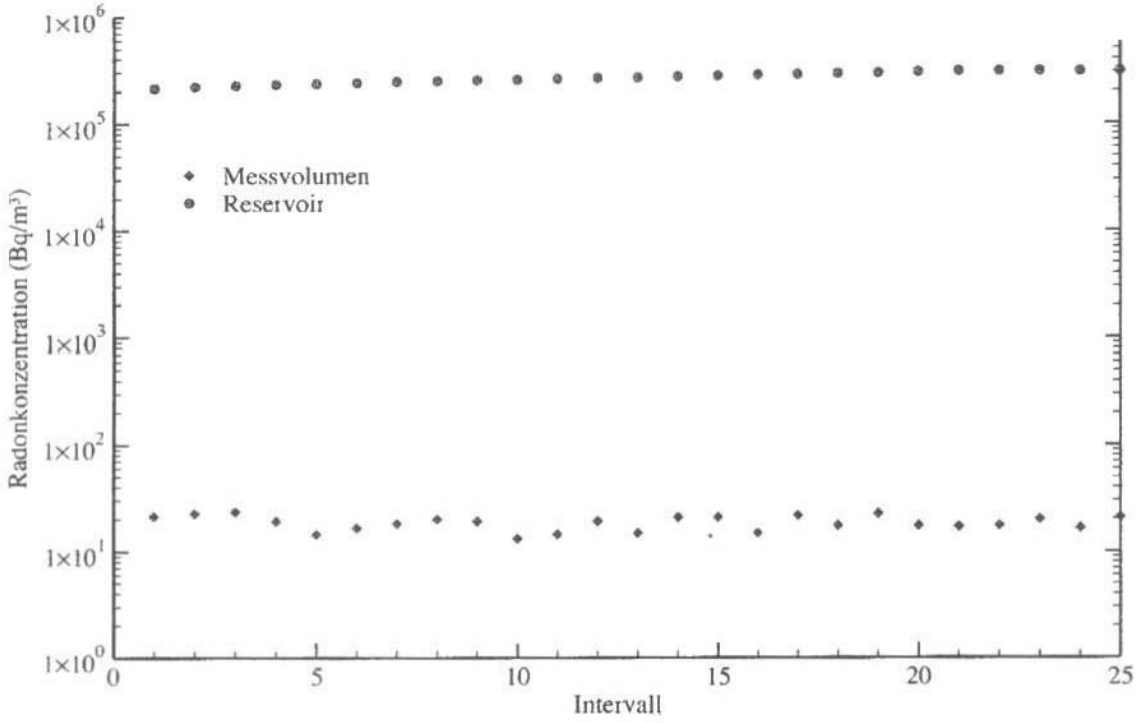
This Report (Certificate, Expert Opinion) was prepared by Professor Dr. G. Keller. The examinations and measurements executed were carried out on the delivered and marked samples according to best knowledge and belief. No liability will be accepted for correctness and validity in general.

Enclosure: Record(s) of measurement

Record of Measurement to Determine the Radon Diffusion Rate

Remmers Baustofftechnik GmbH
Sulfiton Profi Tight

Date of measurement:	April 14, 2005
Thickness of sample:	4.5 mm
Exhaling area:	0.038 m²
Duration of measurement per cycle:	3600 s
Evaluated cycles:	1 …. 24



(Radonkonzentration = radon concentration, Messvolumen = measured volume, Reservoir = reservoir, Intervall = interval)

Result:

Exhalation rate:	--mBq/m²s
Diffusion coefficients:	--m²s
Diffusion length:	--mm
d/R:	--