IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 10, Issue 1 Ver. II (Jan. – Feb. 2018), PP 71-74
www.iosrjournals.org

Preliminary Investigation of Indoor and Outdoor Radiation Levels Within Federal University of Agriculture Makurdi Main Campus, North Central Nigeria.

Sombo T.[1], Ichaver A.[2] , Isah., O.H[3] and Asagah E[4]
[1-3] Department of Physics Federal University of Agriculture, P.M.B 2373 Makurdi, Benue State - Nigeria.
Corresponding Author: Sombo T.

Abstract: *Environmental radioactivity assessment within Federal University of Agriculture Makurdi for the purpose of asserting the radiation exposure level to staff/students and the potential health hazards associated with such exposures. This was achieved by measuring hourly dose rate at 700 sites each for indoor and outdoor dose rate using a digital halogen – quenched Geiger – Mueller dosimeter (inspector alert SNi 35440). The average measurements were obtained on hourly basis and the mean Annual Indoor and Outdoor Effective Dose Rate (AIEDR and AOEDR) were computed to 0.939 ± 0.20 mSv/yr and 0.0356 ± 0.0356 ± 0.061 mSv/yr respectively. Both dose rates are within the International Commission on Radiation Protection (ICRP), 1990, recommended dose rate limit of 1 mSv/yr for general public and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), (2010) permissible limit of 2.4 µSv/yr. However, the radioactivity dose rate received from indoor environment warrant that environmental radioactivity monitoring should be carried out on continuous bases.*

Keywords: *Background radiation, Absorb dose, Radiation injuries, Radiation Radionuclide, Exposure.*

Date of Submission: 12-02-2018 Date of acceptance: 27-02-2018

I. Introduction

Background radiation originates from the Naturally Occurring Radioactive Materials (NORMs) within the earth crust. These NORMs find their way into the soil, air, water, food and human body through different routes (Oladapo, 2012). The background radiation in a given area is a function of the amount of NORMs available in such an area. Researchers have shown that region of the world such as Asia, China, Iran, India, Kercle and Ramsas are very high background radiation areas (VHBRA's) (Ghiassinejad., et al, 2002). Man's activities in his environment (weapon testing, laboratory activities, refuse dumping etc) have greatly increased the concentrations of the radionuclide. These are technically referred to as Technologically Enhanced Naturally Occurring Radioactive Materials (TENORMS) (Dawdall et al, 2004). The two major contributors to natural radiation exposures are the cosmic radiation from the atmosphere and the primordial radionuclide present in the earth's crust (Sadiq and Agba 2011). The estimated dose contribution to the environment by the International Atomic Energy Agency shows 85% of the background radiation received by man is derived from cosmic rays and nuclear processes (Agba et al., 2006) The exposure rate depends on factors such as latitudes, longitudes, altitude and direction of flight for aircraft crew (Sadiq and Agba,2011). Generally speaking, people working at different places are exposed to enhanced levels of natural radiation at their places of work (UNSCEAR – B, 2000). In VHBRA's, the commonest radioactive by product absorbed is radon gas which contributes the greatest percentage of potentially lethal dose and it has been reported to be the cause of the majority of lung cancer and death (Maria et al., 2010 and Don, 2010). Other radiation related effects include: leukemia, bone neurosis, chromosome aberrations, bone and lung cancer, hematological depression, cataract of the eye etc (Ovwiri and Ononugbo, 2012; Russel and Bradley, 2007; AAPM, 1992). The most feasible way of eliminating or reducing radiation injuries is to protect the public from over exposure to radiations. Unfortunately there is little or no information about the assessment of radiation level from Nigerian Primary, Secondary and tertiary institutions including Federal University of Agriculture Makurdi- Nigeria. This calls for an urgent need for environmental radioactivity assessment with the view of ascertaining the exposure level and the potential hazard to staff and students in the Nigerian institutions so as to proffer ways of avoiding or reducing unnecessary radiation exposures and their associated effects.

