International Journal of Modern Physics and Applications
Vol. 1, No. 4, 2015, pp. 181-185
http://www.aiscience.org/journal/ijmpa

Alpha Radiation and Environmental Safety Case Study: Some Block Industries in Gwagwalada Area Council Abuja, Nigeria

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Abstract

The world today has been experiencing a lot of pollution due mainly to the human activities on the surface of the earth. Such activities include among others burning of fossil fuels, industrial activities, and factory activities etc. These activities in many ways have affected the environment negatively. This paper work, measured the total amount of alpha radiation from block industries in Gwagwalada Area Council of Abuja, this was achieved by using a Gamma Scout (Model GS2 with serial number A20). Measurements were taken by placing the detector at gonad level i.e. 1 metre above the sources of radiation. Four (4) cement Block industries were located, the result obtained showed that location A (Fremo Block Industry, beside Saint Many Hospital Gwagwalada), location B (Danjuma Block Industry opposite Christ Academy Gwagwalada), location C (Bone Block Industry, Old Kutunku), location D (Geoffrey Solid Block, Jeremiah Usani Road Gwagwalada) has a dose rate of 0.000035mSv/hr, 0.000020mSv/hr, 0.000118mSv/hr and 0.00005mSv/hr respectively. The mean dose rate for all the four (4) located block industries was 0.00006mSv/hr, and the mean annual dose rate was 0.lmSv/yr, these values obtained when compared to International Commission on Radiation protection (ICRP) are within the standard limit of l.0mSv/yr, therefore workers and the environment of these block industries are not exposed to high level of radiation.

Keywords

Alpha Radiation, Block Industry, Environmental Safety, Gamma Scout, Gwagwalada, Pollution

Received: July 6, 2015 / Accepted: July 13, 2015 / Published online: July 29, 2015

1. Introduction

Radiation is simply defined as emission of energy from a source and it travels through space and may be able to penetrate various materials. Light, radio, and microwaves are types of radiation called non-ionizing radiation, while alpha, beta and gamma etc are ionizing radiation, (en.m.wiki/radiation)

Alpha particle is a Helium nucleus consisting of two protons and two neutrons. It is about 8000 times heavier than an electron and has double electric charge. Alpha radiation has the following characteristics:

It is not able to penetrate human skin

Alpha emitting materials can be harmful to human if materials are inhaled, swallowed and absorbed through an open wound.

Alpha radiation travels a very short distance through air.

There are various sources of alpha radiation but the main source of the radiation is through alpha decay of heavier atom radioactive nuclei, which includes Uranium, Thorium and Radium. (n.m.wiki/radiation:) http://hsp.org/publicinformation/ate/fqs/radiation/html)

Natural sources of alpha radiation found in the ground

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include rocks, building materials and radon gas. These sources of radiation are known as terrestrial radiation. Cosmic radiation is also another source of alpha radiation our bodies also contain natural radioactive nuclides such as potassium 40.

Cement Block Industries, produces cement blocks used for various constructional purposes. The industry uses cement as its major raw material to produce the blocks. Apart from cement other raw material includes sand, water and gravel. The following are the composition of cement used in production of blocks:

- Lime or calcium Oxide, CaO, from Limestone, calcareous rocks, shell and chalk.
- Silica $Si0_2$ from sand, old bottle, clay and argillaceous rocks.
- Iron $Fe0_2$ from clay, Iron.

Gypsum $CaSo_4$ $2H_2o$ found together with limestone

The natural radioactivity of the raw materials and products of the cement has the following average specific concentration; ^{232}Th, ^{226}Ra, ^{40}K. All sample collected has variation in radioactive elements as follows: 0.6 - 199, 0.6 - 288 and 7 - 79 Bq Kg^{-1} respectively.

(en.m.wiki/radiation:http://hsp.org/publicinformation/ate/fqs/radiation/html).

