

Long-Term Measurements of Radon Concentrations in Some Cheroot Samples

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ABSTRACT

Radon is the biggest contributor to natural and radiation in the environment and causes long-term health concern. The link between tobacco, cigarette smoke and cancer has long been established. Smokers are ten times at greater risk of developing lung cancer than that of non smokers. In this work, the radioactive radon concentrations of some cheroot samples in Myanmar were measured using SSNTDs technique and long term measurements were carried out for period of 100 days. According to the detection of alpha tracks, alpha track density and radon concentrations were carried out. And then annual effective dose of radiation in the corresponding samples were calculated.

KEYWORDS: SSNTD, radon, tobacco, cheroot samples

INTRODUCTION

Radon originates in the ground. It is a radioactive colorless, odorless, tasteless, noble gas, occurring naturally as an indirect decay product of uranium or thorium. Its most stable isotope ²²²Rn, has a half life of 3.8 days. A cigar is a product made of tobacco leaves or parts of leaves rolled together and covered with a binder and an outer wrapper made of natural or reconstituted tobacco[1]. The term includes cheroots and cigars. Myanmar people are very fond of smoking cheroot. Cheroot can be made by corn husk or Thnatphet leaf. Radon gas in the air breaks down into tiny radioactive elements that can lodge in the lining of the lungs, where they can give off radiation[2].

This radiation can damage lung cells and eventually lead to lung cancer. Most radon-related lung cancers develop in smokers. Overall risk of lung cancer from radon is even higher in smokers and former smokers[3].

The present work aims, alpha emitter level of the cheroots were measured by using Solid State Nuclear Track Detector. From the alpha track detection, we carried out alpha track density, the radon concentration and annual effective dose[4].

Materials and Methods

Samples Collection and Preparation

The four different brands of cheroot samples were personally bought from local market as shown in Table (1) for the experimental purpose. The photographs of these samples are also mentioned in Fig (1). In order to obtain the powder samples have been grinded and placed by basins. These cheroot samples were measured by using digital balance. The net weight of each sample is 100g. The cheroot samples were used average four packets to obtain the (100g) weight for each. Then each weighted sample has been labeled as cheroot powder.

Table1 Types of sample and its brands

No.	SampleName	Sample Types	Sample Brands
1.	CH-S1	Cheroot Sample	Nagar Ni
2.	CH-S2	Cheroot Sample	Nge Nagar
3.	CH-S3	Cheroot Sample	Yon Min
4.	CH-S4	Cheroot Sample	Shwe Man Thar



Fig. (1) Photographs of some Cheroot samples

Experimental Details for Can Technique

In this technique known amounts (100g) of each cheroot samples were placed in the plastic cans: diameter 9.3cm, height 6.5 cm, volume 441.596cm³. SSNTD LR-115 Type II CN plastic detectors (1cm × 1cm) were fixed on the bottom of the lid of each can with tape such that, sensitive side of the detector faced the specimen. The background level was measured in this condition and the result was recorded as background. The five plastic cans were tightly closed with cello tape to prevent entering the air from the outside. The cans were tightly closed from the top .The exposure time of the detector was 100 days.

Etching Procedure and Track Counting

At the end of exposure time, the detectors were removed from the lid of each can. The beakers were cleaned with tissue. Sodium hydroxide (NaOH), (2.5N) and distilled-water (100cc) was used as the solvent .In order to etch the detectors, a thread and a clip is attached to detector and immersed into the etching solution within a beaker. Then beaker is etched at 60°C for 15 minutes by using oven. After etching, the detectors were cleaned with tap water. Then, the detectors were dried on the air under room temperature. The etching procedure was shown in Fig.(2) and Fig.(3). Finally, the tracks produced by alpha tracks were observed and counted under MT 4300H of Biological Microscope attached with Color Video Camera at Zoology Department in Mandalay University. The mostly used method of track counting employs a biological microscope with an objective magnification of 40× may be adequate to count these tracks. However, field of view (FOV) of the microscope has to be calibrated against a standard graduate for the objective magnification which is used for counting. According to the observations of the different views of the screen of PC, alpha tracks were counted to reduce the statistical errors. The photomicrographs of alpha tracks for four different and background samples are shown in Fig.(4) to Fig.(8).

In this work alpha tracks were counted for different fifty views and the track densities were calculated by using equation:

$$\text{Track Density}(\text{track}/\text{cm}^2\text{day}) = \frac{\text{Number of Net Tracks}}{\text{Area of detector} \times \text{Exposure time}}$$

$$\text{Radon Concentration (Bq}/\text{m}^3) = \frac{\text{Track Density}}{\text{Calibration factor}}$$

$$\text{Annual Effective Dose (mSv}/\text{yr}) = \text{Radon Concentration} \times 0.0172\text{mSv}/\text{yr}$$



