IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 10, Issue 6 Ver. I (Jun. 2016), PP 103-108
www.iosrjournals.org

Measurement Of Specific Activity Concentration Of Radionuclides Of ^{226}Ra, ^{232}Th And ^{40}K In Selected Crude Oil Impacted Fields In The Niger Delta.

[1]Anekwe, U.L., [2]Avwiri, G.O., [2]Ononugbo, C.P.
[1]*Department of Physics, Federal University Otuoke, Bayelsa State, Nigeria*
[2]*Department of Physics, University of Port Harcourt, Choba Port Harcourt, Nigeria.*

Abstract: *The activity concentrations of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K were determined in soil samples collected from crude oil and gas environment in a selected part of the Niger Delta region of Nigeria using NaI detector based on gamma spectroscopy. The activity concentration of ^{226}Ra, ^{232}Th, ^{40}Kin field 1 ranged from15.87±6.6 to 48.08±4.63, 38.29±1.82 to 83.71±2.39, 116.50±7.62 to 243.39±10.73respectively.The activity concentration of ^{226}Ra, ^{232}Th, ^{40}K in field 2 ranged from 14.02±1.60 to 48.08±4.63, 47.79±0.75 to 76.45±5.03, 41.60±0.67 to 227.65±14.14 respectively. The activity concentration of ^{226}Ra, ^{232}Th, ^{40}Kin field 3 ranged from36.38±1.62 to 101.83±9.85, 46.42±2.92 to 81.55±2.62, 125.17±6.22 to 214.90±8.09 respectively. The activity concentration of ^{226}Ra, ^{232}Th, ^{40}Kin field 4 ranged from10.54±2.62 to 62.33±4.40, 50.69±2.05 to 64.55±1.86, 115.69±3.59 to252.53±13.22 respectively. The activity concentration of ^{226}Ra, ^{232}Th, ^{40}K in field 5 ranged from 9.96±1.04 to 101.83±6.5, 35.92±1.71 to 85.24±4.25, 107.60±5.13 to274.34±11.42 respectively. In general, the average activity concentrations for the identified radionuclides of ^{226}Ra, ^{232}Th and ^{40}K for soil samples ranged from 29.30 Bqkg^{-1} to 62.06 Bqkg^{-1}, 53.63 Bqkg^{-1} to 61.15 Bqkg^{-1}, 145.66 Bqkg^{-1} to 193.37 Bqkg^{-1} respectively. At different points, the specific activity concentration exceeded that of the control and world standard values,suggesting that the enhancement is as result of oil and gas activities. It then means that the host communities and oil companies operating in the area should take precautionary measure to curtail the possible health effect through consumption of farm produce from those areas.*

Keyword: *Specific activity, radionuclides, enhancement*

I. Introduction

Human beings could be exposed to ionising radiation through the emission of radionuclides in the contaminated soil and water within active oil fields. The internal hazard requires the incorporation of radioactive materials into the body through ingestion or inhalation. Once incorporated, the radionuclides are distributed in the body and irradiate living tissues at close quarters by alpha, beta particle emission, and gamma photons (1). The doses vary depending on the concentrations of the natural radionuclides of U^{238}, Th^{232}, their daughter products and K^{40}, present in the soils and rocks, which in turn depend upon the local geology of each region in the world (1).

In recent time, there has been an increasing interest in the study of radioactivity in various soil, oil sludge, sand, etc. (2). However, the study areas have not been assessed for radiation contamination, hence the need to investigate specific activity of Ra^{226}, Th^{232} and k^{40} in soil and water of the affected areas using Sodium Iodide detecting technique. Since Naturally Occurring Radioactive Materials (NORMs) can contaminate the environment and may pose a risk to human health, it therefore becomes necessary to assess the level of enhancement of radionuclides of Ra^{226}, Th^{232} and k^{40} in the host community of the oil fields under consideration.

