2024 inac INTERNATIONAL NUCLEAR ATLANTIC CONFERENCE

XXIII ENFIR XVI ENAN VIII ENIN X JR. POSTER XI ExpoINAC

Nuclear Energy:

Assuring Energy, Health and Food

May 06 - 10, 2024

Escola de Guerra Naval (EGN) | Rio de Janeiro - RJ

Proposed method for studying radon exhalation

Taveira N.F1., Santos T.O2., Takahashi L.C3., Lamounier C.S3., Passos R.G3. Hereen A.1

1 natalia.taveira@cdtn.br, Department of Nuclear Engineering at UFMG - Av. Presidente Antônio Carlos, 6627. Campus da UFMG – Pampulha. Belo Horizonte, MG, Brazil

2 Department of Anatomy and Imaging at Faculdade de Medicina da UFMG – Av. Professor Alfredo Balena, 190. Belo Horizonte, MG, Brazil.

3Nuclear Technology Development Center, CDTN – Campus UFMG, Av. Antônio Carlos 6627, Belo Horizonte, MG – Brazil

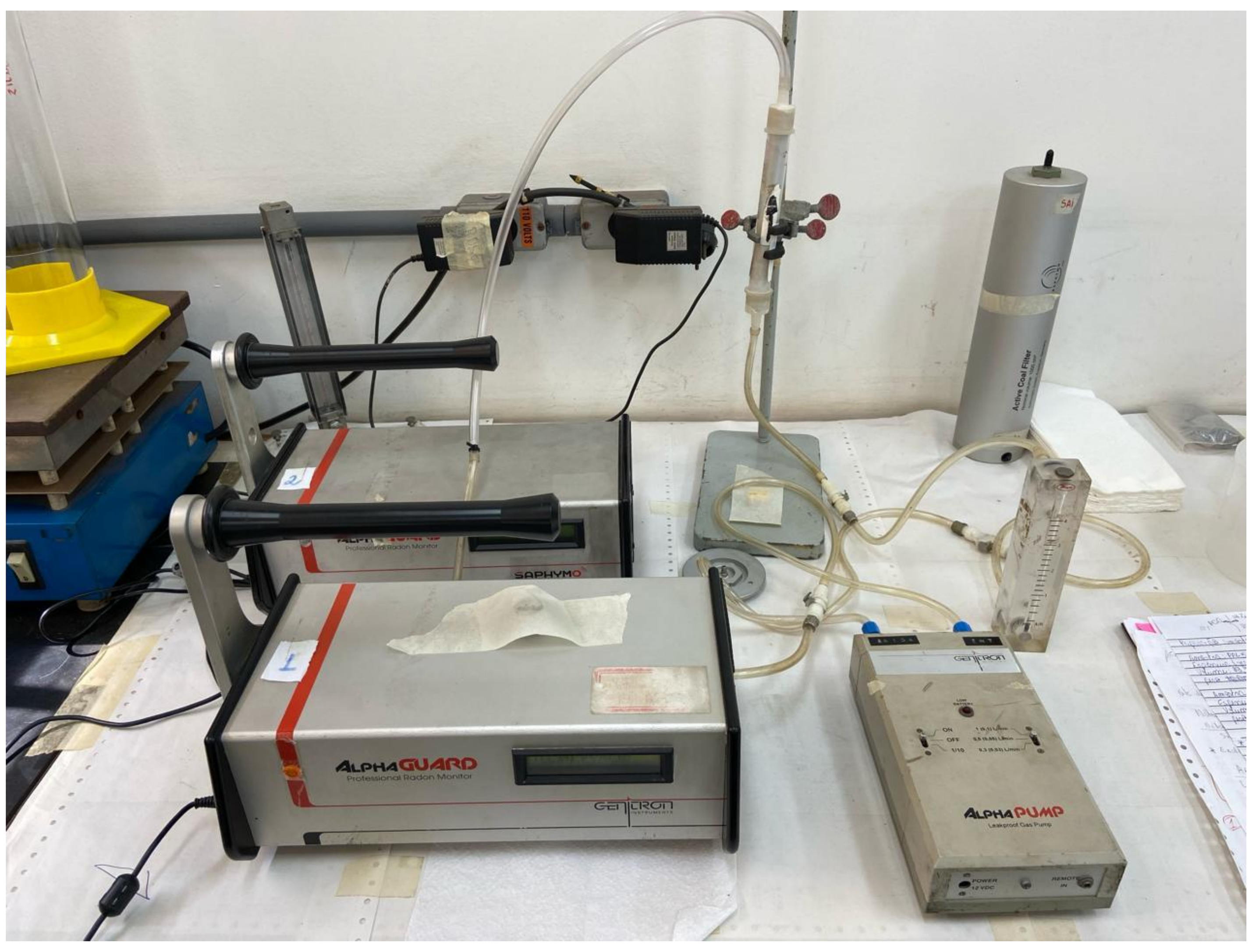
INTRODUCTION

Approximately 65% of the population is expected to receive annual doses between 1 and 3 mSv, 25% below 1 mSv, and 10% exceeding 3 mSv [1]. World Health Organization (WHO) recommends that member countries implement national mapping programs to assess the increasing risk of Rn exposure based on geological and geographical studies [2]. The main objective of the study was to test the methodology for different grain sizes of a granite rock.

METHODOLOGY

- The study of radon by exhalation was performed in closed circuit (Fig. 1), where 1 is sample holder, 2 is the detector, 3 a pump e 4 flow measurements. The detector used was the AlphaGUARD® (AG) model PQ2000 PRO, manufactured by SAPHYMO GmbH, Germany, with an internal volume of 0.56 L.

Fig. 1: Exhalation radon study by closed circuit.



- The parameter of 10 minutes/flow was used to realize the 4 days count protocol.
- An aliquot of 60g was placed in a sample holder, awaiting an equilibrium time between Ra and Rn of 30 days.
- After obtaining the radon concentrations by AG, an exhalation calculation was made according to the equation 1 below.