2. Material and Method

Gwagwalada is one of the six Local Government Area Council of the Federal Capital Territory of Nigeria, located at latitude 8.9366960^o and longitude 7.09248700^o, and has an area of 1043 Km^2 and a population of 157,770 at the 2006 census. There are various human activities in the area, among such activities is production of cement blocks for constructional purposes, such as building houses. Four (4) major block industries were selected in Gwagwalada Area Council of Abuja. They include; Fremo Block Industry, beside Saint Mary hospital Gwagwalada (location A). Danjuma Block Industry, opposite Christ Academy Gwagwalada (Location B). Bone Block Industry, Old Kutunku (Location C). Geoffrey Block industry, along Jeremiah Usani Road Gwagwalada (Location D). The block industries are divided into three (3) sections, production section where the raw materials are mixed in a machine, the second section is the area were the produced blocks are exposed to the sunlight, the last section is the area where blocks are stored for sales and supplies. On an average each blocks industries produces over 2000 blocks of various sizes daily.

The measuring instrument used to detect and estimate the amount of alpha radiation from each of the located block industries was a Gamma-Scout (Model GS2 with Serial Number A20). A Gamma Scout is a radiation detector instrument, which measures various radiations such as X-ray, gamma, alpha and beta radiations. The unit of measurement of the detector is micro sievert per hour (μSv/hr).

The gamma - Scout was placed one meter (lm) above the sources of radiation, it was adjusted to a mode of ($\gamma + \beta$) and the values of measured radiations was recorded after an hour period, the gamma-scout was then readjusted to a mode of ($\gamma + \beta + \alpha$) and the values of radiation was also recorded after another hour period, at the three (3) sections of each block industries.

At the production section, the gamma scout was used to measure radiations during the morning period, at the drying section, the detector was used to measure the radiation during the afternoon period, while at the storage section the detector was used to measure radiation during the evening period of the day.

The total number of days for the measurement of radiation was four (4) days, each day to a block industry. The gamma-scout detection of ($\gamma + \beta$) is G_1 while the gamma-scout detection of ($\gamma + \beta + \alpha$) is G_2, by mathematical operation of subtraction that is:

$$(\gamma + \beta) = G_1 \quad (1)$$

$$(\gamma + \beta + \alpha) = G_2 \quad (2)$$

$$\alpha = (G_2 - G_1)\ \mu Sv/hr \quad (3)$$

3. Result and Discussion

The result obtained were presented in table 1 and table2, the variation in alpha radiation from each divided section of the block industry is represented using a bar chat in figure 1 the mean alpha radiation from each block industries is represented using a bar chat in figure 2.

The block industry in location C has the highest level of alpha radiation due to factors such as, concentration of raw materials during production, and quantities of blocks present at the point when measurement was carried out, so in all the located industries, the higher the blocks and materials used in production of the blocks the higher the level of alpha radiation exposure. In all the four (4) located industries surveyed, the radiation exposure of alpha were 0.000035mSv/hr, 0.000020mSv/hr, 0.000118mSv/hr and 0.00005mSv/hr for block industries A, B, C and D respectively. The mean dose for all the four (4) located points was 0.00006mSv/hr, and the annual dose rate were 0.061mSv/yr, 0.035mSv/yr, 0.207mSv/yr, 0.088mSv/yr for A, B, C, and D respectively, and the mean annual dose was 0.lmSv/yr

Table 1. Data Obtained from the Four Block Industries.

Location		G_1 (µSv/hr)	G_2 (µSv/hr)	$G_2 - G_1 = \alpha$ (µSv/hr)
	MORNING	0.218	0.223	0.005
A	AFTERNOON	0.259	0.346	0.087
	EVENING	0.236	0.246	0.013
	MORNING	0.280	0.299	0.019
B	AFTERNOON	0.304	0.340	0.036
	EVENING	0.240	0.250	0.010
	MORNING	0.200	0.340	0.140
C	AFTERNOON	0.260	0.350	0.090
	EVENING	0.235	0.360	0.125
	MORNING	0.230	0.290	0.060
D	AFTERNOON	0.295	0.360	0.065
	EVENING	0.240	0.260	0.025

Table 2. Mean Value from each of the Block Industries.

