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Industrial Ionising Radiation Activity: A Case Study of Western Geophysical Industry in Port Harcourt, Nigeria

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Abstract: In this study, the measurement of industrial ionizing radiation background was reported in Port Harcourt, Nigeria taking the western Geophysical Industry as a case study. The Geiger Muller Counter and its associated sensors were used to obtain counts of radiation at intervals of 10 min for about 1 h at each site. Count rates for the three chosen locations were 26.98±0.64, 37.19±1.06 and 35.40±1.95 cpm, respectively. The corresponding dose rates were 8.42±0.34, 11.60±0.28 and 11.04±0.30 μRh^{-1}. These values were found to be below the maximum permissible rate of 57 μRh^{-1} accepted internationally by the National Council on Radiation Protection (NCRP).

Key words: Ionising radiation, background radiation, environmental radiation, absorbed dose, dose rate, radioactivity

INTRODUCTION

The determination of ionizing radiation levels at the premises of industrial plants and buildings is receiving greater attention as the nation places emphasis on environmental standards required by the industries for their operations. It is ordinarily believed that the industrial activities of oil and oil related companies may raise the background radiation of their environment. This reasoning arises from the fact that the by-products of hydrocarbon (oil and gas), the chemicals used in sourcing for oil may contain radioactive particulates. To avert such reasoning which might or might not be true, there is therefore every justification to have regular radiation monitoring within the premises and operational locations of the affected industries. This is in line with the demands of the Federal Government of Nigeria for the operations of industries. This forms the basis of this study. Also, it is clear that there may be some amount of radioactivity in the soil or sand which adds to the background radiation to which man is exposed in any environment. However, the level of radioactivity of any soil or locality will depend on the elements found in such soils or locality. The awareness of the implications of the health situation of the environment with workers of an industry is another reason for this study.

The main contributor to background radiation is the gamma-ray absorbed dose from radioactive elements which may be uranium, thorium, radon or radioactive potassium (Klement *et al*., 1972). Ionising radiation monitoring has been done by some industrial companies in recent years. Notable among such industries are the Refinery and Fertilizer plants in Port Harcourt (Ebong and Alagoa, 1992). Monitoring radiation levels involves both *in situ* and laboratory methods. The particular method to be used depends on several factors. For fast estimates the *in situ* method is more suitable as this allows for quick results, preventing further damage to persons. In this study, estimates has made for three localities within the company.

MATERIALS AND METHODS

The Geiger Muller (GM) tubes have used for this particular measurement with associated Scalars. The Geiger Muller Counters are known to be non-energy dispersive and hence are effectively used for environmental radiation measurements. Reports of environmental monitoring levels in which GM counters have been used include, Ebong and Alagoa (1992); Day and King (1983); Aten *et al*. (1961). The GM tubes have a cylindrical geometry with internal diameter of 20 mm, a length of 56.0 mm and collector (sensor) window at one end of the cylinder. The mean dead time for the counter is 208±40 μs.

Calibration of equipment: Researchers followed an initial laboratory calibration. Two sources of known activities, Caesium 137 and Cobalt 60 were used which emit gamma-radiation of 0.662 MeV and a combination of

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1.17 and 1.33 MeV, respectively. These sources were exposed to a standard dosimeter which was calibrated in absorbed dose (0-200 μR). The dosimeter was placed 1 m away from the source and dose rates determined for times varying between 1 and 24 h.

In place of the dosimeter the GM tube was placed at 1 m away from the source and the corresponding count rates taken. In this way count rates were translated to absorbed doses after some calculations involving the diameter of the tube (Day and King, 1983). One count rate corresponds to an absorbed dose of 0.312 μRh^{-1} by the estimation.

Measurement in the field: Measurements were taken at three sites within the premises of the company:

- The open field area around the location of the explosive tanks
- Within the incinerator area
- Within the rooms of the core laboratory

The GM tube was place at 1 m above the ground and the count rates taken at 10 min intervals for 1 h at each site. The selected sites were chosen in accordance with the directives received during a reconnaissance survey which sites represent the likely or suspected impact localities.

Background measurements which serve as control were taken within the Rivers State University of Science and Technology, Port Harcourt. Count rates obtained from the sites were converted to absorbed or exposure dose-rates equivalent for man.

RESULTS AND DISCUSSION

Table 1-3 show the counts obtained for the open field area, the incinerator area and the core laboratory, respectively.