$$Ex = \frac{C \times V \times \lambda}{S}$$

where *Ex* is the exhalation rate per unit area and time (Bq.m-2.s-1), C is the radon concentration, *V* is the volume of the system (0.00133 m3), λ is the radon decay constant (s-1), and Sis the exhalation surface area of the sample (m2)

RESULTS

The preliminary results (Table 1) revealed a limitation of the method for granulometries below 350#. This limitation arises because the air flow passing through the tube displaces the sample column, reducing airflow at the ends (fluid pressure loss).

Tab. 1: Radon Concentration and its exhalation.

Sample	Granulometry	Rn Concentration (Bqm^{-3})	Rn exhalation (Bqs^{-1}m^{-2})
1	1#	10899.5 ± 1500	6,16E^{00}
2	4#	6412.6 ± 130	3.70E^{00}
3	16#	8715.46 ± 250	2.12E^{01}
4	350 #	1426.17 ± 100	2.46E^{03}
Mean	-	6863.43	6.16

CONCLUSIONS

The studied method proved to be effective with particle sizes up to 16#. For very fine particle sizes, the air flow is hampered and therefore reduces the effectiveness of transporting the radon-filled gas. It is proposed for future work to try to reduce the pressure loss caused by the air flow from the pump in the sample column. The Computational Fluid Dynamics (CFD) simulations can help understand the limitations encountered.

Acknowledgements

The authors would like to thank all the professionals at the nuclear development center (CDTN) for providing material, space and personnel for the development of the research, as well as CAPES for financing the first author's doctoral scholarship.

ISBN: 978-65-594-1256-3

References

[1] UNSCEAR- UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION - Annex B. Exposures from natural radiation sources. Unscear 2000 Rep [Internet]. 2000;1:74

[2] WHO. Who Handbook on Indoor Radon - A Public Health Perspective. World Heal Organ. 2009.

9 786559 412563

ABEN ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR