ENVIRONMENTAL IMPACT ASSESSMENT OF SELECTED PETROL STATIONS OPERATING FOR BETWEEN (19-25) YEARS OLD IN THE WARRI – EFFURUN METROPOLIS IN DELTA STATE OF NIGERIA

By

ARIERHE ARHAGBA

Petroleum and Natural Gas Processing Engineering Technology Department.
Petroleum Training Institute Effurun, Delta State, Nigeria

ABSTRACT

This paper is the result of a research work carried on some selected Petrol station aged between 19 and 25 years in the Warri – Effurun Metropolis.

It was found that the level of acidity in the soil up to a depth 1.524m was very high in all the Petrol stations under study as compared to the ones at the control point location. The values of the heavy metals in the locations under study (N_i, P_b, G) *showed highest concentrations in all the stations under study except those of the control location. These values are also higher than the standard of the World Health Organization (WHO).*

The paper called for compliance and that all stake-holders should adhere strictly to the environmental quality standards and control measures already established to ensure safe ecosystems monitoring and management. It stressed that all the statutory monitoring/Inspectorate units of the government should be fully equipped with the necessary working tools and personnel to ensure that safe environmental quality is sustained. Corporate Organizations must be sensitized to be in their operations socially responsible the paper also, stressed that environmental of communication and community education should be fully encouraged to sensitize stake-holders on compliance and reporting implications.

INTRODUCTION

[1]According to the American society of testing and materials (ASTM (1989)) over the last twenty years, contamination of soil and ground water by crude oil and refined Petroleum products has gained national and International attention because of the serious problems that have been discovered across the United States of America.

[2]From available data, ground water contamination is of special concern as approximately 50% of all drinking water supplies come from ground water sources in developed world. [3]In Nigeria, as an under developed country the statistics is put at about 95%.

[4]One of the most recent prominent phenomena is what is referred to in this paper as "Petrol Station scroll." Petrol stations dot every city in Nigeria, from state to state. The unplanned nature of many Nigerian cities are even more compounded and complicated by unplanned and unapproved Petrol Stations that do not conform to government statutory specifications, standards or any health, safety and environment standards of the oil and gas industry. [5]The same spectacle of future danger is heightened by the presence of Petrol storage tanks at most road sides welding and fabrication workshops which are at the moment doing brisk but bizarre business of fabricating specifications below sub-standard fuel storage tanks with low quality materials for the storage Petroleum products.

[6]A great deal of concerns are now being expressed over the consequences of increasing soil contamination around petrol stations operating in Nigeria due to incidence of leakage and massive petroleum products spillage in some Nigerian cities, and their immediate environs and effect of the these products on the underground water table. [7]Furthermore, several scientific reports show that Petroleum products spread and leakages of the underground product storage tanks into subterranean ground water beds and formation would poison and contaminate the water beds. Other schools of thought opine that petroleum products in sufficiently high concentration may negatively impact on something of value such as: underground water, soil nutrient and physico-chemical and bacteriological characteristics of the soil, quality of life of man, health, safety and environmental and optimum condition for all living things. [8]It

should be noted that refined petroleum products are more toxic than crude oils.

[9]Infact, toxicity is related to the content of light aromatics fractions present.

[10]The toxicity of hydrocarbons increase with increasing molecular weight of product and related to aqueous solubility and bio-concentration potential. [11]The adverse biological effects on birds and mammals via inhalation, ingestion and exposure from: Petroleum product contaminated food, drinking petroleum – contaminated water, orally consume petroleum product during processing and grounding behaviour. [12]On human beings acute toxic effects of petroleum products includes.

1. Drying of the skin
2. Irritation of mucous membranes
3. Diarrhea
4. Narcotic effects and possible death may occur.

[13]Generally, the releases of Petroleum products may have an immediate and direct effect on wild life population; the potential for the physical and toxicological effect attenuates with time as the value of material diminishes, leaving behind more persistent, less volatile and less water soluble compounds.

1.0 [14]Sources of Petroleum Stations Ecosystem Pollution

1. Underground storage tank leakages includes

a. Nigeria environment is highly corrosive.

b. Inappropriate materials selection of substandard materials that are usually cheaper but not specified by the technical experts.

c. Presence of weld defects and weldment underground tanks

d. Patronage of quack welders and usage of their tank products without NDT testing to validate or detect defects and correct errors in fabrication.

e. Poor welding process and practice

f. Insufficient trained and certified welders.

g. [11]Insufficient/non-availability of high quality welding equipment facility.

h. High corrosivity of most Nigerian soils

i. Non-monitoring and compliance to mandatory retirement /replacement of underground storage system/structures and such like facility

j. [12]Non-monitoring of the effect of vibration on underground storage system with heavy duty tonnage vehicular movement in and out of filling-station

k. Improper location of petrol stations

1.1 [15]Ring-off from activities operational other sources of ecological systems of pollution are runs-off from usually overfilled tanks of vehicles into petrol station grounds and which are later washed – off into the environment. [16]Other includes engine-oil, gear box oil etc changed by station mechanics that are poured into nearby drainage.

2.0 Methodology This is an experimental research. The purposive sampling method was used. Age of petrol station was a major consideration.

