



# **RADON EXHALATION FROM BUILDING MATERIALS FOR DECORATIVE USE**

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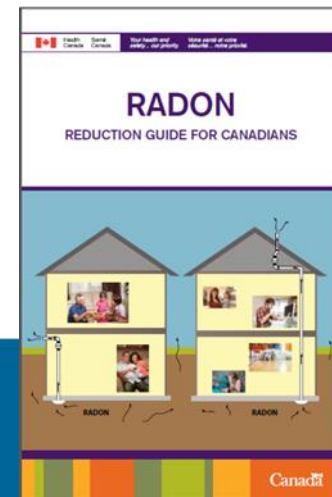
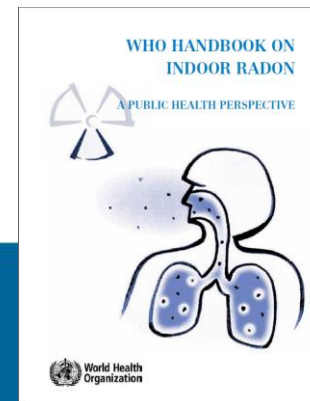


# BACKGROUND INFORMATION

Long-term exposure to radon increases the risk of developing lung cancer.

There is considerable public concern about radon exhalation from building materials and the contribution to indoor radon levels.

To address the public concern, radon exhalation rates were determined for 53 samples of building materials available on the Canadian market for interior home decoration.



# MEASUREMENT SETTING

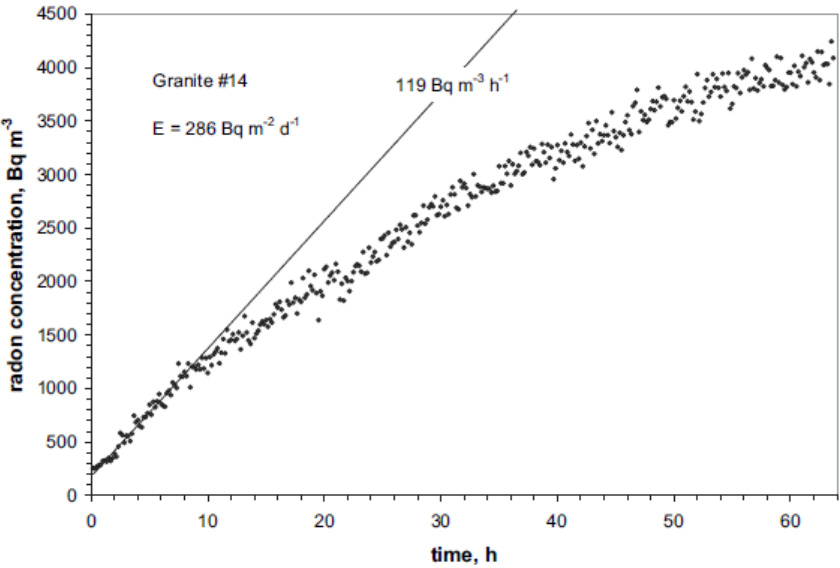
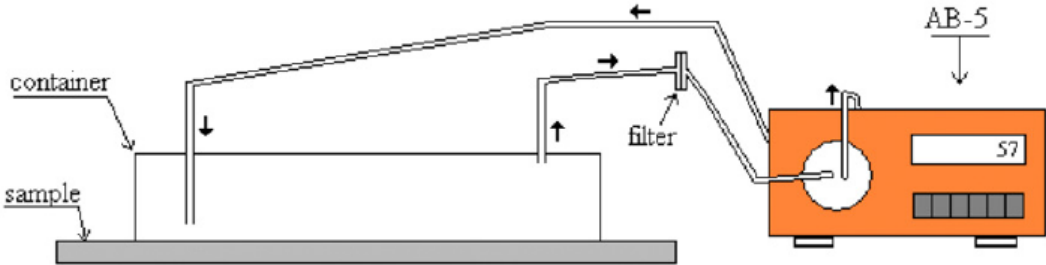


Fig. 2. Radon concentration as a function of time inside the container due to radon exhalation from the granite slab #14.



# TEST RESULTS

The average radon exhalation rates for drywall, marble, ceramic and porcelain tiles:

$$0.9 \pm 0.8 \text{ Bq/m}^2\text{d};$$

for slates:

$$30 \pm 16 \text{ Bq/m}^2\text{d}$$

Radon exhalation rates of decorative materials: drywall, marble, porcelain, ceramic and slate.