II. Experimental Method

The actual measurement was done by using sodium iodide detector doped with Therlium,{NaI(TI)}. Theoretically, the activity concentrations (C) in Bqkg^{-1} of the radionuclides in the samples could be calculated after decay correction using the expression:

$$C_s = \frac{N_{Ey}}{\varepsilon_{Ey} x M_s x t_c x P_\gamma} \quad (\text{Bqkg}^{-1}) \qquad (1)$$

Where C_s = Sample concentration, $N_{Ey=}$ net peak area of a peak at energy, ε_{Ey}= Efficiency of the detector for a γ-energy of interest, M_s =Sample mass, t_c= total counting time, P_γ=Emission probability of radionuclide of interest. The prepared samples were stored for a period of four weeks before measurement commenced to ensure secular equilibrium between ^{226}Ra and short lived daughters (3). The detector {NaI(TI)} is interfaced with the electronic system through coaxial cable. In the process of detecting radiation, the radiation detectors produce electrical signals and these signals are processed through the processes of amplification, shaping and analysis.

III. Results

The results are shown in tables 1 to 5 and in figures 1 to 8

Table i: Specific Activity concentration of Radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 1

S/N	Sample Code	^{226}Ra Bq/kg	^{232}Th Bq/kg	^{40}K Bq/kg
1	M_1	26.06±3.48	47.33±1.60	181.31±8.71
2	M_2	34.07±3.59	74.70±1.82	212.56±8.90
3	M_3	32.79±4.98	47.33±1.87	132.79±7.15
4	M_4	15.87±6.60	38.29±1.82	116.50±7.62
5	M_5	48.08±4.63	57.14±3.36	227.65±14.15
6	M_6	18.93±3.13	83.71±2.39	243.39±10.73
Average Value		29.30±4.40	58.10±2.14	185.70±9.54
Control		25.84±2.34	48.20±2.54	162.14±2.49
UNSCEAR (4)		35	30	400

Table ii: Specific Activity concentration of Radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 2

S/N	Sample Code	^{226}Ra Bq/kg	^{232}Th Bq/kg	^{40}K Bq/kg
1	AL_1	48.08±4.63	57.14±3.36	227.65±14.15
2	AL_2	44.48±3.41	76.45±5.03	132.17±6.22
3	AL_3	14.02±1.60	48.83±1.59	41.60±0.67
4	AL	23.87±2.66	47.79±0.75	144.30±5.58
5	AL_5	21.66±9.27	58.17±4.68	115.69±5.59
6	AL_6	34.07±3.59	74.70±7.82	212.56±3.90
Average Value		31.03±4.19	60.51±3.87	145.66±6.02
Control		25.84±2.34	48.20±2.54	162.14±2.49
UNSCEAR (4)		35	30	400

Table iii: Specific Activity concentration of Radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 3

S/N	Sample Code	^{226}Ra Bq/kg	^{232}Th Bq/kg	^{40}K Bq/kg
1	AgI_1	36.38±1.62	52.69±1.73	130.31±4.66
2	AgI_2	49.70±3.24	50.41±1.26	214.90±8.09
3	AgI_3	101.83±9.85	59.42±1.14	185.97±9.13
4	AgI_4	44.25±3.48	81.55±2.62	212.25±11.21
5	AgI_5	44.49±1.40	76.41±1.03	125.17±6.22
6	AgI_6	95.69±3.71	46.42±2.92	198.26±7.46
Average Value		62.06±3.38	61.15±1.78	177.81±7.80
Control		25.84±2.34	48.20±2.54	162.14±2.49
UNSCEAR (4)		35	30	400

Table iv: Specific Activity concentration of Radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 4

S/N	Sample Code	^{226}Ra Bq/kg	^{232}Th Bq/kg	^{40}K Bq/kg
1	Ig_1	62.33±4.40	63.53±6.96	179.60±12.94
2	Ig_2	21.66±9.27	58.17±0.68	115.69±3.59
3	Ig_3	23.87±2.67	47.79±0.75	144.30±5.60
4	Ig_4	36.38±1.62	52.69±1.73	130.31±4.67
5	Ig_5	14.74±4.59	50.69±2.05	199.81±12.59
6	Ig_6	10.54±2.62	64.55±1.86	252.53±13.22
Average Value		28.25±4.20	56.27±2.34	170.37±8.77
Control		25.84±2.34	48.20±2.54	162.14±2.49
UNSCEAR (4)		35	30	400

Table v: Specific Activity concentration of Radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 5

