INVESTIGATION OF THE RADON GAS CONCENTRATION INSIDE HEINDA TIN MINE IN DAWEI TOWNSHIP, TANINTHARYI DIVISION, MYANMAR

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Abstract

This investigation aims to report the radon gas concentration inside of the Heinda Tin Mine in Dawei Township, Tanintharyi Division of Myanmar. In this research, the determinations of the radon gas concentration have been carried out in soil samples of some places inside Heinda Tin Mine. Soil samples were collected from four different parts inside of the Mine. RAD 7 detector was used to obtain the results. The experimental results were compared with the recommended values of ICRP and EPA. And then, a precious massage concerned with the radon gas hazard could be given to the public for health.

Keywords*: –* *radon gas, RAD 7, soil samples*

Introduction

When the earth was formed, billions of years ago, there were probably many radioactive elements included in the mix of material that became the earth. Radioactive elements are unstable. At some indeterminate moment, it will change to another element, emitting some form of radiation in the process. While it is impossible to predict exactly when the transformation of an individual atom will take place, there have been a very good measure of the probability of decay chain, within a given time slot. A natural radioactive transformation is accompanied by the emission of one or more of alpha, beta or gamma radiation. There are several types of radon monitors on the market. Nearly all of these are designed to detect alpha radiation, but not beta or gamma radiation. Because it is very difficult to build a portable detector of beta or gamma radiation that has both low background and high sensitivity.

An important fact is that uranium, thorium and their progeny are the main source of ionizing radiation in the earth crust. Therefore, uranium is a radiotoxic element. Radon (^{222}Rn), one of the decay products of uranium, continually decays to its daughters. The natural decay of ^{222}Rn emits alpha particles entering into the air through the earth crust. And then it exposes to the population and causes to be the natural radiation dose. Radon is a chemically inert gas and do not combine with other. Radon and its daughters can lead to change the respiratory function and can cause to the lung cancer. For these reason, the tracking of radon gas concentration is an important role of the radiation protection. There are many types of radon detection technique. To perform this research, the radon gas concentrations were detected by using RAD 7 detector.

Health Effects of Radon

All radon risk comes from breathing the air that consists of radon gas. These dust particles can easily be inhaled into the lung by the human being and then decay by emitting the alpha radiation which damage cells in lung. Alpha radiation can destroy DNA of these lung cells and can

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lead to cancer. Because of a low solubility in body fluids, it can lead to a uniform distribution of the gas throughout the body. Alpha radiation travels only extremely short distances in the body. Therefore, when we breathe that radiation, it cannot reach cells in any other organs. Especially it is important lung cancer hazarded by radon. There is no safe level of radon any exposure poses some risk of cancer.

Radon concentration depends upon the environmental conditions. The soil and rocks characteristics also control the transportation of radon. Radon concentration varies with time by time, day by day, year by year, grain size, content of radium and uranium.

Situation of Heinda Tin Mine

Heinda Mine is one of the tin mine in Dawei township, Tanintharyi Division in Myanmar. Tanintharyi Region is covering the long narrow southern part of the country on the Kra Isthmus. It borders the Andaman Sea to the west and Thailand to the east. To the north is the Mon State. It is the main manufacturing place for Myanmar's Natural resources like pearl and sea food. Dawei is the capital city of the Division. Especially, Maungmagan Beach is a well-known landmark of Dawei because of its very beautiful sigh seeing. Many local and foreign visitors have frequently paid a visit to this Region.

Heinda Mine is situated on the north-east of Dawei. It is about 142 kilometers or 35 miles far away from Dawei. Its location is north latitude 14º 8'49" and east longitude 98º 28'19". Heinda Mine is a large old tin mine in the northern part of the Great Tenasserim River Basin in Tanintharyi Region of Myanmar. This mine is in the proximity of Myitta town. The area of the Mine is about 2100 acres. Myaung Pyo is the closest village to Heinda Mine. Myaung Pyo village is the community most directly and adversely affected by the mining operation. The small tin mine has expanded into a large mining operation using modern technologies today.The map of the Heinda Mine is as shown in Figure 2.