Fig.(2) weighting NaOH with Digital balance

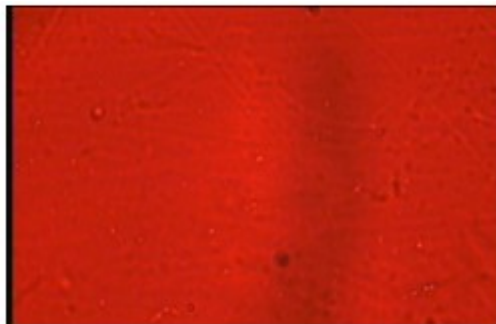


Fig.(3) Etching Process of Detectors

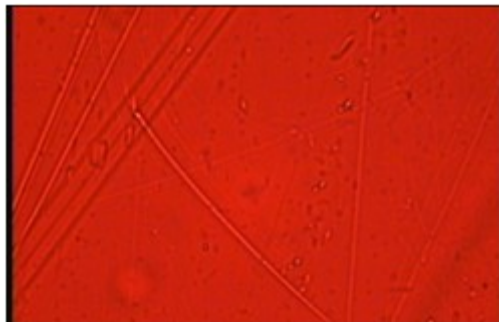


Fig. (4) Photograph of Alpha Track in LR-115 Detector for Cheroot Sample CH-S1

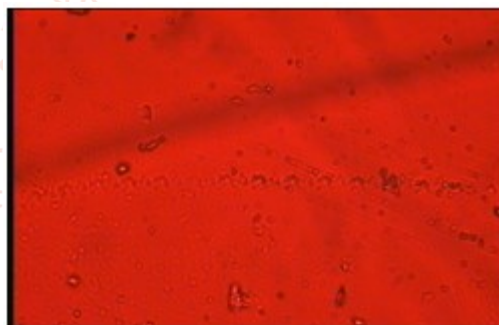


Fig.(5) Photograph of Alpha Track in LR-115 Detector for Cheroot Sample CH-S2

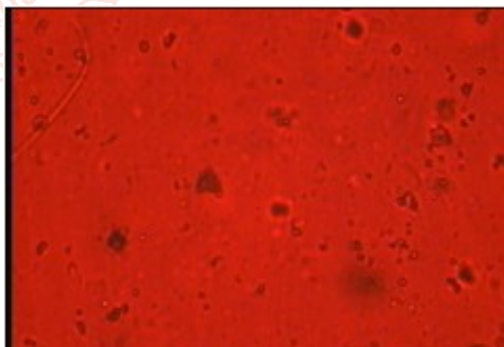


Fig.(6) Photograph of Alpha Track in LR-115 Detector for Cheroot Sample CH-S3



Fig.(7) Photograph of Alpha Track in LR-115 Detector for Cheroot Sample CH-S4

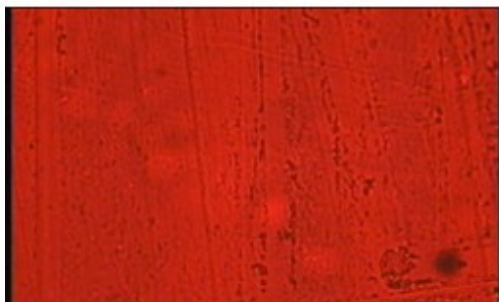


Fig.(.8) Photograph of Alpha Track in LR-115 Detector from Background

Results and Discussion

The average number of net track and track densities were mentioned in Table (2). The radon concentration and annual effective dose were mentioned in Table (3). According to the Table (2), the maximum alpha track density 2.77 ± 0.0099 track/cm²day in cheroot sample CH-S4 and minimum alpha

track density 2.03 ± 0.0090 track/cm²day in cheroot sample CH-S2 were found. According to the Table (3), the maximum radon concentration 55.223 ± 0.197 Bq/m³ in cheroot sample CH-S4 and minimum radon concentration 40.470 ± 0.179 Bq/m³ in cheroot sample CH-S2 were found. According to the Table (4.2), the maximum annual effective dose 0.949 ± 0.003 mSv/yr in cheroot sample CH-S4 and minimum annual effective dose 0.688 ± 0.003 mSv/yr in cheroot sample CH-S2 were found. International Commission on Radiological Protection (ICRP) recommended level for radon concentration is 300-600 Bq/m³ (ICRP, 2009). The result from the present work, the lowest value concentration is found to be 40.470 ± 0.179 Bq/m³ and the highest concentration is found to be 55.223 ± 0.197 Bq/m³. These obtained values within the recommended action level. According to the result of annual effective does due to radioactive radiation radon were below the recommended ICRP intervention level of 3-10 mSv/yr (ICRP, 2009).

Sr. No	Name of Sample	Average Number of Net Alpha Track	Alpha Track Density (track /cm ² day)
1	CH-S1	257 ± 0.95	2.57 ± 0.0095
2	CH-S2	203 ± 0.90	2.03 ± 0.0090
3	CH-S3	210 ± 0.88	2.10 ± 0.0088
4	CH-S4	277 ± 0.99	2.77 ± 0.0099

Table2 The Average Alpha Tracks and Track Densities

Sr. No	Name of Samples	Radon Concentration (Bqm ³)	Annual Effective Dose (mSv/yr)
1	CH-S1	51.236 ± 0.189	0.881 ± 0.003
2	CH-S2	40.470 ± 0.179	0.688 ± 0.003
3	CH-S3	41.866 ± 0.175	0.720 ± 0.003
4	CH-S4	55.223 ± 0.197	0.949 ± 0.003

Table3 Radon Concentration and Annual Effective Dose

Conclusion

The solid state Nuclear Track Detectors (SSNTDs) is an important tool in investigations concerning the presence of radon gas. In this work, we can found that the cheroot samples have less than the average overall radon doses to the population. The Commission keeps the value of 10mSv/yr as a reference level, ICRP proposes to revise the value of the reference level expressed in radon gas concentration the value of 300Bq/m³ is now recommended. Radon is the biggest contributor to natural radiation in the environment and causes long term health concern. The alpha tracks were found in cheroot powder sample of present research. Therefore, we can conclude that radioactive pollutant was found in these samples. Because of alpha radiation pollutant, it could be more chance to occur the lung cancer who consumes the cheroot for a long term period. The smokers are at a higher risk of lung cancer.

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