IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 8, Issue 3 Ver. II (May. - Jun. 2016), PP 78-81
www.iosrjournals.org

Radiological Impact Assessment Due to Radioactivity Levels in Port Said Government, Egypt

Kh. A. Allam[1], O. Haggag[2], M. Tahawy[1] and Abd El Raoff[2]
[1] *Nuclear and Radiological Regulatory Authority, Egypt*
[2]*Faculty of science, Port-Said University,, Egypt*

Abstract: *The assessment of radioactivity levels of soils samples from Port Said government in Egypt has been studied. The radioactivity level of 15 samples have been measured with a low-background HpGe and RS-230 detector. The radioactivity concentrations of ^{238}U, ^{232}Th and ^{40}K. In order to evaluate the radiological hazard of the natural radioactivity, the radium equivalent activity Ra_{eq}, the absorbed dose rate D, the annual effective dose rate and the external hazard index (H_{ex}) have been calculated and compared with the internationally approved values. The study provides background radioactivity concentrations in a Port Said government, specifically in the beaches area.*

Keywords: *Natural radioactivity, HPGe detector,Port Said; External hazard index.*

I. Introduction

Natural radioactivity contributes significantly to the radiation doses received by humans. Among the natural radionuclides, 238U, 232Th and 40K make the biggest contribution to the total background dose. It is necessary to monitor release of radioactivity into the environment in order to be able to provide an appropriate protection of humans. The radioactivity of sand is essential for understanding changes in the natural radiation background. Sand contains small quantities of radioactive elements U and Th along with their progeny. The main sources of the external ɣ-radiation are the radionuclides of the ^{238}U and ^{232}Th series and ^{40}K. High levels of the natural radiation near uranium deposits may make living conditions hazardous.

A gamma-ray spectrometer based on high-purity germanium (HpGe) detector was used to determine the concentration of natural radionuclides in samples from Port Said government in Egypt. The annual effective dose rates and the gamma activity concentration index will be evaluated and compared to the average worldwide exposure limits represented in UNSCEAR 2000 and to the dose criteria recommended European Commission (EC, 1999), respectively. In addition, the correlations between Th, U and K will be shown in this paper.

II. Material and Methods

2.1 Sample collection and preparation

In this study, 15 sand samples were collected directly from Port Said government in Egypt as shown in Figure 1 and listed in Table 1. Each sample is sieved and then dried in an oven at 110 ^{o}C for 24h. Then the samples were weighed and packed in Marinelli-type beaker (100 and 1000 CC capacities according to the available sample amounts) to be analyzed using gamma spectrometers. Samples were carefully sealed and stored for more than 4 weeks for secular equilibrium. The samples were analyzed in the geometries used during the procedure of efficiency determination.

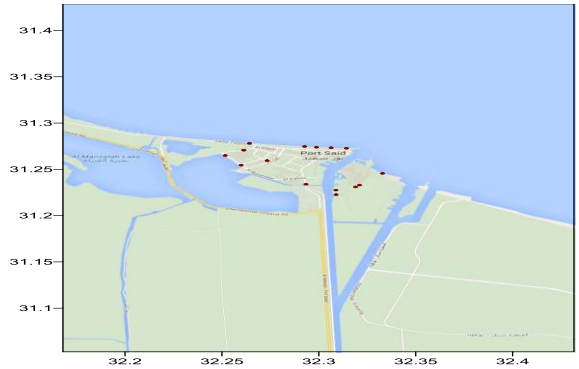

Figure 1: Sampling locations

2.2 Calibration and measurements by gamma ray spectrometry

The gamma ray spectra of the prepared samples were measured for at least 82,000 s using a typical high resolution gamma spectrometer based on a coaxial type shielded HpGe detector, with a relative photo peak

efficiency of 35% and energy resolution of 1.9 keV full width at half maximum for the 1332 keV gamma ray line of 60Co. The spectrum was collected and analyzed using computer software called Genie 2000 software made by Canberra Industries Inc, USA. The activity of ^{40}K was measured directly via its 1461 (10.7%) keV peak of the gamma ray spectra. To determine the activity concentration of ^{226}Ra, the average value of gamma ray lines 295.1 (19.2%) and 351.9 (37.1%) keV from ^{214}Pb to 609.3 (46.1%) and 1764.5 (15.9%) keV gamma rays from ^{214}Bi are used. Activity concentration of ^{232}Th is determined using the average value of gamma ray lines 238.6 (43.6%) keV from ^{212}Pb, 338.4 (12%), 911.1 (29%) and 968.9 (17.4%) keV from ^{228}Ac, 583.1 (86%) and 2614 keV from ^{208}Tl. The detector was calibrated for the efficiency using 226Ra point source to first produce a relative efficiency curve followed by standardization using KCl as a standard solution (Farouk and Al Soraya, 1980). [1]

Quality control and quality assurance of the measurements using International Atomic Energy Agency (IAEA) reference materials (Soil6, IAEA-326). In addition, duplicate samples were added to insure the analyses consistency of the measurements. Blank samples were added to eliminate the cross-contamination occurrence in the samples.

