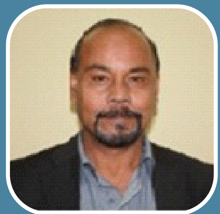
Editor Profile

Dr. Deiborlang Nongsiang

Dr. Deiborlang Nongsiang is an Assistant Professor in the Department of Mathematics, Union Christian College, Meghalaya, India. He has published 6 papers in International peer reviewed journals. His area of research is group theory, graph theory and poset theory. He is also currently the Regional Co-ordinator of the Indian National Mathematical Olympiad (INMO), Meghalaya Region.

Prof. Dibyendu Paul



Prof. Dibyendu Paul is a Ph. D in Ecology (Entomology) from North Eastern Hill University (NEHU), and is currently Head of the Department of Environmental Studies. His current research focuses around Biopesticides, Bioresource utilization for value added products and Pollution abatement through biotic interventions.Professor D. Paul has more than 30 publications in peer reviewed international and national journals and is member of different Scientific committees and Academic bodies of other Universities and expert committees of NGOs and State Government. He has successfully completed 20 externally funded research projects. Professor Paul has wide experience in EIA and EMP related work and has collaborated with Power Grid, Reliance Power, Tato, JICA, LaFarge, MCL, MottMacDonald. MBB and BARC for their impact assessment studies and environmental monitoring and management planning requirements.

Dr. Jimcarbrist P. Marak

Dr. Jimcarbrist P. Marak, Assistant Professor, is currently teaching in the department of Botany, Union Christian College, Meghalaya. He has done his specialization in Forest Ecology and has been working on provenance variations of important timber tree species in Meghalaya. His other area of research includes silviculture, conservation biology, ecological restoration and watershed management. He is presently working on variations of wood density and mechanical properties of Pinus kesiya in Meghalaya.

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303, Maharana Pratap Complex, Opp.Kapadia
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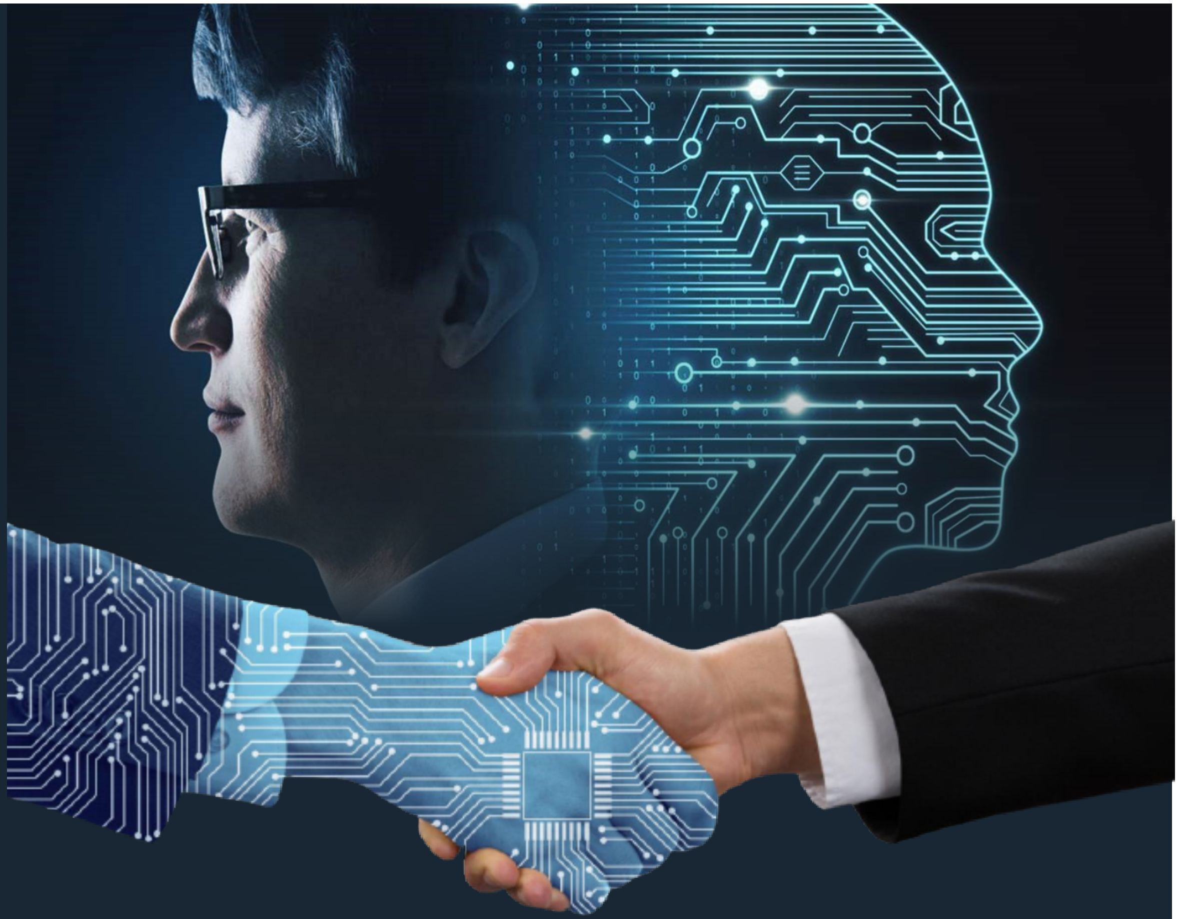

Recent Advancements in Science and Technology

Dr. Deiborlang Nongsiang
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RECENT ADVANCEMENTS IN SCIENCE AND TECHNOLOGY

Dr. Deiborlang Nongsiang

Assistant Professor, Department of Mathematics, Union Christian College, Umiam Khwan, Meghalaya, India-793122.

Prof. Dibyendu Paul

Professor, , North-Eastern Hill University, Umshing Mawkynroh, Shillong, Meghalaya, India-793022.

Dr. Jimcarbrist P. Marak

Assistant Professor, Department of Botany, Union Christian College, Umiam Khwan, Meghalaya, India-793122.

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Editors : **Dr. Deiborlang Nongsiang**
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Phone: +91 8866 00 3636, +91 8866 11 3636

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This book is dedicated to the memory of

(L) P. A. Sangma
Former Speaker of the Lok Sabha
(1st September 1947- 4th March 2016)

PREFACE

Science and Technology has always been the decisive field of human activity that moulded the development of the modern world: from the period of the Industrial Revolution to the technological revolution we experience today. The role of science and technology has become inextricable to human existence and survival. New technological innovations which gained acceleration in the 20th century have become an integral part of life in the 21^{st} century.

India's contribution to the world of science and technology is immense. Our country could boast pioneering some of the foundations in the fields of Mathematics, Architecture, Astronomy, Medicine, Physics, and Natural Philosophy. Today, India can reap the benefits from the applications of its scientific contribution. Many scientific researchers in the field of Pharmaceuticals, Nuclear Energy, Space Technology, Biotechnology, Electronics and others have helped to transform the economic status of India and created spaces for the younger generation to grow and flourish in a technologically advanced environment.

Technological development in any field enhances the economy of any nation. In order to improve the power of science and technology in India, the Indian government has formed the Council of Scientific and Industrial Research in the year 1942, and the Board of Scientific and Industrial Research in the year 1940. In order to emphasize the growth of science and technology in the country, the Indian government has established a chain of national laboratories and research institutes in various regions.

After independence, our country has been involved in the promotion of science for national development. A variety of policies by the government has emphasized self-sufficiency, sustainable growth and development all through the country. Both science and technology have impacted the economic growth and social development in the country in an extraordinary manner.

This volume, is the outcome of the National Conference on “Recent Advancements in Science and Technology” held at Union Christian College from the 12th - 14th June 2019, seeks to understand the advancements in science and technology during the year 2019.

Editors
Dr. Deiborlang Nongsiang
Prof. Dibyendu Paul
Dr. Jimcarbrist P. Marak

CONTENTS

LIST OF TABLES

CHAPTER 6

Comparative Case Study between Bare-Mode Lr-115 Detector Film and Pin-Hole Dosimeter in the Measurement of Indoor Radon

A. Pyngrope, A. Khardewsaw, Y. Sharma,
D. Maibam and A. Saxena

Introduction

Radon (^{222}Rn) is a colourless and odourless gas which exists in different isotopic forms namely, ^{222}Rn (called radon), ^{220}Rn (called thoron) and ^{119}Rn (called actinon). This gas is of special interest due to the fact that it is radioactive and also inert in nature. Unfortunately, on inhalation this gas may reach the lungs and cause impairment of lung tissues by irradiating them with alpha particles. Overtime it can cause cancer. Radon gas originates from ^{238}U, a primordial constituent of the earth's crust. With a half-life of 3.82 days and considerable permeability range (2.9 x 10^{-9} to 1.4 x 10^{-7} cm^2) in soil; this gaseous element is easily transported from soil matrix (source) to atmosphere and finally percolates the basement through some cracks, lose plumbing etc., thereafter reaching the interior of the house (UNSCEAR, 2000; Matiullah & Steck, 2011; Durrani & Illi c, 1997).

