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Radiation Emission Characterization of Waste Dumpsites in the City of Ibadan in Oyo State of Nigeria

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Abstract: This study aimed at characterizing the total radiation emanating from waste dumpsites across the city of Ibadan. Results of the investigation revealed that the mean annual absorbed dose rate from the waste dumpsites in the city is $26.2 \mu\text{Sv year}^{-1}$, which is far lower than the average of $70 \mu\text{Sv year}^{-1}$ put forward by United Nations Scientific Committee on Effect of Atomic Radiation. Thus, there should be no fear of serious health hazards due to the exposure level of the emitted radiation on the entire populace of the city of Ibadan. However, focus should be on the proper management of the waste generated in the city to prevent outbreak of diseases, better improve the environment and conserve natural resources.

Key words: Waste, dumpsites, radiation, dose rate, characterizing, hazards

INTRODUCTION

Waste dumpsites in most cities in Nigeria, apart from constituting a threat to the environment, poses serious health hazard to the populace. However, the hazards posed by such dumpsites are not only in terms of odour and presence of disease causing micro-organisms, but can arise from the radiation emanating from such dumpsites.

Various radioactivity measurements have shown the existence of traces of radionuclide in the staple food consumed in Nigeria (Jibiri *et al.*, 2007; Eyebiokin *et al.*, 2005). It has also been established that vegetation and environmental fields in Nigeria contain traces of radionuclides (Akinloye and Olomo, 2005). All these, are contained in the domestic wastes which are indiscriminately dumped on open fields, rivers and even on roadsides. In addition, industrial wastes that are liable to contain traces of radionuclide are also dumped indiscriminately. Consequently, the radionuclide contents in the waste dumpsites, if not properly managed emit mixed radiation to the environment.

Ibadan is the capital of Oyo State which is in the Southwestern geopolitical zone of Nigeria. It is the largest city of African origin south of the Sahara. This description becomes quite understandable when it is realized that the city, apart from having a pre-colonial origin with a large area belonging to the old unplanned section, is located in the midst of a rich agricultural land, stretching far outside its immediate environs or regions. This has made the metropolis a market place for cocoa and other local agricultural produce. Chemical, Electronics, Plastic and tobacco Industries, as well as various forms of small businesses flourish in the Metropolis. The attendant effect of all these is the rapid generation of domestic, agricultural and industrial waste.

The city of Ibadan is also noted for its chaotic street patterns with layouts that are hardly passable especially by heavy vehicles needed to remove the waste. The roadsides are now waste dump sites and in some cases, such waste dumps have taken over several roads and damaged others as a result of accelerated rate of weathering of the bituminous surface. The city could be classified as a degraded environment with wraps of table water, leaves, disposables and other related refuse littering all nooks and crannies of the city.

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This however motivated this study at characterizing the radiation emanating from these waste dumpsites and to provide data as part of environmental monitoring research for proper assessment of radiation exposure rate of the population of the metropolis.

MATERIALS AND METHODS

Study Area

The study was carried out in July 2006 with measurements taken from 20 different waste dumpsites across Ibadan as depicted in Fig. 1. The city of Ibadan as earlier stated is in the southwestern part of Nigeria and is the capital of Oyo State. Oyo state lies within latitude 4°N and 14°N and longitude 3 and 15°E, with a population of about 3, 847, 500. It shares boundary with Kwara State to the North, Osun State to the South and partly Ogun State, partly Republic of Benin to the West. It covers an area of approximately 35, 743 km².

Technique

A portable Scintillation Survey meter, Panaramic Victoreen, Model 407A, Serial No.4093 was utilized in this study for measurement of the total dose rate or exposure in a mixed field. It has twelve overlapping ranges and measurements can be obtained for subdivisions of rad or rad h⁻¹ depending on