The acceptable maximum permissible exposure rate for gamma-rays in controlled areas is 57 μRh^{-1} according to the United States National Council on Radiation Protection and Measurement (NCRP, 1976). This value is permissible for non-classified persons that is persons who are only occasionally in contact with radiation.

The measurements for the three sites within the company; the open field near the explosive tanks, the incinerator area and the core laboratory showed exposure rates of 8.42±0.34, 11.60±0.29 and 11.04±0.30 μRh^{-1}, respectively. These values are far less than the maximum permissible dose rate accepted internationally as by the records of NCRP (1976).

Table 1: Showing the ionization counts and count rate at open field near the explosive tanks (a)

Time (min)	Count	Count Per Min (CPM)
10	255	25.50
20	555	27.75
30	840	28.00
40	1110	27.75
50	1360	27.20
60	1619	26.98

The average count per min is 26.98±0.64 corresponding to 8.42±0.34 μRh^{-1}

Table 2: Showing the ionization counts and counts rate at inicinerator area (b)

Time (min)	Count	Count Per Min (CPM)
10	344	34.40
20	733	36.65
30	1126	37.53
40	1527	38.18
50	1902	38.04
60	2300	38.33

The average count per min is 37.19±1.06 corresponding to 11.60±0.29 μRh^{-1}

Table 3: Showing the ionization counts and countsand counts rate at the core laboratory (c)

Time (min)	Count	Count Per Min (CPM)
10	420	42.00
20	740	37.00
30	1024	34.41
40	1331	33.28
50	1640	32.80
60	1975	32.92

The average count per min is 35.40±1.91 corresponding to 11.04±0.30 μRh^{-1}

However, they are slightly higher than the average background exposure rates (8.12 μRh^{-1}) shown by Ebong and Alagoa (1992). It is also worthy of note that the values fall within the ranges of typically measured values for some environments in the United States (NCRP, 1976) and Japan (Fujimoto, 1998).

Environmental exposure rates vary between 3-9 μRh^{-1} and in some cases as high as 100 μRh^{-1} in the United States (NCRP, 1976) while minimum and maximum city average exposure rates in Japan measured by Fujimoto (1998) are 3.9 and 16.9 μRh^{-1}, respectively. Wambersie *et al.* (2006) observed that if the exposed dose exceeds the maximum required by as little as (5%) it could result in tissue impairment.

CONCLUSION

Within the limits of calibration and field measurement errors, the valves obtained:

- 8.42 μRh^{-1} (70.22 nG γh^{-1})-Open field near explosive storage tank
- 11.60 μRh^{-1} (101.82 nG γh^{-1})-Incinerator area
- 1.04 μRh^{-1} (96.91 nG γh^{-1})-Core laboratory

showed that the incinerator has the highest exposure rate (11.60 μRh^{-1}). The materials burnt in the incinerator would therefore require proper disposal, so as not to allow it accumulate and cause possible radiation hazard. Also, for purposes of safety, persons working in the core laboratory may be made to wear dose meters to indicate any change in the radiation level of their environment. Generally, the company has normal radiation levels about the background exposure rate.

REFERENCES

Aten, A.H.W. Jr., I. Heertje and W.M.C. De Jong, 1961. Measurements of low level environmental radiation by means of Geiger Müller counters with observations in the Amsterdam area. Physica, 27: 809-820.

Day, L.R. and C.M. King, 1983. Radioactivity in water from River Lea. Environ. Pollut. Series B, Chem. Physical, 5: 1-8.

Ebong, I.D.U. and K.D. Alagoa, 1992. Estimates of gamma-ray background air exposure at a fertilizer plant. Discovery Innovat., 4: 25-28.

Fujimoto, K., 1998. Correlation between indoor radon concentration and dose rate in air from terrestrial Gamma Radiation in Japan. Health Phys., 75: 291-296.

Klement, A.W., C.R. Miller, R.P. Miux and B. Shleien, 1972. Estimates of ionising radiation doses in the United States 1960-2000. US Environmental Protection Agency Report ORP/CSD 72-1.

NCRP, 1976. Recommendations of the national council on radiation protection and measurement. Report No. 50, National Council on Radiation Protection Publication Office, Washington DC.

Wambersie, A., P.M. Deluca and J.C. MacDonald, 2006. Measurement quality assurance for ionizing dosimetry. J. ICRU, 6: 1-50.