S/N	Sample Code	^{226}Ra Bq/kg	^{232}Th Bq/kg	^{40}K Bq/kg
1	$Obgb_1$	9.96±1.04	44.37±3.80	274.34±11.42
2	$Obgb_2$	95.69±3.70	46.42±3.92	198.26±7.46
3	Obgb3	30.24±1.62	35.92±1.71	179.16±6.93
4	$Obgb_4$	49.70±3.24	50.41±1.25	214.90±8.09
5	$Obgb_5$	40.55±2.78	85.24±4.25	107.60±5.13
6	$Obgb_6$	101.83±6.5	59.42±1.14	185.97±12.13
Average Value		54.83±3.15	53.63±2.68	193.37±8.53
Control		25.84±2.34	48.20±2.54	162.14±2.49
UNSCEAR (4)		35	30	400

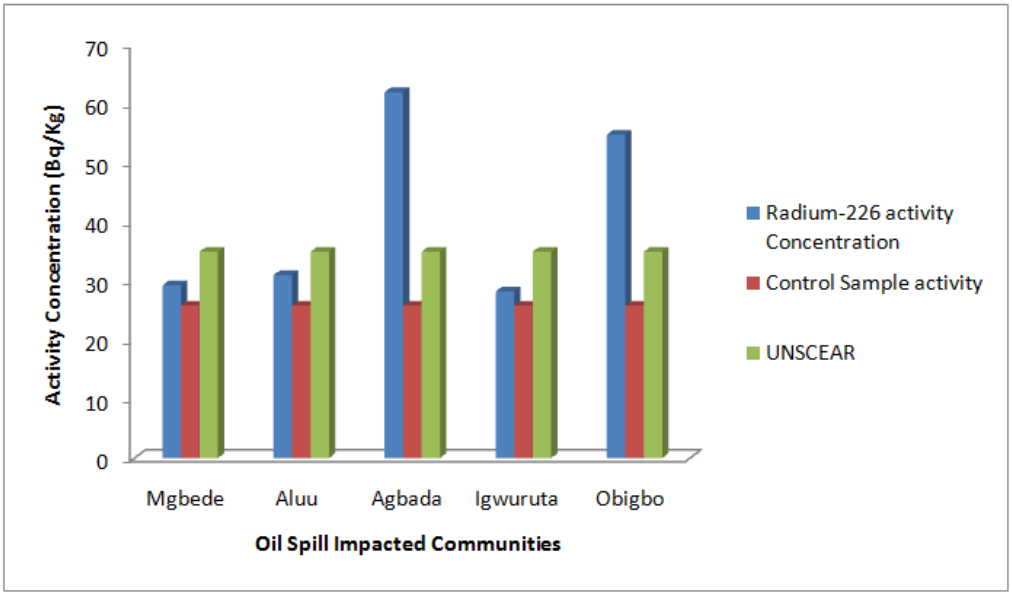

Fig 1: Comparison of Average ^{226}Ra concentration in study areas with control sample and world background level

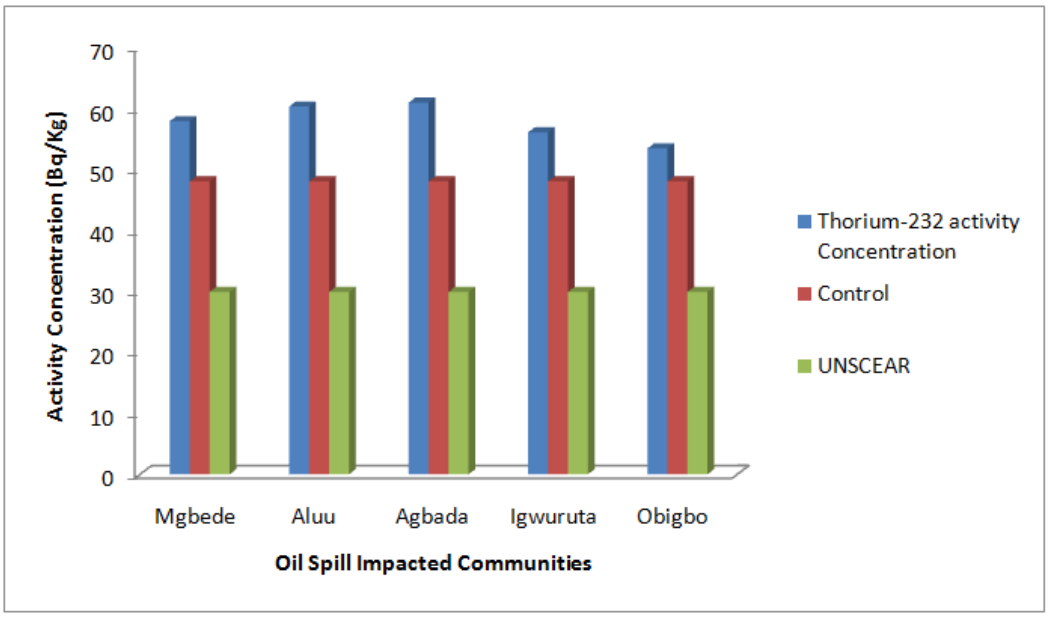

Fig 2: Comparison of average ^{232}Th concentration in study areas with control sample and world background level