Material	Sample	Radon exhalation rate (range), $\text{Bq m}^{-2} \text{d}^{-1}$
Drywall	Regular #1	$0.9 \pm 0.5$ (0.5–1.3)
	Regular #2	$1.1 \pm 0.9$ (0.4–1.7)
	Humidity #1	$1.1 \pm 1.2$ (0.3–2.0)
	Humidity #2	$2.7 \pm 0.3$ (2.5–2.9)
Marble	#1	$0.1 \pm 0.1$ (ND–0.2)
	#2	$0.4 \pm 0.2$ (0.3–0.6)
	#3	ND
	#4	$0.2 \pm 0.4$ (ND–0.6)
Porcelain	#1	ND
	#2	$1.4 \pm 1.4$ (0.2–2.9)
	#3	$1.0 \pm 1.1$ (0.2–1.7)
	#4	$0.5 \pm 0.7$ (ND–1.3)
Ceramic	#1	$0.2 \pm 0.3$ (ND–0.4)
	#2	$2.2 \pm 0.3$ (2.0–2.4)
	#3	$1.2 \pm 0.4$ (0.8–1.8)
	#4	$1.6 \pm 1.3$ (0.7–3.0)
Slate	#1	$30 \pm 4$ (25.3–33.0)
	#2	$46 \pm 4$ (42.2–49.2)
	#3	$35 \pm 18$ (6.9–62.5)
	#4	$8.6 \pm 2.9$ (6.3–12.9)

ND, not detectable.



Radon exhalation rates of granites from various countries.

Sample index (product name)	Origin	Radon exhalation rate (range), Bq m <sup>-2</sup> d <sup>-1</sup>
#1 (Nero Assoluto)	Africa	2.3 ± 2.8 (0.3–4.3)
#2 (Nero Asoluto)	Africa	16 ± 5 (11.3–21.5)
#3 (Ornamental)	Brazil	3.1 ± 2.8 (1.1–5.1)
#4 (Brasil Colonial)	Brazil	8.7 ± 1.5 (7.7–9.8)
#5 (Bianco Antico)	Brazil	50 ± 6 (45.6–54.3)
#6 (Uba Tuba)	Brazil	5.1 ± 1.5 (4.0–6.1)
#7 (Verde Butterfly)	Brazil	5.6 ± 2.7 (2.6–7.9)
#8 (Silver Sea Green)	Brazil	53 ± 10 (41.4–59.4)
#9 (Tan Brown)	Brazil	10 ± 12 (ND–22.6)
#10 (Tropical Brown)	Brazil	58 ± 26 (25.4–89.3)
#11 (Giallo San Cecilia)	Brazil	9.2 ± 4.1 (5.8–13.8)
#12 (Carmen Red)	Brazil	103 ± 37 (49.0–165)
#13 (Ivory Brown)	Brazil	130 ± 9 (123–136)
#14 (Red Dragon)	Brazil	261 ± 37 (212–299)
#15 (Serrizo Formaza)	Brazil	70 ± 16 (49–89)
#16 (Ornamental) <sup>a</sup>	Brazil	2.9 ± 1.6 (1.2–5.0)
#17 (Oubatouba)	Brazil	0.6 ± 0.7 (ND–1.1)
#18 (Uba Tuba) <sup>b</sup>	Brazil	2.5 ± 0.8 (1.6–3.3)
#19 (Golden Leaf)	Brazil	208 ± 97 (120–312)
#20 (Astra)	Canada	9.6 ± 3.3 (7.2–11.9)
#21 (Caladonia)	Canada	0.4 ± 0.4 (0.2–1.0)
#22 (Cashmere Gold)	India	54 ± 5 (49.2–61.2)
#23 (Cashmere White)	India	16 ± 1 (15.5–16.8)
#24 (Tan Brown)	India	73 ± 6 (69.0–76.9)
#25 (Giablly)	India	0.5 ± 0.7 (ND–1.0)
#26 (Crema Romano)	India	2.2 ± 0.2 (2.0–2.3)
#27 (Lavender Blue)	India	2.9 ± 0.8 (2.3–3.4)
#28 (Jade Green)	India	128 ± 6 (123–132)
#29 (Himalayan Blue)	India	7.2 ± 5.7 (0.6–14.3)
#30 (Tan Brown) <sup>c</sup>	India	10 ± 5 (5.9–17.3)
#31 (Rosa Beta)	Italy	2.2 ± 1.3 (0.8–3.7)
#32 (Tropic Brown)	Saudi Arabia	83 ± 13 (73.6–97.1)
#33 (White Georgia)	USA	0.9 ± 0.4 (0.6–1.3)

## TEST RESULTS

The radon exhalation rates of granite ranged from non-detectable to 312 Bq/m<sup>2</sup>d.

The average is 42 Bq/m<sup>2</sup>d.

Generally speaking, some granite and slate materials have higher radon exhalation rates than other building materials.

