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Survey of Background Ionization Radiation Level in Some Selected Automobile Mechanic Workshops in Uvwie LGA Delta State, Nigeria

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Abstract
Environmental radiation measurement was carried out in automobile mechanic workshops in Effurun, Uvwie Local government area of Delta State, Nigeria. An *in-situ* measurement was done using a well calibrated nuclear radiation meter (Radalert-100) and a geographical positioning system (GPS). The mean background Ionization radiation value in all the automobile mechanic workshops is 0.0167±0.002mR/hr while the mean Equivalent Dose Rate value is 1.428±0.002mSv/y. Both the background ionization radiation and equivalent dose rate levels obtained values exceeded the normal world average background ionization radiation (BIR) level of 0.013mR/h and 1.0mSv/y respectively (ICRP, 1999). This study revealed that the automobile mechanic workshops environment may have been impacted, but there is no immediate health implication. However, it will pose some long-term health side effects on the workers, residents and the environment.
Keywords: Survey, Ionization, Radiation, Dose, Automobile, Mechanic, Workshop.

Introduction

Environment radiation has been both advantageous and disadvantageous to man and the environment because of its many uses and hazards. Radiations come from mainly three sources namely: cosmic radiation, terrestrial radiation and radioactivity in the human body (Ike, 2003). It is the spontaneous decay of the nuclei of heavy isotopes that leads to emission of radiation. Man is continuously exposed to background ionization radiation emitting from Naturally Occurring Radioactive Materials (NORM) and petroleum product like fuel, kerosene, diesel, engine oil etc used by man both at home and in the work place. Furthermore, earth is naturally radioactive, and about 90% of human radiation exposure arises from natural sources such as cosmic radiation, exposure to radon gas and terrestrial radionuclides (Lee et al., 2004). If inhaled the aerosols containing radon may attach themselves to the lungs where gamma rays emitted in the decay may pose increase risk of lung cancer, eye cataracts and mental imbalances to man. It is important to monitor the terrestrial background ionization radiation mainly from automobile mechanic workshops.

Petroleum products (a by-product of crude oil) contain radionuclides since it is a naturally occurring liquid mineral deposited beneath the earth surface. Crude oil occurrence is most times accompanied with the existence of natural gas. The oil, gas, produce water and associated gas are generally these by-product of crude oil by automobile mechanics, the natural eco-system has been altered. This can gave rise to elevated background gamma radiation and environmental pollution. Background gamma radiation is emitted to the immediate environment from the used byproducts of crude oil and artificial sources. Excessive exposure to these ionizing radiation from by-products of crude oil can cause various long term health hazard on workers, immediate environments and the general public like, cancer, mental disorder, genetic mutation etc. (Jibiri *et al*., 1999; Abison, 2001). Researchers have found a strong correlation between radiation exposure and health hazard on man and its environmental ecosystem which are attributed to the domestic waste, agricultural waste, chemical toxic wastes, radiation waste, hazardous industrial waste, medical waste, metal scraps etc.

Nworgu *et al*., (2012) studied the measurement of gamma radiation in automobile mechanic workshops in an area of Benin city, Nigeria and reported that the average annual effective dose rate from the studied sites is approximately 0.4mSvy^{-1} which is lower than the standard value 1.0 mSvy^{-1} . The external background ionizing radiation exposure within the sites varied between 0.1272mR/hr and 0.01411mR/hr with an average of 0.01314±0.000658mR/hr in the locality which is relatively higher than the background ionization radiation standard.

Laogun *et al*., (2006) studied the variation in wellhead gamma radiation levels at the Nigeria petroleum development company oil field in Ologbo and reported that the values obtained are fairly higher than the normal background level, but they are in agreement with the International Atomic Energy Agency's standard on ionizing radiation background level.

Anekwe *et al*. (2013) studied the assessment of gamma-radiation levels in selected oil spilled areas in Rivers State, Nigeria and reported an average radiation value of 0.019±0.006mRh^{1}, and the average equivalent dose rate value of 1.6mSvy-^{1} both results exceeded the maximum permissible limit recommend for the public and non-nuclear industrial environment by International Council on Radiological Protection (ICRP,1999). This will

pose some long-term health side effects on the clean-up workers and residents of the host communities.

Some selected automobile workshops within Uvwie Local government area of Delta State, Nigeria were studied. The area lies within latitude $5^0$18"N and $5^0$68"N and longitude $5^0$33"E and $6^0$40"E South-West of Niger delta region of Nigeria. The geology of the study area has been reported earlier (Taiwo and Akalia, 2009). The lithological log correlation showed that the topsoil layer, which is composed of plastic clay, has a thickness ranging from 30ft-35ft, which is capable of protecting the underlain aquifer unit from being contaminated by surface toxic discharge. A silty sand/sandy layer directly underlies this, which form the aquifer unit of the study area. The area under study is a cosmo-political, heavily populated area of Delta State in the coastal area of Niger Delta. The automobile mechanic workshops are located within the communities. The need for precise and accurate information on the background ionization radiation levels of automobile mechanic workshop and the inadequate data on background radiation levels in this kind of environment lay credence to this study. Further estimate more of the level of degradation of the radioactive equilibrium of the areas and ascertain the radiological health side effects on the populace and the environment were examined.

2. Materials and Methods

2.1 Experimental Method

Well calibrated portable radiation survey meter with serial number 22205 containing a Geiger Muller tube capable of detecting Alpha, Beta, Gamma and X-rays within the temperature range of -10^{o}C to 50^{o}C was used to measure the exposure level in the field. An *in situ* approach of background radiation measurement was preferred and adopted to enable samples maintain their original environmental characteristics. A geographical positioning system (GPS) was used to measure the precise location of sampling. Measurements were taken once a day in each of the automobile mechanic workshop for one week and the average values obtained.

Readings were obtained between the hours of 1300 and 1600 hours each day, because the exposure rate meter has a maximum response to environmental radiation within these hours (Louis et al, 2005). The tube of the radiation meter was raised to a height of 1.0m above the ground with its window facing vertically downward (Avwiri et al., 2007). The detector was switched on to absorb radiation for a few seconds and the highest stable point was recorded. This was converted to annual absorbed dose rate in micro sievert per year ($mSvyr^{-1}$) (Avwiri and Agbalagba, 2012).

$1mRh\text{-}1=(0.96x24x365/100)mSvy^{-1}$ 1

3. Results and Discussion

The analysis of the obtained results showing the exposure rate and the dose equivalent of the Automobile Mechanic Workshops are presented in Tables 1 to 4.

TABLE 1: Background Radiation measurement at automobile mechanic workshop round DSC roundabout Effurun (AMWDSCRE).

S/NO	GEOGRAPHICAL LOCATIONS	Background Radiation level (mR/hr)						AV. RAD. VALUE (mR/hr)	Equivalent dose rate ($mSvy^{-1}$)
1.	N05^0 34.204', E005^{0}48.547'	0.017	0.017	0.019	0.016	0.020	0.019	0.0180±0.003	1.514±0.002
2.	N05^0 34.279', E005^{0}48.499'	0.018	0.020	0.023	0.019	0.017	0.018	0.0192±0.003	1.615±0.003
3.	N05^{0}34.300', E005^0 48.444'	0.016	0.014	0.017	0.015	0.016	0.016	0.0157±0.001	1.320±0.001
4.	N05^0 34.335', E005^0 48.387'	0.014	0.016	0.016	0.017	0.015	0.016	0.0156±0.001	1.312±0.001
5.	N05^0 34.334', E005^0 48.356'	0.026	0.022	0.019	0.023	0.020	0.018	0.0213±0.005	1.791±0.003
6.	N05^0 34.321', E005^0 48.342'	0.019	0.017	0.018	0.020	0.017	0.019	0.0183±0.003	1.539±0.002
7.	N05^0 34.402', E005^0 48.318'	0.015	0.013	0.013	0.015	0.016	0.017	0.0148±0.001	1.245±0.001
8.	N05^0 34.424', E005^0 48.300'	0.020	0.020	0.019	0.018	0.022	0.017	0.0193±0.003	1.623±0.003
9.	N05^0 34.444', E005^0 48.289'	0.016	0.016	0.017	0.015	0.018	0.017	0.0165±0.002	1.388±0.001
10.	N05^0 34.466', E005^0 48.268'	0.022	0.020	0.018	0.019	0.020	0.020	0.0198±0.003	1.665±0.003
MEAN		**0.0183**	**0.0175**	**0.0179**	**0.0177**	**0.0181**	**0.0177**	**0.0179**±0.002	**1.505±0.002**
STANDARD		0.013	0.013	0.013	0.013	0.013	0.013	0.013	I.00

