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SURVEY OF TERRESTRIAL RADIATION LEVELS OF ONNE SEAPORT, RIVERS STATE, NIGERIA

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ABSTRACT

A terrestrial radiation survey of the Onne seaport in Rivers State of Nigeria has been carried out. The area under study was divided into two locations, and investigated. An insitu measurement approach was adopted using Nuclear Radiation Meter (Radarlerst – 100) and a handheld Global Positioning System (GPS 76 CSX) equipment. Ten (10) readings were taken in each of the two locations making a total of twenty (20) readings in all.The measured average background radiation levels ranges between 0.010mR/hr (0.0045mSv/week) to 0.021 mR/hr (0.00g3mSv/week) in the area. The average dose equivalents obtained for most locations within the study area is above the standard background radiation of 0.013mR/hr (ICRP, 1994) but is within the safe radiation limit of 0.02mSv/week recommended by UNSCEAR, (1998). However, results obtained do not indicate any immediate health side effects on the staff and the host communities (Avwiri et al, 2007) as the highest radiation exposure level of 0.0093m/wk recorded is below the recommended value of 0.2mSv/wk by the Texas Regulation for Control of Radiation and Protection of Public Health. (UNSCEAR, 1998).

Keywords: Terrestrial Radiation, Dose equivalent, Health side effects.

INTRODUCTION

Terrestrial radiation varies from place to place depending upon the variation of radionuclide concentration in soil. (Shanthi et al; 2009). Human beings are exposed outdoors to the natural terrestrial radiation that originates predominantly from the upper 30cm of the soil. (Senthilkumer et al; 2010).Background radiation is the radiation of man's natural environment, consisting of that which comes from cosmic rays, the naturally radioactive elements of the earth and that within the body of living matter (Ballinger, 1991). Over the last three decades, there has been increasing global concern over the public health impacts attributed to radioactivity and environmental degradation. Increasing environmental regulation and more exact standards for the quality of water, air, soil, and food have led to a significant expansion of the environmental monitoring industry throughout the world (Menzies et al. 2002). Consequently, Scientists and Environmental Professionals make critical, objective and what can be considered legally defensible use of analytical data. These data are obtained from sound laboratory and in-situ techniques with adequate understanding of the theory and practice of toxicity testing and proven competence in calculating the risk that a given level of contamination may present to an ecosystem. Apart from this naturally occurring radiation in the atmosphere and terrestrial sources, it has been reported proven that human activities such as those due to the quest for technological advancement and comfort application, have gradually led to the increase of background ionizing radiation and even in some cases, much above recommended tolerable level

(Patel, 1998). The study of these elements and other radioactive elements in the environment is essential because it provides information on health hazards of radiation exposure on both high and very low radiation environment (Ajayi et al; 1995). Some of the companies such as cement factories, pipe coating and vendoring, oil and gas industries, etc are located within our communities and these companies use raw materials that could be radioactive, harmful and dangerous to lives and the environment at large. The onne seaport is an important hub for oil and gas activities and logistics for West and Central Africa. About fifty- five (55) service boats move through the port to service 16 offshore platforms each week. All major oil and gas prospecting companies in the country have their presence in onne Seaport and this lay credence to the study of the background ionization radiation level of the seaport operated by the Nigerian Ports Authority (NPA).

STUDY AREA

Onne seaport, located in Onne Town, Port Harcourt is situated along Bonny Estuary on Ogu creek which is about 25 kilometers South of Port Harcourt, Rivers State of Nigeria. The geographical area of the port spans between NAFCON (now NOTORE) Jetty and Bonny Island at Latitude 4^0 4^1' 6" and longitude 7^0 g^1 4g" E. it spans across three local Government Areas of Rivers State – Eleme, Ogu- Bolo and Bonny respectively (fig.1.1) there are two major terminal facilities – the Federal Ocean Terminal (F0T) and the Federal Lighter Terminal (FLT). The FLT has a total quay length of 1,670 meters with the following operation companies – Addax, Total EPNL, ITS Drilling Services, Tenaris, Titan Tubulars, Delta Environmental, Pipe Coaters, Total Premier, Cameroon valve, Saipem etc. the activities of these companies vary from oil servicing, drilling and waste management services, pipe vendoring, pipe coating etc. and the materials used in operation could contain some radiation. Emitting substance on the other land, the FOT has a total quay length of 750metres with three berths out of the original design of six berths to boost logistics support for the LNG (Liquidfied Natural Gas) and other deep offshore explorations.