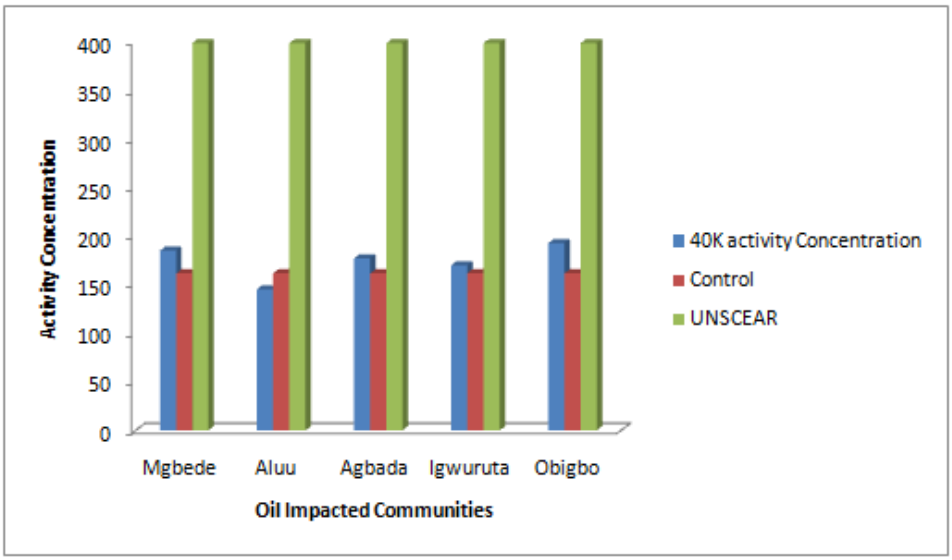

Fig 3: Comparison of average ^{40}K concentration in study areas with control sample and world background level

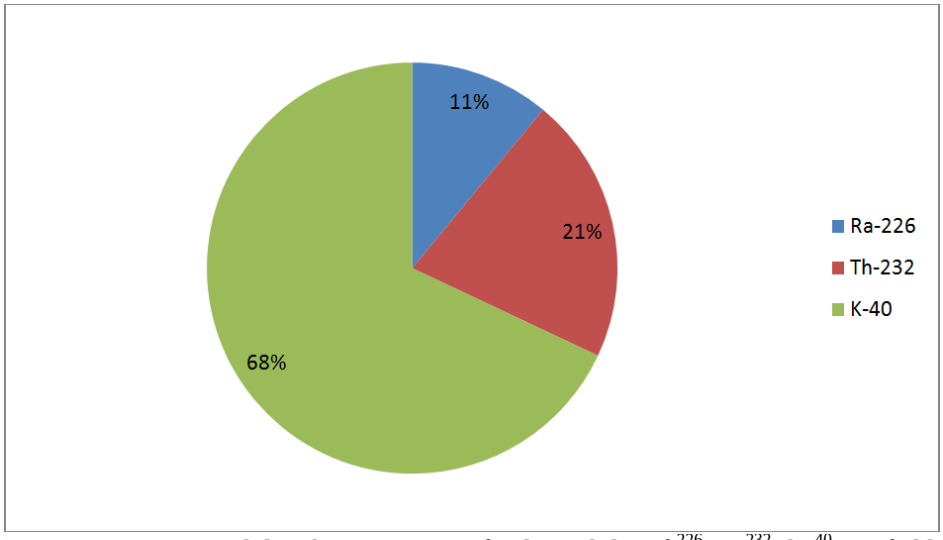

Fig 4: Percentage spatial distribution pattern of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 1