TABLE 2: Background Radiation measurement at automobile mechanic workshops in Uti Road Effurun (AMWURE).

S/NO	GEOGRAPHICAL LOCATIONS	Background Radiation level (mR/hr)						AV. RAD VALUE (mR/hr)	EQUIVENT DOSE RATE ($mSvy^{-1}$)
1.	$N05^0$ 33.652', $E005^0$ 48.111'	0.016	0.015	0.017	0.018	0.016	0.016	0.0163±0.002	1.371±0.001
2.	$N05^0$ 33.655', $E005^0$ 48.099'	0.012	0.011	0.013	0.015	0.014	0.013	0.0130±0.001	1.093±0.001
3.	$N05^0$ 33.638', $E005^0$ 48.056'	0.025	0.023	0.021	0.024	0.019	0.020	0.0220±0.004	1.850±0.004
4.	$N05^0$ 33.680', $E005^0$ 48.189'	0.018	0.016	0.019	0.017	0.018	0.016	0.0173±0.002	1.456±0.002
5.	$N05^0$ 33.702', $E005^0$ 48.340'	0.016	0.019	0.016	0.016	0.014	0.018	0.0163±0.002	1.388±0.001
6.	$N05^0$ 33.785', $E005^0$ 48.607'	0.020	0.019	0.021	0.018	0.018	0.022	0.0197±0.003	1.657±0.003
7.	$N05^0$ 33.781', $E005^0$ 48.616'	0.018	0.018	0.017	0.019	0.016	0.017	0.0175±0.002	1.472±0.002
8.	$N05^0$ 33.773', $E005^0$ 48.634'	0.013	0.014	0.015	0.014	0.016	0.014	0.0142±0.001	1.194±0.001
9.	$N05^0$ 33.752', $E005^0$ 48.661'	0.015	0.017	0.016	0.016	0.015	0.016	0.0158±0.001	1.329±0.001
10.	$N05^0$ 33.736', $E005^0$ 48.683'	0.014	0.014	0.013	0.016	0.015	0.017	0.0148±0.001	1.245±0.001
MEAN		**0.0167**	**0.0165**	**0.0168**	**0.0173**	**0.0161**	**0.0169**	**0.0167**±0.002	**1.405±0.002**
STANDARD		0.013	0.013	0.013	0.013	0.013	0.013	0.013	1.00

TABLE 3: Background Radiation measurement at automobile mechanic workshop in sapele road Effurun (AMWSRE).