Fig. 1.1 Map of Study Area

The berths are Intel's berth 4, 5 and 6 where bulk cargo/ container operations from mining and petrochemical industries within the Niger Delta region and its bordering communities are received. Other companies situated at FOT are Atlas Cement, Adamac, Dangote Cement, Tonimas, NPA fire Service, West Atlantic shipyard, sahara, Arkleen Oil and gas, West African Container terminal.

LITERATURE REVIEW

Previous researches have shown that industrial activities have the potential of raising the background ionization. in an environment. Foland et al. (1995) reported that human activities that have led to the depletion of the ozone layer increated the cosmic rays reaching the earth's surface thereby affecting the background radiation. Avwiri and Ebeniro (1998) studied the external environmental radiation in an industrial area of Rivers state. They reported an average of 0.014mR/hr of background radiation. The results indicated significant elevation from the standard background radiation of 0.013mR/hr Nwankwo and Akoshile (2005) monitored the external background radiation level in Asa Dam industrial area of Ilorin, Kwara State, Nigeria. The obtained background radiation level of the studied area was above the recommend standard external radiation level by the US Nuclear Regulation Commission (CFR, 1979). Avwiri et al; (2007) carried out terrestrial radiation survey around oil and gas facilities in

Ughelli, Nigeria and found out that though the dose equivalent is within the safe radiation limit of 0.02mSv/week recommended by UNSCEAR (1998), the radiation levels within the facilities are far above the normal background levels. Chukwocha et al; (200g) carried out the radiation monitoring facilities in some oil wells in Bayelsa and Rivers State. The computed exposure rates were found to be slightly above the standard background radiation and very much below the ICRP (1990) recommended permissible limit of radiation exposure rate. Avwiri et al. (200g) studied the occupational radiation profile oil and gas facilities during production and off-production periods in ughelli, Nigeria. The result revealed that the background radiation levels of these areas have been affected by oil activity especially during the period of resumption of activities/operations. Although the dose equivalent is still within the safe radiation limit of 200uSv/wl. Recommended by the UNSCEAR, the radiation levels within the oil field and the immediate lost communities are far above the standard background levels.

In view of the potentially dangerous effects of high background values all effort should be geared towards reducing to minimum, all activities capable of elevating the background radiation levels of a particular environment.

MATERIALS AND METHODS

An insitu approach of background radiation measurement was adopted using a digital alert nuclear radiation, monitor and a handheld Geographical positioning System (GPS) for measurement of geographical coordinates of points. For adequate coverage of the study area, ten different points' radiation levels were taken for the two partitioned locations making a total of twenty (20) readings in all. At each point of observation, three readings was taken and an average taken. The digital alert nuclear radiation monitor adopted (Radert-100) is a health and safety instrument that measures alpha. Beta, gamma and X-ray radiation. It uses a Geiger – Muieller Tube (GM) to detect radiation.The tube of the radiation monitoring meter was raised to a standard height of 1.0m above the ground (Ebong and Alagoa, 1992) with its window facing site to be measured and then vertically downward, while the GPS readings taken at that spot.

The GM-tube generates a pulse of electrical current each time radiation passes through the tube and causes ionization (Avwiri et al., 2011). Each pulse is electronically detected and registered as a count. The count rate perminute was converted to milli-roentagen per hour (mRh-1) using the relation:

Count rate perminute = 103mR/hr-1 X Q.F

Where Q.F is the quality factor, which is unity.

The dose equivalents in milli-sieverts per week were obtained using the relation.

mR/hr = 0.445mSv/week.

DATA PRESENTATION

The readings obtained from the two partitioned stations- the Federal Llighter Terminal (FLT) and the Federal Ocean Terminal (FOT) are presented in tables 1 and 2. Tables 3 shows the exposure rate determined for the twenty (20) locations within the study area. Figure 1 shows result of FLT compared with standard background radiation and figure 2 shows results of FOT compared with standard background radiation of the study area.

