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Estimation of Equivalent Radaition Dose on Dumping Sites near Residential Area in Ojota, Lagos Nigeria

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ABSTRACT

This project takes a look at the radiation dose emanating from Olososun dump site in Ojota, Lagos Nigeria. This was achieved using a radiation survey meter (RADEYE B20- ER) to measure the radiation dose exposure rate in micro Sievert per hour (µSvhr^{-1}). Readings were taken by placing the survey meter 1meter above the ground level at five (5) different locations within the facilities, taking the readings while ascending and descending along the path of different locations. This was done at the interval of 5meters away from a point of reference up 20 meters. The result obtained shows that the equivalent dose rate measurement taken at the dump site are within the permissible limit to which humans can take. There is likely probability of this small dose of radiation to cause cancer in the nearest future after long term effect on people living in the area. Safety measure should be taken so as to reduce effects that could be arising in the nearest future.

KEYWORDS; ***Dose from Radionuclides in the body, Exposure, Equivalent dose (H_T), Effective dose (H_E)***

1 INTRODUCTION

Environmental pollution is one of the greatest problems the world is facing today. The indiscriminate waste dumping may result into soil and air pollution, which Can lead to unsustainable and wasteful utilization of resources giving rise to dwelling of wildlife, more land Degradation (Odunaike *et al.*, 2008) and threat to human health. Environmental radiation and the outward vulnerability, depend mainly on the earthly and geographical condition that may appear at various levels in the soils of each region in the world. In the biosphere, the propagation of radionuclides depends on the transportation of the geological materials from which they are made from and the processes which establish them at a given Location in specific area. The major way to understand these distributions, therefore, is to study the transportation of the source materials and the physical and geochemical processes that lead to increased concentrations of radionuclides under given conditions.

DOSE FROM RADIONUCLIDES IN THE BODY

Inhaled radionuclides include cosmogenic radionuclides and terrestrial radionuclides that become air-borne. Of all sources of background radiation, radon (the gas emitted by uranium and thorium in soil and rocks) and its decay products result in the greatest dose to humans. Yet indoor radon concentrations are also the most variable dose components, since they depend on how a house is built, the soil it is built on, where in the house the radon is measured, and more. Even granite countertops can contribute to the radon levels in a house, but this contribution is typically very small compared to the radon from the soil under the house. The average dose from all inhaled radionuclides is about 2.3 mSv per year, which is about 73 percent of the average total dose from background radiation. People ingest radionuclides when they eat food grown in soil

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that contains uranium, thorium, potassium, and rubidium; drink milk from animals fed crops that grow in the soil; and drink water containing dissolved terrestrial radionuclides. The average dose from all ingested radionuclides is about 0.3 mSv per year (about 9 percent of the average total dose from background radiation).

EXPOSURE

Exposure is used to described a γ or X ray incident on a body at any point in time. γ or x ray ionize strongly in air and the human body is usually the medium for their depositions.Exposure can be expressed as where ΔQ is the absolute value of the total charge of one sign produced in air within the volume element Δm as a result of ionization of the air.

It is measured in Roentgen(R), where 1R = 1.61×10^{15} ions/kg = =2.58×10^{-4}C/KG.

Exposure rate is expressed as;

$$\mathbf{Exposure}(\dot{X}) = \lim_{\Delta t\to 0}\frac{\Delta X}{\Delta t} = \frac{dX}{dt} \qquad 1$$

EQUIVALENT DOSE (H_T)

The Human equivalent dose, $\mathbf{H_T}$ measures the biological damage to human due to exposure to a particular type of radiation. It defined as $\mathbf{H_T = W_R \times D_R}$, where **T** represents a specific tissue or parts of the body. **H** is also called the 'radiation weighted dose'.