2.1 Equipment/materials configuration The equipment used in this research as shown in table 1.0

Table 1.0: Equipment/materials configuration

S/N	EQUIPMENT/MATERIALS	GRADE/MODEL	VENDOR/PRODUCERS
1	Atomic absorption spectrophotometer (AAS)	Buck scientific model VGP 210	Pye unicam limited Cambridge England
2	Weighing machine	PB 303	Mettler Toledo limited England
3	Hot plate	-	Gollenkampi
4	Spectrophotometer	DR/4000U	HARCH
5	Conductivity meter	HACH 150 D	HARCH
6	pH meter	5900 – 20	Cole palmer Instrument company
7.	Filter paper (425nm)	Whatman No. 41	W and palmer Instrument company
8	Measuring cylinder	500ml, 100ml	E-mil, England
9	Volumetric flask	50ml, 100ml, 1000ml	Wood brother glass co limited, England.
10	Micro pipette	0.20cm^{3}m in 0.01 Ex 20°c	Moramber Limited in Great Britain
11	Crude Oil	-	UQCC
12	Concentrated H_2SO_4	AR Grade	BDH, England
13	Centrifuge		HACH
14	Sodium sulphate (N_2SO_4)	-	-
15	Hydrogen peroxide (H_2O_2)	-	-

3.1 Standard Chemical Laboratory Procedures and Process

in this research. Two locations were carefully selected for purposes of collecting samples of soils around each of the filling stations labeled A, B, C, D, E and K (a control point). The age of these stations ranged from 19 to 25 years at depths of 0.305m, 0.914m and 1.524m respectively. A total of 18 – samples were collected and carefully labeled with respect to the location/point from which they were collected.

3.2.1 Experimental Work Results

The detailed procedures and standard scientific chemical laboratory practices and international recognized codes as Hach were complied with. The procedures carried-out included the determination of: soil (PH), electrical conductivity (Ms/cm) total

hydrocarbon content (THC-mg/d), nitrogen content (total kjeldahl nitrogen %) and heavy metals (Pb, k, N_i, chromium)

[14]Generally, the results obtained from the analysis of soils at the various depths of 0.305m, 0.914m and 1.524m respectively of the five selected petrol stations in Effurun – Warri metropolis A, B, C, D, E, and k (control point) show general regular pattern indicating that data generated were actually representative of samples collected and were properly processed to acceptable quality.

The results are shown in fig 1.0

Table 2.0: The result of survey data

Location	Depth (m)	pH	Electrical conductivity EC ms/cm	Total hydrocarbon content THC (mg/I)	N (%)	P (mg/I)	K (meg/g)	Ni (mg/kg)	Pb (mg/kg)	Cr (mg/kg)
A	0.305	5.6	1028.5	10.9	0.08	8.45	0.08	1.331	1.499	1.332
	0.914	6.5	1187.2	3.15	0.12	10.38	0.09	0.124	1.12	1.019
	1.524	6.8	1053.7	<1.00	0.12	9.65	0.1	0.094	0.06	0.195
B	0.305	6.0	1057.3	6.35	0.09	6.88	0.09	1.24	1.304	1.225
	0.914	6.3	1146.6	2.7	0.11	8.49	0.1	0.152	0.649	0.731
	1.524	6.7	1039.8	0.8	0.1	9.54	0.11	0.12	0.115	0.203
C	0.305	6.0	1014.4	1.62	0.09	7.36	0.05	1.253	1.532	1.317
	0.914	6.4	1164.9	1.05	0.12	9.17	0.1	0.133	1.119	1.01
	0.524	6.8	1274.5	<1.00	0.17	9.69	0.14	0.075	0.045	0.19
D	0.305	5.6	1124.3	5.76	0.09	7.43	0.1	1.421	1.503	1.275
	0.914	6.2	1054	2.46	0.13	10.64	0.12	0.156	0.642	0.597
	0.524	6.5	1136.7	<1.00	0.17	11.47	0.15	0.064	0.064	0.175
E	0.305	6.0	1031.6	9.75	0.1	6.79	0.08	1.201	1.503	1.24
	0.914	6.5	1195.8	3.06	0.14	10.42	0.1	0.12	1.12	0.675
	0.524	7.2	1067.4	<1.00	0.17	11.34	0.13	0.037	0.037	0.21
K (control)	0.305	6.2	1014.9	1.62	0.1	6.76	0.07	0.253	0.537	0.624
	0.914	6.5	1264.3	1.02	0.15	8.49	0.11	0.13	0.452	0.379
	0.524	7.2	1346.7	<1.00	0.17	9.04	0.14	0.049	0.039	0.277

