Advances in Physics Theories and Applications
ISSN 2224-719X (Paper) ISSN 2225-0638 (Online)
Vol.35, 2014

Evaluation of Background Ionization Radiation Level in Some Selected Dumpsites in Delta State, Nigeria

Avwiri Gregory O.[1] Esi Emmanuel O.[2]
1.Department of Physics, University of Port Harcourt, Choba, Rivers State, Nigeria
2.Department of GNS (Physics unit), Delta State School of Marine Technology, Burutu, Delta State, Nigeria
Email: gregory.avwiri@uniport.edu.ng; esiemmanuel@yahoo.com

Abstract
This paper reports on the evaluation of background Ionization radiation level (BIR) in some selected Dumpsites in Uvwie, Udu and Ughelli North Local government area of Delta State, Nigeria. Background ionization radiation measurements were carried out in five Dumpsites. An *in- situ* measurement was done using a well calibrated nuclear radiation meters Radalert-100 and a geographical positioning system (GPS). Readings were taken once in a week for one month in ten different locations within each of the Dumpsites. The mean background Ionization radiation values in all the five Dumpsites ranges from 0.017±0.006mR/hr to 0.018±0.007mR/h. All the background ionization radiation level obtained values exceeded the normal world average BIR level of 0.013mR/h. The mean Absorbed Dose Rate values range from 1.430mSv/y to 1.541mSv/y. The results showed that all the dumpsites yearly absorbed dose rate exceeded the 1.0mSv/y maximum permissible limit recommend for the public and non-nuclear industrial environment by International Council on Radiological Protection (ICRP, 1999). This research work indicated that the Dumpsites environment may have been impacted radiologically. This will pose some long-term health side effects on the workers and residents.
Keywords: Evaluation, Ionization, Radiation, Dose, dumpsites.

1. Introduction

The goal seven of the Millennium Development Goals (MDGs) is to ensure environmental sustainability while the targets are to integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources and to reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss, etc (Vincent, 2012). These targets are far from being achieved owing to the insincerity of the oil companies operating in the Niger Delta region of Nigeria and government which is a major stakeholder in the actualization of the MDGs. The arbitrary and indiscriminate dumping of wastes in dumpsites is conceded to be of a grave health risk to the populace as it cause soil pollution and underground water pollution which can lead to unsustainable and wasteful utilization of resources giving rise to land degradation and threat to human health (Odunaike et al, 2008). It was revealed that staple food stuffs consumed in Nigeria contain traces of radionuclide (Jibiri et al., 2007) and as a result when dump in dumpsites (landfill), the refuse landfills are liable recipients of any such failure in containment of radioactive materials (Farai et al., 2007). It has also been established that vegetation and environmental fields in Nigeria contain traces of radionuclides (Akinloye and Olomo, 2005).

Human activity create wastes and it is the way this waste are collected, handled, stored, and disposed of, that constitute risk to the environment and public health. This has lead to the degradation of abiotic and biotic components of these nation ecological systems. The dumping of large amount of waste materials in sites without adequate soil protection measures results in soil surface and groundwater pollution (Namasivayam et. al., 2001; Avwiri et. al., 2011). Dumpsite contain mixed waste of different sorts ranging from domestic waste, agricultural waste, chemical toxic wastes, hazardous industrial waste, medical waste, metal scraps and other debris. These waste constitute a small fraction of the municipal solid waste (MSW), the potential environmental and health hazards could be deleterious if not properly handled. The disposal of the waste without adequate management, particularly the radioactive contaminants expose the populace to radiation hazard.

Fig. 1.0: Section of Ovwian Dumpsite

Fig. 2.0: Section of Express Road Effurun Dumpsite

Man is continuously exposed to background ionizing radiation emitting from Naturally Occurring Radioactive Materials (NORM) and waste dumpsite. The origin of these radioactive materials is the earth crust, but they find their way into soil, building materials, air, water, food and the human body itself.