The S I unit for human equivalent dose is the Sievert **(Sv)**

$$\mathbf{1\ Sv = 1\ gray \times W_R}$$

The traditional unit for human equivalent dose is the rem, where **1 rem = 'Roentgen equivalent Man' = dose in rad x Q=0.01Sv**. Typical values are (Milli-rems and tens of micro - Sieverts)

Often the body can be exposed to different types and energies of radiation at the same time. Then the human-dose equivalent is given by the weighted sum of absorbed dose of radiation of type R, resulting in the observed biological damage to tissue/organ. **T**

$$\mathbf{H_T = \sum W_R \times D_{T,R}} \qquad 2$$

EFFECTIVE DOSE (H_E)

The same size of dose can cause different degrees of biological damage depending on which part/organ of the body is exposed.

In order to account for this, the ICRP (Publication Number 60, 1990) provides a list of Tissue weighting factors, $(\boldsymbol{W_T})$ for the organs and tissues which are susceptible to the main biological radiation damage.

Thee Effective Dose $(\boldsymbol{H_E})$ is a way of determining the whole-body biological damage due to radiation exposure of different types to different types to different parts of the body.(This is given by the weighted sum of the equivalent dose for that type of radiation, multiplied by the tissue weighted factors for that particular area of the body, $\boldsymbol{H_T}$. Thus,

$$\boldsymbol{H_E = \sum_T W_T \times H_T} \qquad 3$$

Note; $\mathbf{H_E}$ and $\mathbf{H_T}$ both have **SI** units of Sieverts (**Sv**).

2 METHODOLOGY

STUDY AREA

The study was carried out in Lagos state, which lies within latitude 6º and 35Nº and longitude 3º and 45Eº, with population of about 17,553,924 (Lagos state Social Security Exercise 2006 Census). Lagos state covers an area of approximately 3,475.1km2. Lagos state is divided into five administrative divisions which are further divided into 16 local government areas. These local governments are: Agege, Alimosho, Ifako-ijaye, Ikeja, Kosofe, Mushin, Oshodi-isolo, shomolu, Apapa, Eti-osa, Lagos Island, Lagos mainland, Surulere, Ajeromi-ifelodu, Amuwo-odofin, Ojo, Badagry, Ikorodu. The readings were taken in Ikeja local government, Lagos state. It covers an area an area of about 42 hectares of land (Aderibigbe, 2010). Olusosun refuse dumpsite is a controlled dumpsite located between longitude 30 37' E to 3o 74' E and latitude 60 58' N to 60 59' N in Ojota,This dumpsite which is claimed to be the largest landfill in Lagos cover areas around Ikosi Ketu, Oregun industrial estates, the commercial of Kudirat Abiola way, and Ojota residential area. The dump site is being managed by the Lagos State Waste Management Authority (LAWMA). The dumpsite is said to be the repository of more than 50% of about 9,000 metric tonnes of solid waste generated in Lagos Metropolis on a daily basis. Individual living above 2,000 meters will receive several times as much.

DATA COLLECTION

The readings were collected at a dump site in Ojota Olososun dump site. The sample collection was done on the basis of the levels of effective dose rates obtained using the handheld meter and also the economic activity of the area. Readings were taken on five different locations within the dump site. The survey meter was placed one meter above the ground level to take measurement in micro Sievert per hour. At the dump site(Olusosun dump site in Ojota, Lagos), the dirt and scraps in the dump site are packed in way that there are heap up. i.e. – there are different altitudes at different points in the dump site. Two methods were used when determining the equivalent radiation dose at the site;

The Ascending approach- In this approach, readings were taken with increase in altitude. Radiation dose increases with increase in altitude. The Descending approach- In this approach, readings were taken with decrease with altitude. Radiation dose decreases with decrease in altitude.

