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Radiation Dose Survey of Refuse Dumpsites in Abeokuta in Ogun State in the Southwestern Zone of Nigeria

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Abstract: This study aimed at employing radiation detection method to examine the total radiation intensity of 20 identified dumpsites in Abeokuta, the capital of Ogun state in the Southwestern part of Nigeria. The result which is comparable to those reported for environs in Nigeria and the World showed the absorbed dose rate from the dumpsites ranged from 12.3 to 49.1 $\mu Sv\ year^{-1}$ and the mean annual absorbed dose rate of 36.0 $\mu Sv\ year^{-1}$. The results indicated that the observed radiation dose is minimal when compared to Nigeria's average and the world average but no matter how low; all levels of radiation still constitute a hazard. However, it is recommended that these dumpsites be managed or the wastes be converted to useful raw materials through employment generation.

Key words: Radiation detection, radiation intensity, absorbed dose, hazard, dumpsites, Abeokuta

INTRODUCTION

Environmental pollution is one of the greatest problems that the world is facing today. The indiscriminate waste dumps causes soil pollution which can lead to unsustainable and wasteful utilization of resources giving rise to dwindling wildlife, more land degradation (Odunaike *et al*., 2008) and threat to human health.

Soil pollution is the misuse of land in a way which makes it unfit for man's future needs, such as construction of buildings or the growth of food or other related materials which he uses in his daily life and which could cause either dangerous toxic contamination of air and water resources (Nwajei and Iwegbue, 2005).

Domestic and industrial wastes contain various substances which includes radioactive materials resulting from the use of processing chemicals. Also the remnants from staple foods contain traces of radioactive materials or contaminants. The dispersal of these refuse dumps without adequate management, particularly the radioactive contaminants expose the populace to radiation hazard.

Abeokuta is the state capital of Ogun State in Southwestern part of Nigeria. It has undergone considerable industrialisation and urbanisation since Ogun state was created in, 1976. This economic growth and industrial development have been achieved at the expense of the environment and natural resources base.

The bulk of the hazardous industrial and domestic waste generated are dumped indiscriminately on open fields, streams, rivers and even on road sides, thereby threatening to cause disease epidemics, flooding and blocking motorways (Iwegbue *et al*., 2006). Some of the industries in Abeokuta use chemicals that contain traces of radioactive materials for processing of their goods/products. It is pertinent to note that the recent study of Jibiri *et al*. (2007) revealed that staple food stuffs consumed in Nigeria contain traces of radionuclide. Thus, the refuse dump sites are liable recipient of any such failure in containment of radioactive materials (Farai *et al*., 2007).

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In view of these facts, it is therefore necessary to develop and apply strategies to reduce or control the refuse dumps in the environment of Abeokuta in order to minimise the exposure of the populace to hazardous radiation. This motivated the authors to conduct an assessment of the interaction of radiation with matter on dumpsites in Abeokuta city, using a radiation survey meter.

MATERIALS AND METHODS

Study Area

The assessment conducted in July, 2006 was carried out in 20 locations within and around Abeokuta city, the capital of Ogun State (Fig. 1). Ogun State presently has a population of 3, 658, 098 as adopted by the recent headcount in Nigeria. It has a land mass area of 16,409.26 km^2 and lies within longitude 2.5 and 5.0°E and latitude 6 and 8°N. The state shares boundaries with Oyo State in the North, Lagos and Atlantic Ocean in the South, Ondo state in the East and Republic of Benin in the West. However, Abeokuta the place of survey has a population of 593,140 which is about 16.21% of the total population of the state. The open space covered by each dumpsite is between 3.0 and 10.0 ha.