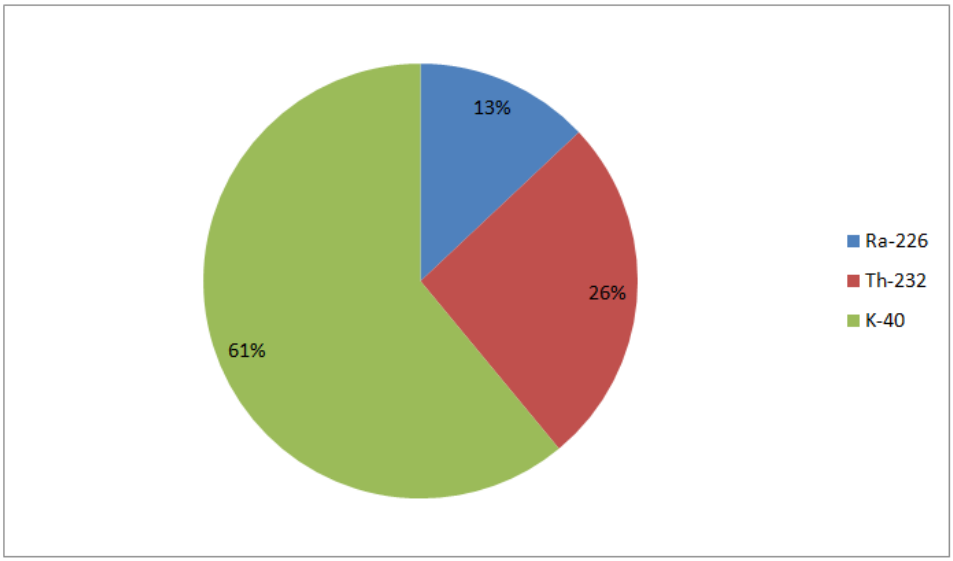

Fig5: Percentage spatial distribution pattern of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 2

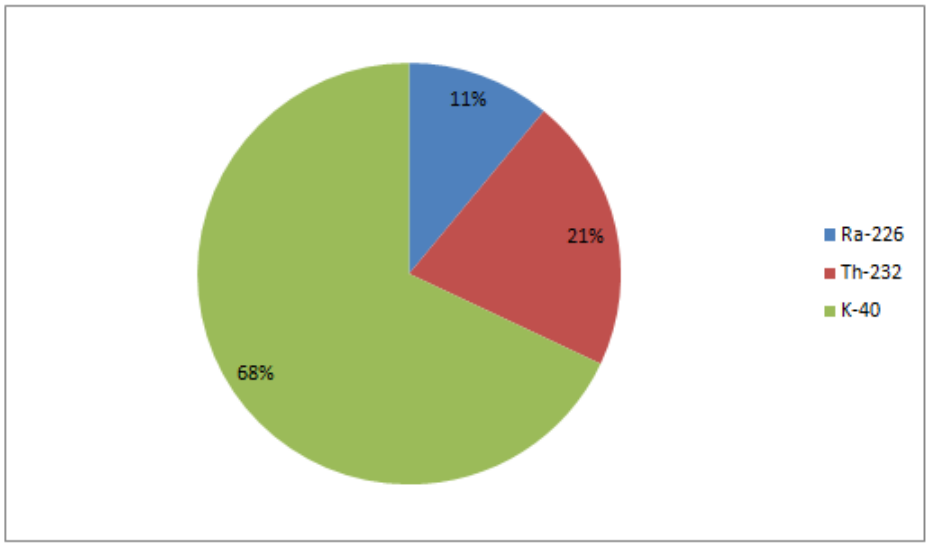

Fig 6: Percentage spatial distribution pattern of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 3

