MEASUREMENTS OF RADIATION LEVELS IN SOME REFUSE DUMPS ACROSS JOS METROPOLIS- NORTH CENTRAL NIGERIA

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Abstract
Most urban cities in Nigeria are faced with the problem of increasing rate of waste generation and disposal. Health hazard from these dumpsites are real and threatening, hence the level of the hazards should be determined in order to enlighten the public on the danger if the wastes are inadequately or ineffectively managed. This motivated the present study in which the authors used radiation measurements to measure radiation levels emanating from identified 20 refuse dumpsites within Jos and its environs and examine its interaction with the nature. The radiation levels were monitored using Gamma Scout which records radiation levels in μSvh^{-1} and later converted into μSvy^{-1}. The results showed that the mean annual absorbed radiation was $36\mu Svy^{-1}$, a value which is comparable with the ones obtained across the country and the world radiation level. But no matter how low a radiation level is, it constitutes some amount of hazard to life and the environment. It is recommended that solid wastes should be effectively managed in order to reduce the negative aesthetic appeal it has on the environment.

Keywords: waste dumps, Jos metropolis, hazards, radiation detection, annual absorbed, dose rate and Gamma Scout**.**

INTRODUCTION

The increasing rate of generation and subsequent release of pollutants into the environment is one of the greatest problems facing the world today. In most Nigerian cities, refuse are being dumped indiscriminately along roads, gutters and streams and even near residential buildings. At designated refuse dumps, they are usually ineffectively managed. This leads to some natural disaster or the other which presently threatens live of plants and animals (Odunaike *et al.*, 2008). This may eventually affect human lives either directly or indirectly. Many industrial products used at homes, institutions and public places are known to contain some traces of radioactive nuclide. Hospitals make use of nuclear and atomic radiation for diagnosis and treatments of some diseases. Some staple foods are now found to contain some radioactive nuclides (Jibiri *et al.*, 2007). Mine dumpsites are sources of radiation from leftovers of radioactive nuclides of chemical composition of long mined minerals (Jwanbot *et al.*, 2010).

Plateau State is known as the home of peace and tourism. Its capital is Jos, located at north – western part of the state. Since creation of the state, Jos had undergone considerable industrialization and urbanization but at the expense of nature. Many food materials consumed in the city are from areas of high background radiation as a result of tin mining /milling activities. All wastes generated from these end up on waste dumps, or indiscrimately litter around neighborhoods in the city. In the view of these facts, it is important to monitor and measure the radiation levels from these dumpsites and find a way of controlling the spread of refuse on streets so that lives could be protected from hazardous radiation levels emanating from these dumps.

MATERIALS AND METHOD

The study was conducted in June 2011 in twenty locations within and around Jos city the capital of Plateau State. Plateau State has a population of about 3.5 millions (National Population Commission 2007). The area is located on a coordinate of latitude 9.56˚N and Longitude 8.53˚ E. The state has landmass 26,899km and situated on altitude between 1200 and 11829 meters above sea level. Plateau state shares boundary with other states like Bauchi, Nasarawa and Kaduna. The highest concentration of the state population is found within the Jos metropolis, accounting for about 40% of the total state population. In Jos Metropolis, there are some industries located at the city centre. Some of these are involved in bottling, manufacturing processes, mining/milling of tin and columbite and automobile mechanical services. These industries may be using raw materials which are either radioactive, corrosive or toxic which may be harmful to humans and affect the environment. Some of these industries may generate radioactive materials during processing. Excessive and prolonged exposures of lives to radioactive elements however do have general deteriorating side effect on health (Nobel, 1990). Suspected sources of radiation in the city include mining dumpsites, domestic dumpsites industrial dumpsites and radiation from hospital dumpsites.

The use of radiation survey meter to detect and measure the radiation absorbed dose rate is a rapid method of assessing radiation intensity but it will only give the total dose or exposure rate so a portable Geiger Muller counting meter with halogen filler called Gamma Scout is used to examine and determine the absorbed radiation dose of the spectrum at the dumpsites. The Gamma Scout is of standard version GS2 model with serial number A20. It has nine overlapping ranges, switchable between integral modes where measurements can be read in subdivisions sieverts (Sv) and count rate mode where radiation can be expressed in microsieverts per hour (μSvh^{-1}).

The Gamma Scout is used to measure alpha, gamma and beta radiations. It has wide measuring range and can be used for diverse measurement in-situ radiations. The meter has a long lasting battery, and can measure radiations continuously for averagely 10 years. At each dumpsite, the survey meter was held at gonad level (about 1m above the ground) and the count rate mode which reads radiations in μsvh^{-1} was selected. Four readings were taken at each dumpsite and the average determined. The background radiation is also taken by measuring and recording radiations around the dumpsite at about 1 meter distance away.

Annual radiation dose D from each dumpsite is determined using relation from (Marilyn and Maguire,1995)

$$\boldsymbol{D = \frac{\delta \times 0.2 \times 24 \times 365.26}{10}}$$

Where; δ is measurement in μsvh^{-1}
0.2 is the outdoor occupancy factor

Annual dose rate in nGy^{-1} is also obtained by multiplying radiation dose rate by 0.7, which is the conversion factor from μSvy^{-1} to nGy^{-1}

RESULTS AND DISCUSSION

Table1: Results of radiation dose measurement from twenty dumpsites across Jos metropolis.