Radioactive radon daughters which are solids under ordinary conditions, attach themselves to atmospheric dust. The health hazard is more from the inhale dust particles thathad adsorbed radioactive radon progeny on their surfaces (Cember & Johnson, 2009; Nazaroff & Nero Jr, 1988). Due to such fatal issue as a result of inhalation of these gaseous elements, there arose the necessity of designing accurate detector. Earlier, bare-mode technique was largely used [Khardewsaw et al., 2017; Khan et al., 2011; Srivastavaa et al., 2001), but with the passage of time sources of errors/accuracies in the methodology were discovered and better techniques were devised. One of the recently developed devices to measure these elements is the single entry pin-hole dosimeter based solid state nuclear track detector (Sahoo et al., 2013), which have also been deployed in some parts of Meghalaya for indoor radon and thoron measurements (Pyngrope et al., 2018). The aim of this study is to compare the response of these two techniques by exposing equal number of detectors under same environmental conditions for about three months. The detailed results of radon concentration using both the technique are presented and discrepancy between two results are noted.

Materials and Methods

LR-115 film which belongs to the class of Solid State Nuclear Track Detector, have been used. It is a 12 μm thick cellulose nitrate film coloured deep red and coated onto 100 thick polyester backing. When an energetic alpha particle strikes the surface of the film, it leaves a trail of damage/track that can be made permanent and optically visible by chemical etching process. In bare-mode technique, LR-115 film of size 2.5 x 2.5cm^2 is pasted on a card and then hanged in a test room. In pin-hole technique the dosimeter used has two chambers with single entry fitted with filter paper of thickness 0.56 µm. The first chamber is called radon + thoron chamber and the second chamber is called radon chamber. Each chamber is cylindrical having length of 4.1cm ad radius 3.1cm. Chambers are internally coated with metallic powders to have neutral electric field inside the chamber volume, so that the deposition of progenies formed from this gas will be uniform throughout the volume (Sahoo et al., 2013).

Methodology

LR-115 (type-II) films are fitted on a bare-mode exposure sheet and inside the Pin-hole as well. Both have been exposed in the same test room. After exposure of about 99 days, these exposed films are retrieved and then undergo chemical etching in 2.5N NaOH solution at 60 ºC for 90 minutes. The alpha track formed is then counted using a Spark Counter at an operating voltage of 500V prior to pre-spark of 900V. The track density obtained is then converted into radon activity concentration using the following equations:'

$$C_{R_b}\ (Bq.m^{-3}) = \frac{\rho}{k_b.T} \qquad 1$$

$$C_{R_p}\ (Bq.m^{-3}) = \frac{\rho - B}{k_p.T} \qquad 2$$

Where ρ is the density of tracks (number of tracks counted per unit area of the film), B is the background track density, T is the duration in days for which the detectors were exposed, k_b= 0.02 tr."cm^{-2}". d^{-1} $(Bq.m^{-3})^{-1}$ and k_p=0.017 ±0.002 tr.cm^{-2} d^{-1} $(Bq.m^{-3})^{-1}$ are the calibration factors used for bare-mode and pin hole technique respectively (Sahoo et al., 2013; Eappen & Mayya, 2004).

Results and Discussions

The respective radon concentration and track density for bare-mode and pin-hole techniques are presented in Table 1. Radon concentration varies from 161.62 ± 9.03 to 411.62 ± 14.42 $Bq.m^{-3}$ in bare-mode technique and 54.39 ± 5.58 to 172.63 ± 10.07 $Bq.m^{-3}$ in pin-hole technique. From the box plot of the data shown in Figure 9, it is clearly seen that bare-mode technique gives much higher concentration of radon as compared to pin-hole. The reason may be due to the experimental procedure followed while exposing the detector. Besides, there is a high possibility of contribution from thoron and daughter products as well to track formation in the case of bare-mode technique. The lower radon concentration in case of pin-hole technique may be due to the intrinsic design of the device which restrict radon daughters from entering the chamber due to the presence of filter paper, thus allowing only radon and thoron to enter the first chamber (radon + thoron chamber). The presence of four small holes at the separation layer between the two chambers facilitate the passage of radon only to the second chamber (radon chamber), this is due to its comparatively longer half-life (Durrani & Illi c, 1997; Sahoo, 2013).

Table 1: Radon concentration in bare-mode and pin-hole techniques.