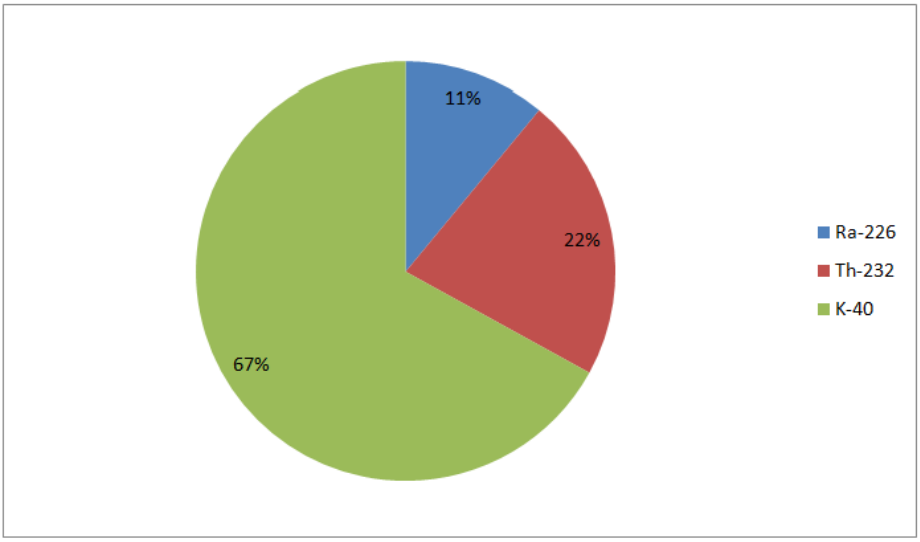

Fig 7: Percentage spatial distribution pattern of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 4

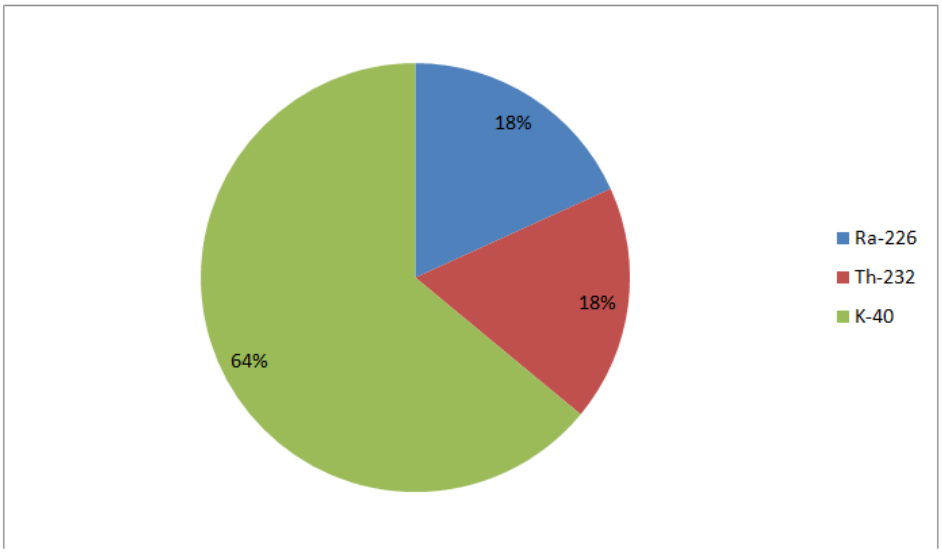

Fig 8: Percentage spatial distribution pattern of radionuclides of ^{226}Ra, ^{232}Th, ^{40}K in field 5

IV. Discussions

The mean activity concentration of ^{226}Ra at oil field 1 is within the international standard of 35 $Bqkg^{-1}$ and it is in agreement with that obtained by Ononugbo and Avwiri (2012) in a similar oil and gas environment. The mean activity concentration of radioisotopes of ^{232}Th and ^{40}K at field 1 are well above the values reported by *Olomo et al*.,(1994) for non oil bearing environment of Ile-Ife. This therefore suggests that the oil spills have impacted negatively on the environment investigated.

Activity concentrations of radionuclides of ^{232}Th and ^{40}K at field 5 were found to be higher when compared with the values obtained by Senthilkumar*et al*., (2010) for soil sample for non oil bearing environment. At field 2 the values obtained for ^{232}Th exceeded the world standard as well as the control. However, these obtained values are in agreement with results recorded by Agbalagba*et al*., (2012) in a similar environment of the Niger Delta region of Nigeria. At the field 3 oil spilled site, the values obtained for ^{226}Ra and ^{232}Th are well above the world standard values of 35 and 30 Bq/kg respectively, and are also higher when compared with the values of 27.41 $Bqkg^{-1}$ and 19.27 $Bqkg^{-1}$ obtained by Olarewaju*et al*., (2011) in non oil polluted environment of Eliozu Landfill. Therefore, the elevation of the activity concentrations may be as a result of the oil spillage. At field 4 oil spilled site the mean activity of ^{40}K remains within normal and it is in agreement with that obtained by Agbalagba*et al*., (2012) in a similar environment. The mean value of activity concentration of ^{232}Th at field 4 is well above that recorded by Alaamer (2012) for soil sample in non crude oil spill environment of Saudi Arabia. Therefore the enhancement of activities of these radionuclides in the study area may be associated with frequent oil spillages.

