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Survey of Radiation Dose-Rate in Major Dumpsites In Ijebu-Ode And Ijebu-Igbo In Ogun State, Southwestern Zone, Nigeria

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Abstract

The research work is aimed at investigating the radiation dose from two major dumpsites in Ijebu-ode and Ijebu-igbo local government of Ogun State. These major dumpsites are used by companies, residences, schools,e.t.c as their dumpsites. Radioactive materials from the wastes from these users find their ways into the dumpsites. A total of twenty spots were randomly selected at the dump sites and a radiation detector dosimeter Gamma RAE II placed at one meter above the ground level was used for in-situ measurement of the dose rate per spots for a stipulated period of time. Gamma RAE II R uses CsI (TI) as detector. It has in-built daily calibration capacity and factory calibration is not required. Energy range is 0.06MeV-3.0MeV. It's sensitivity is greater than 100 cps per µSv/hr. Dose equivalent range (DER) for ^{137}Cs is 0.01-40µSv/h and accuracy of ±30%.The average of the dose rates per spot was estimated to be 64nGy/h for the dump site at Ijebu-Igbo while the dose rate for the dump-site at Ijebu-ode is 128nGy/h. The annual dose rate estimated for Ijebu-Igbo dump site is 78.5µSv/yr and the annual dose rate for Ijebu-Ode dump site is 157.0µSv/yr. The values of the annual dose rate for both dump sites are quite lower than the world acceptable limit of 1mSv/yr for public exposure to radiation. Conclusively, there is no health implication of exposure to radiation from the possible radioactive materials at the dumpsites in the locations for both the public users and the workers at the dumpsites.

Keywords: Survey, Radiation, Dose Rate and Major dump Sites

1.0 Introduction

Wastes from industrial and domestic activities can contain various radioactive materials which can results to exposure of the general public and workers to ionizing radiation at the dump sites. Chemicals used in the processing of the finished products in industries can contain radioactive materials as well. Also, there had been works that showed that staple foods in Nigeria contain traces of radionuclide [1] and waste from these food finds there ways into the dumpsites. The dispersed of these refuse dumps without adequate management, particularly the radioactive contaminants expose the populace to radiation hazard. Also, the bulk of the hazardous industrial and domestic waste generated and dumped indiscriminately on open fields, streams, rivers and even on road sides, thereby threatening to cause diseases, epidemics, flooding and blocking motor ways [2]. Hazards posed by such dumpsite are not only in term of odor and presence of disease causing micro-organism, but can arise from the radiation emanating from such dumpsite [3]. It has also been established that vegetation and environmental fields in Nigeria contain traces of radionuclide [4]. All these are contained in the domestic waste which are indiscriminately dumped on open fields [3] farms soils [5], Quarry sites [6], rivers [7], well and boreholes [8], industries [9] and even on road sides and mechanic workshops [10]. Radiation emission characterization of waste dumpsites and measurement of radiation level in refuse dumps shows the level and long term effects of these radiations if not properly monitored [11]. The two major dump sites are in Ijebu-Ode and Ijebu-Igbo of keen interest since for the survey of dose rate will reveal the level of exposure

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of the workers and the general users of the dump sites to ionizing radiation coupled with the fact that all possible sources of elements of radioactive wastes (industrial and domestic) may find the ways into the dump sites. The result of the research work will avail the dwellers, business owners, farmers and others in the vicinity of the dumpsites the radiological impact of the location of the dumpsite to them if any. It will also avail the government the knowledge radiological impact of such dumpsites in the vicinity of the public if any as well. It will also serve as base-line for future radiologic survey of the dumpsite in case of future location of more industries in Ijebu which is the out-cry of the generality of the populace. Finally, the work will also contribute to the existing body of knowledge in this field of interest of environmental studies.

The research work is to aimed at accessing the occupation and public exposure level at the major dumpsites in Ijebu-Ode and Ijebu-Igbo as a result of exposure to ionizing radiation from possible radioactive and domestic wastes dumped at the sites. The following are the specific objectives of the work:

(i) Measurement of in-situ dose rates at the dumpsites,
(ii) Estimation of the annual dose rate at the dump sites
(iii) Compare the result of the work with similar works in the carried out in the nation and to compare the result of the research work with permissible limit of exposure to ionizing radiation.