# CONTRIBUTION TO INDOOR RADON

- Case 1 – radon exhalation from a granite countertop

Consider a granite countertop (0.67m x 2.50m x 0.025m) installed in a kitchen (20m<sup>2</sup> in area and 2.5m in height) ventilated with the minimum required ACH of 0.3/hour,

radon concentration added to the kitchen due to radon exhalation from both sides of the granite countertop is

**0.5 Bq/m<sup>3</sup>** for countertop with  
the average Rn exhalation rate of 42 Bq/m<sup>2</sup>d;

**3.6 Bq/m<sup>3</sup>** for countertop with  
the highest measured Rn exhalation rate of 300 Bq/m<sup>2</sup>d;

Under normal ventilation in a kitchen, granite countertops contribute very little to indoor radon concentration.



# CONTRIBUTION TO INDOOR RADON

- Case 2 – radon exhalation from a floor area

Consider a room has its entire floor decorated with building material, radon concentration in the room depends on the radon exhalation rate from the surface of the floor material and air exchange rate of the room.

Estimate steady-state radon concentration ( $\text{Bq m}^{-3}$ ) due to radon exhalation from floor material.

$E$ ( $\text{Bq m}^{-2} \text{d}^{-1}$ )	ACH = 3	ACH = 1	ACH = 0.3	ACH = 0.15	ACH = 0
5	0.03	0.09	0.3	0.6	12
10	0.06	0.2	0.6	1.2	25
50	0.3	0.9	3.0	5.9	123
100	0.6	1.8	6.0	12	246
300	1.8	5.5	18	35	737
500	3.1	9.2	30	59	1228



# CONCLUSIONS

Slate and granite generally have higher radon exhalation rates than other decorative materials.

Granite countertops contribute very little to the radon concentration in a kitchen.

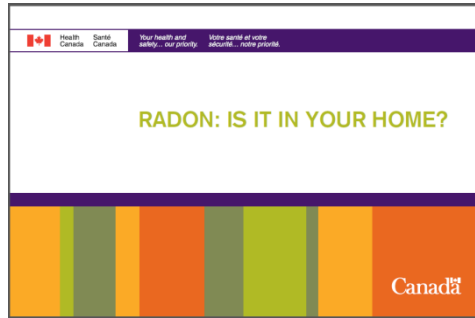
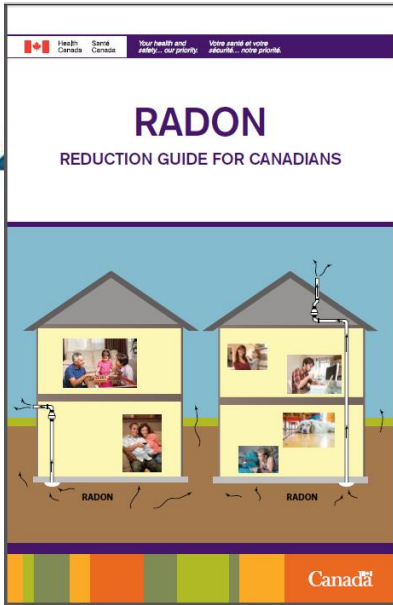
If an entire floor were covered with granite slabs of radon exhalation rate of  $300\text{Bq}/\text{m}^2\text{d}$  (the highest rate measured here), it adds only  $18\text{Bq}/\text{m}^3$  to indoor radon, provided an air exchange system was operated properly.

*Generally speaking, building materials used in home decoration make no significant contribution to indoor radon for a house with adequate air exchange.*





# Thanks for your attention!



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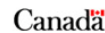
**Canadian - National Radon Proficiency Program (C-NRPP)** is a certification program designed to establish guidelines for training professionals in radon services.

**Radon** is a gas which can be found in concentrated levels inside homes. When people are exposed to concentrated amounts of radon gas it can increase their chance of developing lung cancer. If a *non-smoker* reduces radon levels in their home and workplace it may prevent their chance of developing lung cancer. If a *smoker* reduces radon levels in their home and workplace it may reduce their chances of developing lung cancer.

#### Consumers - [Find a Professional](#)

As a consumer you will benefit finding a C-NRPP certified professional because they have been trained to a recognized standard of practice and are held accountable for working to established guidelines.

#### Professionals - [How to become a C-NRPP Professional](#)



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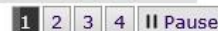
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<b>Transparency</b>	You can also hire a certified radon measurement professional to come and test your home. Health Canada recognizes the Canadian certification program, <a href="#">the Canadian National Radon Proficiency Program (C-NRPP)</a> 1-855-722-6777. Lists of certified Canadian measurement and mitigation professionals are available through the <a href="#">Canadian National Radon Proficiency Program</a> .

## Environmental and Workplace Health

## Radon



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