3 RESULT AND DISCUSSION

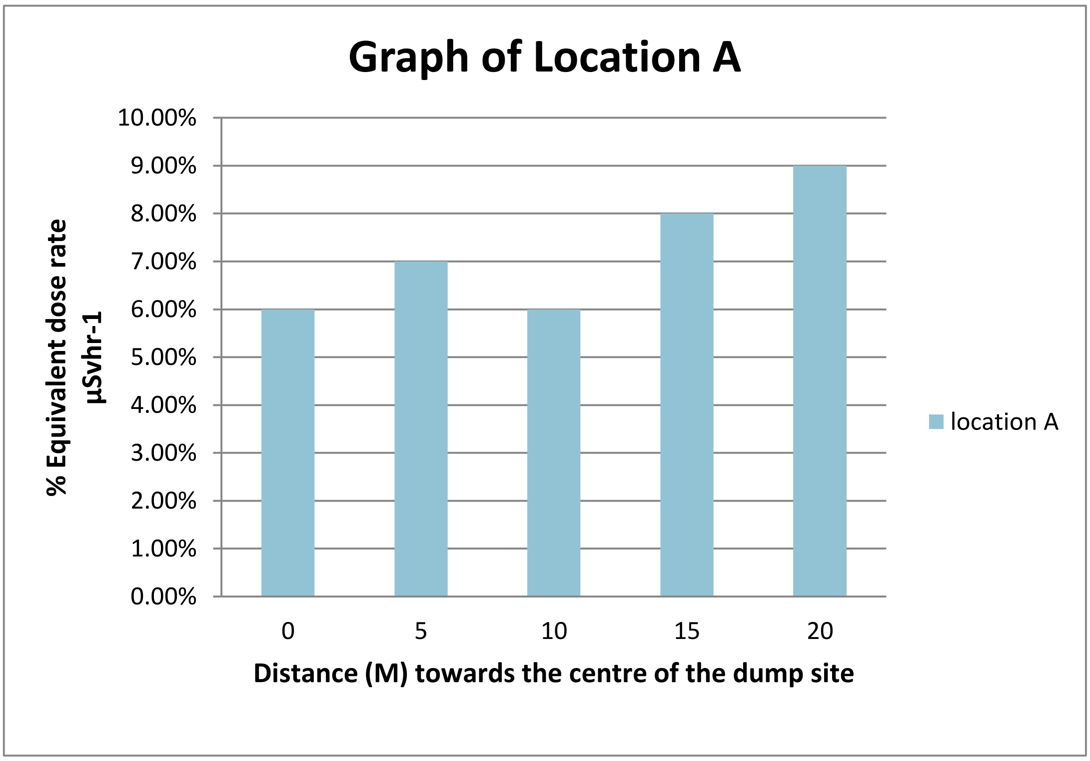
The Equivalent dose rate measured 1m above the surface at each point within the site is presented in (Table 4.1). The value for the sampled Ojota dump site varied from 0.06 & 0.14µSvhr-1. The radiation dose rates were found to change significantly with the change in altitude and latitude. The geomagnetic field effect was evident since as one move away from the equator towards the poles the radiation dose was found to be increasing. However the difference noted in radiation readings was not so huge since the changes in altitude was so small. The distance was measured with increase in Altitude. The Descending approach- In this approach, readings were taken with decrease with altitude. Radiation dose decreases with decrease in altitude.

Table 2

The table below shows the value of Estimated equivalent radiation dose in the dump site.