2.0 Materials and Methodology

The location of the study Ijebu-Ode and Ijebu-Igbo in Ogun state with coordinate of 7^0 11′0″ North and 3^0 24′ 0″ and the locations of the dumpsites are specifically at Ijebu-Igbo and Ijebu-Ode. The population of Ijebu-Igbo and Ode are 284,336 and 226,6543 respectively[11, 12].Also the two locations has an areas 967km^2 and 192km^2[11,12]. Ijebu-Igbo town's primary economic activity is in timbre, cocoa and other mineral resources and is home of many saw- mills. UNSCEAR [13] observed that there could be some exposure at work which would require regulatory control but is not really considered. There had been research work carried out on Radiation exposure levels within timber industries in Calabar, Nigeria [9] and this supports the importance of the research work in Ijebu-Igbo dumpsites where the wastes from the saw-mills may find their way into the dumpsite. Ijebu-ode is the trade center of a farming region where yam, cassava, grain, tobacco and cotton are grown. There are more industries located in Ijebu-ode compared to Ijebu-Igbo. A total of twenty spots(10 per location) were randomly selected at the dump sites and a radiation detector dosimeter Gamma RAE II placed at one meter above the ground level was used for in-situ measurement of the dose rate per spots for a stipulated period of time(5minutes). Gamma RAE II R uses CsI (TI) as detector. It has in-built daily calibration capacity and factory calibration is not required. Energy range is 0.06MeV-3.0MeV. It's sensitivity is greater than 100 cps per µSv/hr. Dose equivalent range (DER) for ^{137}Cs is 0.01-40µSv/h and accuracy of ±30%.In normal operation mode, the dosimeter can detect gamma radiation and accumulate dosage data. It can also record maximum and minimum radiation level detected since last cleared. The average of the in-situ dose rates for the ten spots per location was estimated using equation (1). Conversion calculator for radiation dose [19] was used to convert the values of dose rate in µSv/hr to nGy/hr before using equation(1) to estimate the annual dose rate for the dumpsites.

The insi-tu mean absorbed rate per hour is calculated using the equation (1)

$$X = \frac{\sum x}{n} \quad \text{.....} \quad (1)$$

Where: $\sum \mathbf{x}$ = Summation absorbed dose rate in micro sievert per hour

X = Mean of absorbed dose rate per hour

n= Number of spots per locations

The annual effective dose rate to the population, H_e was calculated by the formula:

$$H_e = DTF_O \quad \text{.....} \quad (2)$$

Where D is the calculated total dose rate , T is the occupancy time (T=f X 24 X 365.25h year $^{-1}$) f is the occupancy factor with value of 0.2 and 0.8 for outdoor and indoor measurements respectively and F_o is the conversion factor (0.7 SvGy-1) UNSCEAR[14]

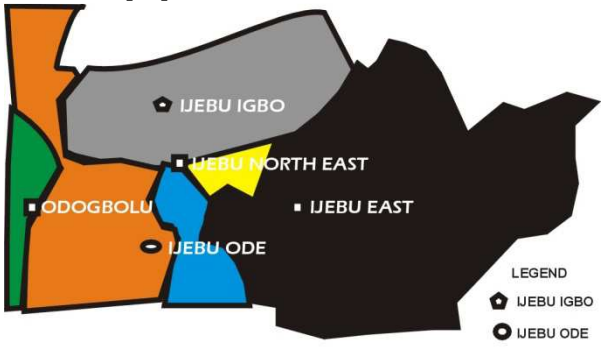

FIG.1: Map showing the locations of data collection

3.0 Result and Discussion

This section presents the result of the result of the research and the pictorial representation of dose rates from the dump sites.

Table 1: Result of In-situ Dose Rate (µSv/ hour) for Dump site at Ijebu-Igbo

SPORTS	PEAK DOSE RATE(X)µSv per hour
1	0.04
2	0.04
3	0.03
4	0.07
5	0.09
6	0.09
7	0.09
8	0.09
9	0.08
10	0.02

The average of the dose rates per spot was estimated to be 64nGy/h for the dump site at Ijebu-Igbo while the annual dose rate estimated for Ijebu-Igbo dump site is 78.5µSv/yr. The values of the annual dose rate for the dump sites are quite lower than the world acceptable limit of 1mSv/yr for public exposure to radiation. The result of the research work is higher than the work of Olubosede et., *al* [15] for five dumpsite in Lagos State with values of 29.08 µSv/yr,28.05 µSv/yr,19.29 µSv/yr,17.53 µSv/yr and 15.78 µSv/yr respectively. The mean effective dose obtained from the study was found to be greater than the world average of 70.0µSv year^{-1} specified by UNSCEAR [14] for an outdoor effective dose.