Table 1. Background radiation count for FLT

S/N	Location's	Geographical coordinates	Radiation Rate in counts per minute			
			1	2	3	Average
1	NPA Administrative Block	No4^0 41 52.7 Eoo7^0 10' 24.5"	107	110	105	107
2	Delta Environmental and Logistics Ltd.	No4^0 42', 51.8" E o7 10' 14.1"	142	145	147	145
3	Pipe Coaters Nig Ltd	No4^0 42' 07.3" Eo7 09' 59.8"	160	180	156	165
4	African Petroleum (AP)	No4^0 42' 25.0" Eo7 09' 55.9"	137	137	139	138
5	Total Premier Service Nig. Ltd	No4^0 41' 47.7' Eo7^0 10' 16.4"	132	140	133	135
6	Titan Tubular	No4^0 41' 54.3" Eo7^0 10' 15.9"	147	146	148	147
7	Tenaris	No4^0 42' 11.6" E07^0 10' 9.8"	146	146	150	147
8	ITS Drilling services	No4^0 42' 04.8' E07^0 10' 16.7"	169	170	166	168
9	Total EPNL	No4^0 41' 50.1" E07^0 10' 04.2"	137	138	140	138
10	Addax Petroleum	No4^0 41' 55.9" Eo7^0 10' 05.8''	127	129	130	129

Table 2. Background of radiation count for FOT

S/N	Location's	Geographical coordinates	Radiation Rate in counts per minute			
			1	2	3	Average
1	Atlas Cement	No4^0 41' 56.7" Eo7 09' 38.6"	127	129	130	129
2	Adamac	No4^0 42', 6.8" E o7 09' .13.7"	136	140	136	137
3	Dangote Cement	No4^0 41 36.8" Eo7^0 09' 20.5''	98	100	96	98
4	NPA fire Service	No4^0 41' 21.9" Eo7^0 09' 14.9"	105	111	102	106
5	Tonimas	No4^0 41' 2.6'' Eo7^0 09' 8.1	110	116	101	109
6	Intel's Berth 4	No4^0 41' 33.6'' Eo7^0 09' 15.9''	206	208	217	210
7	West African Atlentic Shipyard (WAS)	No4^0 41' 40.5" Eo7^0 09' 17.9"	130	180	110	140
8	Sahara /PWSL	No4^0 41 11.4" Eo7^0 09' 6.2"	133	134	138	135
9	Arkleen oil & Gas ltd	No4^0 41 7.1" Eo7^0 09 22.1"	132	133	136	134
10	WACT (West African Container Terminal)	No4^0 40' 31.0" Eo7^0 09' 2.9"	139	142	136	139