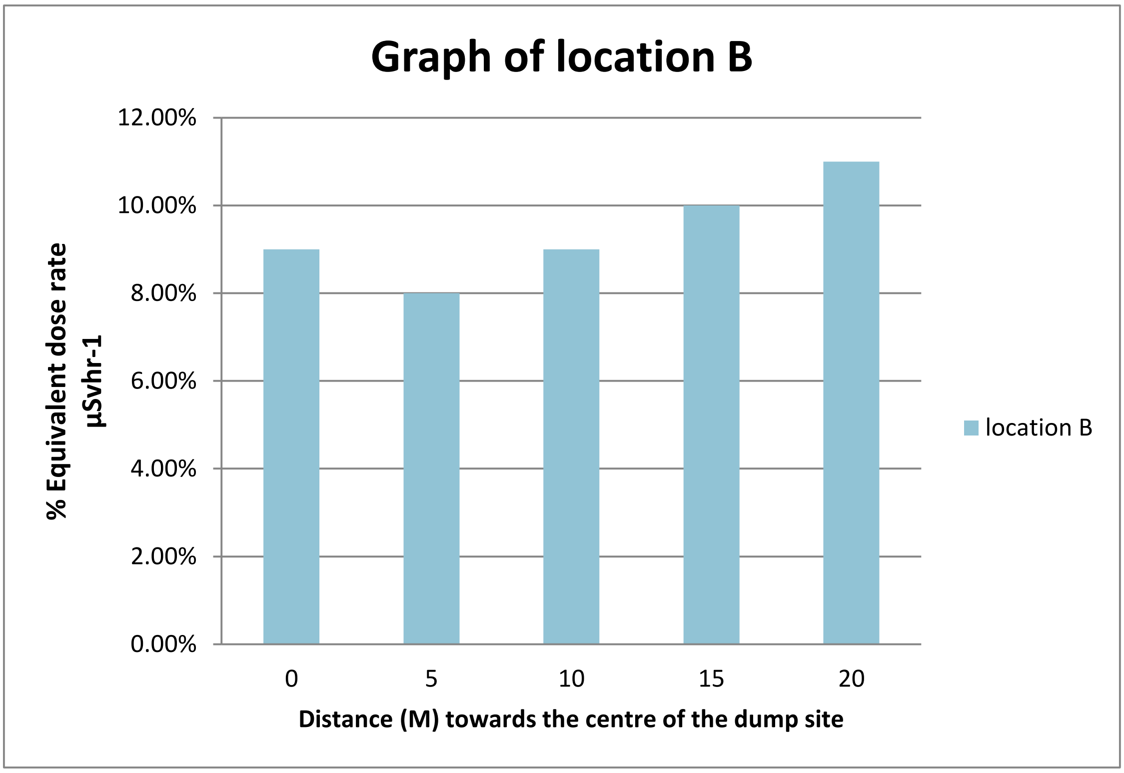
Distance (meter) Ascending	Equivalent Dose in Location A (μSvhr-1)	Equivalent Dose in Location B (μSvhr-1)	Equivalent Dose in location C (μSvhr-1)	Equivalent Dose in location D (μSvhr-1)	Equivalent Dose in location E (μSvhr-1)
0	0.06	0.09	0.11	0.08	0.09
5	0.07	0.08	0.1	0.08	0.13
10	0.06	0.09	0.11	0.14	0.12
15	0.08	0.1	0.12	0.13	0.1
20	0.09	0.11	0.13	0.11	0.12

FIGURE 1: The graph below shows the plot of equivalent dose rate percentage against distance with increase in Altitude in location A.



In figure 1, the graph shows that the equivalent dose rate measured increases 5 meters (m) away from the reference point (0 meter) on the dump site and if a distance of 10 m is further moved away from the reference point, a decrease in the equivalent dose rate at that point is noticed. Moving another 5 m away from the point where a decrease in the equivalent dose was noticed, the value of equivalent dose increases again. At 15 m and 20 m distance away from the reference point an increase in the value of the measured equivalent dose is noticed.

FIGURE 2: The graph below shows the plot of equivalent dose rate percentage against distance with increase in Altitude in location B



In figure 2, the graph shows that the equivalent dose rate measured 5 meters (m) away from the reference point (0 meter) first decreases, and if a distance of 5m is further moved (i.e. 10 m away from the reference point), an increase in the measured equivalent dose rate is now noticed. Further increase in the distance away from the reference point show that a further increase in the equivalent dose was measured.

