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Determination of Radionuclides in Building Blocks Made in Kaduna Metropolis

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ABSTRACT

Ten samples of building blocks were collected from different block making industries in Kaduna metropolis. The radioactivity concentration of the natural radionuclide in the samples were determined by gamma-ray spectrometry with a NaI(Tl) detector. The radioactivity concentration varied from(6.27±0.1473 to 51.14±0.372) x 10^{-3} mSv, (0.55±0.01734 to 1.64±0.1216) x 10^{-3} mSv and (2.04±0.057 to 5.56±0.0741) x 10^{-3} mSv for ^{40}k, ^{226}Ra and ^{232}Th respectively. The result obtained fall within the limit of the international standards for building materials. This indicates that the blocks made in Kaduna metropolis are radiologically safe for building.

Keyword: *Radionuclide's ,Building block, Kaduna.*

1. INTRODUCTION

Naturally occurring radioactive materials (NORM) generally contain radionuclide's found in nature, such as radium, thorium, uranium, e.t.c. Once this NORM becomes concentrated through human activity, such as mineral extraction or oil production, it can become a radioactive contamination hazard or a radioactive waste.

The two types of Norm material are discrete and diffuse. The discrete NORM, has relatively high radioactivity concentration in a very small volume, such as a radium source used in medical procedures or level gauges. Because of its relatively high concentration of radioactivity, this type of NORM poses a direct radiation exposure hazard. The diffuse NORM, has a much lower concentration of radioactivity, but is spread out over a large volume of material, such as contaminated soil. Diffuse NORM poses a different type of problem because of its high volume and low concentration of radioactive material. The following are six (6) source of diffuse NORM: metal mining and processing Waste, Coal Ash, Phosphate Waste, Uranium Mining Overburden, Oil and Gas Production Wastes and Water Treatment Residues. Diffuse NORM may pose a health hazard because of its many uses. For example, though most metal-mining waste is stored near where it is generated; small amounts have been used as construction backfill and road building materials. It is also used in concrete and wallboard. Coal ash is primarily used as an additive in concrete and backfill. Phosphate waste (slag) from the processing of elemental phosphorous has been used in construction and in paving. Uranium mining waste is the soil and rock that is removed during surface or underground uranium mining. This waste is sometimes used to backfill mined-out areas and to construct roads around the mining site. Oil and gas production may produce radioactive pipe scale (a residue left in pipes from producing oil wells) and sludge that leave sites and equipment contaminated. In the past, some contaminated piping and other organizations for play ground equipment, welding material, fencing; e.t.c. Because this contaminated metal was recycled before it was found to be contaminated. Radiation-contaminated water treatment residue accumulates when radioactive material is filtered out of drinking water during the purifying process. This waste may be disposed of in landfills or lagoons. It may also be used in agriculture as soil conditioner. There is increasing evidence that improper use or disposal of such naturally-occurring radioactive materials can result in significant contamination of the environment and elevated radiation exposure. This can adversely affect the health of those occupationally exposed, as well as the general public.

2. MATERIALS AND METHOD

2.1 Method of Making Building Blocks

The materials for making blocks are cement, sand and water sand is referred to as aggregate.

The cement was mixed with sand and some amount of water was added to make a reaction (not too watering). The type of block mixed can be expressed as 1:2 which means 1 part cement and 2 parts sand. To make a good block one should ensured that the materials are measured accurately. The cement and sand were mixed till completely blended, a crater was made in the middle of the pile and half the measured amount of water was poured. The side of pile was raked up and into the water. When all the water was absorbed, a new crater was made and the rest of the water was added to it (not too watery). The mould of a power machine was filled and a compaction was used to bring the compacting head to a stop. The removal of the mould were done carefully to avoid the damage of the fresh block.

2.2 Sample Collection

Ten (10) samples of block were collected at random from some block making industries in Kaduna metropolis. The industries from which the samples were collected are listed in.