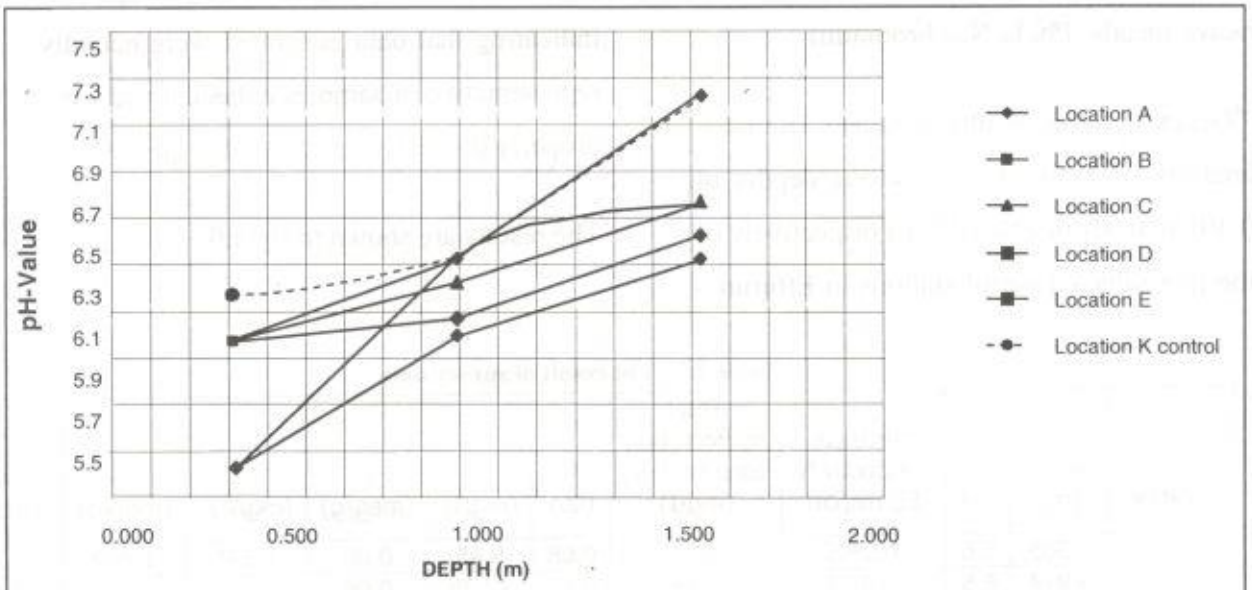

Figure 1: Plot of pH against depth

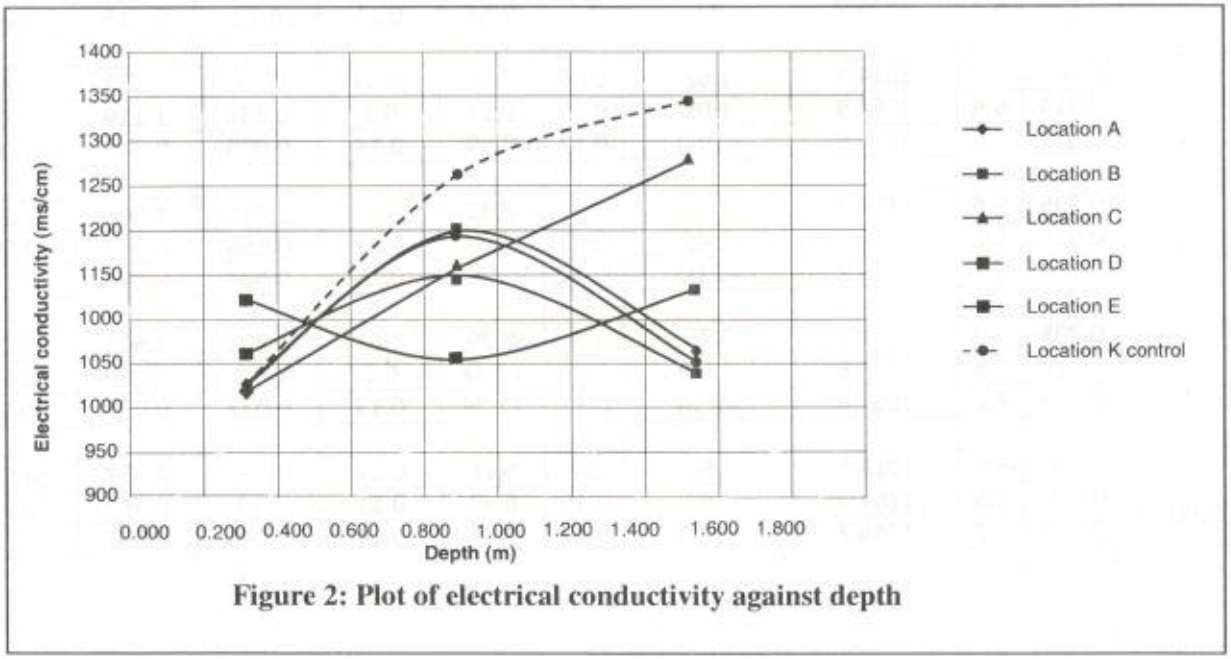

Figure 2: Plot of electrical conductivity against depth

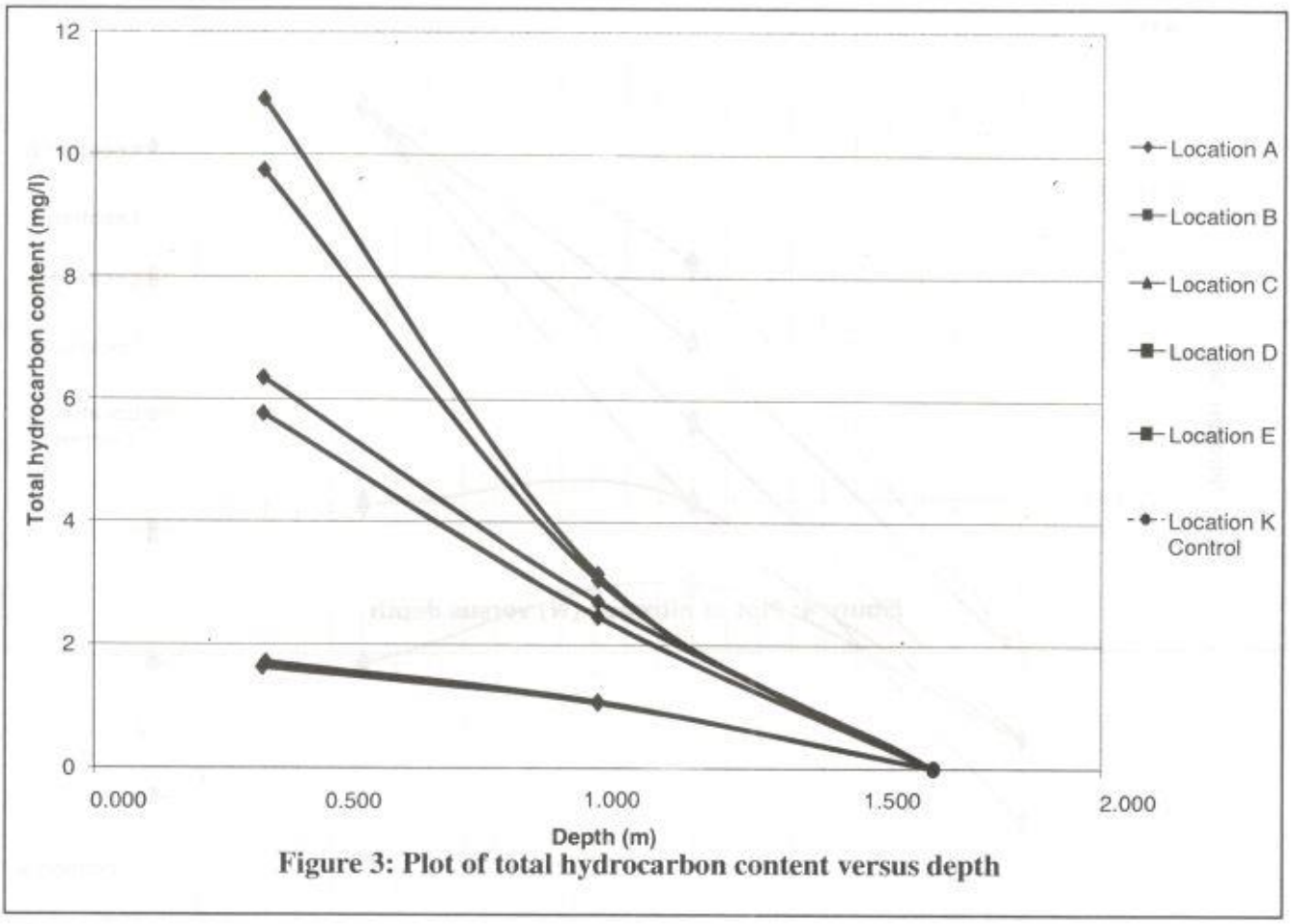

Figure 3: Plot of total hydrocarbon content versus depth

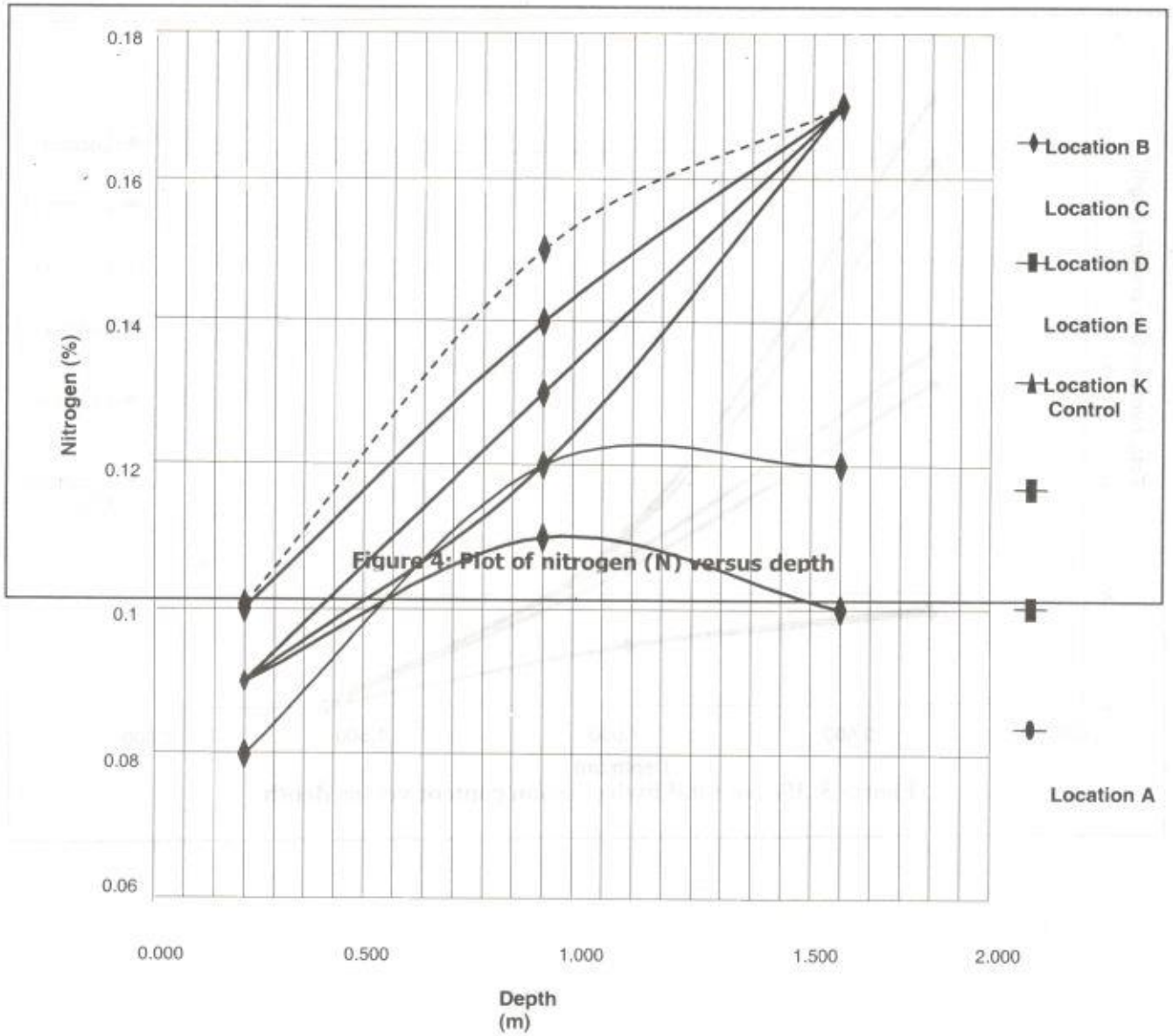

Figure 4: Plot of nitrogen (N) versus depth

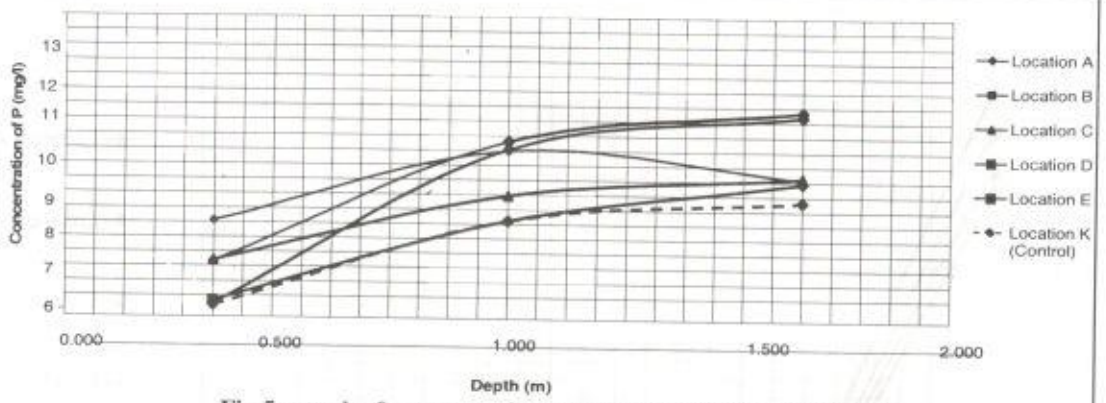

Fig 5: graph of concentration of phosphorus (p) versus depth

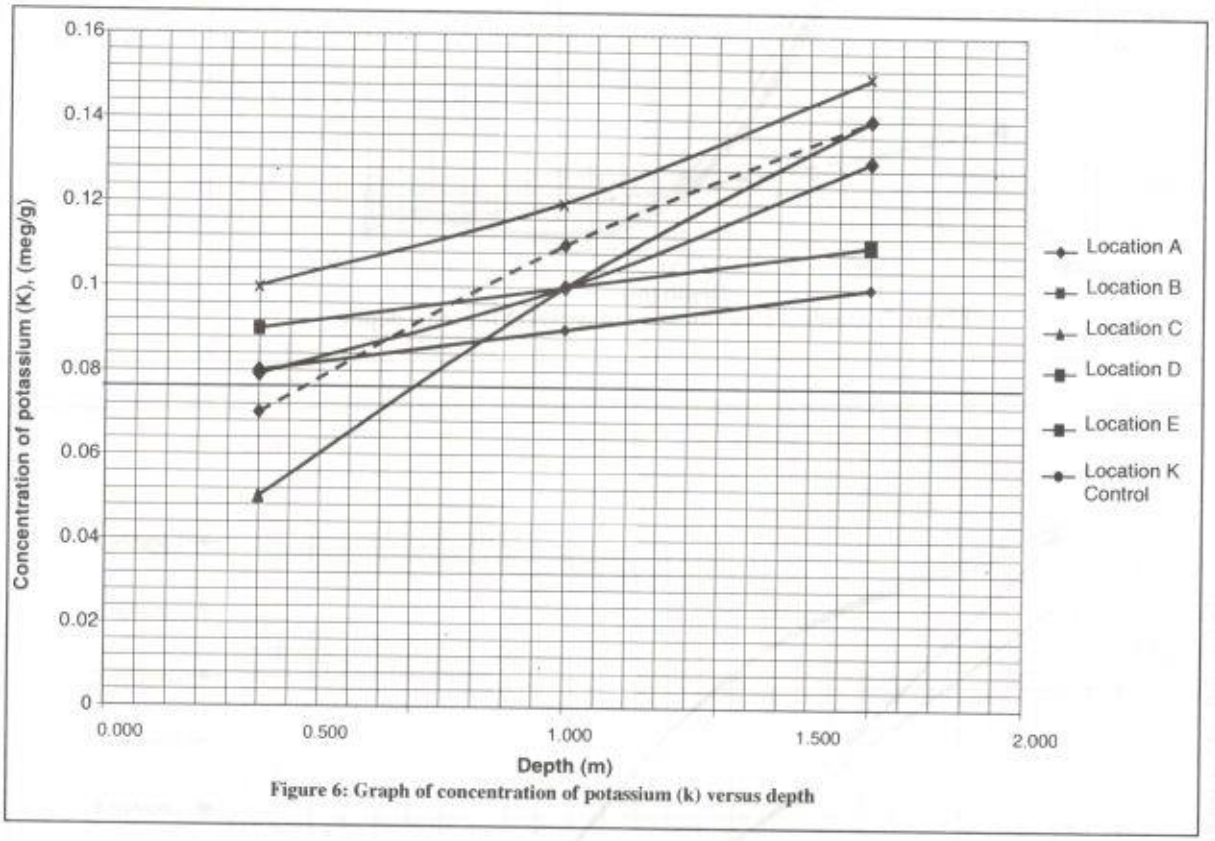

Figure 6: Graph of concentration of potassium (k) versus depth

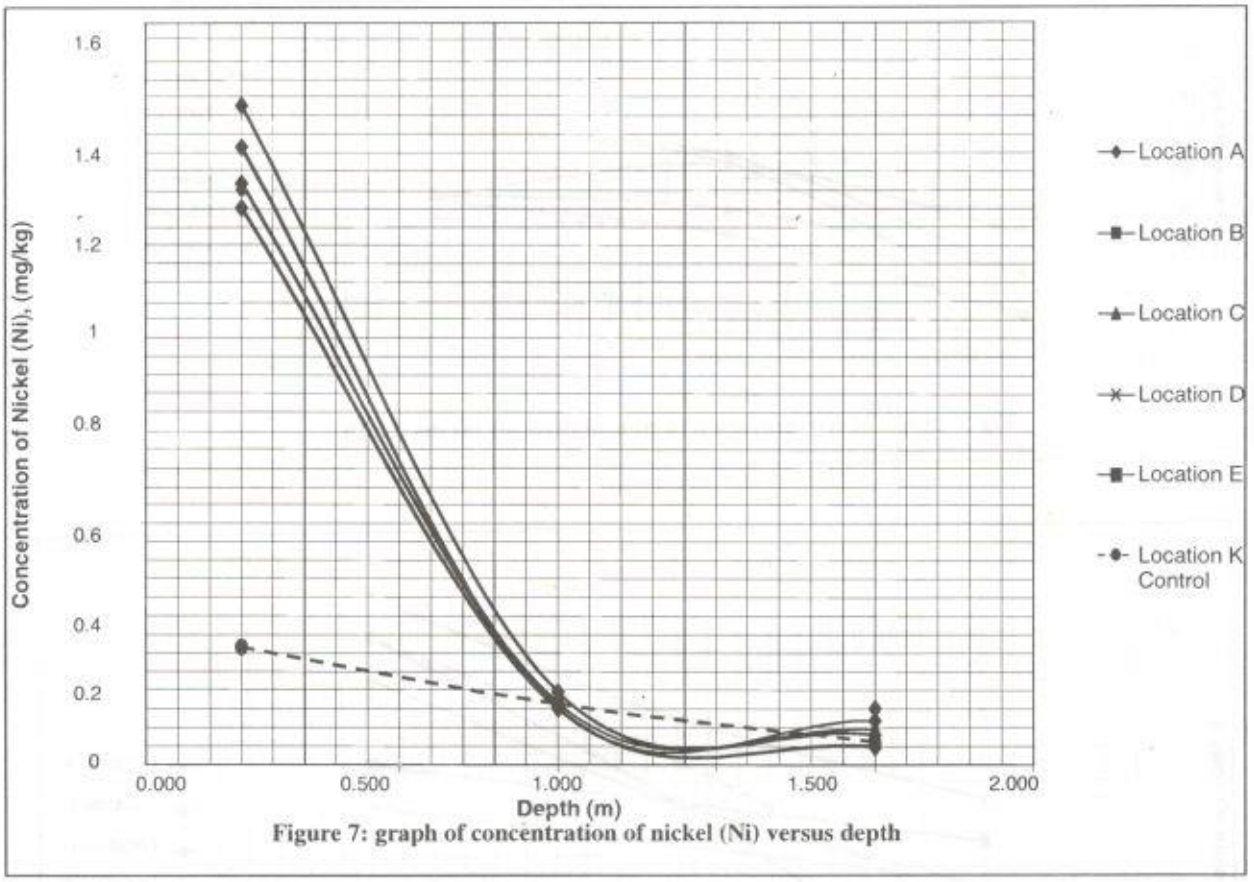

Figure 7: graph of concentration of nickel (Ni) versus depth