Location		α (µSv/hr)	Mean value = $\frac{(Total)}{3}$ (µSv/hr)
	MORNING	0.005	
A	AFTERNOON	0.087	0.035
	EVENING	0.013	
TOTAL		0.105	
	MORNING	0.19	
B	AFTERNOON	0.036	0.020
	EVENING	0.010	
TOTAL		0.065	
	MORNING	0.140	
C	AFTERNOON	0.090	0.118
	EVENING	0.125	
TOTAL		0.125	
	MORNING	0.060	
D	AFTERNOON	0.065	0.050
	EVENING	0.150	
TOTAL		0.150	

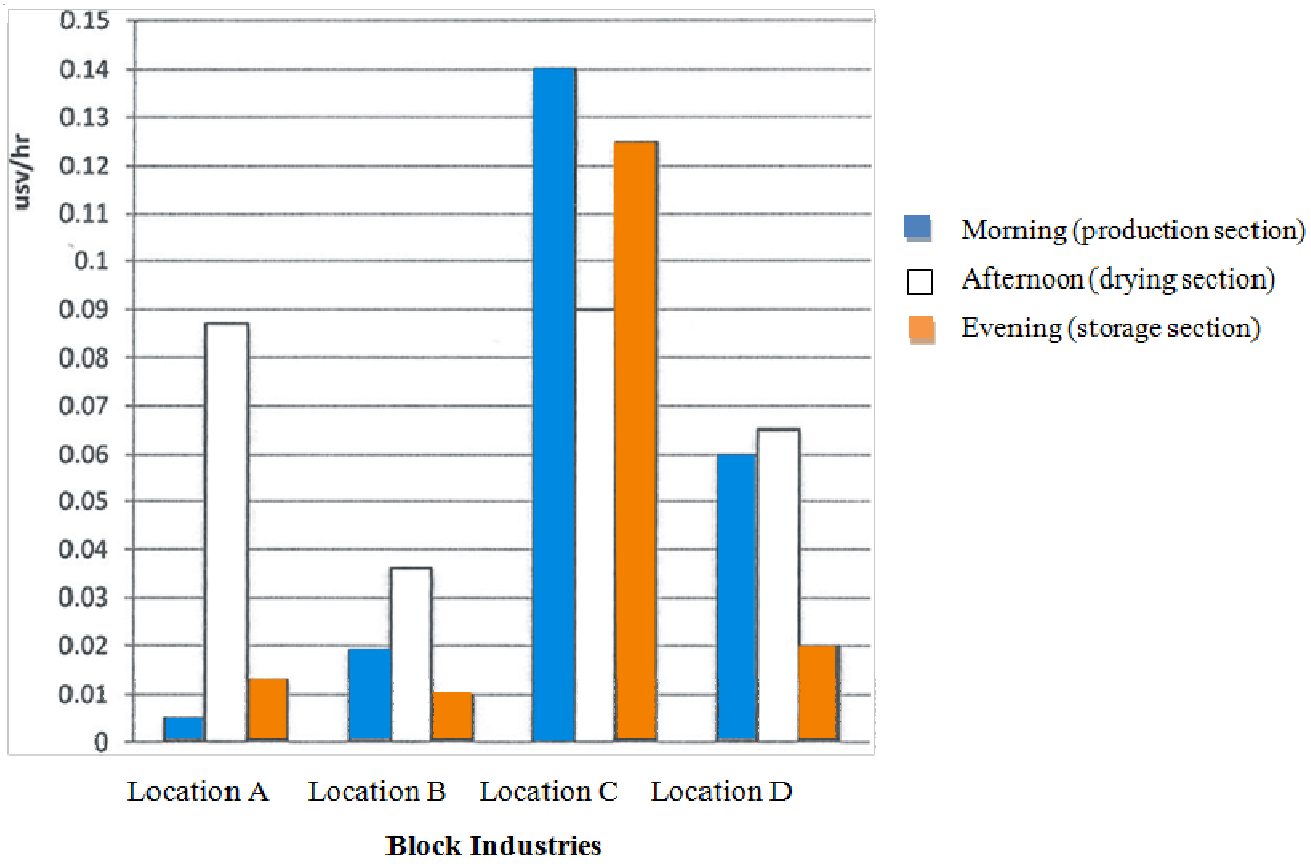
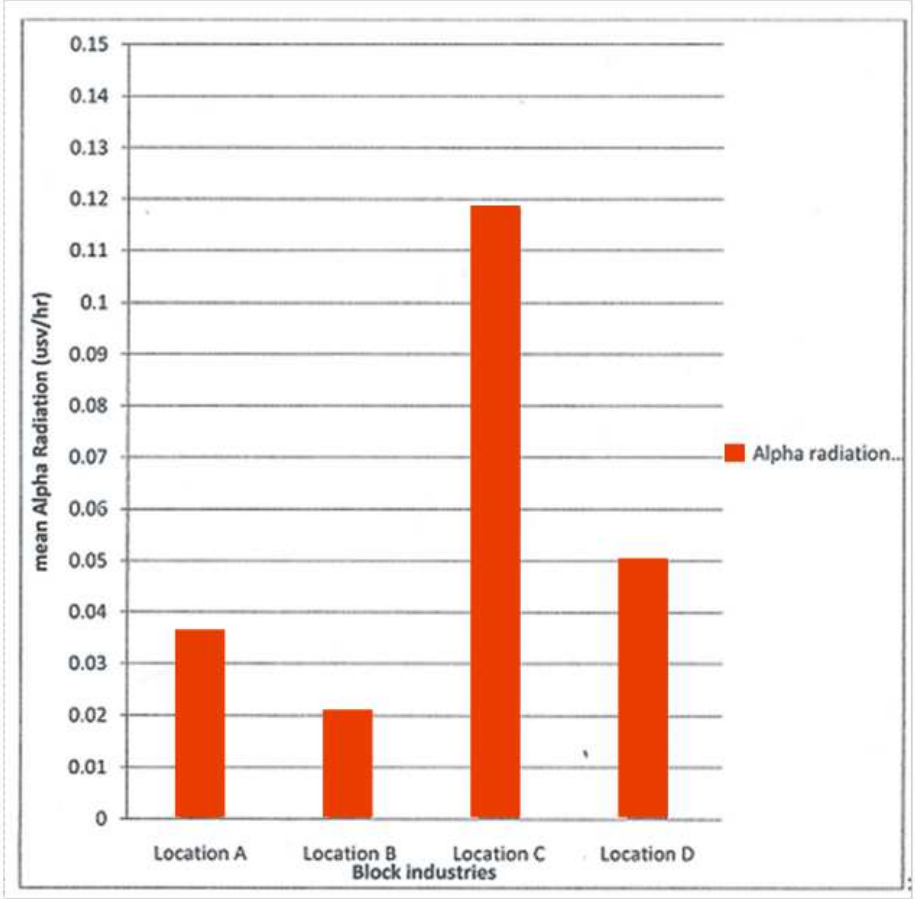


Fig. 1. Alpha Radiation from Each Section of Located Block Industries.



Location A: Fremo Block Industry beside Saint Mary Hospital Gwagwalada.

Location B: Danjuma Block Industry, Opposite Christ Academy Gwagwalada.

Location C: Bone Block Old Kutunku, Gwagwalada.

Location D: Geoffrey Solid Block, Jeremiah Usani Road, Gwagwalada

Fig. 2. Mean Alpha Radiation Daily from each located Block industries.

