Analysis on Gamma Spectra by NaI (Tl) Detector

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Abstract

The (3" x 3") NaI (Tl) detector at the Experimental Nuclear Laboratory, Physics Department, Mandalay University was used for gamma spectrum analysis incorporation with Gamma Vision 32 software. The standard gamma source ^{152}Eu (Spectrum Technique, USA) was used to calibrate the NaI (Tl) detector. Calibration range was 122 keV to 1408 keV and showed a linear relation of 0.943 keV per channel. Sand sample from Moemauk Hot Spring, Banmaw Township, Kachin State was analyzed by gamma spectroscopy. The gamma emissions were observed at ^{212}Pb (239 keV), ^{228}Ac (338 keV), ^{208}Tl (583 keV), ^{228}Ac (911 keV) and ^{40}K (1460 keV). With high resolution detector, such as HpGe, more gamma emissions were expected to be observed.

Keyword: Gamma Spectrum Analysis, Energy Calibration, Gamma Emissions

1. Introduction

This research work intends to get hands-on experience in the gamma ray measurement and to understand the reliable approach of radionuclides identification in the environmental samples. NaI (Tl) detector at the Experimental Nuclear Physics Lab, Department of Physics, University of Mandalay as shown in Fig.1. (a) was used for gamma ray measurements. Fig.1. (b) is Moemauk Hot Spring, Banmaw Township, Kachin State where sand sample was collected to be analyzed.

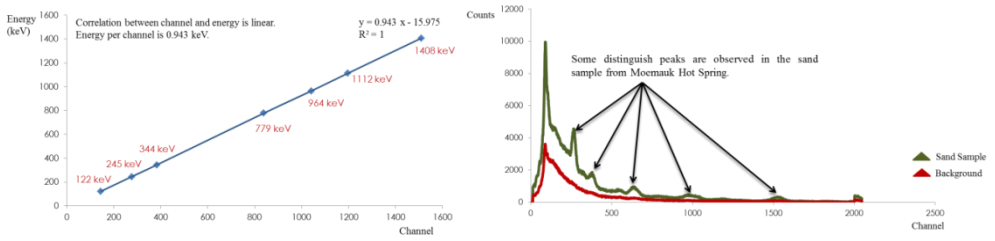
(a) (b)

Fig.1. (a) Experimental Arrangements for Gamma Ray Measurement (b) Moemauk Hot Spring

2. Gamma Ray Measurement and Spectrum Analysis

To calibrate the NaI (Tl) detector, standard gamma source ^{152}Eu (Spectrum Technique, USA) was utilized. Calibration ranges from 122 keV to 1408 keV. Correlation between channel and energy is linear within the calibration range which is described in Fig.2. (a). Energy per channel is 0.943 keV per channel. After calibrating the detector, laboratory background and sand sample from Moemauk Hot Spring were conducted for 3 hours by using NaI (Tl) detector. Fig.2. (b) is measured spectra of laboratory background and sand sample from Moemauk Hot Spring. In this research work, qualitative analysis was performed rather than quantitative one. Before investigating the natural radionuclides obtained in the sand sample from Moemauk Hot Spring, we have to confirm linearity of our calibration.

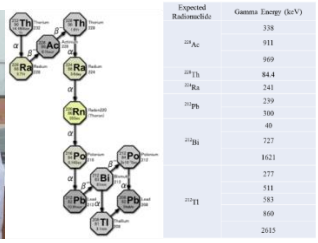
Confirmation on linearity of energy calibration is mentioned in Fig.3. (a). We also estimate expected radionuclides from Uranium and Thorium decay series by gamma ray spectroscopy. Expected radionuclides from Thorium decay series are shown in Fig.3. (b).



(a) (b)

Fig.2. (a) Energy Calibration Curve (b) Spectra of Laboratory Background and Sand Sample

Channels	Energy Difference (keV)
200 - 201	0.95
400 - 401	0.94
600 - 601	0.94
800 - 801	0.94
1000 - 1001	0.94
1200 - 1201	0.94
1400 - 1401	0.94
1600 - 1601	0.95



Expected Radionuclide	Gamma Energy (keV)
^{228}Ac	338
	911
	969
^{208}Tl	84.4
^{224}Ra	241
^{212}Pb	239
	300
	40
^{212}Bi	727
	1621
	277
	511
^{212}Tl	583
	860
	2615

(a) (b)

Fig.3. (a) Linearity Confirmation (b) Expected Radionuclides from Thorium Decay Series

4. Conclusion

The gamma emissions were observed at ^{212}Pb (239 keV), ^{228}Ac (338 keV), ^{208}Tl (583 keV), ^{228}Ac (911 keV) and ^{40}K (1460 keV). With high resolution detector, such as HpGe, more gamma emissions were expected to be observed. Background subtracted spectrum of sand sample is presented in Fig.4.

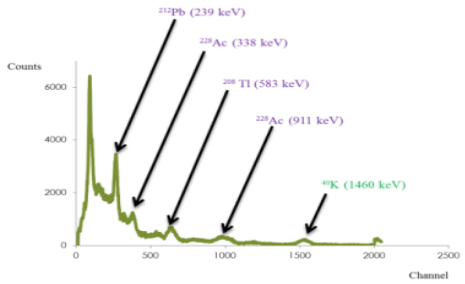


Fig.4. Background Subtracted Spectrum of Sand Sample

Acknowledgements

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