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SYSTEM Advanced Laboratories for Radiation Measurements

Test Report - Determination of the Radon Diffusion Coefficient

A. General Details:

Project Name:	**יריעות ביטומניות**	**Project No.:**	142289
Address:	**היצירה 4 חיפה מיקוד 2629004**	**Report Date:**	17 May 2023
Customer's Name:	**ביטום בע"מ**	**Order No.:**	1900722A
Customer's Phone No.:	**052-2365756**	**Analysis Date:**	11 May 2023

B. Sampling Details:

Producer/Supplier:	ביטום בע"מ
Production Date:	-
Sampled by:	System Advanced Laboratories for Radiation Measurements
Date of Arrival:	09/04/2023
Sample Size:	11cm diameter disc

C. Calculations and Procedure:

Radon flow through a medium is described by the diffusion equation:

$$L^2 \frac{\partial^2 C(x,t)}{\partial x^2} - C(x,t) = \frac{1}{\lambda_{Rn}} \frac{\partial C(x,t)}{\partial t} \qquad (1)$$

Written here for the one dimensional case and neglecting radon production in the medium, C(x,t) is the radon concentration at point x and time t, λ_{Rn}=2.1 10^{-6} sec^{-1} is the radon decay constant and L is the radon diffusion length, related to the diffusion coefficient D by the relation:

$$L = \sqrt{\frac{D}{\lambda_{Rn}}} \qquad (2)$$

A simple two-chamber experimental setup was used. We measure [L] with a setup (see Fig.1) comprising of chambers 1 and 2 with volumes [V_1] and [V_2] separated by a thin partition (sample) of area [S] and thickness [ℓ] in which we wish to measure the radon diffusion length. Chamber 1 contains a radon source of known activity [A_S].

Since the source is placed in chamber 1, $C_1 > C_2$. The radon released from the source fills the first chamber and diffuses through the sample into the second chamber. 4-inch activated charcoal canisters were used in both chambers as radon detectors. In order to ensure that the steady state was reached in both chambers, independently of the value of the diffusion length, the measurement time was chosen to be 21 days. All measurements were conducted at room temperature.

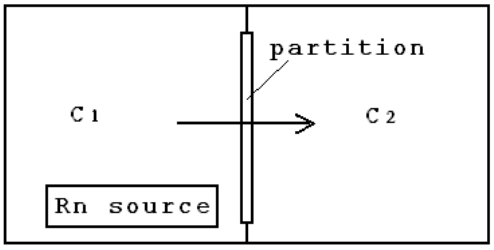

Fig. 1. Determination of the radon diffusion length in the partition (sample) separating two chambers.

Fig. 2 illustrates an experimental setup in which the sample covers a radon canister. The large cell was filled with a 10.25 kBq Radon source and a radon canister.

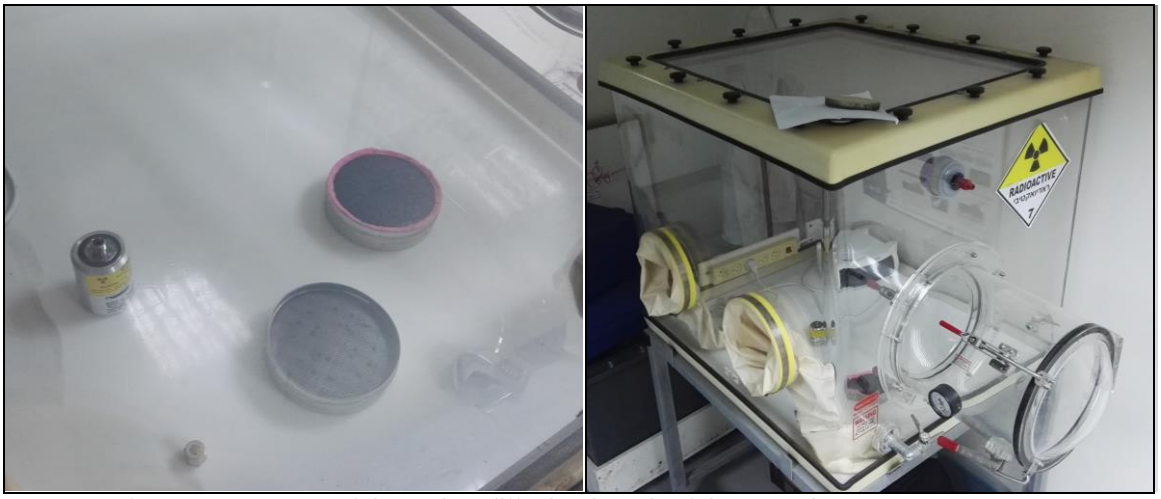

Fig. 2. Setup for measurement of the radon diffusion length of the sample.

D. Results:

Sample No	Sample Name	Thickness (mm)	Diffusion Coefficient (m^2/s)	Diffusion Length (mm)
1	יריעת"ביטומפרוף"	4.5	$2.1x10^{-12}$	1.0
2	ביטומסטיק	2.2	$2.2x10^{-13}$	0.33
3	A12	3.0	$4.4x10^{-13}$	0.46

E. Conclusions:

To be considered **Radon-tight** according to the Israeli Ministry of Environmental Protection, the material width must be greater or equal to 3 diffusions lengths.
Therefore, the 3 materials tested were found to be **Radon-tight**.

F. Remark:

System Labs is not responsible for the use or misinterpretation of the test results.

G. Approval:

		Date	Signature
Tested by:	**Dmitry Strelian**	**17 May 2023**	
Approved by the Lab. Manager:	**Binyamin Bair-Moshe**	**17 May 2023**	