The Earth is naturally radioactive, and about 90% of human radiation exposure arises from natural sources such as cosmic radiation, exposure to radon gas and terrestrial radionuclides (Lee et al., 2004). Gamma rays are known to be highly penetrating and are part product of the radioactive materials containing radon gas that may be ingested or inhaled into the human body from waste dumpsites. If inhaled the aerosols containing radon may attach themselves to the lungs where gamma rays emitted in the decay may pose increase risk of lung cancer, eye cataracts and mental imbalances to man. It is important to monitor the terrestrial background ionizing radiation mainly from waste dumpsites.

Researchers have found a strong correlation between radiation exposure and health hazard on man and its environmental ecosystem which are attributed to the domestic waste, agricultural waste, chemical toxic wastes, radiation waste, hazardous industrial waste, medical waste, metal scraps and other debris in waste dumpsites.

Avwiri *et. al.,* (2013) studied the Radiometric Survey of Aluu Landfill, In Rivers State, Nigeria and reported that the mean site radiation levels in all the four cardinal points range from 0.0123± 0.0026 mR/hr (1.034mSv/y) to 0.0151± 0.0012mR/h (1.270mSv/y). The equivalent dose has an average value range of 1.001mSv/y to 1.270mSv/y. They concluded that the radiation levels exceeded the normal background level of 0.013mR/h and equivalent dose is slightly above the recommended dose limit of 1.0mSv/y for the general public. The study indicated that there is no immediate radiological health hazard for the general public, however there may be long-term health challenges.

Olubosede *et. al.,* (2012) studied the assessment of radiation emission from waste dumpsites in Lagos State of Nigeria, and reported that the results obtained revealed that the annual absorbed dose rate measurements taken inside the five dumpsites are 29.80μSvhr^{-1}, 28.05μSvhr^{-1}, 19.29μSvhr$^{-1,}$ 17.53μSvhr^{-1} and 15.78μSvhr^{-1}. They concluded that the radiation values are far lower than the average of 70μSvhr^{-1} recommended by UNESCO on effect of atomic radiation.

Five dumpsites within Uvwie, Udu and Ughelli North Local government area of Delta State, Nigeria were studied. The area lies within latitude $5^0$18"N and $5^0$68"N and longitude $5^0$33"E and $6^0$40"E South-West of Niger delta region of Nigeria. The geology of the study area has been reported earlier (Taiwo and Akalia, 2009). The lithological log correlation showed that the topsoil layer, which is composed of plastic clay, has a thickness ranging from 30ft-35ft, which is capable of protecting the underlain aquifer unit from being contaminated by surface toxic discharge. A silty sand/sandy layer directly underlies this, which form the aquifer unit of the study area. The area under study is a cosmo-political, heavily populated area of Delta State. The dumpsites are located within the communities with a high number of scavengers sources for recycles waste daily. Figure 1 and 2show the dumpsites at Ovwian and Effurun respectively.

The need for precise and accurate information on the background ionization radiation levels of dumpsite and the inadequate data on background radiation levels in this kind of environment lay credence to this study. Further estimate more of the level of degradation of the radioactive equilibrium of the areas and ascertain the radiological health side effects on the populace and the environment were examined.

2. Materials and Methods

2.1 Experimental Method

Well calibrated portable radiation survey meter with serial number 22205 containing a Geiger Muller tube capable of detecting Alpha, Beta, Gamma and X-rays within the temperature range of -10^{o}C to 50^{o}C was used to measure the exposure level in the field. An *in situ* approach of background radiation measurement was preferred and adopted to enable samples maintain their original environmental characteristics. Readings were taken at ten (10) locations in each of the five dumpsites to spatially reflect the sites, while a geographical positioning system (GPS) was used to measure the precise location of sampling. Measurements were taken once weekly in each of the dumpsites for one month and the average values obtained.

Readings were obtained between the hours of 1300 and 1600 hours each day, because the exposure rate meter has a maximum response to environmental radiation within these hours (Louis et al, 2005). The tube of the radiation meter was raised to a height of 1,0m above the ground with its window facing first the Dumpsites and then vertically downward (Avwiri et al., 2007). The detector was switched on to absorb radiation for a few seconds and the highest stable point was recorded. This was converted to annual absorbed dose rate in micro sievert per year (mSvyr-1) (Avwiri and Agbalagba, 2012).