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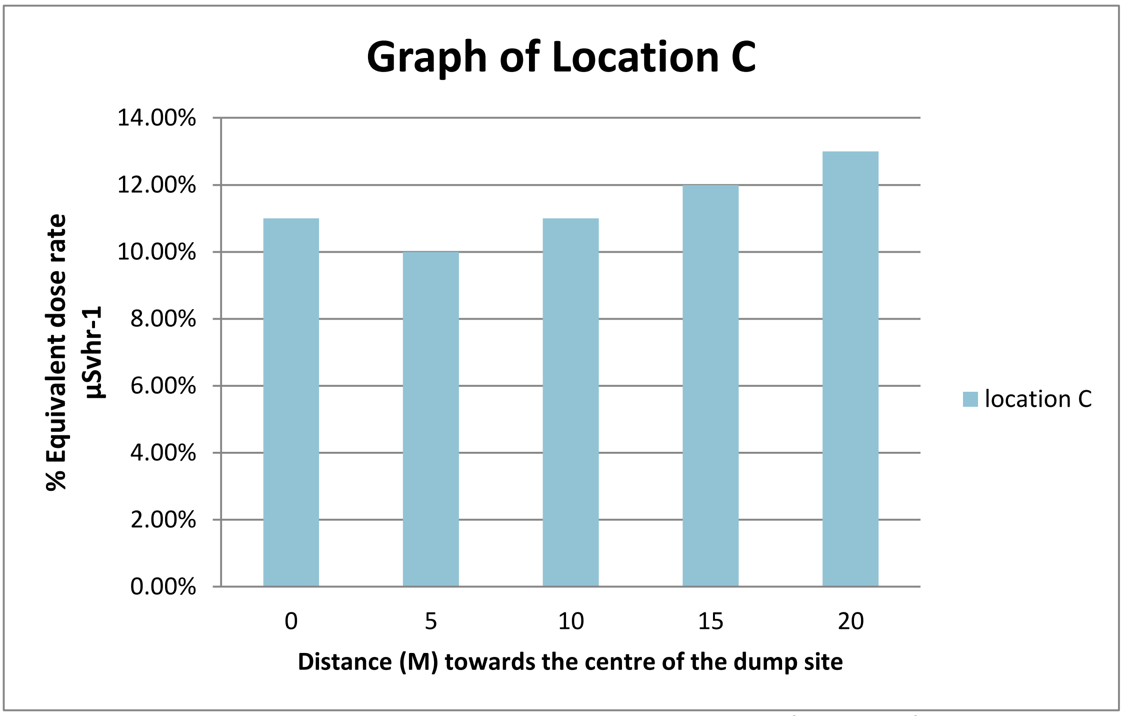
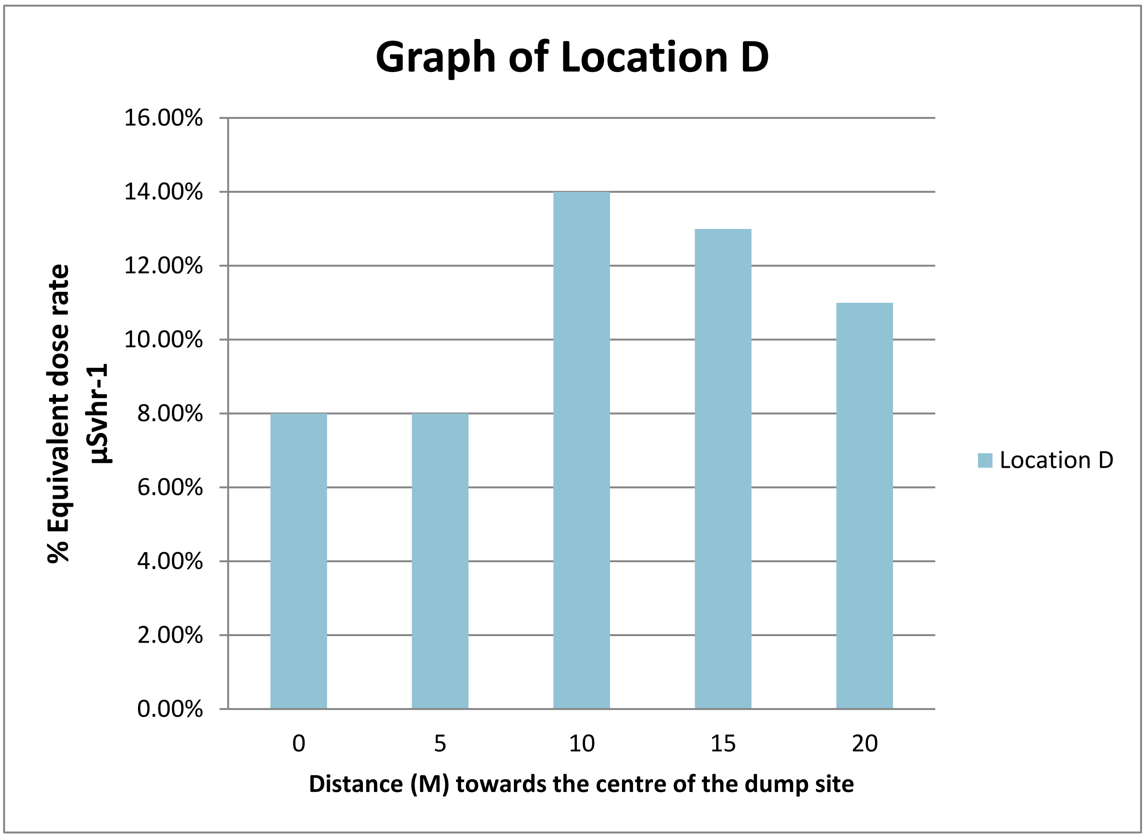
FIGURE 3: The graph below shows the plot of equivalent dose rate percentage against distance with increase in Altitude in location C.