4. Conclusion

The estimated mean annual dose rate of 0.lmSv/yr, obtained from all the block industries when compared to International Commission on Radiation protection (ICRP) standard of l.0mSv/yr, falls within the limit of acceptable standard for mean annual dose rate, thus the surveyed block industries posed no radiological health hazard to workers and the immediate environment. Further research work on alpha radiation measurement in cement block industries and brick block industries, should be carried out regularly.

References

[1] Ademola JA (2008). Exposure of high background Radiation level in Tin Mining Area of Jos Plateau, Nigeria. Journal of radiological protection, (28): 93 -99.

[2] Ajayi JO, Balogun O, *Olabisi* BB (2012). Natural Radionuclide Cements in Raw materials and. the Aggregate Finished product from Dangote Cement Plc Obajana, Kogi State, North Central Nigeria, Research journal of Environmental and Earth Science 4(iv): 959-961, ISSN; 2041 - 0492.

[3] Augustine KA and Aku MO (2013). Gamma radiation Measurements and dose rates in cements used in Nigeria, Nigeria journal of Physics Vol. 24.

[4] Ezekiel O. Agbalagba, Gregory O. Avwi, Yehuwdah E. Chad Umoren (2013). Gross a and activity concentration and estimation of adults and infants dose intake in surface and ground water of Ten oil fields environment in Western Niger Delta of Nigeria, *www.ajoi.intoa* and www.bioline.org,br/ja J.appl. sci Environ. manage, 17(2): 267 - 277.

[5] Harb S, El Kamel AH, Zahran AM, Abbady A, and Ahmed FA (2014). Assessment of Natural radioactivity in soil and water samples from Adeu Governorate South of Yeman Region International Journal of recent research in physics and chemical sciences. 1(1): 1–7. (www, paper publications.org).

[6] http://hsp.org/publicinformation/ate/fqs/radiation/html

[7] http://rpd.oxfordjournal.org/content7/l- 4/69

[8] http://www.foe.arc.net.aulkoUnlern/ko/mpaper4.html

[9] Inayng SO, Inyang IS and Egbe NO (2009). Radiation exposure level within timber industries in Calabar, Nigeria. *J.* med Phys 24(e): 97-100 dos 10.41031071 - 6203.51937.

[10] James IU, Moses JN, Vand,(2014). Measurement of Gamma radiation in an Automobile Mechanic Village in Abuja, North Central, Nigeria. J. appl. Sci. Environ, Manage. 18(2): 293-298 full text (www.ajol.info and www.bioline.org.br/ja).

[11] Odunaike Rk, Alausa SK, Oyebemjo OA, Ijeoma GC, and Alo AO, (2008). Measurement of radiation level in refuse dumps across Lagos metropolis South Western part of Nigeria *environ* Res J. Z: 174-176.

[12] Olaminye JO, Shanrifat J, Baba-Kutigi AN, Kolo MT, Aladeniyi, K (2010). Measurement of background gamma radiation levels at two tertiary institutions in Minna Nigeriawww. bio 1 ine. org. br/ja; J.applscienuiron:manage. 14(1): 59-62.

[13] Oyeyinka OD, James JU, Akuche EC, Shonowo OA, Adesami CA (2012). Estimation and radiation dose rate level around a nuclear establishment in Abuja, North central, Nigeria Sciences and Tech. 2(6); 163 - 167.

[14] Wanbot DI, Mni- Izam J, Nyam GG, Yusuf M (2014). Indoor and outdoor gamma dose rate exposure level in major commercial building materials distribution outlets in Jos Plateau state Nigeria. Asian review of environmental and earth sciences. 1(1): 3-7.

[15] Wali EJ, Akpan IO (2005). Radiation monitoring along the Creeks of Calabar River and its environ Global Journal of pure and applied sciences. 11 (91): 137-140.

[16] www.engr.psu.edu/ce/courses/ceso4concrete/library/constrtuction/cuning/composition%2007 20cement.html.