1mRh-1=(0.96x24x365/100)mSvy-1 1

3. Results and Discussion

The results obtained are presented in Tables 1 to 5 and the comparison of the mean BIR and absorbed dose rate compared with standard are shown in figure 3 and 4 respectively

Table 1: Background ionization Radiation at Sapele Road Effurun Dumpsite (BIRSERD)

Location Number	Geographical Location	Background Ionizing Radiation (mR/hr)				Average Radiation value (mR/hr)	Absorbed Dose Rate (mSvy^{-1})
		Week 1	Week 2	Week 3	Week 4		
1	N05^{0}35.691, E005^0 46.644	0.015	0.019	0.013	0.016	0.016±0.002	1.346±0.002
2	N05^{0}35.697, E005^0 46.651	0.022	0.020	0.019	0.020	0.020±0.005	1.682±0.003
3	N05^{0}35.704, E005^0 46.659	0.014	0.016	0.016	0.017	0.016±0.003	1.346±0.002
4	N05^{0}35.710, E005^0 46.661	0.016	0.019	0.017	0.016	0.017±0.003	1.430±0.002
5	N05^{0}35.713, E005^0 46.663	0.014	0.018	0.016	0.015	0.016±0.002	1.346±0.002
6	N05^{0}35.716, E005^0 46.776	0.022	0.018	0.020	0.019	0.020±0.005	1.682±0.004
7	N05^{0}35.719, E005^0 46.682	0.025	0.020	0.018	0.022	0.021±0.006	1.766±0.005
8	N05^{0}35.726, E005^0 46.686	0.018	0.018	0.017	0.019	0.018±0.004	1.514±0.004
9	N05^{0}35.733, E005^0 46.691	0.015	0.016	0.014	0.018	0.016±0.003	1.346±0.002
10	N05^{0}35.746, E005^{0}46.705	0.014	0.017	0.017	0.016	0.016±0.003	1.346±0.002
	Mean	**0.018±0.004**	**0.018±0.004**	**0.017±0.003**	**0.018±0.004**	**0.018±0.004**	**1.514±0.004**
	BIR STANDARD	0.013	0.013	0.013	0.013	0.013	1.00

Table 2.0: Background ionization Radiation at Ohorhe II Effurun Dumpsite (BIROHED)

Location Number	Geographical Location	Background Ionizing Radiation (mR/hr)				Average Radiation value (mR/hr)	Absorbed Dose Rate ($mSvy^{-1}$)
		Week 1	Week 2	Week 3	Week 4		
1	$N05^0$36.754, $E005^0$ 47.754	0.018	0.019	0.019	0.017	0.018±0.005	1.514±0.004
2	$N05^0$36.746, $E005^0$ 47.852	0.017	0.020	0.019	0.018	0.019±0.004	1.599±0.006
3	$N05^0$36.728, $E005^0$ 47.840	0.014	0.014	0.016	0.015	0.015±0.002	1.261±0.002
4	$N05^0$36.722, $E005^0$ 47.830	0.022	0.018	0.025	0.020	0.021±0.006	1.766±0.007
5	$N05^0$36.715, $E005^0$ 47.823	0.018	0.015	0.017	0.018	0.017±0.003	1.430±0.003
6	$N05^0$36.708, $E005^0$ 47.818	0.016	0.018	0.016	0.017	0.017±0.003	1.430±0.003
7	$N05^0$36.645, $E005^0$ 47.815	0.018	0.020	0.019	0.019	0.019±0.005	1.599±0.006
8	$N05^0$36.690, $E005^0$ 47.808	0.016	0.017	0.015	0.016	0.016±0.002	1.346±0.002
9	$N05^0$36.693, $E005^0$ 47.814	0.014	0.014	0.016	0.017	0.015±0.002	1.261±0.001
10	$N05^0$36.714, $E005^0$47.824′	0.015	0.018	0.016	0.017	0.017±0.003	1.430±0.003
	Mean	**0.017±0.003**	**0.017±0.003**	**0.018±0.004**	**0.017±0.003**	**0.017±0.003**	**1.514±0.004**
	BIR STANDARD	0.013	0.013	0.013	0.013	0.013	1.00