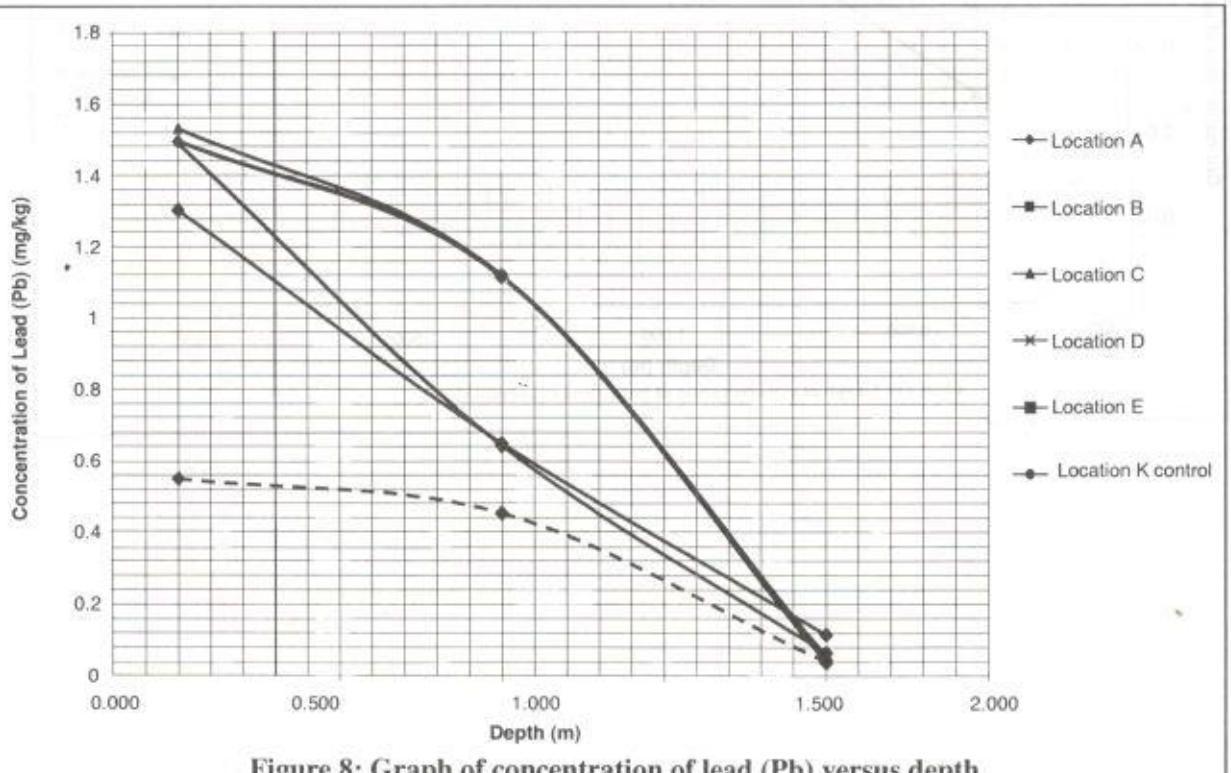

Figure 8: Graph of concentration of lead (Pb) versus depth

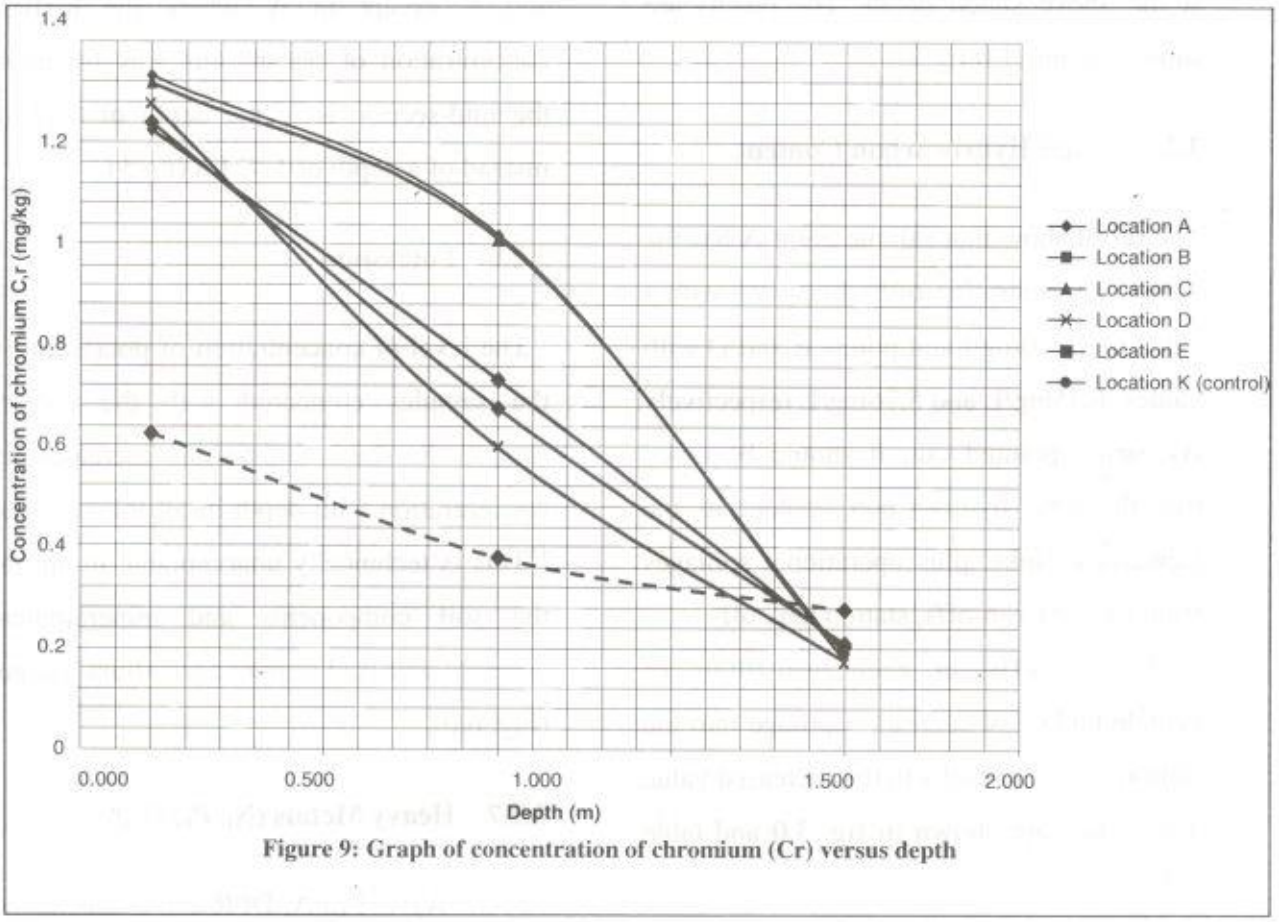

Figure 9: Graph of concentration of chromium (Cr) versus depth

3.22 PH – Values

The general increase of acidity from the depths of 1.524m to 0.305m or a general increase in alkalinity from the surface down ward (i.e. increase in alkalinity with depth in all the stations including the control point K). However, the toxicity in the severity of station environment is more ominous in acidity and corrosivity. This means that apart from the underground leakage of tanks other sources of pollution exists. The results are shown in table 2.0 and fig 1.0