RESULT OF FLT COMPARE WITH STANDARD BACKGROUND RADIATION OF STUDY AREA

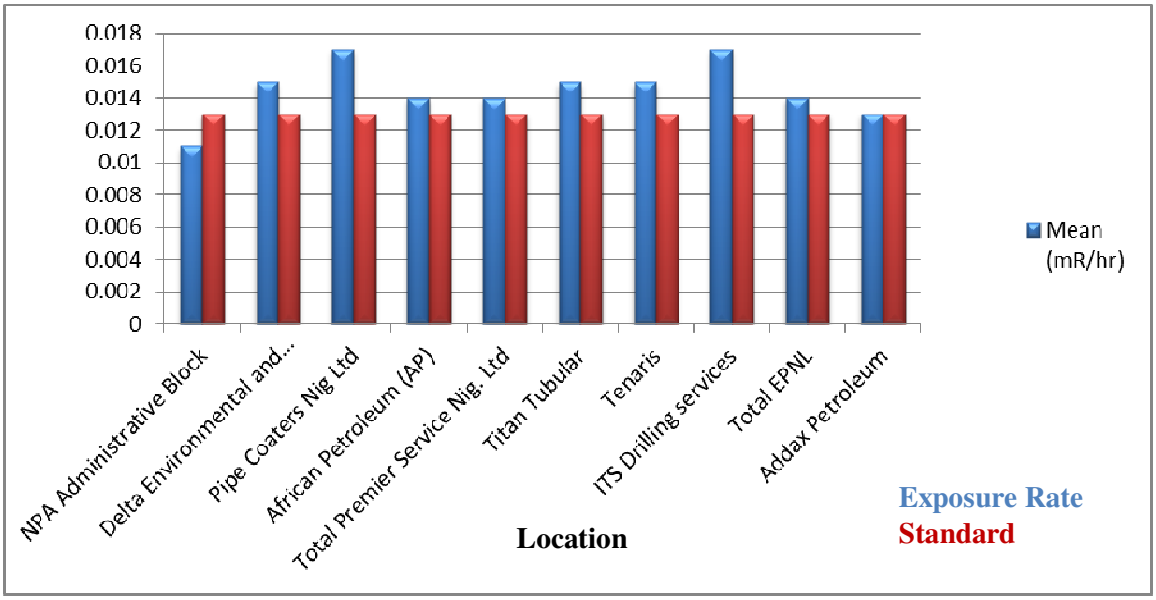

Figure 1: A bar Chart of Count for FLT

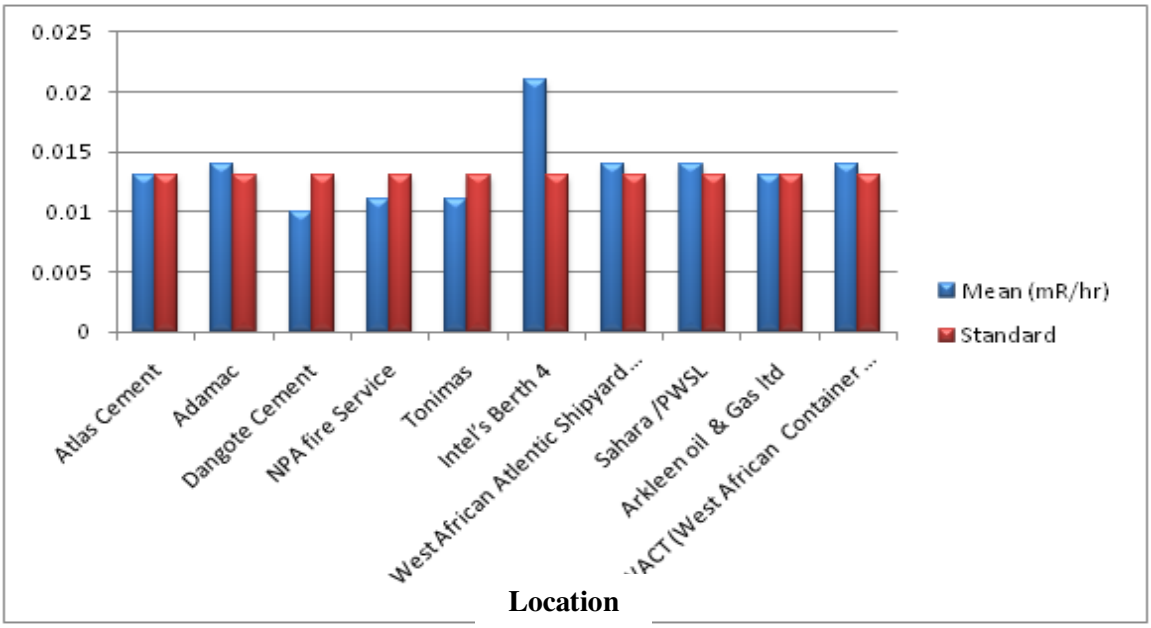

Figure 2. A bar Chart of Count for FLT

DISCUSSION

A survey of terrestrial radiation levels of Onne seaport in Rivers State of Nigeria has been conducted using an insitu method. The results obtained are presented in Tables 1 and 2. The analysis of the results showing the exposure rate and the dose equivalent of the twenty locations in the two portioned major stations are presented in Tables 2 and 3. The results when compared with the standard value of the background ionization radiation level are shown in figures 1 and 2. Table 3 shows a t-test distribution of all the locations indicating that there is no significant difference between the mean exposure rates of the study area to that of the standard background ionization radiation level. Intel's Berth 4 recorded the highest radiation levels of 0.021mR/hr while the least radiation. Levels of 0.010mR/hr were recorded at Dangote Cement Company. The increase in the high value gotten in Intel's Berth 4 can be attributed to the activities going on in the site. Since the port is a gateway through which most companies in Port Harcourt, Aba and South- south receive their raw materials, processing materials and machineries; there could be a buildup of radiation in the environment. On the other hand, the low value obtained at Dangote Cement Company could be attributed to the fact that the company was not in cement production during the time of this study. Its value is much less compared with what was obtained by Avwiri, (2005) when the company was producing. The levels obtained for Atlas Cement also less compared with that of Avwiri, (2005) in his study on the determination of the radionuclide levels in soil and water around cement companies in Port Harcourt..Furthermore, the levels recorded by ITS drilling services limited and Pipe Coaters Nig. Ltd are slightly higher than others. This could be attributed to the fact that the drilling processes used to extract oil from the earth often generate radioactive waste i.e. produced water, drilling mud, sludge, or evaporated ponds and pits containing concentrations of Naturally Occurring Radioactive Material (NORM). it can also concentrate in the mineral scales that form in pipes (pipe scale) storage tanks or other extraction equipment. Also, in heat induced form of coating applied by pipe coaters involves the use of induction coil for heating up the pipes before application of the coating material (fusion bonded

Leena and Luna International, **Oyama, Japan.**

epoxy). This electrodynamics induction energy though non- radioactive but emits some radioactive losses.

Table 3. T-test distribution tables comparing the sample mean and the population mean

S/N	Location's	Mean (mR/hr)	Standard Deviation	M	T	T_{tab}	Remark
1	NPA Administrative Block	0.011	0.0039	0.013	-2.98	2.09	$T<t_{tab}$
2	Delta Environmental and Logistics Ltd.	0.015	0.0008	0.013	11.18	2.09	$T<t_{tab}$
3	Pipe Coaters Nig Ltd	0.017	0.0028	0.013	6.39	2.09	$T<t_{tab}$
4	African Petroleum (AP)	0.014	0	0.013	0	2.09	$T<t_{tab}$
5	Total Premier Service Nig. Ltd	0.014	0.0008	0.013	0	2.09	$T<t_{tab}$
6	Titan Tubular	0.015	0.001	0.013	8.94	2.09	$T<t_{tab}$
7	Tenaris	0.015	0.001	0.013	8.94	2.09	$T<t_{tab}$
8	ITS Drilling services	0.017	0.003	0.013	5.96	2.09	$T<t_{tab}$
9	Total EPNL	0.014	0	0.013	0	2.09	$T<t_{tab}$
10	Addax Petroleum	0.013	0.001	0.013	0	2.09	$T<t_{tab}$
11	Atlas Cement	0.013	0.001	0.013	0	2.09	$T<t_{tab}$
12	Adamac	0.014	0	0.013	0	2.09	$T<t_{tab}$
13	Dangote Cement	0.010	0.004	0.013	-3.35	2.09	$T<t_{tab}$
14	NPA fire Service	0.011	0.0034	0.013	-2.63	2.09	$T<t_{tab}$
15	Tonimas	0.011	0.0031	0.013	-2.89	2.09	$T<t_{tab}$
16	Intel's Berth 4	0.021	0.0073	0.013	4.90	2.09	$T<t_{tab}$
17	West African Atlentic Shipyard (WAS)	0.014	0.0029	0.013	1.54	2.09	$T<t_{tab}$
18	Sahara /PWSL	0.014	0.0008	0.013	0	2.09	$T<t_{tab}$
19	Arkleen oil & Gas ltd	0.013	0.0008	0.013	0	2.09	$T<t_{tab}$
20	WACT (West African Container Terminal)	0.014	0	0.013	0	2.09	$T<t_{tab}$

The highest radiation exposure level of 0.0093mSv/week recorded at Intel's Berth 4 is below the recommended value of 0.2mSv/week by the Texas Regulation for Control of Radiation (above background) and protection of public health RRC, 2007, UNSCEAR, 1998) Above all, these results obtained do not indicate any immediate health side-effects on the staff and the host communities (Avwiri et al; 2007; Avwiri et al., 2011).

CONCLUSION

The terrestrial radiation level of Onne seaport has been studied. The study revealed that the background ionization radiation levels of the area have been altered by the various industrious industrial activities going on in the area. However the result obtained do not indicate any immediate health side effects on the staff and the host communities as the highest radiation exposure level of 0.0093mSv/week recorded is below the recommended value of 0.2mSv/week by the Texas Regulation for control of Radiation and Protection of Public Health (RRC, 2007), (UNSCENT, 1998). But notwithstanding, it is recommended that control mechanism based on sound radiation protection principles should be incorporated into the activities design of the companies to allowed occupational dose level, dose levels to members of the public that approach the area for any form of transaction and as well as to protect the environment.

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