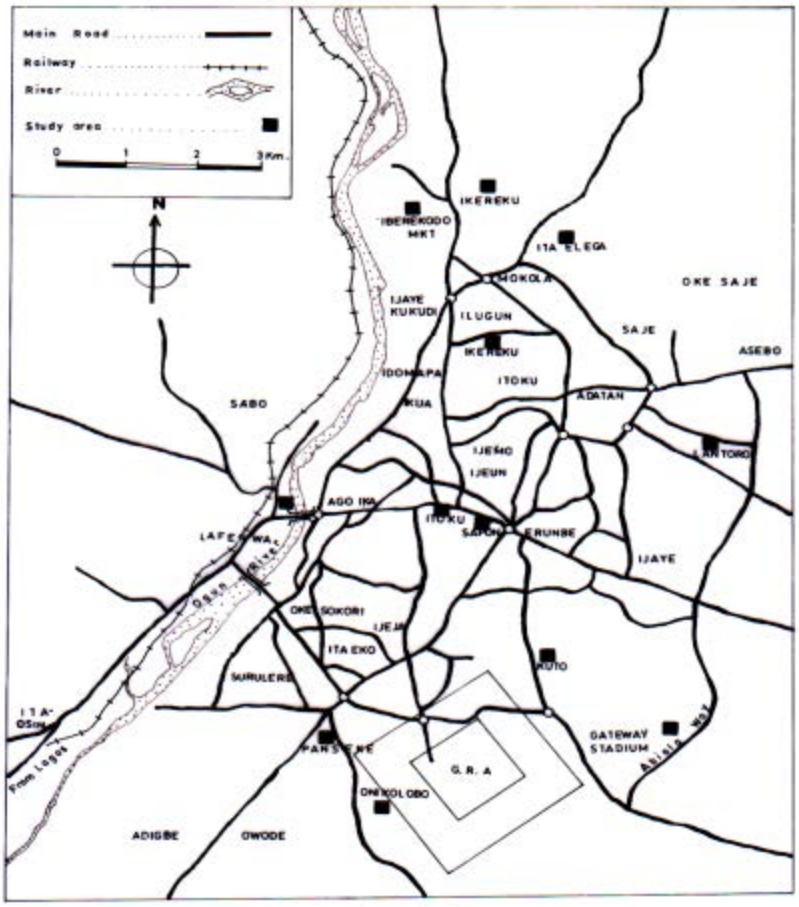

Fig. 1: Map of Abeokuta showing some of the site locations

Technique

A rapid method of assessing total radiation intensity in a mixed field was employed. A typical portable cutie pie scintillation survey meter specified as Panoramic Victoreen was used to detect and measure the radiation absorbed dose or exposure rate. The survey meter, model 407A, serial No. 4093 has twelve overlapping ranges and is switchable between integral mode, where the measurements can be read in subdivisions of rad (r) and count rate mode where the measurements are expressed in subdivisions of rad h^{-1} (R/h). The survey meter is run by two 1.5V D batteries and has a temperature dependence of less than 0.2% per degree Celsius. The humidity limits are 0-99% non-condensing. At each dumpsite, the survey meter was held at the gonald level, that is, about 1.0 m above the ground level (Ademola, 2008), switched on and count rate mode with rad h^{-1} subdivision was selected. Since radioactivity measurement or process is statistical, ten readings were taken on each dumpsite and the average of the readings obtained.

The absorbed dose in μrad h^{-1} from the survey meter was converted to Gy h^{-1} using the relation from (Marilyn and Maguire, 1995).

$$1 \text{ rad } h^{-1} = 1.0 \times 10^{-2} \text{ Gy } h^{-1}$$

However, the annual dose rate from each location was determined using:

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

where, δ is absorbed dose in Gy h^{-1}, the outdoor occupancy factor, u = 0.2 and conversion factor to convert from Gy to Sv, k = 0.7 Sv/Gy.

RESULTS AND DISCUSSION

Table 1 shows the total annual absorbed dose rate in mixed field of each dumpsite in Abeokuta metropolis. The absorbed dose rate from the dumpsites ranges from 12.3 to 49.1 μSv $year^{-1}$ and the mean annual absorbed dose rate was obtained as 36.0 μSv $year^{-1}$.

Table 1: Measurements at the 20 dumpsites identified in Abeokuta

Locations	Dose rate (μrad h^{-1})	Dose rate (nGy h^{-1})	Annual dose rate (μSv $year^{-1}$)
Panseke A	3.00	30.00	36.8
Panseke B	2.00	20.00	24.6
Onikolobo A	3.30	33.00	40.5
Onikolobo B	3.00	30.00	36.8
Omida	2.70	27.00	33.2
Sapon	4.00	40.00	49.1
Itoku A	3.00	30.00	36.8
Itoku B	2.80	28.00	34.4
Ita elega	3.00	30.00	36.8
Lafenwa	1.80	18.00	22.1
Kuto	2.00	20.00	24.6
Isale igbein	3.90	39.00	47.9
Nepa road	1.00	10.00	12.2
Abiola way	3.50	35.00	43.0
Sodeke	3.00	30.00	36.8
Ikereku	3.30	33.00	40.5
Iberekodo bode market	3.70	37.00	45.4
Brewery	3.00	30.00	36.8
Lantoro	3.00	30.00	36.8
Ogun river bridge	3.60	36.00	44.2

However, Gamma spectroscopy assay of soil sample approach which was used by Farai *et al*. (2007) to determine the absorbed dose rate from dumpsites in Port-Harcourt, South-south geopolitical zone of Nigeria; a biological dose rate of 24.6 μSv year^{-1} was obtained. In Obed *et al*. (2005) an average of 24.5 μSv year^{-1} was reported.

The mean absorbed dose rate value in the soils of Bangalore region India was reported as 73.9 nGy h^{-1} (90.7 μSv year^{-1}) (Shiva Prasad *et al*., 2008) while Odunaike *et al*. (2008) mentioned 98.0 μSv year^{-1} as the Nigerian average annual dose rate. The absorbed dose rate value reported by Farai *et al*. (2007) was smaller than the mean value obtained from the dumpsites in Abeokuta. This may be as a result of background radiation from the rocks around Abeokuta.

The value reported by Shiva Prasad *et al*. (2008) is about three times the value obtained from the dumpsites in Abeokuta. Whereas the value of the absorbed dose rate from the assessment is approximately one-half of the world average of 0.06 μGy h^{-1} (~ 70 μSv year^{-1}) (Ademola, 2008).

CONCLUSION AND RECOMMENDATION

The result shows that the overall mean absorbed dose rate measured in the study area was comparable to those reported for the environs in Nigeria and the world. The result in this research study also shows that the absorbed radiation dose is minimal when compared to Nigeria's average and the world average. Although no matter how low, all levels of ionizing radiation are hazardous to health (Imtiaz *et al*., 2005). It is therefore not expected that there should be fear of any serious hazard from radiation exposure or dose emanating from the dumpsites in Abeokuta. However, the wastes from refuse dumpsites could be converted to compost manure particularly the organic waste for the use of the farmers. It could also be recycled to improve aesthetically the environment of the waste sites.

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