Table 3: Background ionization Radiation at Ovwian Dumpsite (BIROVWD)

Location Number	Geographical Location	Background Ionizing Radiation (mR/hr)				Average Radiation value (mR/hr)	Absorbed Dose Rate ($mSvy^{-1}$)
		Week 1	Week 2	Week 3	Week 4		
1	$N05^0$28.606, $E005^0$ 48.312	0.015	0.017	0.016	0.017	0.016±0.002	1.346±0.002
2	$N05^0$28.609, $E005^0$ 48.300	0.019	0.020	0.017	0.016	0.018±0.004	1.514±0.004
3	$N05^0$28.603, $E005^0$ 48.292	0.013	0.015	0.015	0.016	0.015±0.002	1.261±0.001
4	$N05^0$28.632, $E005^0$ 48.285	0.020	0.018	0.018	0.017	0.018±0.004	1.514±0.004
5	$N05^0$28.638, $E005^0$ 48.276	0.017	0.014	0.016	0.015	0.016±0.002	1.346±0.002
6	$N05^0$28.618, $E005^0$ 48.298	0.015	0.015	0.016	0.014	0.015±0.002	1.261±0.001
7	$N05^0$28.606, $E005^0$ 48.308	0.016	0.018	0.018	0.017	0.017±0.003	1.430±0.002
8	$N05^0$28.594, $E005^0$ 48.326	0.018	0.020	0.019	0.020	0.019±0.006	1.599±0.005
9	$N05^0$28.586, $E005^0$ 48.318	0.015	0.017	0.016	0.016	0.016±0.003	1.346±0.002
10	$N05^0$28.577, $E005^0$48.320	0.017	0.017	0.019	0.018	0.018±0.004	1.514±0.004
	Mean	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**1.430±0.002**
	BIR STANDARD	0.013	0.013	0.013	0.013	0.013	1.00

Table 4: Background ionization Radiation at Eruemukohwara-Ughelli Dumpsite (BIRERUD)

Location Number	Geographical Location	Background Ionizing Radiation (mR/hr)				Average Radiation value (mR/hr)	Absorbed Dose Rate ($mSvy^{-1}$)
		Week 1	Week 2	Week 3	Week 4		
1	$N05^0$32.242, $E005^0$ 55.512	0.017	0.017	0.015	0.016	0.016±0.002	1.346±0.002
2	$N05^0$32.250, $E005^0$ 55.520	0.020	0.018	0.019	0.020	0.019±0.006	1.514±0.004
3	$N05^0$32.252, $E005^0$ 55.523	0.014	0.013	0.016	0.014	0.014±0.002	1.177±0.001
4	$N05^0$32.254, $E005^0$ 55.527	0.017	0.016	0.019	0.015	0.017±0.003	1.430±0.003
5	$N05^0$32.256, $E005^0$ 55.531	0.018	0.017	0.017	0.016	0.017±0.003	1.430±0.003
6	$N05^0$32.257, $E005^0$ 55.542	0.016	0.016	0.015	0.017	0.016±0.002	1.346±0.002
7	$N05^0$32.249, $E005^0$ 55.536	0.020	0.020	0.018	0.017	0.019±0.006	1.599±0.005
8	$N05^0$32.244, $E005^0$ 55.525	0.020	0.019	0.020	0.018	0.019±0.006	1.599±0.005
9	$N05^0$32.524′, $E005^0$ 55.52	0.018	0.016	0.016	0.019	0.017±0.003	1.430±0.003
10	$N05^0$32.238, $E005^0$55.496	0.017	0.020	0.019	0.019	0.019±0.006	1.599±0.005
	Mean	**0.018±0.003**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**1.430±0.003**
	BIR STANDARD	0.013	0.013	0.013	0.013	0.013	1.00

Table 5: Background ionization Radiation at Express Road Effurun Dumpsite (BIRERED)