S/NO	GEOGRAPHICAL LOCATIONS	Background Radiation level (mR/hr)						AV. RAD. VALUE (mR/hr)	Equivalent dose rate ($mSvy^{-1}$)
1.	$N05^0$ 35.322', $E005^0$46.498'	0.014	0.017	0.016	0.016	0.015	0.016	0.0157±0.001	1.320±0.001
2.	$N05^0$ 35.346', $E005^0$46.466'	0.021	0.018	0.017	0.020	0.022	0.018	0.0193±0.003	1.623±0.003
3.	$N05^0$ 35.361', $E005^0$ 46.482'	0.016	0.018	0.015	0.016	0.017	0.016	0.0163±0.002	1.371±0.001
4.	$N05^0$ 35.365', $E005^0$ 46.489'	0.016	0.017	0.017	0.016	0.018	0.020	0.0173±0.003	1.455±0.002
5.	$N05^0$ 35.383', $E005^0$ 46.497'	0.015	0.013	0.019	0.016	0.015	0.014	0.0153±0.001	1.287±0.001
6.	$N05^0$ 35.401', $E005^0$ 46.521'	0.018	0.020	0.017	0.015	0.016	0.016	0.0170±0.003	1.430±0.002
7.	$N05^0$ 35,433', $E005^0$ 46.544'	0.017	0.017	0.018	0.016	0.015	0.014	0.0162±0.002	1.362±0.001
8.	$N05^0$ 35.450', $E005^0$ 46.568'	0.013	0.011	0.012	0.013	0.014	0.016	0.0132±0.001	1.110±0.001
9.	$N05^0$ 35.472', $E005^0$ 46.635'	0.016	0.018	0.015	0.017	0.014	0.015	0.0158±0.001	1.329±0.001
10.	$N05^0$ 35.611', $E005^0$ 46.642'	0.022	0.020	0.020	0.019	0.017	0.021	0.0198±0.003	1.665±0.003
MEAN		**0.0168**	**0.0169**	**0.0166**	**0.0164**	**0.0163**	**0.0166**	**0.0166**±0.002	**1.396±0.001**
STANDARD		0.013	0.013	0.013	0.013	0.013	0.013	0.013	I.00

Table 4: Background Radiation Measurement in Automobile Mechanic Workshops at Ekpan, Effurun (AMWEE).

S/NO	GEOGRAPHICAL LOCATIONS	Background Radiation level (mR/hr)						AV. RAD. VALUE (mR/hr)	Equivalent dose rate ($mSvy^{-1}$)
1.	$N05^0$ 34.342', $E005^0$44.568'	0.013	0.016	0.014	0.013	0.017	0.015	0.0147±0.001	1.236±0.001
2.	$N05^0$ 34.366', $E005^0$44.604'	0.018	0.017	0.016	0.018	0.018	0.017	0.0173±0.002	1.455±0.002
3.	$N05^0$ 34.416', $E005^0$ 44.844'	0.015	0.014	0.017	0.016	0.013	0.016	0.0152±0.001	1.278±0.001
4.	$N05^0$ 34.448', $E005^0$ 44.900'	0.020	0.017	0.019	0.019	0.021	0.020	0.0193±0.003	1.623±0.003
5.	$N05^0$ 34.222', $E005^0$ 44.368'	0.014	0.016	0.015	0.013	0.016	0.016	0.0150±0.001	1.261±0.001
6.	$N05^0$ 34.249', $E005^0$ 44.380'	0.018	0.018	0.019	0.017	0.016	0.018	0.0176±0.002	1.480±0.002
7.	$N05^0$ 34.285', $E005^0$ 44.411'	0.017	0.016	0.015	0.017	0.018	0.015	0.0163±0.002	1.371±0.001
8.	$N05^0$ 34.304', $E005^0$ 44.430'	0.016	0.014	0.014	0.014	0.015	0.017	0.0150±0.001	1.261±0.001
9.	$N05^0$ 34.531', $E005^0$ 44.846'	0.023	0.019	0.021	0.020	0.017	0.018	0.0197±0.003	1.657±0.003
10.	$N05^0$ 34.566', $E005^0$ 44.872'	0.015	0.016	0.017	0.018	0.016	0.016	0.0163±0.002	1.371±0.001
MEAN		**0.0169**	**0.0163**	**0.0167**	**0.0165**	**0.0167**	**0.0168**	**0.0167**±0.002	**1.404±0.002**
STANDARD		0.013	0.013	0.013	0.013	0.013	0.013	0.013	I.00