III. Results and Discussion

3.1 Specific radioactivity

The distribution of natural radionuclides in sand samples is presented in Table 1. The activity concentrations of ^{238}U ranged from <D.L. to 12.85 Bq/kg. From the 15 samples measured studied. In this work, the maximum activity value of ^{238}U was in the sample (2) 12.85 Bq/kg and the minimum value was in the sample (4) <D.L. Bq/kg. While for ^{232}Th the maximum level was observed in sample (2) 16.37 Bq/kg and the minimum level in sample (12) 1.93 Bq/kg. The value of ^{40}K ranged from <D.L. Bq/kg in the samples (4 and 5) to 400.32 Bq/kg in the sample (3) as shown in [Table 1].

Table 1: Sample specific activity

Code	^{238}U	^{232}Th	^{40}K
1	12.8±0.2	15.6±0.9	188.3±2.2
2	12.9±0.2	16.4±0.9	215.0±4.5
3	4.9±0.5	5.9±0.5	400.3±10.6
4	<D.L	2.2±1.3	<D.L
5	7.8±0.7	6.4±0.8	<D.L
6	8.5±0.7	7.5±0.7	193.6±4.6
7	9.1±0.7	3.7±1.0	226.0±8.1
8	9.1±0.4	10.6±1.2	226.0±3.6
9	9.3±0.4	9.1±1.0	219.7±5.0
10	8.1±0.4	7.72±1.05	226.04±5.12
11	8.95±0.58	6.36±0.64	226.03±8.14
12	3.24±1.02	1.93±0.54	181.86±8.45
13	10.88±0.93	9.81±1.20	308.23±6.39
14	7.00±1.04	7.43±0.87	267.85±5.39
15	4.00±0.20	5.00±0.30	111.00±2.30

3.2 Internal hazard index (Hint)

Inhalation of alpha particles emitted from the short-lived radionuclides (radon ^{222}Rn, the daughter product of ^{226}Ra) and thoron (^{220}Rn, the daughter product of ^{224}Ra) is also hazardous to the respiratory organs. This hazard can be controlled by the internal hazard index (H_{int}), which is given by the following Eq.

$$H_{int} = \frac{A_{Ra}}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad (1)$$

3.3 External hazard index (Hext)

Some authors proposed a model for a room in the house where the inhabitants live with infinitely thick walls without windows and doors and calculated H_{ext} using the following relation (Model I)

$$H_{ext} = \frac{A_{Ra}}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad (2)$$

Other authors modified such model to a room with windows and doors and calculated H_{ext} using the following equation (Model II)

$$H_{int} = \frac{A_{Ra}}{740} + \frac{A_{Th}}{518} + \frac{A_K}{9620} \leq 1 \quad (3)$$

3.4 External (ɣ-radioactivity) level index Iɣ

This index is also known as the representative level index and was calculated from the following relation

$$I_\gamma = \frac{A_{Ra}}{300} + \frac{A_{Th}}{200} + \frac{A_K}{3000} \leq 1 \quad (4)$$

3.5 Internal (α-radioactivity) level index Iα

The excess alpha radiation due to radon inhalation originating from building materials is estimated using the relation below

$$I_\alpha = \frac{A_{Ra}}{200} \leq 1 \quad (5)$$

I_α should be lower than the maximum permissible value of $I_\alpha = 1$, which corresponds to 200 Bq kg^{-1}. For alpha radiation and taking into consideration that a building material with Ra concentration lower than 200 Bq kg^{-1} could not cause indoor radon concentration higher than 200 Bq m^{-3}.

3.6 Figures and Tables

Place illustrations (figures, tables, drawings, and photographs) throughout the paper at the places where they are first discussed in the text, rather than at the end of the paper. Number illustrations sequentially (but number tables separately). Place the illustration numbers and caption under the illustration in 10 pt font. Do not allow illustrations to extend into the margins or the gap between columns (except 2-column illustrations may cross the gap). If your figure has two parts, include the labels "(a)" and "(b)".