Location Number	Geographical Location	Background Ionizing Radiation (mR/hr)				Average Radiation value (mR/hr)	Absorbed Dose Rate ($mSvy^{-1}$)
		Week 1	Week 2	Week 3	Week 4		
1	$N05^0$34.445, $E005^0$ 44.915	0.016	0.015	0.014	0.015	0.015±0.002	1.261±0.001
2	$N05^0$34.447, $E005^0$ 44.905	0.016	0.017	0.017	0.017	0.017±0.003	1.430±0.003
3	$N05^0$42.469, $E005^0$ 44.935	0.020	0.019	0.020	0.018	0.019±0.005	1.599±0.004
4	$N05^0$34.490, $E005^0$ 44.941	0.016	0.018	0.015	0.017	0.017±0.003	1.430±0.003
5	$N05^0$34.458, $E005^0$ 44.924	0.025	0.019	0.023	0.018	0.021±0.006	1.766±0.006
6	$N05^0$34.456, $E005^0$ 44.930	0.018	0.018	0.016	0.019	0.018±0.004	1.514±0.004
7	$N05^0$34.450, $E005^0$ 44.917	0.014	0.016	0.013	0.015	0.015±0.002	1.261±0.001
8	$N05^0$34.454, $E005^0$ 44.921	0.017	0.018	0.016	0.016	0.017±0.003	1.430±0.003
9	$N05^0$34.483, $E005^0$ 44.937	0.015	0.014	0.016	0.017	0.016±0.002	1.346±0.002
10	$N05^0$34.495, $E005^0$44.946	0.018	0.019	0.016	0.017	0.018±0.004	1.514±0.004
	Mean	**0.018±0.004**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**0.017±0.003**	**1.430±0.003**
	BIR STANDARD	0.013	0.013	0.013	0.013	0.013	1.00