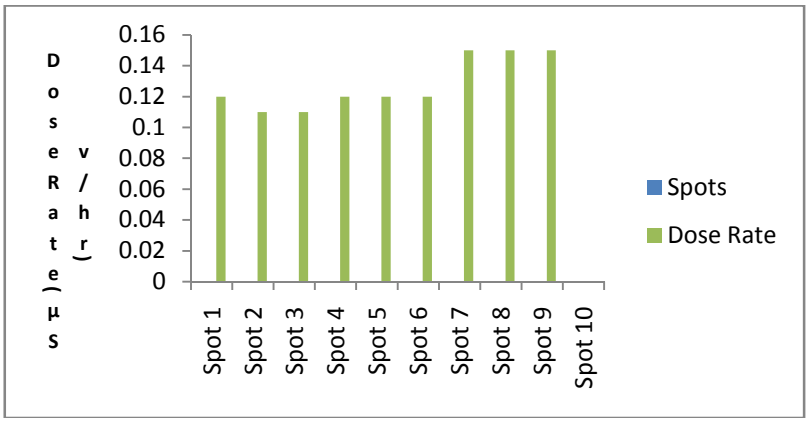

Fig 2: Pictorial Representation of In-situ Dose Rate(µSv/hr) at Ijebu – Igbo Dump Site

Table 2: Result of In-situ Dose Rate (μSv/ hour) for Dump site at Ijebu-Ode

SPORTS	PEAK DOSE RATE(X)μSv per hour
1	0.12
2	0.11
3	0.11
4	0.12
5	0.12
6	0.12
7	0.15
8	0.15
9	0.15
10	0. 13

The average of the dose rates per spot was estimated to be 128.0 nGy/h for the dump site at Ijebu-Ode while the annual dose rate estimated for the dump site is 157.0μSv/yr. The values of the annual dose rate for the dump sites are quite lower than the world acceptable limit of 1mSv/yr for public exposure to radiation. The mean effective dose obtained from the study was found to be greater than the world average of 70.0μSv year^{-1} specified by UNSCEAR for an outdoor effective dose.
Additionally, the result of the research work for the annual dose rate is greater than the work by Olubosede et., *al* [15].It is of keen interest to note also that the result of the research work for the in-situ dose rate and annual dose rate per annum for both dump sites are greater than that of Lateef et., *al*[16](38.01μSv/yr),Odunaike et *al*.,[6](21.8 μSv year^{-1}) and Odunaike et *al*.,[17](36.0 μSv year^{-1}).However, the values of the annual dose rate for both dump sites are quite lower than the world acceptable limit of 1mSv/yr for public exposure to radiation,CNSC[18].

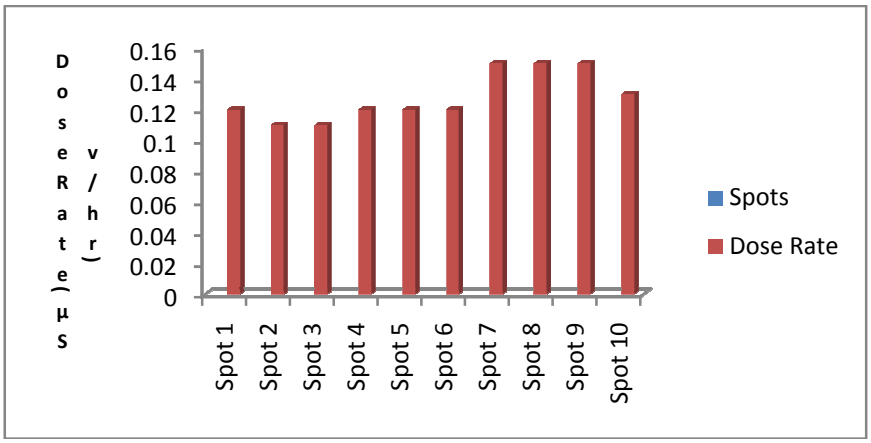

Fig 3: Pictorial Representation of In-situ Dose Rate(μSv/hr) at Ijebu – Ode Dump Site

4.0 Conclusion

The survey of radiation dose rate in major dump sites in Ijebu Ode and Ijebu-Igbo has been carried out and the result shows that the both the in-situ dose rate and the estimated annual dose rate is higher than other research work considered in the literature review in the work[16,6,17]. Additionally, the mean effective dose obtained from the study was found to be greater than the world average of 70.0μSv year-1 specified by UNSCEAR [14] for an outdoor effective dose. However, the values of the annual dose rate for both dump sites are quite lower than the world acceptable limit of 1mSv/yr for public exposure to

radiation, CNSC [18]. In conclusion, there is no health implication of exposure to radiation from the possible radioactive materials at the dumpsites in the locations for both the public users and the workers at the dumpsites.

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