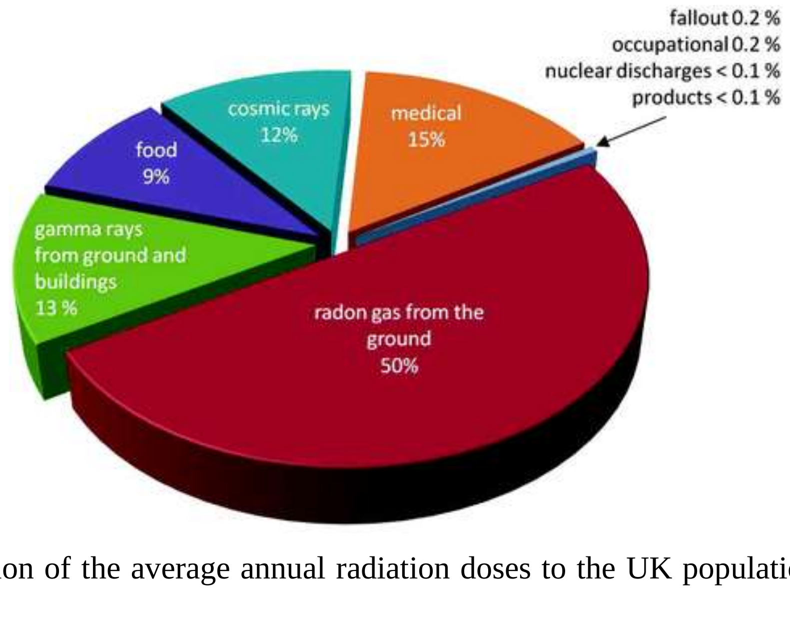

Figure 1 Proportion of the average annual radiation doses to the UK population [Watson et al., 2005]

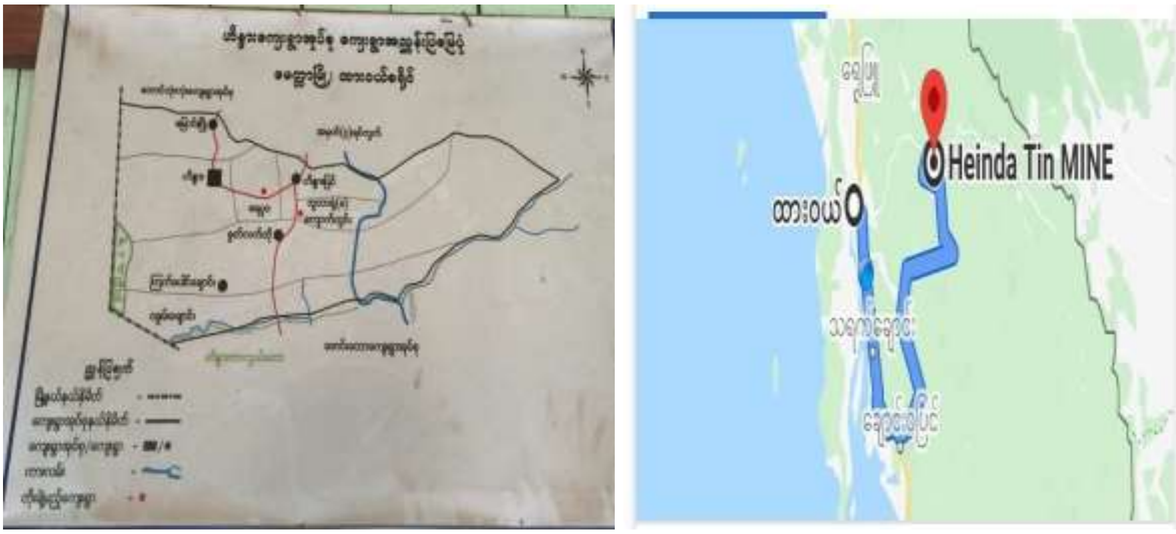

Figure 2 Map of the Heinda Tin Mine

Experimental Procedures

The Collection of Soil Samples

For this experiment, the soil samples were collected from the different parts of Heinda Mine. These are four different parts inside of the Mine. The collected soil samples were packed with the plastic bags and covered with zip. And then the balance was used to know their weights. The photographs of collected soil samples are as shown in Figure.

Measurement Procedure

The RAD 7 Durridge detector which consists of small drying tube with computer connectivity was used to obtain the measurement results. Firstly, the soil sample was filled in the plastic can through the sampling point. The soil gas probe should be inserted into the plastic can and it made sure that a reasonable seal between the probe shaft and the surrounding soil, so that ambient air does not descend around the probe and dilute the soil gas sample. The detector draws air from within the enclosed space, through the desiccant and inlet filter, and into the measurement chamber. The RAD 7 pulls samples of air through a fine inlet filter, which excludes the progeny, into a chamber for analysis. The radon in the RAD 7 chamber decays, producing detectable alpha emitting progeny, particularly the polonium isotopes. Though the RAD 7 detects progeny radiation internally, the only measurement it makes is of radon gas concentration.

Generally, soil gas is normal high concentration so it always uses the short cycle times to gain precision. The total time of the short cycle is 15 minutes. This time to complete a test is the pump sample time 5 minutes plus the delay period 5 minutes plus the count period 5 minutes. This is also called 5 minutes' cycle. The counted data from the detector is transferred to the display monitor computer system. It provides a wealth of graphing and data analysis options and then offers the best precision data acts as a graph. The preparations of RAD professional 7 detector with Computer PC are setup as shown in Figure 4.

The RAD Professional 7 detector always gives the unit of concentration with Bqm^{-3}. Becquerel is the favored unit in Europe and Canada. The favored unit of radon activity in US is PicoCurie. Therefore, to calculate the concentration with PicoCurie and the annual effective dose, the following calibration coefficients were used.

$$1\ pCi/L = 37\ Bqm^{-3}$$

$$1\ Bqm^{-3} = 0.0172\ mSv\ y^{-1}$$ (ICRP, 2007)

(a) (b) (c)

Figure 3 (a) and (b) The photographs of Heinda Tin Mine where were collected the soil samples (c) The photographs of the soil samples inside of the Mine.

(a) (b) (c)

(d)

Figure 4 (a), (b), (c) and (d) The photographs of the laboratory preparations for the detection of soil samples.

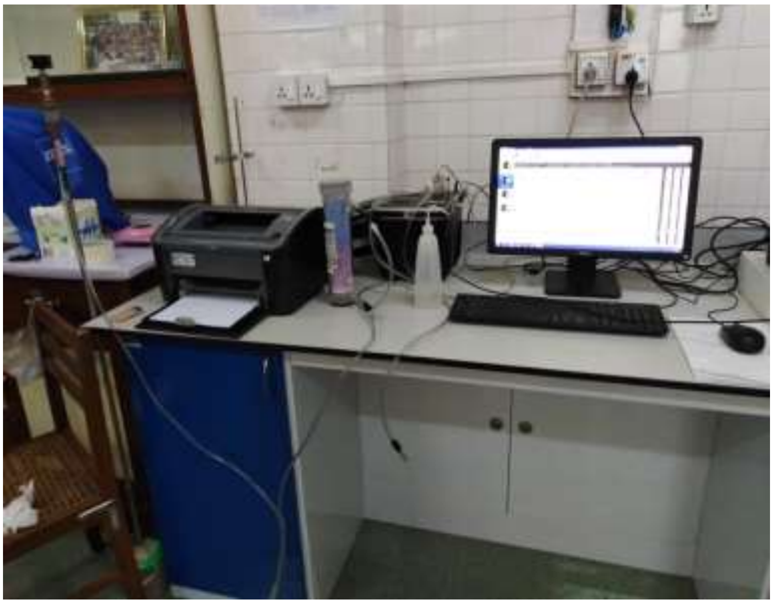

Figure 5 The photograph that was measuring soil sample with RAD 7 detector connected to PC.