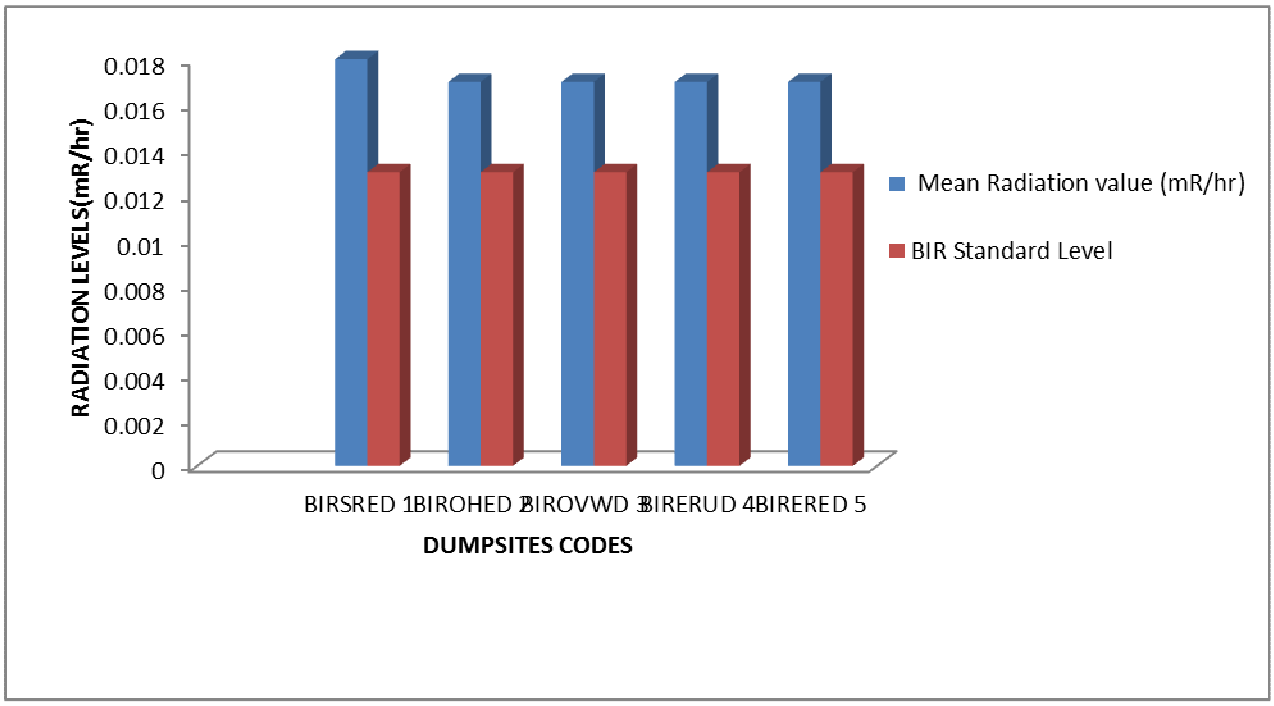

Fig. 3: Comparison of Mean BIR Levels with the Standard BIR Level

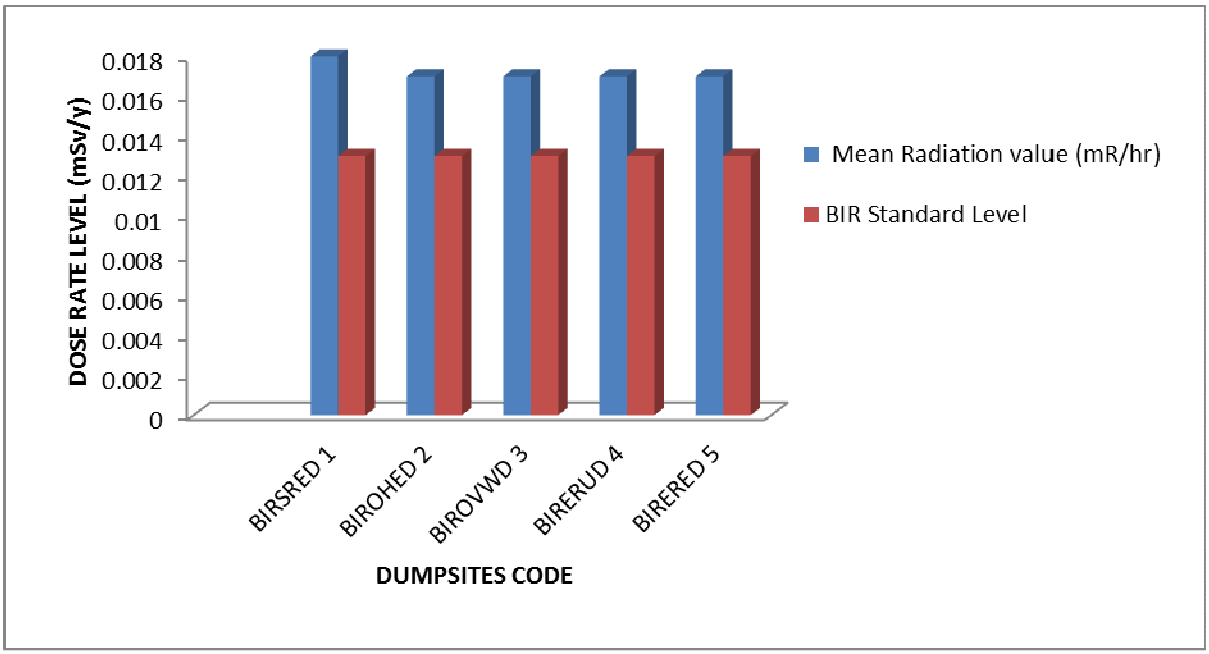

Fig. 4: Comparison of Mean absorbed dose rates with the Standard BIR Level

The background ionization radiation measured at Sapele road Effurun Dumpsite (BIRSERD) environment exposure rate ranged from 0.013mRh^{-1} to 0.025mRh^{-1} with a mean average value of 0.018±0.007mRh^{-1}. The exposure rates of background ionization radiation measured at Ohorhe II Effurun Dumpsite (BIROHED) ranged from 0.014mRh^{-1} to 0.025mRh^{-1} with a mean average value of 0.017±0.006mRh^{-1}. The exposure rate values of background ionization radiation measured at Ovwian Dumpsite (BIROVWD) ranged from 0.013mRh^{-1} to 0.020mRh^{-1} with a mean average value of 0.017±0.006mRh^{-1}. The exposure rates of background ionizing radiation measured at Eruemukohwara-Ughelli Dumpsite (BIRERUD) is not different, its values ranged from 0.013mRh^{-1} to 0.020mRh^{-1} with a mean average value of 0.017±0.006mRh^{-1} while the exposure rate of background ionization radiation measured at Express Road Effurun Dumpsite (BIRERED) ranged from 0.013mRh^{-1} to 0.025mRh^{-1}with a mean average value of 0.017±0.006mRh^{-1}. The values obtained when compared with the global BIR standard of 0.013mRh^{-1} shows that they are slightly higher than the standard. Fig. 3 shows the comparison of mean BIR levels of the all five background ionization radiation measured Dumpsites with the standard BIR level. The mean values obtained in all the sites were higher than the 0.013 mRh^{-1} global BIR levels. The results obtained are well above previously reported values in similar environment by Avwiri, Egieya, and Ononugbo (2013); Olubosede *et. al.,* (2012). But these values reported are below the results reported by Avwiri and Agbalagba (2012); Anekwe, Avwiri and Agbalagba (2013); Laogun *et al*., (2006); Agbalagba *et al*.,(2007) in oil and gas environment of the Niger Delta of Nigeria.

Absorbed dose rate is the measure of the amount of energy (radionuclides) deposited by ionization radiation in the human body for a given period. To avoid any somatic, epidemiological and radiological health side effect, ICRP, 1999 recommended and consequently set the maximum permissible limit for non–radionuclide industrial worker and the public as 1.0mSvy-1. Figure 4 shows the comparison of the mean average absorbed Dose Rate and ICRP, 1999 maximum permissible limit. The computed mean average