RADON MEASUREMENTS OF WATER SAMPLES AT SOME LAKES FROM MANDALAY REGION

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Abstract

The aim of the present work is to carry out the radon concentration of water at some lakes from Mandalay Region and annual dose received by the people. Water samples from Sedawgyi, moat of Mandalay, Kandawgyi and Taungthamann were collected. Radon level in raw water (40 mL) was measured with RAD7 continuous radon monitor. By verification of the results, it can be checked out whether the WHO recommended permissible level (100 pCi/L) was exceeded or not. Mean radon concentration of the water samples are 10.6 pCi/L, 16.0 pCi/L, 10.7 pCi/L, 8.0 pCi/L and do not exceed the safe limit level. However, continuous monitoring of radon concentration is basic description of public water safety.

Keywords: Radon, RAD 7, water at some lakes, Mandalay region

Introduction

Nowadays, radon concentration has been interested for radiological safely because of radon is a radioactive gas for which both ingestion and inhalation present health risks, therefore radon in air and water has become a public health concern. Radon is produced continuously in soil, rocks and water source through alpha decay of Uranium, Thorium and Actinium series and Radium. Radon and its progenies emit alpha particles –USEPA Report (2003). RAD7 was designed to detect alpha particle only, so we will emphasize alpha radiation. Environmental Protection Agency (USEPA) established a voluntary program to promote radon awareness, testing and reduction and has warns the public that any radon has some risk of causing lung cancer therefore should always try to reduce the radon level in water and air – USEPA Report (2017). The recorded values of radon concentration in water are within the safe limit of 300pCi/L or 11.1 Bq/L (US Environmental Protection Agency) and 100pCi/L or 3.7Bq/L (WHO) were recommended –USEPA Report (1999). Many studies have been done to measure radon in water from different places around the world due to radon health hazard. They were showed the other samples more than the EPA recommended safe limit of 300pCi/L or 11.1Bq/L. Radiological health hazards associated with natural radionuclide and their progenies due to the consumption of water. Safe and effective ways to reduce radon content in water is needed for public water safety as any radon has some risk of causing lung cancer and stomach cancer. Radon content in public using lakes water has not been tested in Mandalay region yet. This experimental study was to determine the natural radon content in public lakes water from Mandalay region and then to compare the Radon concentration level in lake water at recommended safe limits.

RAD7 Radon Detector

Every nucleus of radon-222 eventually decays through the sequence polonium-218, lead-214, bismuth-214, polonium-214, and lead-210. With each transformation along this path the nucleus emits characteristic radiation: alpha particles, beta particles, or gamma rays, or combinations of these – Gruber, Maringer, & Landstetter (2009). The RAD7 was designed to

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detect alpha particles only, so we will emphasize alpha radiation.Radon-222 is an inert gaseous alpha-emitter that does not stick to or react with any materials. It has a half-life of 3.82 days. A particular radon nucleus may decay at any time, but it is most likely to decay between now and 8 days (two half-lives) from now –K.Badham, R.Mehra & R.G.Sonkawade (2010). There are several types of continuous radon monitors on the market. Nearly all of these are designed to detect alpha radiation, but not beta or gamma radiation. Why? Because it is very difficult to build a portable detector of beta or gamma radiation that has both low background and high sensitivity. Three types of alpha particle detectors are presently used in electronic radon monitors: 1. Scintillation cells or "Lucas cells" 2. Ion chambers 3. Solids state alpha detectors. Each of these types has advantages and disadvantages relative to the others. All of these types can be used for low background alpha particle counting. The DURRIDGE RAD7 uses a solid state alpha detector. A solid state detector is a semiconductor material (usually silicon) that converts alpha radiation directly to an electrical signal. One important advantage of solid state devices is ruggedness. Another advantage is the ability to electronically determine the energy of each alpha particle. This makes it possible to tell exactly which isotope (polonium-218, polonium-214, etc) produced the radiation, so that you can immediately distinguish old radon from new radon, radon from thoron , and signal from noise. This technique, known as alpha spectrometry, is a tremendous advantage in sniffing, or grab-sampling, applications. Very few instruments other than the RAD7 are able to do this - DURRIDGE (2015). A distinction should be made between true, real-time continuous monitors, and other instruments and devices. With a continuous monitor, you are able to observe the variation of radon level during the period of the measurement. This can sometimes show big swings in radon concentration and may allow you to infer the presence of process influencing the level. For good data, it is important that there be sufficient counts to provide statistically precise readings. Devices which give just a single, average reading, or whose precision is inadequate except after a long measurement time are not, in this sense, continuous monitors. Another important parameter is background. This is the reading given by the instrument when there is no radon in the air sample. For low level continuous monitoring, it is necessary that the background be extremely low and stable. Because of the high quality alpha detector, and unique real-time spectral analysis, the RAD7 background is vanishingly small, and is immune to the build-up of lead-210, which plagues other instruments – DURRIDGE (2012).