Detector ID	Exposure time (days)	Bare-Mode		Pin-Hole	
		Track Density (ρ)	Radon Conc. ($Bq.m^{-3}$)	Track Density (ρ)	Radon Conc. ($Bq.m^{-3}$)
C-T1	99	419	211.62 ± 10.34	208	121.53 ± 8.43
C-T2	99	374	188.88 ± 9.77	95	54.39 ± 5.58
C-T3	99	320	161.62 ± 9.03	105	60.33 ± 5.89
C-T4	99	541	273.23 ± 11.75	294	172.63 ± 10.07
C-T5	99	815	411.62 ± 14.42	131	75.78 ± 6.62

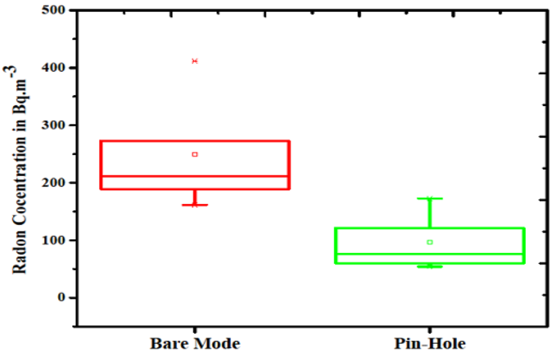

Figure 9 : Box plot of the radon concentration values obtained using the bare-mode and the pin-hole dosimeter techniques.

Conclusion

From the results obtained of the comparative study of indoor radon measurement given above (Figure 9), which clearly shows that radon concentration is shown to be much higher by the bare-mode as compared to pin-hole technique, we may infer this that the bare-mode exposure method clearly allows much more false positives to be identified than the pin-hole technique. Plate-out effects can also be a factor in the higher number shown by the bare-mode (Abu-Jarad, 1981). A supplementary thorough comparison exercise is required to put our conjecture, which was based on the results of limited experiments on firmer footing.

REFERENCES

Abu-Jarad, F., Wilsont, C. K., & Fremlin, J. H. (1981). The registration of the alpha-particles from polonium isotopes plated-out on the surface of the plastic detectors LR-115 and CR-39. *Nuclear Tracks, 5* (3), 285-290.

Cember, H., & Johnson, T. E. (2009). *Health Physics*. McGraw-Hill Medical, New York, 111-117.

Durrani, S. A., & Illi c, R. (1997). *Radon Measurements by Etched Track Detector*. World Scientific Publishing co. Pte. Ltd, New Jersey London, 3-17.

Eappen, K. P., & Mayya, Y. S. (2004). Calibration factors for LR-115 (type-II) based radon thoron discriminating dosimeter. *Radiation Measurements, 38*, 5-17.

Khan, M. S., Zubair, M., Verma, D., Naqvi, A. H., Azam, A., & Bhardwaj, M. K. (2011). The study of indoor radon in the urban dwellings using plastic track detectors. *Environmental Earth Science, 63*, 279–282.

Khardewsaw, A., Maibam, D., Sharma, Y., & Saxena, A. (2017*). Studies on indoor radon activity concentration in two villages of West-Khasi Hills District of Meghalaya, India*. 9th National Conference on Thermophysical Properties-2017, AIP Conference Proceedings 1950, 02011, American Institute of Physics, Melville, New York, 1-8.

Matiullah, R. S., & Steck, D. J. (2011). *Indoor Radon, Thoron and Natural Radioactivity Measurements*. Lambert Academic Publishing, Deutschlad, 1-3.

Nazaroff, W. W., & Nero Jr, V. A. (1988). *Radon and its decay products in indoor air*. Wiley Inter Science Publication, California, 5-24.

Pyngrope, A., Khardewsaw, A., Maibam, D., Sharma, Y., Saxena, A., & Sahoo, B. K. (2018). Measurement of indoor radon and thoron in East Khasi Hills district of Meghalaya, India. *Journal of Applied and Fundamental Sciences, 4* (1), 37-40.

Srivastavaa, A., Zamanb, M. R., Dwivedic, K. K., and Ramachandrand, T. V. (2001). Indoor radon level in the dwellings of the Rajshahi and Chuadanga regions of Bangladesh. *Radiation Measurements, 34*, 497– 499.

Sahoo, B. K., Sapra, B. K., Kanse, S. D., Gaware, J. J., & Mayya, Y. S. (2013). A new pin-hole discriminated ^{222}Rn/^{220}Rn passive measurement device with single entry face. *Radiation Measurements, 58*, 52-60.

UNSCEAR (2000), United Nations Scientific Committee on the Effects of Atomic Radiation.