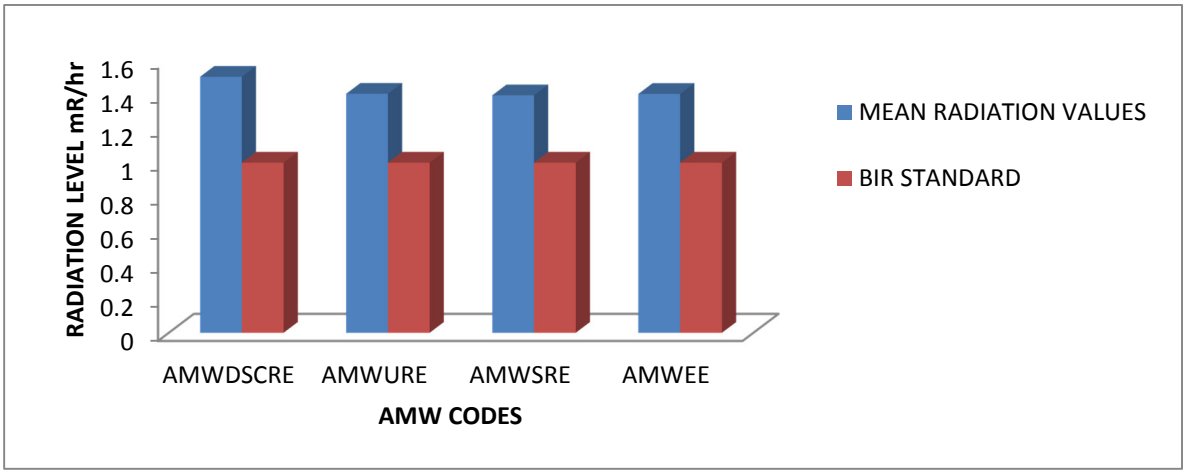

Fig. 1: Comparison of Automobile Mechanic Workshops Mean BIR Levels with the Standard BIR Level

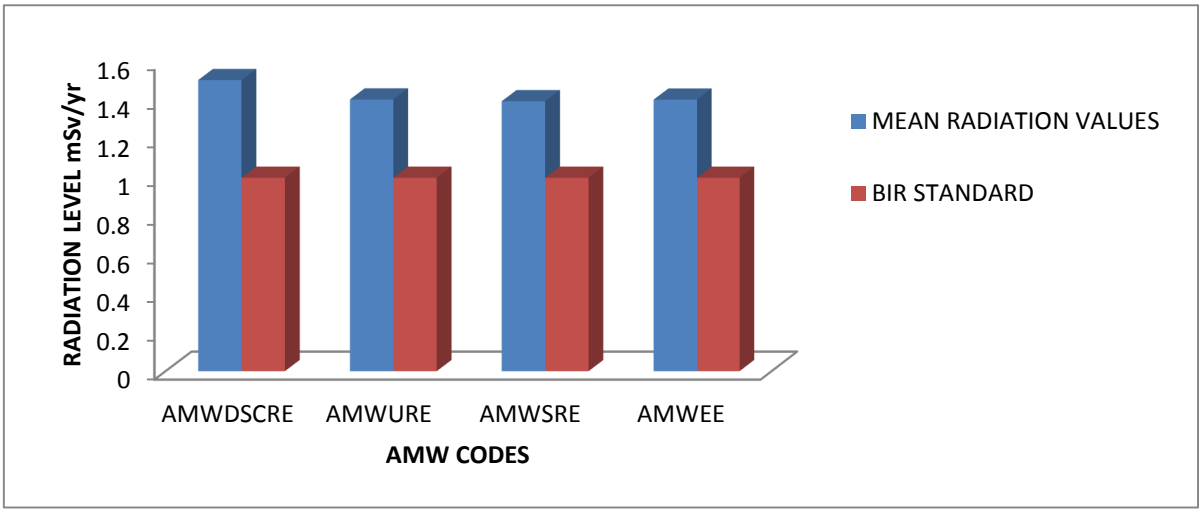

Fig. 2: Comparison of Automobile Mechanic Workshops Mean Equivalent dose rates with maximum permissible limit standard.

