Research Article
Volume 12:9, 2021

Journal of Nuclear Medicine & Radiation Therapy

ISSN: 2155-9619 Open Access

Evaluating the Radiation Dose Hazardous Indexes Using Hpge Detector in Sekota, Ethiopia

Baye Zinabe Kebede*

Department of physics, University of Mekdela Amba, Mekdela Amba, Ethiopia

Abstract

This research paper desired to illustrate the presence of naturally occurring radioactive minerals concentration and the way how naturally occurring radioactive minerals were identified in Wag-himra iron ore deposit soil site. The deposit area covers five Kebelles of the border of Sekota wereda, Ziquale and Abergelle wereda. We were used HPGe detector to identify the presence of natural occurring radioactivity concentration in iron ore/alloy deposit soil, and applied appropriate research methodology particularly experimental design were more preferable. The researcher was collected samples from ten places across iron ore deposit area by using critical sampling techniques and prepared as a desirable manner. The chosen sample was sealed for four weeks in order to obtain secular equilibrium, wherein the rate of decay of the daughters' equivalent that of the parent. Radium equivalent activity, external hazard index and representative gamma index of the sample were 56.19 Bq/kg,0.1515 Bq/kg,0.804 Bq/kg,0.408Bq/kg,0.00011 Bq/kg respectively. However, internal hazard index was slightly approaching to recommended value and it may cause the significant radiation hazard through long dwelling to the area.

Key word: Radiation • Concentration • Hazard index • Radium equivalent • Radionuclide

Introduction

Henri Becquerel discovered radioactivity. It is a process in which an unstable parent nucleus spontaneously transforms into one or more daughter nuclei that are more stable than the parent nucleus due to increased binding energies per nucleon than the parent nucleus. The daughter nucleus may also be unstable, and it would decay further through a chain of radioactive decay until it begins to take nuclear configuration. Radioactive decay is commonly caused by the formation of energetic particles that can be used in science, industry, agriculture, and medicine. There are 2 kinds of radioactive nuclides (radio nuclides): It is a natural occurrence. artificially produced or formed by man . The man-made (artificial) radionuclide are manufactured by bombarding stable or very long-lived nuclides with energetic particles produced by machines of various kinds, whereas the naturally occurring radioactive elements are found by nature on surface of the earth as form of ore and the atmosphere with very long-lived parents that have half-lives of the order of the age of the earth. The term NORM refers to naturally occurring radioactive materials. The majority of NORM contains radionuclides from the so-called long-lived "primordial" decay chains, that result from the decay of U-238, U-235, and Th-232, as well as other long-lived radio nuclides such as K-40. Even though all soils and rocks are naturally radioactive, all ores are just as well. The radio nuclides that occur naturally can be divided into those that occur singly and those that are components of three chains of radioactive elements . The three remaining radioactive element chains and the long-live primordial nuclide 40K make up the majority of the external background radiation dose from radioactivity to which humans are exposed. Of the 22 identified cosmogonic nuclides, only four, 14C, 3H, 22Na, and 7Be, provide any effect on human dose. In nature, 235U and a few other uranium and thorium nuclides fission be it spontaneously or as a result of interactions with neutrons emitted by cosmic rays or other natural sources. The half-life of235U due to spontaneous fission is between 1015 and 1016 years, which means that decay by this process proceeds at a rate less than 10 -7 of that due to an emission. Others of the heavy nuclides undergo spontaneous fission with half-lives that range from 1014 to 1020 years. Many transuranic elements, such as plutonium, neptunium, and americium, which now exist because they have been produced artificially, must have existed in nature at one time, but their half-lives are so short that they disappeared long ago. However, some of the transuranic elements are produced in minute amounts by naturally occurring neutrons that result from cosmic radiation and spontaneous fission of uranium isotopes. Uranium is found in all rocks and soils. The high uranium content of phosphate rocks is reflected in correspondingly high uranium concentrations in commercial phosphate fertilizers. The overall effect of soil development results in the average soil concentration of uranium being less than the average rock

***Address to correspondence:** Baye Zinabe Kebede, Department of physics, University of Mekdela Amba, Mekdela Amba, Ethiopia, Tel: 251922908417; E-mail: bayezinabe82@gmail.com*

Received: 02 August, 2021; **Accepted:** 16 August, 2021; **Published:** 23 August, 2021

concentration. Uranium occurs in traces in many commercial products. Radioactive equilibrium is the term usually used to explain the state when the members of the radioactive series decay at the same rate as they are produced. There are three predominant cases of the state of equilibrium, but for this study the researcher explains only secular equilibrium (Secular Equilibrium; 'Secular equilibrium' is a steady-state condition that in which the half-life of the parent is very much greater than that of the daughter.

Materials and methods

This study was experimental because the major purpose of experimental research focus on cause effect relation between the variables (independent and dependant variable). Experimental research can be qualitative or quantitative. It can be done in lab-setting or field. The study was required all necessary nuclear physics laboratory equipment such as high pure germanium gamma ray spectroscopy, Stainless steel cylindrical sampler,10 cm lead layer shield, High power supply, oven, Polyethylene beaker, Mortar and Pestle (grinder). The sample was drawn from the targeted population by using convenience-sampling technique. Although, non-probability sampling has problems related to selection bias, in small inquiries and researches by individuals, the sampling technique adopted. Thus, smaller chunks of a unit sample were chosen to represent the relevant attributes of the whole of the units. For the purpose of this study only convenience sampling was considered as a sample frame, because convenience sampling is conducted based on the interest me. First, the iron ore deposit soil area was arranging in to ten clusters based on the information of iron ore soil deposition from the whole area and then each cluster was divided in to four units which are apart from meanly 300m in study area. Samples were taken from a depth of 25-30cm after removing the possible contamination on the top surface of undisturbed soil . Therefore, from small chunk unit 500g-1000g sample were pack in a plastic container. Soil samplings were collected from ten specific places of iron ore deposit site at Wag-himra zone, Ethiopia. After completing the collection of samples from each cluster, mix each sample in one polyethylene plastic. Finally, by quartering equally in magnitude in to four then pick one until remaining desired quantity. The sample of soil was dried in at room temperature for five consecutive days and dried by oven with a temperature of 105℃ for 24 hours to ensure that moisture is completely remove and until sample had constant weight. From the selected sample of 1kg soil, the researcher prepared two samples and each sample was measured 500g by digital beam balance. The samples were crush, homogenized, and sieve through a standard 2 mm mesh size, which is the optimum size enrich in heavy minerals. Weight samples researcher was placed in polyethylene beaker, of 300cm3 volume each. The beakers were completely sealed for four weeks to achieve secular equilibrium, which takes place when the rate of decay of the daughters represents that of the parent. This step is necessary to ensure that radon gas confined within the volume and the decay products were also remaining in the sample.

HPGe Gamma Ray Spectroscopy

In this research, analyses of the sample soils were performing with a computer-based gamma-spectrometry system with software of G-2000 for qualitative and quantitative determination of gamma-emitting radionuclide of NORM. The High Purity Germanium (HPGe) detector is coupled to a Multi-Channel Analyzer (MCA), and has cooled with liquid nitrogen (cryostat) to temperature of -196.25◦C to reduce noise and for good resolution. Increased cancer across all of life at a given level of exposure, risk represents the risk of developing cancer over a lifetime. The relative efficiency of the detector is 70% with energy resolution of 1.9 keV at gamma ray energy of 1332 keV γ-emission of Co-60. The measurement of activity concentrations of the radionuclide of 238U, 232Th, 226Ra and 40K in the sample was evaluated by using software associated with the detector of GENIE-2000 software, the gamma ray spectra was analyzing. In all measurement of radiation, the background radiation outside and inside the detector shielding were measured using an empty Marnelle beaker. The activity concentrations of the sample were measured under the same manner as background radiation. This background radiation was subtracting from measured gamma spectrum of the sample before calculating the activity concentration. The two-soil sample each were counted for 10 hours for two consecutive days to get measurable concentration activity because the amplifier must take a longer time to process the signal and develop its linear pulse, or else not all of the incident energy would reflect in that pulse. The major objective of this study was an estimation of naturally occurring radionuclide mineral concentration and radiation in soil sample of Wag-himra iron ore deposit area. In order to achieve/evaluated those mentioned objectives of the study, a different technique has been applied. For instance, soil samples were sealed 4 weeks in plastic beaker and finally by using high pure germanium (HPGe) detector the concentration of NORM were analyzed.

Result and Discussion

We have discussed the result of gamma radiation level index and excess lifetime cancer risk, external and internal radiation hazard index. The composite samples prepared from the ten soil samples collected from the wag-himra iron ore deposit area were assigned with the sample codes S1 and S2 but the result of the two were the same. The study was also focused the radiation index with radium equivalent activity.

It shows soil sample result of radium equivalent activity (Ra□), external hazard index (H□□), internal hazard index (H□□) and γ-level index, and were less than the limited value from recommended one. From the assessment soil sample of iron ore deposit area in Wag-himra an internal hazard index value was slightly near to limited value recommended .

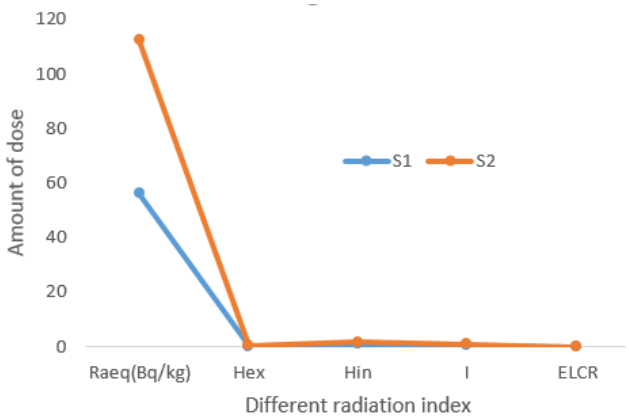

Figure 1. Radiation dose for different radiation index. .

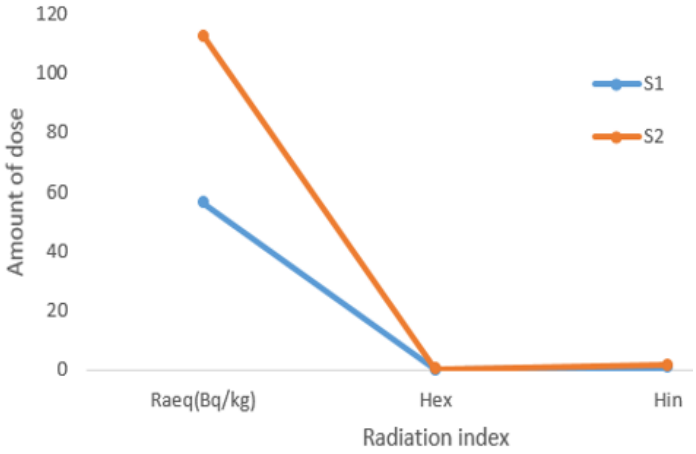

Figure 2. Radium equivalent, external and internal hazarded index.

Conclusions

This work considered the estimation of the level of NORMs and associated radiological hazards and risks of iron ore deposited area in Wag-himra, Ethiopia. This study NORM was analysis from sample of soil from at mineral/iron ore deposit area.

The NORMs identified in the samples were 238U, 232Th and 40K. The average radium equivalent activity values for the soil were 56.19 Bq/kg, which was below the internationally accepted value of 370 Bq/kg. In addition to this, the average external and gamma index were below the internationally accepted value of unity. Internal hazard index of the sample soil was slightly near to the international accepted value of unit. The recommendation proposed for all building materials must have external hazard, internal hazard and gamma indices would be less than or equal to unity. Therefore, the soil from the study area can be used for construction purposes without causing any significant radiological hazards to humans for the time being. In generally, the study area is enriching with mineral. So, the risk factor and significant harm of activity concentration may increase through long live and due to extraction if it is performed.

References

1. Podgorsak, Ervin B. Radiation physics for medical physicists. Berlin: Springer, 2006.
2. Eisenbud, Merrill, and Thomas F. Gesell. Environmental radioactivity from natural, industrial and military sources: from natural, industrial and military sources. Elsevier, 1997.
3. Ayham, Abdul-Jabbar A, S Awatif, and H Asia. "Determination of natural radioactivity by gamma spectroscopy in Balad soil, Iraq." Advances in Applied Science Research 7 (2016): 35-41.
4. Derib, Belete. "Evaluation, Characterization and management of Naturally Occurring Radioactive Materials and disused radioactive waste in Water and Soil Samples." PhD diss., Master's Thesis, Addis Ababa University, Institute of Technology, 2017.
5. Beretka, J, and P J Matthew. "Natural radioactivity of Australian building materials, industrial wastes and by-products." Health physics 48 (1985): 87-95.

How to cite this article: Kebede Baye Zinabe. "Evaluating the Radiation Dose Hazardous Indexes Using Hpge Detector in Sekota, Ethiopia." *J Nucl Med Radiat Ther,* 12 (2021) : 1