II. Materials and Method

The indoor and outdoor radiation levels were measured at 1400 sites (i.e 700 sites each for indoor and outdoor measurements) using Halogen - quenched GM detector (SN I 355440). The detector was held 1 m above ground level during the measurement of hourly dose rate for indoor and outdoor measurements. The mean dose rates were computed using the expression by (Eguda, 2006):

$$C_{av} = \frac{\sum C_i}{n} \tag{1}$$

where C_{av} is average concentration, C_i is the radiation dose rate concentration and n is the number of observations. Annual effective dose rate were computed from the mean dose rate obtained using equations 2 and 3 the result presented on Tables 1 and 2.

$$E_{in}(X) = T \text{ x } A \text{ x } D \text{ x } OFI \tag{2}$$

$$E_{out}(Y) = A \text{ x } D \text{ x } OFD \tag{3}$$

where E_{in} :is annual effective dose for indoor radiation

E_{out} : is annual effective dose for indoor radiation.

T : is the total number of hours in a year (8760).

A: is the corrosion coefficient (0.7).

OFI: is the occupancy factor for indoor radiation = (0.8)

OFO: is occupancy fact for outdoor radiation = 0.2

D = is the mean dose rate µSv/hr.

III. Results and Discussion

Results

The Environmental radiation level corresponding to indoor and outdoor effective dose rates at the selected sites are presented on Tables 1 and Figures 1.

Table 1: Indoor and outdoor hourly radiation level and the corresponding Annual Indoor and Outdoor Effective dose rate (AIEDR) (AOEDR) at the university main campus, south core.

S/No	Name of site	Site code	Mean indoor dose rate (µSv/hr)	Mean outdoor doserate (µSv/hr)	AIEDR	AOEDR		
1	Hostel block A	HA	0.140± 0.02	0.160± 0.03	0.98±0.14	0.029± 0.04		
2	Hostel Block B	HB	0.128± 0.04	0.127± 0.02	0.89±0.28	0.022± 0.04		
3	Hostel Block C	HC	0.133±0.02	0.148± 0.03	0.81±0.14	0.026± 0.06		
4	Academic block A	AA	0.128±0.04	0.142± 0.02	0.18±0.28	0.020± 0.03		
5	Academic block B	AB	0.140±0.03	0.128± 0.03	0.98±0.29	0.023± 0.03		
6	SLT	SL	0.139±0.02	0.144± 0.02	0.97±0.29	0.025± 0.05		
7	ETF	ET	0.128±0.04	0.135± 0.02	0.81±0.28	0.024± 0.04		
8	Convocation square	CS	0.142±0.03	0.134± 0.02	0.99±0.15	0.081±0.14		
9	Mini – market	MM	0.144±0.01	0.140± 0.02	1.01±0.14	0.025±0.04		
10	Multipurpose	MP	0.160± 0.02	0.134± 0.02	1.12± 0.14	0.081±0.14		
	Average		0.138±0.028	0.139±0.023	0.937±0.198	0.0356±0.061		