results of the absorbed dose rate in all the dumpsites with a highest value of 1.541mSvy^{-1} at Sapele Road, Effurun Dumpsite (BIRSERD) and its lowest value of 1.430mSvy^{-1} at Ohorhe II Effurun Dumpsite (BIROHED). When compared with the standard, the obtained results are all higher than dose limit of 1.0mSv/yr for the general public and far lower than dose limit of 20.0mSv/yr. Fig. 4 shows the comparison of the mean average absorbed dose rate of all the five Dumpsites with the maximum permissible limit standard. The high values of both background ionizing radiation and absorbed dose rate obtained at all the dumpsites may be mainly attributed to some medical wastes, chemical wastes and other hazardous materials co-disposed in the dumpsites. This shows that immediate water, soil and underground water sources of the environment may be contaminated due to build up of radionuclide in the atmosphere, precipitation and seepage from the dumpsites Leachate. Therefore, residents, Scavengers and workers in dumpsites areas are exposed to different doses of radiation; these may result to health problems such as radiation poisoning, cancer and cell mutation. This call for a concern and detailed studies of all the dumpsites in Delta State to ascertain the level of radiological impact of the sites workers, communities and the immediate environment.

CONCLUSION

The evaluation of background Ionization radiation level in five dumpsites in Uvwie, Udu and Ughelli North Local government area of Delta State, Nigeria has been carried out. The mean average radiation obtained values in all the dumpsites are higher than the normal background standard of 0.013mR/h. The computed absorbed dose rate obtained results are also higher than dose limit of 1.0mSv/yr for the general public and far lower than dose limit of 20.0mSv/yr for the general public (ICRP, 1999). The results of statistical analysis showed that there is significant difference between the obtained and the computed results and their standards. These reported values may indicate no immediate health hazards, but may cause long-term health hazard to the Dumpsites workers and residents of the host communities due to increase with longer period of operation.

We therefore recommended the following:

- Waste material must be adequately sorted out before disposing into the dumpsites.
- There should be a regular monitoring/inspection of radiation levels in these environments by the government.
- Dumpsite workers should operate shift system.