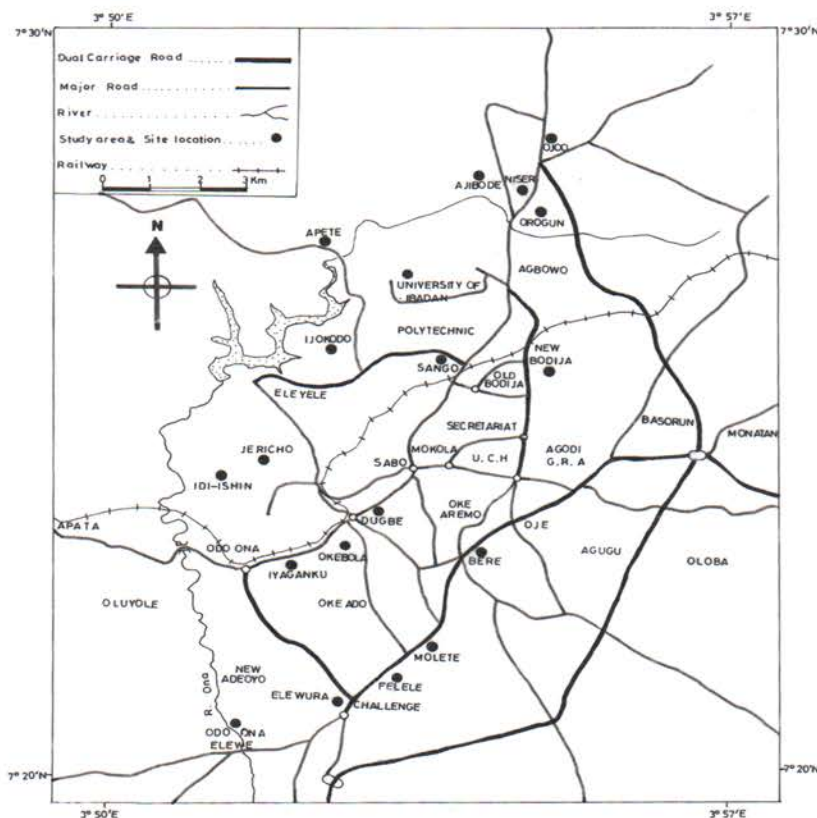


Fig. 1: Map of Ibadan metropolis showing the site locations

the level of the radiation. The meter uses a 3V battery. In each of the twenty waste dumpsites selected across the metropolis, the detector was placed at about one meter above ground level for effective detection; ten different readings were taken on different points and the average value obtained.

Using the relation:

$$1 \text{ rad h}^{-1} = 1.0 \times 10^{-2} \text{ Gy h}^{-1} \text{ (Marilyn } et al., 1995)$$

the absorbed dose in rad h^{-1} was converted to Gy h^{-1} . The annual dose rate was further determined using the relation.

$$D = \delta \times \mu \times k \times 24 \times 365.25 \text{ Sv year}^{-1}$$

Where:

δ = Absorbed dose in Gy h^{-1}

μ = 0.2, the occupancy factor

k = 0.7 Sv year^{-1} , which is the conversion factor from Gy to Sv.

RESULTS AND DISCUSSION

The results of the measurements obtained from each of the 20 dumpsites are presented in Table 1. Apete/Awotan, Ajibode, Dugbe, Mokonla, Ijokodo, Niser, New Bodija and Odo-Ona Elewe are all areas that are densely populated either for residential or commercial purposes. The annual absorbed dose rate of waste dumpsites from these areas is greater than $30 \mu\text{Sv year}^{-1}$, which can be attributed to the large volume of waste generated by the population. Iyaganku has the lowest value for the annual absorbed dose rate of $12.27 \mu\text{Sv year}^{-1}$. This low value can be attributed to the low volume of waste generated in this area since it is not a residential area, but rather plays host to Offices, banks and Commercial Stores.

The mean annual absorbed dose rate obtained in this study is $26.2 \mu\text{Sv year}^{-1}$. It is comparable, though higher than both the result obtained from Obed *et al.* (2005) with an average of $24.5 \mu\text{Sv year}^{-1}$ as reported in *in situ* gamma spectroscopic measurement and that obtained from the investigation of radiation level in waste dumpsite across Lagos metropolis, Nigeria, with a mean annual absorbed dose rate $21.8 \mu\text{Sv year}^{-1}$ reported by Odunaike *et al.* (2008). However, world's average is $0.06 \mu\text{Gy h}^{-1}$ ($\approx 70 \mu\text{Sv year}^{-1}$) (Ademola, 2008), this is higher than the result obtained in the this study.

Table 1: Measurements obtained from the waste dumpsites at each location

Location	Dose rate ($\mu\text{rad h}^{-1}$)	Dose rate (nGy h^{-1})	Annual dose rate ($\mu\text{Sv year}^{-1}$)
Apete/Awotan	3.20	32.00	39.27
Ajibode road	2.70	27.00	33.14
Beere	2.30	23.00	28.23
Challenge elewura	1.80	18.00	22.09
Dugbe	2.70	27.00	33.14
Felele	1.30	13.00	15.95
Idi-Ishin	1.80	18.00	22.09
Ijokodo	3.00	30.00	36.82
Iyaganku	1.00	10.00	12.27
Jericho	2.20	22.00	26.99
Mokonla	2.50	25.00	30.68
Molete	2.20	22.00	26.99
Niser	3.00	30.00	36.82
New bodija	2.50	25.00	30.68
Odo-Ona elewe	2.50	25.00	30.68
Ojoo	2.00	20.00	24.54
Oke-Bola	1.30	13.00	15.95
Orogun	1.70	17.00	20.86
Sango	1.80	18.00	22.09
University of Ibadan	1.20	12.00	14.73

CONCLUSION AND RECOMMENDATION

The radiation dose rate characterization of the waste dumpsites in Ibadan Metropolis has been investigated in this study and a mean annual absorbed dose rate obtained as $26.2 \mu\text{Sv year}^{-1}$. Despite the fact that all levels of ionizing radiation are hazardous to human health (Imtiaz *et al.*, 2005) the exposure level of the emitted radiation on the populace of Ibadan metropolis is low when compared with Nigeria and World averages. Hence, fear of serious health hazards arising from the exposure to radiation emanating from these dumpsites should not be entertained. However, there should be continuous monitoring of the radiation emanating from both the waste dumpsites and the environment in general, while effort should be made at re-cycling these wastes to better improve the environment and conserve natural resources, since there is a strong relationship between increased generated refuse and annual dose rate.

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