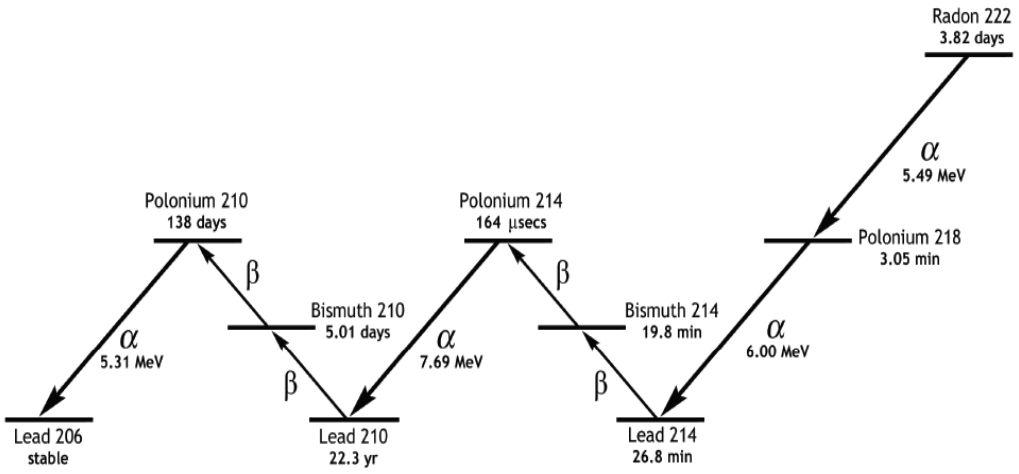

Figure 1 Radon decay sequence

Sample Collection

In this paper, four lakes were selected to include all different parts of the Mandalay region, namely Sedawgyi, moat of Mandalay, Kandawgyi and Taungthamann on January 30th 2019 (Wednesday).The altitude of the samples collected area is about 80 meter or 260 feet above sea level. Altogether four lakes were selected purposively because of these area public using these water. The samples were collected within evening of one day because the half-life of radon is 3.8 days. The locations of sample collected were described by Google maps of Figure (2), (3), (4), (5) and (6). Approximately 60ml of raw water samples are collected from each lake directly with quality control procedure. Before taking water samples, each sample container rinsed with distilled water.

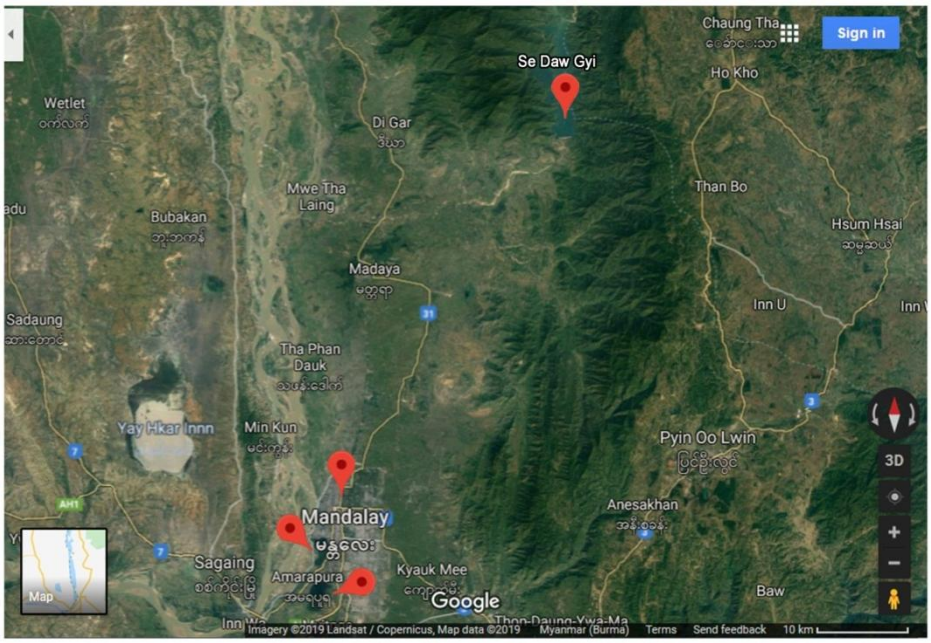

Figure 2 The Google map of sample collected area in Mandalay region

Figure 3 The location of Sedawgyi lake in Google map

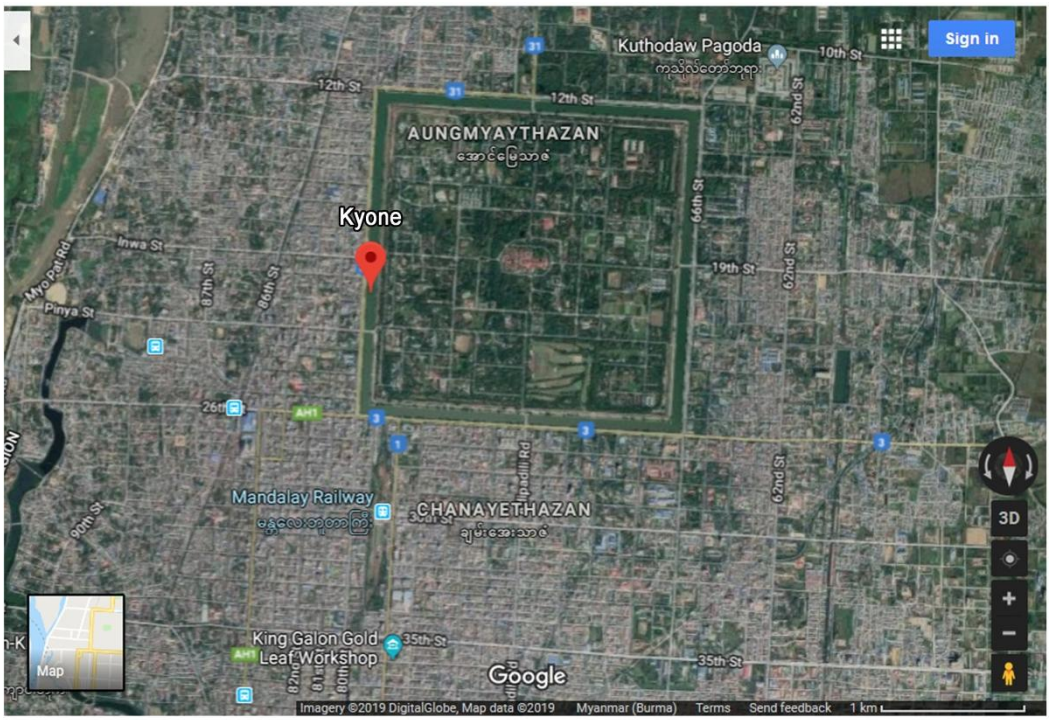

Figure 4 The location of moat of Mandalay in Google map

Figure 5 The location of Kantawgyi in Google map

Figure 6 The location of Taungthamann lake in Google map

Measurement of radon concentration in water samples

Radon content level in raw water (40ml) was measured onsite using by RAD7, Electronic Radon Detector. RAD7 connected to a RAD-H_2O accessory (DURRIDGE Co.Ltd USA) as shown in Figure (7). RAD 7 is a well calibrated, fast and accurate radon detector. After the 10 minutes purging the inner RAD7 detector, it was connected the tested water sample glass vial. Before the test, on the RAD7 go to setup water Protocol depending on water glass vial is being used and started. Data printed at the end of 4 cycles (30 minutes), and a summary, bar chart and cumulative spectrum was printed at the end of the run – DURRIDGE CO-Ltd-USA (2014). Four synthetic spectrums were describe for four water samples, as shown in Figure (8), (9), (10) and (11). Radon content level in water sample in mean, standard range of specific activity and median values were computed using by CAPTURE Software of RAD7, DURRIDGE Co-Ltd-USA. Data analysis was analyzed by Microsoft Excel and SPSS software.

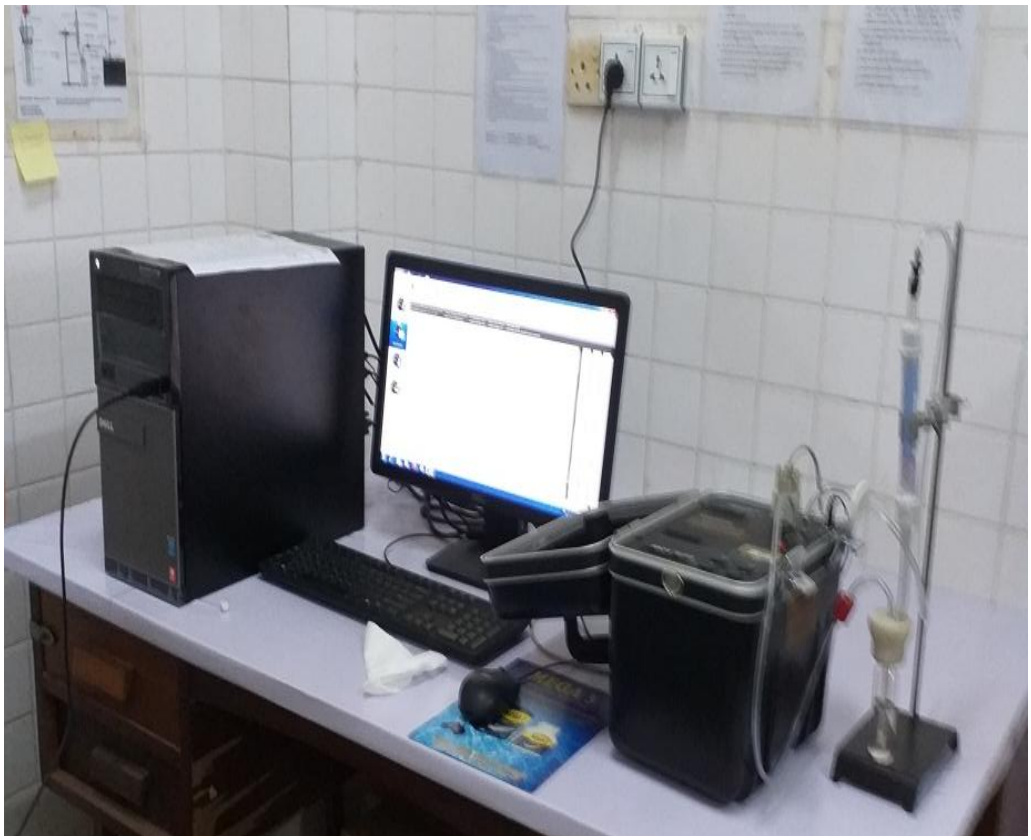

Figure 7 Measurement of radon concentration in water samples by RAD7 detector

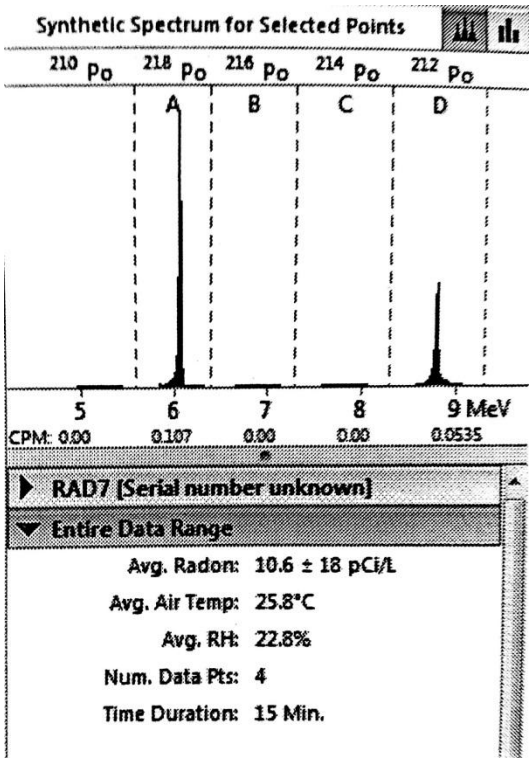

Figure 8 Illustration of synthetic spectrum and entire data range of water samples from Sedawgyi lake

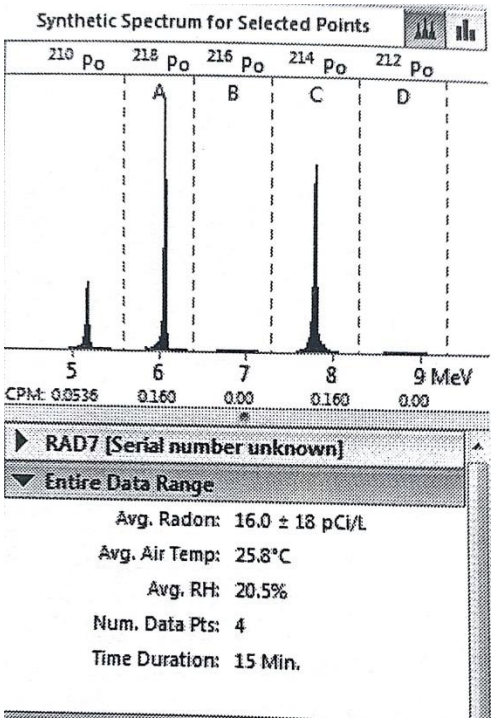

Figure 9 Illustration of synthetic spectrum and entire data range of water samples from moat of Mandalay

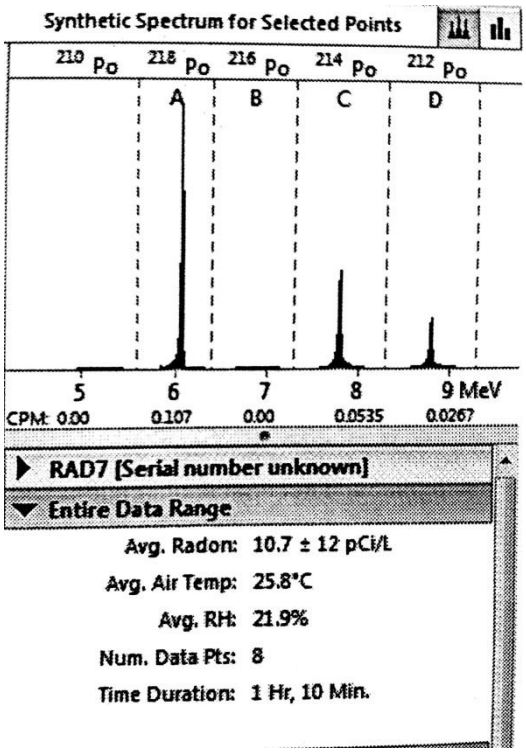

Figure 10 Illustration of synthetic spectrum and entire data range of water samples from Kandawgyi lake

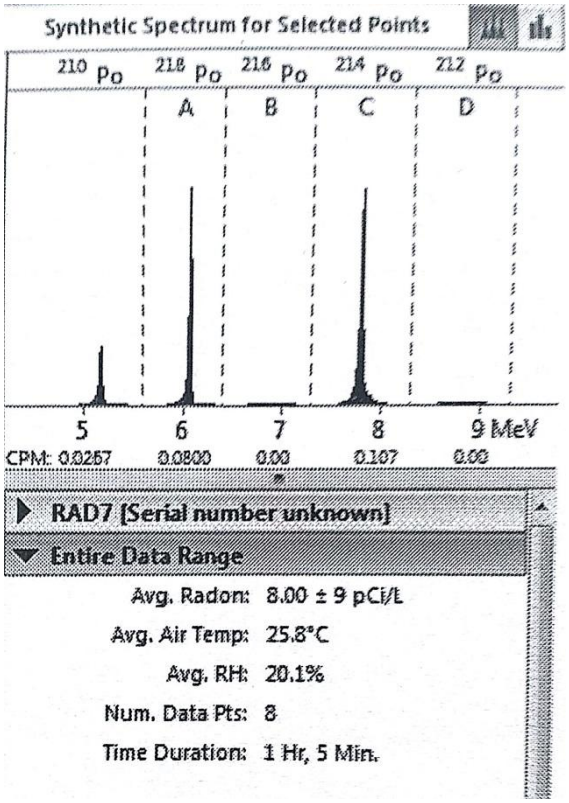

Figure 11 Illustration of synthetic spectrum and entire data range of water samples from Taungthamann lake

Results and Discussion

In this study, the calculated values of Radon concentration in tested 4 samples from selected lakes were described with a Table (1) and the graph of Figure (12). The highest radon concentration was found in moat of Mandalay (16.0 pCi/L) and the lowest radon concentration was found in Taungthamann (8.0 pCi/L). This research highlighted the no risk of radiation exposure from tested 4 water samples to community. Collected water samples of selected lakes contained lower radon concentration in selected place of Mandalay region and that is public safe limit level. Despite the reported radiological risk associate with the exposure to radon and its progenies, the level of awareness of the present of this cancinogenic radionuclide in lake water from selected are of Mandalay region is low. WHO-2009 and international Commission on Radiological Protection (ICRP-2009) has recommended for the public safe limit radon concentration is 100 pCi/ L received from radon and its progenies above which it can be health hazards.

Table 1 Mean radon concentration and range of specific activity of four water samples

No	Locations	Mean Radon Concentration (pCi/L)	Range of specific activity(pCi/L)
1	Sedawgyi	10.6	± 18
2	Moat of Mandalay	16.0	± 18
3	Kandawgyi	10.7	± 12
4	Taungthamann	8.0	± 9

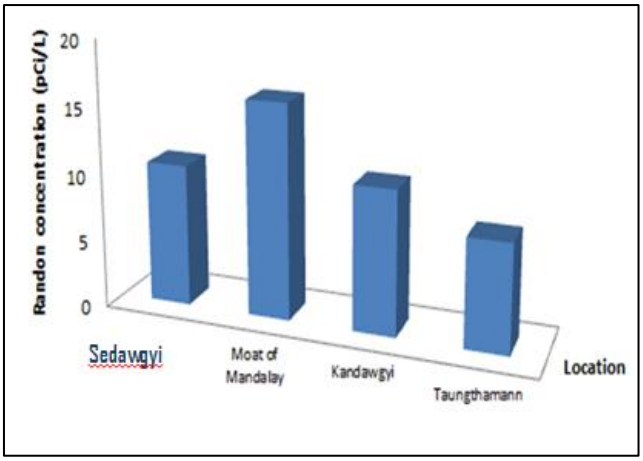

Figure 12 The radon concentration of water samples for four lakes

Conclusion

Knowledge of the distribution of radionuclide levels is important to the public safety and it is also necessary to know simple knowledge of safe and effective ways to reduce radon content in water. The present study will link to ongoing radiological studies on the other area providing information on natural radionuclide level of water. The current research work provides the information on natural radon concentration of water which can be used in developing intervention programs for household different water sources and storage strategies. This research showed that there is a low risk of radon exposure to community living in Mandalay region.

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References

DURRIDGE (2012)RAD7 RADON DETECTOR User Manual. DURRIDGE Company Inc., Boston.

DURRIDGE,C. (2015). Radon in water accessory. Revision 2015-07-28 edition.

Environmental Protection Agency, office of ground water and drinking water rule, (1999) "technical fact sheet EPA 815-F-99-006". Washington DC.

Gruber,v., Maringer, F. J., & Landstetter, C.(2009).Radon and other natural radionuclides in drinking water in Austria: measurement and assessment. Applied Radiation and isotopes, 67,913-917.

http://www.epa.gov/radiation/images/radon-cancer-vs-other.jpg.

http://www.durridge.com/documentation/RADH$_2$O manual.pdf

K . Badham, R.Mehra and R.G. Sonkawade, (2010). " Radon gas and its radioisotopes" Inadian Journal of Pure and applied Physics, Vol.48,pp.508-511.

US Environment Protection Agency, office of Radiation and Indoor Air, (2003) "Assessment of risk from radon in homes". Washington DC.