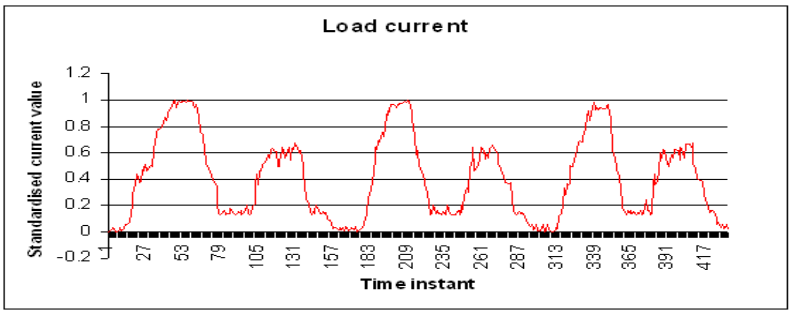

Figure 1: Testing data- load current (amperes)

3.7 Tables

Place table titles above the tables.

Table 1: Margin specifications

Margin	A4 Paper	US Letter Paper
Left	18.5 mm	14.5 mm (0.58 in)
Right	18mm	13 mm (0.51 in)

3.8 Sections Headings

Section headings come in several varieties:

1. first level headings: 1. Heading 1
2. second level: 1.2. Heading 2
3. third level: 1.2.3 Heading 3
4. forth level: (a) Heading 4
5. fifth level: (1) Heading 5

3.9 References

Number citations consecutively in square brackets [1]. The sentence punctuation follows the brackets [2]. Multiple references [2], [3] are each numbered with separate brackets [1]–[3]. Please note that the references at the end of this document are in the preferred referencing style. Please ensure that the provided references are complete with all the details and also cited inside the manuscript (example: page numbers, year of publication, publisher's name etc.).

IV. Conclusions

Exploitation of high-resolution□ □ □ray spectroscopy provides a sensitive experimental tool in studying natural radioactivity and determining elemental concentrations and dose rates in various and samples .All of the samples studied in this work reve allow values for the activity and elemental concentrations of Th, U and K, thus

contributing to the low- absorbed dose rates in the air. In general, the extracted values are distinctly lower than the corresponding population -weighted (world averaged) ones, they lie outside the typical range variability of reported values from world-wide areas due to terrestrial gamma radiation, given in the recent UNSCEAR 2008 Report. [11]

References

[1]. Farouk M A , Al-Soraya A M. 226Ra as a standard source for efficiency calibration of Ge (Li) detector. Nucl Inst Methods 1982; 200: 593-5.

[2]. Tzortzis M, Tsertos H, Christofide S, Christodoulides G. Gamma-ray measurements of naturally occurringradioactive samples from cyprus characteristic geological rocks. Preprint UCY-PHY-02/02 (physics/0212099). RadiatMeas 2003. [In press].

[3]. Beretka J, Matthew PJ. Natural radioactivity of Australian building materials, industrial wastes and by-products. Health Phys 1985;48:87-95.

[4]. Krisiuk E M , Tarasov S I , S ha m o v VP , S ha l ak NI , Lisachenko EP, Gomelsky LG. A Study on Radioactivity in Building Materials. Leningrad: Research Institute for Radiation Hygiene; 1971.

[5]. Stranden E. Some aspects on radioactivity of building materials. Phys Norv 1976;8:167-73.

[6]. Nuclear Energy Agency (NEA). Exposure to radiation from the natural radioactivity in building materials. Report by NEA Group of Experts, OECD, Paris; 1979.

[7]. Kohshi C, Takao I, Hideo S. Terrestrial gamma radiation in Koshi prefecture, Japan. J Health Sci2001;47:362-72.

[8]. Thomas J, Hulka J, Salava J. New houses with high radiation exposure levels. In: Proceedings of the International Conference on High Levels of Natural Radiation, Ramsar, 1990. Vienna: IAEA; 1993.

[9]. Wrixon AD, Green BM, Lomas PR, Miles JC, Cliff KD, Francis EA, et al. Natural Radiation Exposure in UK Dwellings. NRPB-R190 . London: National Radiological Protection Board; 1988.

[10]. Nordic, Åkerblom G, Mjönes L, Annanmäki M, Magnusson S, Strand T, Ulbak K. Naturally Occurring Radioactivity in the Nordic Countries-Recommendations. The radiation protection authorities in Denmark, Finland, Iceland, Norway and Sweden; 2000.

[11]. UNSCEAR. Sources and Effects of Ionizing Radiation. Report to General Assembly, with Scientific Annexes. New York: United Nations; 2008.