3.2.3 Electrical Conductivity

The electrical conductivity was to found to a maximum value in the mid section, that is a depth of 0.914m at the sample points A, B and E, while point C and control point K have increasing electrical conductivity at the depth of 0.914m and began to experience increasing conductivity at a depth of 1.524m. This uniqueness may be interpreted as significant in showing the effect of pollution

at the above stated depth. The results are shown in table 1.0 fig 2.0

3.2.3. Total Hydrocarbon Content

The result show that sample point A has the highest concentration of hydrocarbon with a value of 10.90mg/l and points E and D with values 6.35mg/L and 5.76mg/L respectively. As earlier pointed out, it should be noted that the total hydrocarbon content in the subsurface tanks, plus operational spillages from car-tank run-offs, station tank off-loading run-offs, or even over-filling of vehicle tanks and such like spillage into the station grounds results in the increased value. The results are shown in fig. 3.0 and table 1.0

3.2.4 Nitrogen Content

It was observed that the level of nitrogen has increased by 0.04% at point A from 0.305m to 1.524m. And at point B, it increased by 0.30% point is 0.07% while point D and E are 0.8% and 0.07% respectively. The nitrogen content at 1.524m level is 0.19% (fig 4)

3.2.5 Phosphorus "Total Digestion"

The concentration of phosphorus was found to be with increase with depth in B, C, D, E and K except in A, where the highest concentration of phosphorus was found in the mid-section is in the depth of 0.914m instead of a depth of 1.524m (fig 5).

3.2.6 Potassium

[17]The level of concentration of potassium in the samples compared with the control sample K show substantial increases in concentration with depth in all the samples. [18]This is technically unacceptable in any of the soil components and mineralogical contents will lead to poor agricultural output. (Fig. 6.0).