V. Conclusion

The values of determined specific activity concentration of identified radionuclides of ^{226}Ra, ^{232}Th, ^{40}K for soil samples at field 1 are 29.30±4.40, 58.10±2.14, 185.70±9.54 Bq/kg respectively. The values of determined specific activity concentration of identified radionuclides of ^{226}Ra, ^{232}Th, ^{40}K for soil samples at field 2 are 31.03±4.19, 60.51±3.87, 145.66±6.02 Bq/kg respectively. The values of determined specific activity concentration of identified radionuclides of ^{226}Ra, ^{232}Th, ^{40}K for soil samples at field 3 are 61.15±1.78, 177.81±7.80, 161.77±7.03 Bq/kg respectively. The values of determined specific activity concentration of identified radionuclides of ^{226}Ra, ^{232}Th, ^{40}K for soil samples at field 4 are 28.25±4.20, 56.27±2.34, 170.37±8.77 Bq/kg respectively. The values of determined specific activity concentration of identified radionuclides of ^{226}Ra, ^{232}Th, ^{40}K for soil samples at field 5 are 54.83±3.15, 53.63±2.68, 193.37±8.53 Bq/kg respectively.

The obtained gamma activity spatial distribution pattern showed that the activities of ^{226}Ra and ^{40}K are within the recommended value by UNSCEAR (35, 400 Bq/kg) except the average values of ^{226}Ra in field 3 and field 5, while ^{232}Th exceeded the standard limit (30 Bq/kg) in all the locations. Radiogenic survey of the affected areas is recommended for further studies while the obtained values serve as baseline data.

References

[1]. Mehra, R., Kumar, S., Sonkamade, R., Singh, N.P., and Babhan, K., (2009). Analysis of terrestrial naturally occurring radionuclides in the soil samples from some areas of Sirsa district of Haryana, India. *Environmental earth Sciences*, (59) 1159-1164

[2]. Alam, M.N., Chowdhury, M.I., Kamal, M., Ghose, S., and Ismal, M.N., (1999). The ^{226}Ra, ^{232}Th and ^{40}K activities in beach sand minerals and beach soil of Cox's Bazer. *Bangladesh Journal of Environmental Radioactivity*, 46(2):243- 250.

[3]. Zarie, K.A. and Al Mugren, K.S. (2010). Measurement of natural radioactivity and assessment of radiation hazard in soil samples from Tayma area (KSA). *Isotope and Radiation Research*, 42(1): 1- 9.

[4]. United Nations Scientific Committee on Effects of Atomic radiation (1988). Sources and effects of ionizing radiation, UNSCEAR Report, New York, 1993.

[5]. Ononugbo, C.P. and Avwiri, G.O. (2012). Natural radioactivity levels in surface soil of Ogba/Egbema/Ndoni oil and gas fields. *CSCanada Energy Science and Technology*, volume 4, (2) 92-101

[6]. Olomo, J.B., Akinloye, M.K. and Balogun, F.A. (1994). Distribution of gamma emitting natural radionuclides in soil and water around nuclear research establishments, Ile-Ife, Nigeria. *Nuclear Institute and Methods in Physics*, (A353) 553-557

[7]. Senthilkumar, B., Dhavamani, V., Ramkuma, S. and Philominathan, P., (2010). Measurement of gamma radiation levels in soil samples from Thanjavur, using γ- ray spectrometry and estimation of population exposure. *Journal of Medical Physics*, 35: 48- 53.

[8]. Agbalagba, E.O., Avwiri, G.O., and Chad-Umoren, Y.E., (2012). Gamma spectroscopy measurement of natural radioactivity and assessment of radiation hazard indices in soil samples from oil fields environment of Delta State, Nigeria. *Journal of Environmental Radioactivity*, 109 (2012), 64-70.

[9]. Olanrewaju, A.I., Avwiri, G.O. and Nte, F.U., (2011). Determination of radionuclides concentration of landfill at Eliozu, Port Harcourt. *Scientia Africana*, 10 (1), 46-57.

[10]. Alaamer, A.S., (2012). Measurement of natural radioactivity in sand sample from Ad-DahnaDesert.*Journal of Nuclear Science*, (2), 4