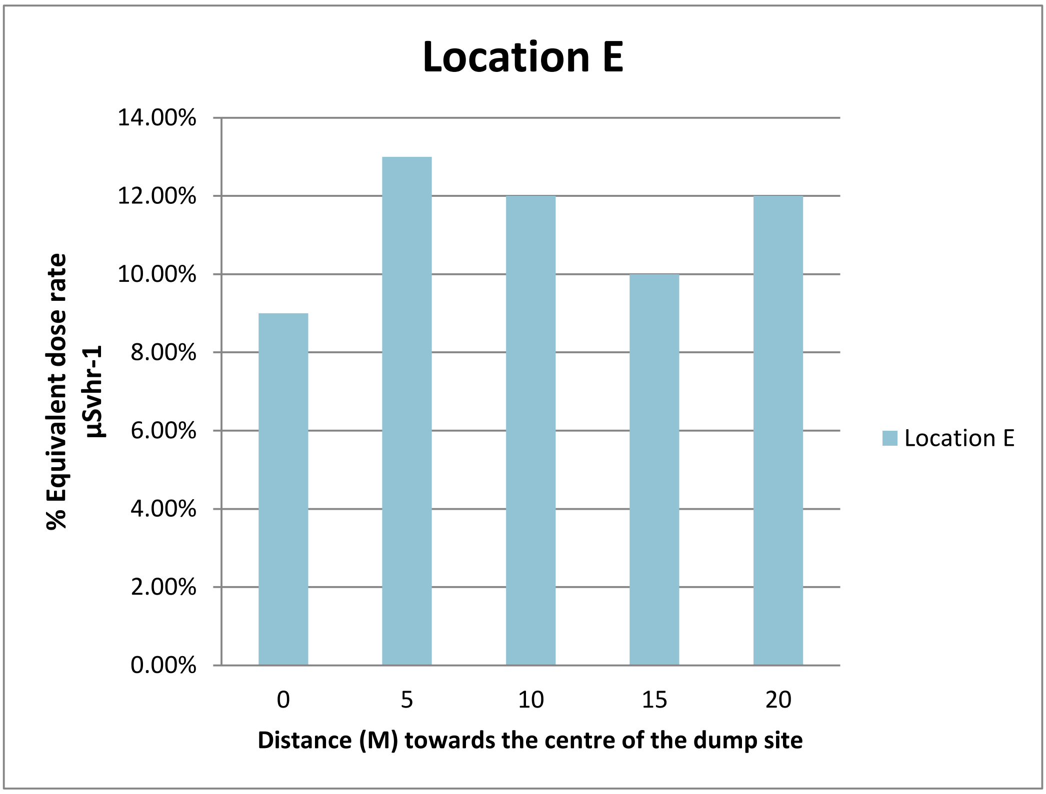
In figure 3, the graph shows that the equivalent dose rate measured 5 meters (m) away from the reference point (0 meter) first decreases, and if a distance of 5m is further moved (i.e. 10 m away from the reference point), an increase in the measured equivalent dose rate is now noticed. Further increase in the distance away from the reference point show that a further increase in the equivalent dose was measured.