The mean Background Ionization Radiation rate measured at automobile mechanic workshop round Delta steel company (DSC) roundabout Effurun (AMWDSCRE) environment exposure rate ranged from 0.0175±0.002mRh^{-1} to 0.0183±0.003mRh^{-1} with a mean average value of 0.0179±0.002mRh^{-1}; and the Equivalent dose rate (mSvy^{-1}) ranged from 1.245±0.001 mSvy^{-1} to 1.792±0.003mSvy^{-1} with a mean value of 1.505±0.002mSvy^{-1}, while it goes from 0.0161±0.002mRh^{-1} to 0.0173±0.003mRh^{-1} with a mean average value of 0.0167±0.002mRh^{-1} and the Equivalent dose rate (mSvy^{-1}) ranged from 1.194±0.001 mSvy^{-1} to 1.850±0.004mSvy^{-1} with a mean value of 1.405±0.002mSvy^{-1} for Background Radiation measured at automobile mechanic workshops at Uti Road Effurun (AMWURE). For Background Radiation measured at automobile mechanic workshop at sapele road Effurun (AMWSRE) the exposure rates ranged from 0.0163±0.002mRh^{-1} to 0.0169±0.002mRh^{-1} with a mean average value of 0.0166±0.002mRh^{-1} and the Equivalent dose rate (mSvy^{-1}) ranged from 1.110±0.001 mSvy^{-1} to 1.665±0.003mSvy^{-1} with a mean value of 1.396±0.001mSvy^{-1}. The exposure rate values of background ionization radiation measured at Automobile Mechanic Workshops at Ekpan, Effurun (AMWEE) is not different, its ranged from 0.0163±0.002mRh^{-1} to 0.0169±0.002mRh^{-1} with a mean average value of 0.0167±0.002mRh^{-1} and the Equivalent dose rate (mSvy^{-1}) ranged from 1.236±0.001 mSvy^{-1} to 1.657±0.003mSvy^{-1} with a mean value of 1.404±0.002mSvy^{-1}. The highest mean average value was recorded at AMWDSCRE, while the least was obtained from AMWSRE. The values obtained when compared with the global background ionization radiation (BIR) standard of 0.013mRh^{-1} shows that they are all slightly higher than the standard. These can be attributed to the hydrocarbon by-products such as fuel, oil, etc used by the Automobile Mechanic technicians and metals scraps. The results of the computed equivalent dose rate in all automobile mechanic workshops are slightly above the dose limit of 1.0mSv/yr for the general public and far below the dose limit of 20.0 mSv/yr for radiological workers as recommended by international Commission on Radiological Protection (ICRP, 1990). Fig. 4 and 5 shows the comparison of mean background ionization radiation (BIR) levels of all background ionization radiation measured

at Automobile Mechanic Workshops with the background ionization radiation (BIR) permissible standard level and comparison of Automobile Mechanic Workshops Mean Equivalent dose rates with maximum permissible limit standard. The results obtained fall below the values reported by Avwiri and Agbalagba (2012) when compared. Furthermore, the results obtained are in agreement with some previously reported values in oil spills (hydrocarbon) environment by Anekwe, Avwiri and Agbalagba (2013); Chad-Umoren and Ohwekevwo (2013), in oil and gas environment of the Niger Delta of Nigeria. Thus confirming the sources of these increase values to the hydrocarbon by-products and metals scrap.

These results showed that the immediate environment are contaminated due to background ionization radiation attributed to hydrocarbon by-product used by Automobile Mechanic technicians.

CONCLUSION

The measurements of the external environmental radiation around automobile mechanic workshops in Uvwie Local government area of Delta State, Nigeria has been carried out. The study revealed that the mean average radiation obtained values are higher than the normal background standard of 0.013mR/h. The computed equivalent dose rate results are also higher than dose limit of 1.0mSv/yr for the general public and far lower than dose limit of 20.0mSv/yr for the general public (ICRP, 1999). The measurement shows that the terrestrial radiation level of the areas may have been affected by the activities of the automobile mechanic. These reported values may indicate no immediate health hazards, but may cause long-term health hazard to the workers and residents of the host communities due to increase with longer period of operation.

We therefore recommended the following:

- All automobile mechanic workshops should be relocated from residence area.
- Used hydrocarbon by-products should be stored in a container for proper disposal to avoid contamination of the area soil.
- Automobile Mechanic technicians should use radiation Personal Protection Equipment during work hours.
- Regular clean up and remediation exercises should be carried out within the automobile mechanic workshops environment.

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