S/N	Location Result	R1	R2	R3	R4	Average (μSvh^{-1})	Average (μSvy^{-1})	Background (μSvy^{-1})	Nature of dump
		Readings (μSvh^{-1})							
1	Resau village	0.18	0.19	0.19	0.20	0.19	33.30	28.10	Domestic
2	Bauchi road	0.14	0.16	0.17	0.18	0.16	28.10	28.10	Domestic
3	Rukuba road	0.17	0.20	0.21	0.20	0.21	35.10	29.19	Domestic
4	Township Stadium	0.16	0.18	0.18	0.18	0.18	31.60	28.10	Domestic
5	Plateau Rider	0.15	0.19	0.16	0.20	0.18	36.60	28.10	Domestic
6	Apata	0.14	0.15	0.16	0.14	0.15	26.30	28.10	Domestic
7	Angwan Rukuba	0.20	0.20	0.20	0.22	0.20	35.10	21.60	Domestic
8	Gada Biu	0.19	0.20	0.20	0.20	0.20	35.10	24.50	Domestic
9	Tundun wada	0.16	0.17	0.19	0.20	0.18	31.60	29.80	Domestic
10	Low cost	0.13	0.15	0.20	0.17	0.22	29.80	22.80	Domestic
11	Terminus	0.16	0.17	0.18	0.19	0.18	31.60	21.60	Domestic
12	Dogon karfe	0.16	0.16	0.18	0.20	0.19	33.30	20.0	Domestic
13	Farin – gada	0.18	0.20	0.21	0.22	0.20	31.10	30.10	Domestic
14	Yelwa	0.30	0.32	0.35	0.35	0.35	61.40	45.60	Mega dump
15	Naraguta village	0.30	0.31	0.30	0.32	0.31	54.30	42.08	Mega dump
16	Zaria road mine	0.35	0.34	0.36	0.40	0.36	63.10	56.10	Mine dump
17	Brewery(JIB)	0.20	0.20	0.22	0.23	0.21	36.80	22.80	Industrial
18	NASCO	0.26	0.26	0.22	0.23	0.23	40.30	24.50	Industrial
19	JUTH	0.20	0.20	0.25	0.30	0.24	42.10	25.80	Hosp. dump
	Plateau Hospital	0.24	0.25	0.24	0.20	0.23	40.30	24.50	Hosp. dump
	TOTAL					4.31	755.5	581.39	

The mean annual absorbed dose rate is

$$\frac{\mathbf{755.5}}{\mathbf{20}} = \mathbf{36.1}\mu \boldsymbol{Svy^{-1}}$$

From the table, the mean annual absorbed dose rate rages between 26.3µSvy^{-1} and 63.1 µSvy^{-1}. Dumpsite at Low cost area recorded the lowest level of absorption dose. This may be due to low population density of the area and the mining dumpsite along Zaria road recorded highest absorption dose. This may be due to activities of radiation nuclides present in the soil from left over of chemical combination of mined minerals. Measurements taken from two hospitals and industries also show radiation levels which are relatively higher than those obtained from domestic dumpsites. The mean annual absorbed dose rate is 31.6µSvy^{-1}.

This value is comparable to similar measurements obtained from different dumpsites around the country. It is approximately equal to the one obtained from dumpsites in Abeokuta, Ogun state, south western part of Nigeria which estimated as 36.0µSvy^{-1}, higher than mean annual radiation from dumpsite across Lagos and Ibadan metropolis which estimated 21.8 and 24.5µSvy^{-1} respectively (R.K Odunaike, *et al.*, 2008). Result of this study shows that radiation dose rates from dumpsites across Jos is higher than that of average south-south of Nigeria which measured 26.0 µSvy^{-1}. This may be due to high background radiation level of Jos metropolis which accounts for about 79% of the total radiation level from the dumpsites.

The mean absorbed dose rate of soils of Bangalore region in India was reported to be 90.7µSvy⁻¹, (Shiva Prased et al., 2008), while Odunake *et al.,* (2008) estimated that of Nigeria to be 98.0µSvy⁻¹. The mean dose rate of Bangalore region is about three times that of Jos metropolis whereas that of Jos is just about half of the world absorbed dose rate of 70µSvy⁻¹, (Ademola *et al.,* 2008).

CONCLUSION

The results show that the overall mean absorbed dose measured across the dumpsites in Jos metropolis is comparable with ones reported from other parts in Plateau State, Nigeria and the world at large. It can also be inferred from the results that high background radiation recorded across the study area influence the result, making it one of the areas having highest absorption radiation dose from dumpsites across the country.

Absorption dose rate across dumpsites in Jos metropolis is found to the less than 70 μSvy^{-1} which is the minimum allowable environmental radiation dose by the United Nation Scientific Committee on Atomic and Nuclear Radiation (UNSCEAR, 2002). Hence effect of radiation on the study area is expected to be minimal. Therefore there should be no fear of any serious hazards from exposure to ionizing radiation due to these dumpsites, except for in near future, due to accumulated dose rate.

However, no matter how low, all levels of ionizing radiation are hazardous to health because they have tendency of being accumulated in the body over time (Imtiaz et al, 2005). It is therefore recommended that refuse across the city should be cleared promptly by the concerned board. Also, mega dumpsites should be situated further away from the city and human activities around them should be restricted. In the like vein, biodegradable wastes should be converted to manure while non-biodegradable wastes should be recycled so as to improve aesthetically, the environment of the waste sites.

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Reviewer's Comment

1) Suitable for publication in its present form
2) Syntax errors have been corrected