3.2.7 Heavy Metals (N_i, P_b, C_r,)

[19]From WHO FEPA, DPR and other quality specification, a good soil must have <0.050mg/kg of heavy metals presence in the soils. Table 1.0 shows heavy metals presence is of very high values. This further shows that the ecosystems in which these petrol stations were located have been heavily polluted. (Fig's 7,8,9)

4.0 Conclusions and Recommendation

4.1 Conclusions

The five – petrol stations under study labeled A, B, C, D, and E with age between 19 – 25 years showed the following results

i. [20]The PH-value of the entire ecosystem was increased by about 10%

ii. The total hydrocarbon content spread is very high. [21]Although there is no reported LUSTS (leakage of underground storage tanks systems), there might be minor leakage due to aging storage tanks and severe corrosion effects developed from weld defects. Furthermore, sources of Petrol spillage in Petrol stations may include the following.

1. Leaking car/vehicle petrol tanks.

2. Operational human errors for over-filled tanks with super active pumps daily do occur for cars whose owners always request for "fill-up" the tank.

3. [22]Impact from atmospheric discharges of pollutants from motor-vehicles.

4. Activities of support services such as vulcanizers, wheel-balancing and oil/grease, axle oil refilling and engine oil change services do increase the discharges of refined petroleum products into the environment.

5. The usually high heavy metals content showed the danger to our ecosystem for such operations to have uncontrolled outlets in our cities unabated.

6. Petrol filling stations should only be granted statutory approvals to operate if they strictly conform to government and international standards in other to maintain a healthy ecosystem and good quality of work life for the people.

7. There was minimum pollution at the control points, due to general atmospheric pollution impacting on that environment.

4.2 Recommendations

1. Government should ensure the closure of all petrol filling stations that do not meet the stipulated government standard.

2. Approval for new petrol stations should ensure that the spacing between one petrol station and another meet the minimum spacing requirements

3. Petrol stations attendants and their owners/operators should be made to attend

regular courses so as to enable them know the implications of their actions and activities especially when it involves disposal of waste products, safety, technology progress, etc.

4. Activities of motor mechanics who buy petrol to clean and wash motor engines/parts and pour them in the nearest gutter open pits or drainage around are potential ecosystem pollution generators

5. Government should formulate engine oil disposal policies for petrol filling stations, and automobile mechanics which should be implemented nation-wide

6. A general environmental education awareness, impact and implication should made available to the various publics of our communities through the federal Ministry of information, radio, television houses and G.S.M services provider

7. Certificate of compliance of an annual training by petrol station owners and their staffs should be monitored for compliance audited annually by the government through the petroleum training institute (PTI) and Department of Petroleum resources (DPR).

REFERENCES

1. ASTMA (2008), "Analysis of soil contaminated with Petroleum Products" STP 1221, American Society testing and materials. PP 23 – 47.

2. Shridhar, M.K.C, "Environmental Lead Levels in African Cities" U.I Press (1977)

3. Walker D.A; Webber P.J, "Effects of Petroleum Products Diesel Oil Spills on plant Community" Prodhoe Bay, Alaska (19878) pp.31-48.

4. Potter, T.L, "Analysis of Petroleum Contaminated soil and water" vol. 2 Lewis publications Inc. Chelsea, MI (1989) pp 1-80

5 Obire, O.; Nwaubeta, O. "Effects of refined petroleum logical characteristics" 1st Edition, UST press (1998) pp. 1-10

6. Miles O. Hayes; Maylo Murday, "Environmental Baseline studies for the establishment of control criteria and standards against Petroleum related pollution in Nigeria" (Nov. 1985) pp 11(1a) – 100

7. Tambar G. Leton and Napoleon O. Umesi, "Effects and solution to Environmental pollution problems (National Conference), Oct 17 -18, 1990 (pp 30 -35)

8. Lucky, T.D; Venugopal B, Hiutcheson D; "Heavy Metal Toxicity safety and Homology supplement" Vol. 1 (1975) pp. 20

9. Uwagboe A, "Environmental concensus of Nigeria oil fuel condition. A lesson from Automobile Gas emissions" SPE – 73145 SPE – NAICE 2001, Nicon Hilton, Abuja.

10. George L. Wadbott; "Health effect of Environmental pollution 2nd Edition (1978) pp's.14, 142, 150.

11. Russel W. Perterson, John A. Busterud and Beatrice E. Willard, "Environmental Quality," 7th Annual report of the council of Environmental quality, September 1976, pp.40

12. M.J Jones, "Environmental Journal, Minerals and the Environmental" Vol. 7 (1975) pp. 20

13. Kelvin T. Pickering and Lewis A. Owen, "An Introduction to Global environmental Issues" (Journal 1995) pp. 369.

14. The Petroleum Inspectorate: "The Petroleum Industry and the Nigerian Environment" (International Seminar) (1997) pp. 11.

15. Otano, E.U.A, "Oil Spill Contingency plan" Environmental science and safety Dept. (1993), pp.1-3.

16. Boniface E.O. Osilaraya, "Environmental Pollution and Control in Port Harcourt refinery", PHRC News, 2nd Edition Port Harcourt (1989) pp. 12.

17. Gossen, R. Parkinson P. "Effects of Oil Spills on Soil Micro-organisms," 3rd Edition, Alberta City (1974) PP.106-117.

18. Emmanuel Elias Onuh, "Environmental pollution Petroleum and Control" NNPC Kaduna Refinery, KDRC News, 2nd Edition, (1989), kaduna, pp.14.

19. Prosper Ayawei, (et al) "Adverse Effects of Crude Oil Spill in Niger Delta, Nigeria", (2000), pp.1-4

20. Material Safety and Hazard Identification Journal, Chevron Texaco Information Centre, Houston Texas, (2002), pp.9.

21. Lentch Water Treatment and Air Pollution Journal, Rotterdam Sewage Company, Netherlands, (1998) pp.43.

22. Department for Environment, Food and Rural Affairs Journal, United Kingdom, (1998) pp.12.