REFERENCES

Akinloye, M.K. and Olomo, J.B. (2005). The radioactivity in some grasses in the environment of nuclear research facilities located within the OAU, Ile-Ife, Nigeria. *Nig. Jour. of Phy.* 17: 219- 225

Anekwe, U. L., Avwiri, G. O.and Agbalagba, E. O. (2013). Assessment of Gamma-Radiation Levels in Selected Oil Spilled Areas in Rivers State, Nigeria. *Energy Science and Technology* Vol. 5:1 pp. 33-37 DOI:10.3968/j.est.1923847920130501.785.

Avwiri, G. O., Agbalagba, E. O., and Enyinna, P. I. (2007), Terrestrial Radiation Around Oil and Gas Facilities in Ughelli Nigeria. Asian Network for Science Information. Journal. Applied Sci., 7(11), 1543-1546.

Avwiri, G. O., and Agbalagba, E. O. (2012). Studies on the Radiological Impact of Oil and Gas Activities in Oil Mineral Lease 30 (OML3) Oil Fields in Delta State, Nigeria. *J. Pet. Environ Biotechnol*, 3(2), 1- 8.

Avwiri, G.O., Nte, F.U., and Olanrewaju, A.I. (2011). Determination of Radionuclides Concentration of Landfill at Eliozu, Port Harcourt, Rivers State, Nigeria. *Scientia Africana,* Vol. 10 (No.1): 46-57

Farai I.P., Okwunakwe C.E. and Makinde O.S. (2007).Gamma Spectroscopy assay soil samples from waste landfills in Port Harcourt, Nigeria. Proceedings of 16th International Conference on Radionuclide Meteorology in Cape Town. June-July, Elsevier B.V. 850-854.

International Commission on Radiological Protection (ICRP). (1999). The 1995 – 99 recommendation of the International Commission on Radiological Protection Publication 76. Pergamon Press.

Jibiri, N.N., Farai, I.P., and Alausa, S.K. (2007). Activity concentration of Ra-226, Ra- 228 and K-40 in food crops from high background radiation area in Bisichi, Jos, Plateau State, Nigeria. *Radiat. Env. Biophy*. 46: 53 – 59.

Laogun, A. A., Ajayi, N. O., & Agaja, S. A. (2006). Variation in Wellhead Gamma Radiation Levels at the Nigeria Petroleum Development Company Oil Field, Ologbo Ede State, Nigeria. *Nigeria. Journal. Physics*, *18*(1), 135-140.

Lee E.M, Menezes G., and Flinch E.C (2004). Natural radioactivity in building material in the Republic of Ireland. *Health Physics*, 86: 378-388.

Namasivayam C., Radhika R., and Suba S. (2001) ―Uptake of dyes by a promising locally K.S.V., Bapat, V.N., David M. available agricultural solid waste: coir pith‖. Waste Management 21, 381-387.

National Council on Radiation Protection and Measurements (NCRP). (1993). Limitation of Exposure to Ionizing Radiation: NCRP Report No. 116, March

Odunaike R.K., Laoye J.A., Alausa S.K., Ijeoma, G. C., and Adelaja, A.D. (2008). Radiation Emission Characterization of Waste Dumpsites in the City of Ibadan in Oyo State of Nigeria, *Research Journal of Environmental Toxicology* (2) Vol, 2: 100 – 103.

Olubosede. O, Akinnagbe .O.B., and Adekoya O. (2012). Assessment of Radiation Emission from Waste Dumpsites in Lagos State of Nigeria. *International Journal of Computational Engineering Research.* Vol. 2 (3);806-811

Taiwo, B.A, and Akalia, T.C., (2009). Spatial variation in groundwater geochemistry and water quality index in Port Harcourt. Rivers State, Nigeria Scientia Africana 8(1): 134-155

Vincent, N. O. (2012). Sustainable Development and Gas Flaring Activities: a Case Study of Ebedei Area of Ukwuani LGA, Delta State, Nigeria. *Resources and Environment,* 2(4): 169-174 DOI: 10.5923/j.re.20120204.06

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar