



## Measurement and analysis of radium 226 in drinking water at Amphoe Muang Khon Kaen via manganese fibers using gamma-spectrometry

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Received April 2016  
Accepted June 2016

### Abstract

Measurement and Analysis of Radium 226 concentration in 111 water samples at Amphoe Muang Khon Kaen were determined by measuring activity of Radium 226 via Manganese Fibers using gamma spectrometry. The average of Radium 226 was found to be 0.03 Bq/l, range 0 – 0.105 Bq/l. The average risk of Annual Equivalent Dose was found to be 0.018 mSv/y, range 0 – 0.064 mSv/y. This study show that Radium 226 in drinking water at Amphoe Muang Khon Kaen is not more than 0.11 Bq/l which is the standard value of the United States Environmental Protection Agency, and its Annual Equivalent Dose not exceed 0.1 mSv/y, which is the maximum for the public drinking water. Therefore, drinking water at Amphoe Muang Khon Kaen is safe for drinking.

**Keywords:** Radium 266, Gamma spectrometry, Drinking water, Khon Kaen

### 1. Introduction

Radium 226 is a radioactive that can accumulate in the environment, such as rocks, soil, water, plants and food [1]. However if radioactive is accumulated in the human body in high level, it will affect your health. When people drink water containing radium dissolved in a high volume, can be a cause of cancer in various organs such as the lungs, liver, kidneys and endocrine organs [2-3]. The researchers were aware of the problems in this regard, so we have measured the amount of radium in drinking water that people use on a regular basis. We choose to study water samples from villages in Research areas in order to measure the safety and the risks that affect the health of people in the study area.

### 2. Materials and methods

2.1 The 111 samples of drinking water were packaged in 10 liter gallons of wastewater (Before packing, the water must be opened 5 -10 minutes). (Figure 1)

2.2 Radium 226 in water samples was trapped with a filter made of acrylic fiber coated with Potassium permanganate (Mn-fiber) in LAB. (Figure 2)

2.3 Mn-fiber was packed through a filter and sealed in a plastic bottle and then left for 30 days to achieve a balance of radiation. (Figure 3)

2.4 The jar containing Mn-fiber was analyzed by gamma spectrometry at Department of Physics, Faculty of Science Khonkaen University. The time to measure is 20 hour / sample. (Figure 4)

2.5 Determination of Radium 226 in water samples was taken

by the peak area from gamma spectrometry. Radium 226 is calculated from Equation 1

$$A_{sample} = \left( \frac{N_{sample}}{(V)(P)(Eff)} \right) \pm \left( \frac{\sigma_{Nsample}}{(V)(P)(Eff)} \right) \quad (1)$$

$N_{std}$  = count rate of standard (cpm)

$\sigma_{Nstd}$  = error of  $N_{std}$

$N_B$  = count rate of blank (cpm)

$\sigma_{N_B}$  = error of  $N_B$

$N_{sample}$  = count rate of sample (cpm)

$\sigma_{Nsample}$  = error of  $N_{sample}$

$A_{std}$  = activity of standard (dpm)

$A_{sample}$  = activity of sample (dpm)

V = volume of water (L)

Eff = Efficiency of Probe at 186.2 keV of Radium 226

P = The proportion of gamma radiation at 186.2 keV of Radium 226 = 4%

2.6 The amount of radiation received per year from drinking contaminated water caused by the Radium 226 was calculated from Equation 2 [4]

Annual Equivalent Dose (AED) = A x W x Dose factor

AED = Radiation received per year (mSv/y)

A = Radium 226 in water (Bq/l)

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doi: 10.14456/kkuenj.2016.91

W = Water consumption per year, which people to drink at least two liters per day, so a year would have to drink at least 730 liters.



Figure 1 Sampling 111 samples of drinking water

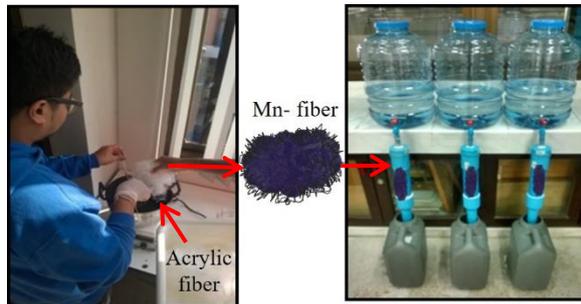


Figure 2 The trapping of Radium 226 in drinking water with Mn-fiber



Figure 3 Mn-fiber packaging units

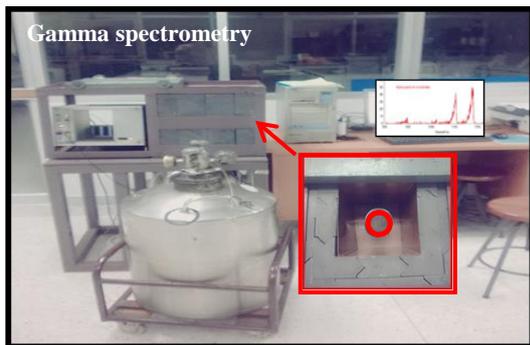


Figure 4 Gamma spectrometry

### 3. Results

The results of 111 samples have Variance Value (S<sup>2</sup>) of Radium 226 was found to be 0.002 and the Standard Deviation (S) was found to be 0.045. From The results were many, Therefore researchers have presented just 10 interesting regions that has an average of Radium 226 higher than other regions at Amphoe Muang Khon Kaen. The result are shown in Table 1.

Table 1 Radium 226 and Annual Equivalent Dose in drinking water

Research areas	Radium 226 (Bq/L)	AED (mSv/y)
1. Ban Gudnang Tui Tambom Bantoom	0.105	0.071
2. Ban Paheam Tambon DonChang	0.099	0.060
3. Banbengniam Tambon Banbengniam	0.093	0.056
4. Ban Donchang Tambon Donchang	0.091	0.055
5. Lao Nadi Tambon Naimeuang	0.084	0.051
6. Ban Khamhai School Tambon banped	0.077	0.046
7. Ban Nongkuay Tambon Thaphra	0.075	0.045
8. Banbenggae Tambon Nonton	0.071	0.043
9. Ban Nonggong Tambon Bantoom	0.070	0.042
10. Ruenjit Tambon Naimeuang	0.067	0.041

The Radium 226 of all region were then use to create contour map for distribution in Amphoe Muang Khon Kaen as shown in Figure 5.

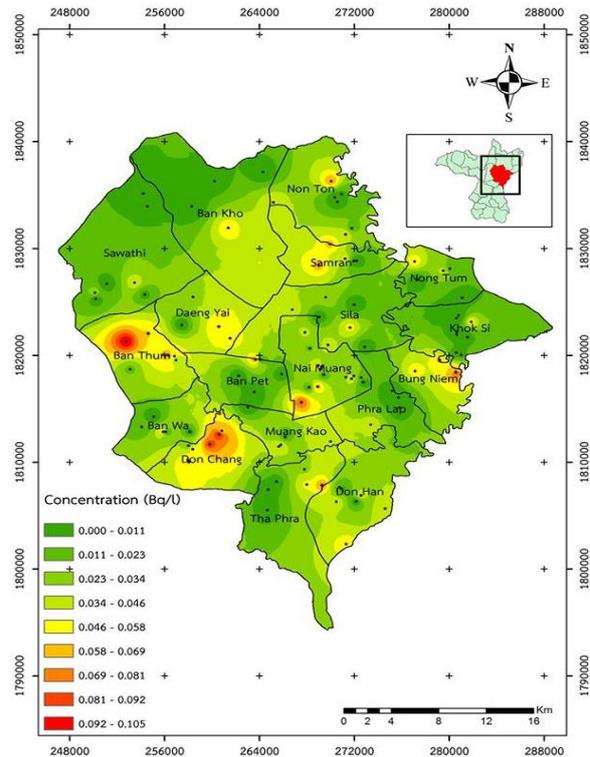


Figure 5 The contour map of Radium 226 in drinking water at Amphoe Muang Khon Kaen

### 4. Discussion

The results show that Mn-fiber can catch Radium 226 in Drinking water. Radium 226 in Drinking water from Ban Gudnang Tui Tambom Bantoom, Ban Paheam Tambon DonChang, Banbengniam Tambon Banbengniam and Ban

Donchang Tambon Donchang (The red area in Figure 5) are similar to the standard value of US Environmental Protection Agency [5-6], which should be monitored and find a solution. The Radium 226 in the remaining areas in Drinking water is lower than standard value. The AED value of all regions in Amphoe Muang Khon Kaen is lower than the standard value. From results should be monitoring in areas that Radium 226 are close to the standard value, because in the long-term, the contamination of Radium 226 in Drinking water may increase as a cause of Cancer in people who use continuously the water in the future. Therefore, the behavior of radon in Drinking water in these areas should be regularly monitored to create security for the people.

## 5. Conclusions

Radium 226 in 111 Drinking water sample at Amphoe Muang Khon Kaen were determined by measuring Radium 226 via Mn-fiber using gamma spectrometry. The Radium 226 was found to be 0.03 Bq/l, range 0 – 0.105 Bq/l. The average risk of Annual Equivalent Dose was found to be 0.018 mSv/y, range 0 – 0.064 mSv/y. These results are lower than the standards value of US Environmental Protection Agency. But in other areas with Radium 226 are similar to the standard value should be monitored continuously. Therefore the Drinking water in areas with Radium 226 lower than standard value in Amphoe Muang Khon Kaen is considered safe to use for consumers. Moreover, this research has shown that Mn-fiber can be used as adsorbent/trap Radium 226 in water for determining Radium 226 contamination in Drinking water samples [7].

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