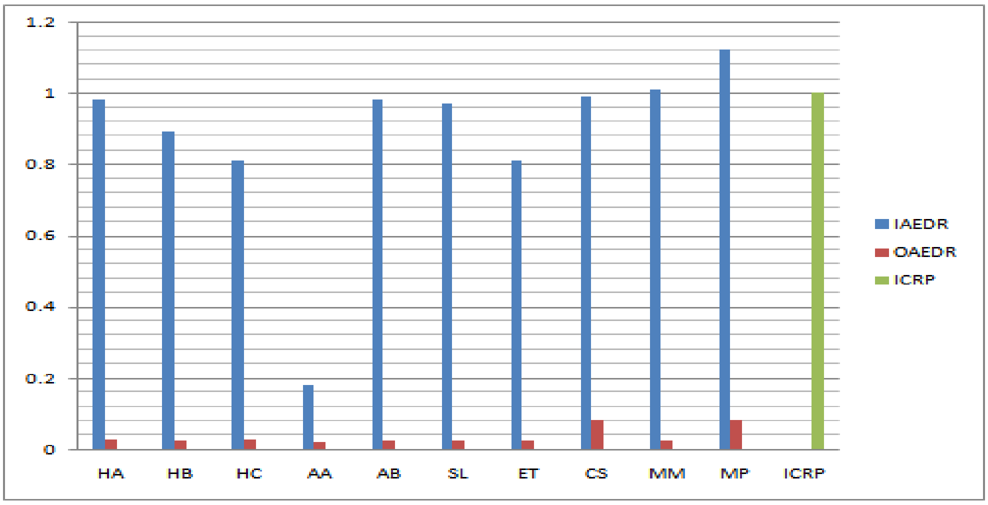

Figure 1: comparison of indoor and outdoor Annual Dose Rate for locations with ICRP at University main campus, south core.

IV. Discussion

The absorbed dose rate of indoor and outdoor sites within Federal University of agriculture Makurdi main campus main campus were measured and the results were obtained as presented in Table 1 and Figure 1. The mean hourly indoor and outdoor absorbed dose rate of 0.138±0.028 mSv/hr and 0.139± 0.23 µSv/hr and the corresponding annual effective indoor and outdoor dose rate (AEDR) were computed to be 0.937±0.198 mSv/yr and 0.0356± 0.061 mSv/yr respectively. These dose rates (i.e AIEDR and OAEDR) below the ICRP (1990) and UNSCEAR (2010). The annual dose rate value below findings of other researchers who measured the annual indoor and outdoor radiation level of some University campus in Nigeria and general background radiation level within North Central Nigerian such as Felix *et al.*,(2015); Nyango (2006); Sadiq *et al.*,(2012) and Termizi *et al.*, (2014) except that the result of Osiga (2014) on the annual indoor and outdoor radiation dose rate Delta State University Campus III, Abraka , Nigeria.The background radiation level in an area is a function of the availability of natural radionuclide within the environment. Granitic rock formations are known to emit high levels of radiation because of the existence of high quantities of radionuclide from uranium and thorium series Jibiril and Farai (2000). Hence, buildings made from such soils/rocks are likely to increase radiation levels with the buildings in addition to radiation emissions from other building materials (Azande *et al.,* 2017).Guma Local Government Area (L G A) shares border with Makurdi L G A and the site of research Federal University of agriculture Makurdi is located at the a border settlement of Ujam community. Recent research by Sombo *et al.*, (2017) on the surface soil radioactivity revealed the existence of uranium – 238, thorium -232 and potassium -40. Thus if during construction of buildings on the University campus sand and rocks were obtained from Guma L G A or if the geographical formation of the campus shares the same features as those Guma L G A then, significant quantity of indoor background radiation will be present within the University campus. The materials used during construction of buildings; research materials in some laboratories and poor ventilation may contribute to the indoor annual radiation dose on the campus. Although, the annual effective dose rate received on the campus is low but its existence (presence) warrants that environmental radiation monitoring should be carried out on a regular bases with the view of ascertaining the level of radiation expose to staff and students on the campus.

V. Conclusion

The results of this research have shown that both indoor and outdoor annual effective radiation dose rate of 0.937±0.198 mSv/yr and 0.0356± 0.061 mSv/yr within Federal University of Agriculture Makurdi main campus main Campus, South core are within the permissible dose rate limit for general public of 1 mSv/yr and 2.4 mSv/yr set by ICRP (1990) and UNSCEAR (2010) respectively. Hence, may not pose significant radiation hazard to the staff and students on the campus.

Acknowledgement

The authors are grateful to the Department of Physics Federal University of Agriculture Makurdi for providing the Digital Halogen – Quenched Geiger-Mueller dosimeter.

References

[1] Agba E.H; Onjefu S.A; and Ugwuaniyi J.U (2006). Preliminary investigation of ambient radiation levels of the mining site in Benue State, Nigeria. Nigeria Journal of Physics 18(2); 219-222.

[2] APPM (1992). Report of the Biological Effects Committee of the American Association of Physicist in Medicine and Biology, published by American Institute of Physics, New York, USA (3rd edition).