FIGURE 4: The graph below shows the plot of equivalent dose rate percentage against distance with increase in Altitude in location D



In figure 4, the graph shows that the equivalent dose rate measured 5 meters (m) away from the reference point (0 meter) does not change initially. Moving another 5 m away from the point where an increase in the equivalent dose was noticed, (i.e. 10 m away from the reference point) the value of equivalent dose measured sharply increases. At 15 m and 20 m distance away from the reference point, the value of equivalent dose rate starts to decrease again. This tells us that if a person should stand 10m away from the reference point, he receives the highest exposure of radiation at that point. Unlike standing at the reference point or 5m away from the reference point where he will receive the lowest radiation dose.

FIGURE 5: The graph below shows the plot of equivalent dose rate percentage against distance with increase in Altitude in location E



In figure 5, the graph shows that the equivalent dose rate measured increases 5 meters (m) away from the reference point (point zero). Moving another 5 m away from the point where an increase in the equivalent dose was first noticed, (i.e. 10 m away from the reference point) the value of equivalent dose measured decreases.

At 15 m distance away from the reference point, the value of equivalent dose rate starts to decrease again, while at 20 m away from the reference point the value of the equivalent dose starts to increase again. This tells us that if a person should stand 5 m away from the reference point, he receives the highest exposure of radiation at that point. Unlike standing at the reference point where he will receive the lowest radiation dose.

DISCUSSION

From the graphs above, the graph appears to increase as distance increases with altitude. These graphs of the equivalent dose against the distance do not perfectly correlate (i.e there is fluctuations on all the graphs). This fluctuation is due to the topography of the dump site where measurement was taken.

The part of the graph that reduces shows that at that point, the topography of the land is not elevated and the equivalent dose measured at that point is low.

4 CONCLUSION AND RECOMMENDATION

CONCLUSION

The measured equivalent dose fall within the permissible dose limit for human, and varies with altitude. Radiation exposure is one of the causes of cancer. Majority of the people in Nigeria are unaware of radiation exposure and the health effects associated to the exposure.

RECOMMENDATION

From the current study the radiation levels in the sampled sites were found to be lower than the world limits. Since this area (Ojota) is one of the most densely populated areas in Lagos, there is likely probability of this small dose of radiation to cause cancer in the nearest future after long term effect on people living in the area. Safety measure should be taken;

1. Workers in the open industry around the area should be advised to use protective clothing so as to reduce the radiation exposure and the health risks accrued to the radiations. This will ensure that exposure is minimised and is within the acceptable limits. Further studies should be done in the study area to investigate the other possible sources of radiation exposure and other carcinogenic substance.

2. The government should enhance awareness on radiation exposure and the effects to the general public and also radiation workers so as to reduce effects that could be arising due to ignorance by the public. It should also take precaution on how waste materials are deposited to reduce effect to people leaving around and those working at the dumpsites.

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