Result and Discussion

Table 1 Average radon concentrations of soil samples inside Heinda Mine

No	Sample	Average Radon Concentration ($Bq\ m^{-3}$)	Average Radon Concentration (pCi/L)	Annual Effective Dose ($mSvy^{-1}$)
1	A1	24.8 ± 29	0.67 ± 0.78	0.43 ± 0.50
2	A2	0.00 ± 60	0.00 ± 1.62	0.00 ± 1.03
3	A3	11.9 ± 20	0.32 ± 0.54	0.21 ± 0.34
4	A4	14.2 ± 15	0.38 ± 0.41	0.24 ± 0.26

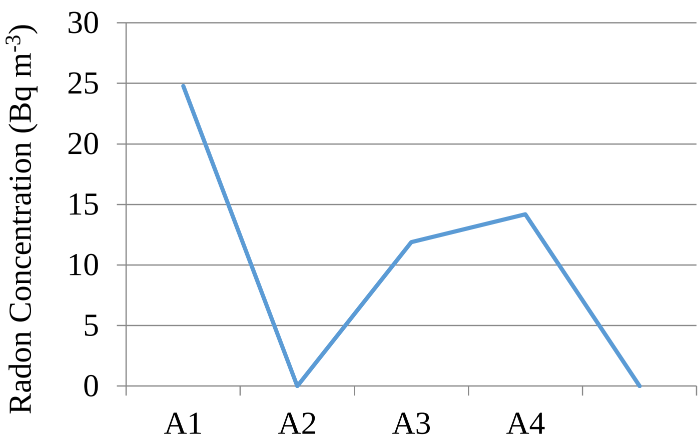

Figure 6 Histogram representing measured radon concentration of four soil samples inside Heinda Mine

The radon gas concentration is association with geology, weather and content of Uranium in the earth crush. As well as radon concentration varies with time by time, day by day and year by year. Therefore, many countries have defined an Action Level of radon concentration to guide their program to control domestic exposure to radon. The Action Level is not a boundary between safe and unsafe, but rather a level at which action on reduction of radon level will usually be justified. There is not acceptance level of radon in soil. Thus the annual effective dose is variable from country to country and from region to another. The Environmental Protection Agency (EPA) states that any radon exposure carries some risk; no level of radon exposure is always safe.

In Myanmar, an action level hasn't been recommended for the public yet. Therefore, there is no an action level which is recommended in Myanmar. In this research, the recommendation values of ICRP have been used for the action level. In 2007, the International Commission on Radiological Protection (ICRP) Publication 103 issued the recommendation value of 600 Bqm^{-3} for dwelling and 1500 Bqm^{-3} for the workplaces corresponding to the annual effective dose limits of 10–20 mSv y^{-1} (ICRP 1993, 2007). In 2009, ICRP issued to reduce radon exposure to upper reference level for dwelling to 300 Bqm^{-3} and 1000 Bqm^{-3} as the entry point for applying occupational radiological protection requirements in existing exposure situations. The Environmental Protection Agency (EPA) in US sets its action level as 148 Bqm^{-3}.

In the recent year, some Myanmar researchers have started to study on radon concentration at various parts in Myanmar. Mostly former researchers have been studied the concentration of radon inside the caves and buildings. There is very little number of researchers who studied at the Mines. There was no one who studied at the Heinda Tin Mine. Therefore, the present results could not be compared with the previous result data.

Conclusion

From the result data, the average radon concentrations of inside the Mine have very few amount of 2009 indoor radon level. The average annual effective doses were under the safe limits of ICRP (10 to 20 mSv y^{-1}). Moreover, it does not reach to EPA's action level (148 Bqm^{-3}). Its highest effective does was 0.43 ± 0.50 $mSvy^{-1}$. This means that the people who stay inside the Mine for the whole year can accept the absorbed dose 0.43 ± 0.50 mSv. This value is very low under the safe limits of ICRP. So it will not be very dangerous for them. For these reasons, the radon concentration of inside the Heinda Tin Mine cannot seriously harmful to the public in health concern for a long time.

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