[3] Adzande, T.S., Abu, G.O and Sombo, T. (2017). Assessment of Health Hazards of some Building Materials use in Nigeria. Nigerian Journal of Pure and Applied Science. 8:236-241.

[4] Dawdall, M., Vicat, K, Frearso, I, Geland, S., Linda, B., shaw, G., (2004). Assessment of the Radiological Impacts of Historical cral mining operations in the Environment of Ny- Alesund, Svalbard. Journal of Environmental Radioactivity 17, 101-114.

[5] Eguda, S.O. (2006): Elementry Data Analysis, a text book on Statistical Methods. Published by Asofad Printing Limited, 2nd Edition: 9.

[6] Farai, I.P and Jibri, N.N. (2000). Baseline Studies of Terrestrial Outdoor Gamma Dose Rate levels in Nigeria. Radiat, Prot. Dosin 88: 247-254.

[7] Felix, B. M., Robert, R.D, and Emanuel W. M, (2015) Assessment of Indoor and Outdoor Background Radiation Levels in Plateau State University Bokkos Jos, Nigeria Journal of Environment and Earth Science. 5(8):1-4.

[8] Ghiassi-nejad, M., Mortazavi, S.M.J., Cameron, J.R., Niroomand –rad., A, and Karam., P.A, (2002). Very high Background Radiation Areas of Ramsar , Irani Preliminary Biological Studies. Health Physics, 82:87-93

[9] Maria, S. Gael., P.H; Michael, K. Anne, M.T and Bernd, G (2010). Accounting for Smoking in Radon related Lung Cancer Risk among German Uranium miner: Result of nested case control study. Health Physics 98(1) 20-28.

[10] Nyango C.B. (2006). Measurement of Rradiation Dose Rate of University of Jos. Nigerian Journal of Physics 16(1): 76- 78.

[11] Sadiq, A.A.,and Agba, E.H., (2011). Background Radiation in Akwanga, Nigeria. FACTA UNIVERSITATIS, working and living Environmental protection 8, 7-11.

[12] Sadiq, A.A, Agba, E.H, (2012) Indoor and Outdoor Ambient Radiation level in Keffi, Nigeria. FACTA UNIVERSITIES. Working and living environmental protection. 8(1) 19 – 26.

[13] Oladapo, O.O., Oni, F.A., Oluwoyin, A.A., Akerele, O.O and Tijani, S.A (2012). Assessment of Natural Radionuclide level in Wasteland Soil around Olusogun Dumpsite, Lagos –Nigeria. IOSR Journal of Applied Physics 2(1): 38-43.

[14] Ovwiri, G.O and Ononugbo, C.P (2012). Natural Radioactivity level in Surface Soil of Ogba/Egbema/Ndoni oil and gas fields. Energy Science and Technology. 4(2): 92-101.

[15] Russel, K.H and Bradley J.R (2007). Intermediate Physics for Medicine and Biology. 457-463.

[16] Sombo, T., Ayaakaa,D.T and Utah E.U (2016). Assessment of Radioactivity and Health Implications of some Surface Soils in Guma Local Government Area of Benue State North Central Nigeria. Asian Journal of Engineering and Technology. 4(5)

[17] Termizi, R., Aliyu, A.S., Agba., E.H. and Saleh, M.A.(2014) Effective Dose from Natural Background Radiation in Keffi and Akwanga towns, Central Nigeria. International Journal of Radiation Research. 12(1) : 47-52.

[18] UNSCEAR-A, Annex-A (2010). Dose Assessment Meltodiogies. United Nations Scientific Committee on the Efforts of Atomic Radiation Source, and Effects of Ionizing

[19] UNSCEAR-B (2000). Exposure from Natural Radiation Sources. United Nation, Scientific Committee in the Effects of Atomic Radiation.

Sombo T "Preliminary Investigation of Indoor and Outdoor Radiation Levels Within Federal University of Agriculture Makurdi Main Campus, North Central Nigeria.IOSR Journal of Applied Physics (IOSR-JAP) , vol. 10, no. 1, 2018, pp. 71-74.