Table 2.1 Name and Address of Sample collected

SAMPLE NO	NAME OF INDUSTRY	ADDRESS
BS 1	Hunkuyi Block Industry	Amingo By Nnamdi Azikiwe Way S/Gari T/Wada Kaduna. Kaduna South, Kaduuna
BS 2	Dutsin Bula Block Industry	Abattoir, Kabala West, Igabi, Kaduna
BS 3	Hamisu Block industry	U/Sunusi , Kaduna South, Kaduna.
BS 4	Godiya Block Industry	Nassarawa Bye – pass, Kaduna South, Kaduna.
BS 5	Divine Providence Block Industry	Peugeot Junction U/Romi Bye – Pass Kaduna South, Kaduna.
BS 6	Barnawa Blocks Industry	Danwai Road, Barnawa, K/South, Kaduna.
BS 7	Olusco Block Industry	Constitution Road, Opposite Police Barrack Kaduna North ,Kaduna.
BS 8	Yan Tumaki Block Industry	3 Yan Tumaki Close U/Dosa Kaduna North, Kaduna.
BS 9	Alh Bello Blocks Industry	Kurmin Marshi By – Pass, Kaduna Igabi Kaduna.
BS 10	Ibrahim and Haruna Block industry	Hayin Dan Bushiya Chukum, Kaduna.

2.3 Sample Preparation

The collected samples (i.e. soil or sediment) brought into the laboratory were left open (if wet) for a minimum of 24hrs to dry under ambient temperature. They were ground into a fine powder with the use of a table ceramic mortar and pistil and then a pulverizer. The process was followed by packaging into radon impermeable cylindrical plastic containers of height 7cm by 6cm in diameter. This satisfied the selected optimal sample container height (Ibeanu, 1999) i.e the detector geometry. Each container would accommodate approximately 300g of sample. Sample ranges from [50g to 100g]

A 3 – stage sealing system was made for each of the packaging to prevent Ra – 222 from escape. This include, smearing of the inner rims of each container lid with Vaseline, filling the lid assembly gap with candle wax to block the gaps between lid and container and tight – sealing lid – container with a masking adhesive tape. The prepared sample were then stored for a period of about 30 days to allow for radon and its short – lived progenies to reach secular radioactive equilibrium prior to gamma spectroscopy measurements.

3. CHAPTER

3.1 Result and Discussion

The activity concentration of ^{226}Ra, ^{232}Th, and ^{40}K (CRa, CTh and CK contents of the building block samples are presented in table 3a.

Table 3a The activity concentration of ^{226}Ra, ^{232}Th, and ^{40}K

S/N	ID	^{40}K(mSv)X10^{-3}	^{226}RA(mSv)X10^{-3}	^{232}TH(mSv)X10^{-3}
1	Sample 1	9.34±0.2	1.0 ±0.06	3.05 ± 0.097
2	Sample 2	51.14±0.372	1.19 ±0.005	3.44 ±0.1311
3	Sample 3	6.27±0.1473	0.72 ±0.029	2.04 ±0.057
4	Sample 4	15.84±0.3255	0.77 ±0.695	3.44 ±0.0855
5	Sample 5	11.91±0.279	0.83 ±0.1043	2.52 ±0.0741
6	Sample 6	12.02±0.279	0.55 ± 0.01734	2.90 ± 0.097
7	Sample 7	19.40±0.3643	1.64 ±0.1216	4.36 ±0.0855
8	Sample 8	8.83±0.9379	0.70 ±0.926	2.52 ±0.0.114
9	Sample 9	11.66±0.1783	1.09 ±0.029	2.90 ±0.1026
10	Sample 10	6.77±0.2015	1.15 ±0.0753	5.56 ±0.0.741

The above results was compared with the international standard under the radiation hazards stipulated by the US government, it was discovered that, the values are below the international standard of 2-3 mSv per year at sea level for radiation exposure from cosmic rays, natural radio activity in soil and building materials. In particular that of the Radium (226Ra) which is a daughter of ^{238}U and decay series that produces Radon (^{222}Rn) which is a very poisonous gas in the homes as stated in chapter 2 under the radiation in the home.

4. CONCLUSION

Gamma-ray spectrometry definitely appeared to be a useful and sensitive method for obtained information on radionuclide in the environment.

Building block sample from Kaduna Metropolis have been investigated for activity concentration due to ^{40}k, ^{226}Ra and ^{232}Th respectively. The activity concentration of ^{40}k range from (6.27±0.1473 to 51.14±0.372) x 10^{-3} mSv with an average of (15.32±0.3285) x 10^{-3} mSv. The activity concentration of ^{226}Ra range from (0.55±0.01734 to 1.64±0.1216) x 10^{-3} mSv with an average of (0.96±0.0604) x 10^{-3} mSv. The activity concentration of ^{232}Th range from (2.04±0.057 to 5.56±0.0741) x 10^{-3} mSv. The values obtained for all the above naturally occurring Radioactive Materials (NORMS) has been compared with the international standard and was found to be below the recommended limit, showing that the building blocks are safe for use in building.

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