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RESEARCH ARTICLE

INVESTIGATION OF HYDROCARBON EFFECT ON SOIL QUALITY AND ITS IMPACTS ON THE ENVIRONMENT: A CASE STUDY OF IDU-EKPEYE COMMUNITY IN AHOADA WEST AREA OF RIVERS STATE IN NIGER DELTA REGION OF NIGERIA

***Nte Felix, U., Esi Emmanuel and Michael Chizurumoke, M.**

Department of Physics, University of Port Harcourt, Choba, Rivers State, Nigeria

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ABSTRACT

This study investigates the effect of hydrocarbon on soil qualities and its impact on the environment. Six soil samples collected from the study area where analyzed using Atomic Absorption Spectrophotometer, PH meter, conductivity meter and standard chemical methods. From the samples analyzed the average concentration of IMS 1 obtained are: PH (5.37kg/l), conductivity (65.00 kg/l), Alkalinity (120,000 kg/l), organic matter (3.24 kg/l), Nitrogen (0.084 kg/l), Phenol (64.38 kg/l), Chloride (400.00 kg/l), THC (2,400.00 kg/l), TOC (2.76 kg/l), $S0^{2}_{4}$ (688.89 kg/l), $N0_{2}$ (44.12 kg/l), $P0^{3-}_{4}$ (12.38 kg/l), etc. On the other hand, the average concentration of IMS 2 obtained are: PH (4.98 kg/l), conductivity (30.00 kg/l), Alkalinity (120.00 kg/l), organic matter (12.40 kg/l), Nitrogen (0.182 kg/l), Phenol (33.22 kg/l) Chloride (400.00 kg/l), THC (18000.00 kg/l), TOC (3.73 kg/l), $S0^{2}_{4}$ (516.668 kg/l), $N0_{2}$ (4.412 kg/l), Po^{3-}_{4} (8.25 kg/l) etc. High concentration of copper, Mg, Ca, Na, K, Zn, Ni, Mn and Fe was also obtained for both IMS 1 and IMS 2. Sulphide, Hg, Cr and Pb were not detected in the soil samples analyzed. The results obtained reveal the pollution level of the soil due to exploration and exploitation of oil activities in the area.

INTRODUCTION

Soil is generally composed of sand, silt and clay particles, organic matter humus, water and air space. Sand and other mineral parts of the soil result from the weathering of rocks. Soil itself is more complex than an assemblage of clay minerals. It is a vital part of our environment, and an essential resource of life (Chauban, 2008; Victor, 2005). Soil pollution involves accumulation on land of substances in dispersed solid or liquid form that are injurious to life and ecosystems. (Narayanan, 2009). Soil pollution can be defined as the contamination of soil system by considerable quantities of chemical or other substances, resulting in the reduction of fertility with respect to the qualitative and quantitative yield of plants (Santosh, *et al.,* 2007). Pollution may be natural (natural organic and inorganic decays, volcanic eruption etc) or artificial (activities of man). There is a strong relationship between human activities and pollution of the environment (Howard, 1985; Asthana, 2003). Pollution of the environment can be confirmed by determining level of pollution in soil, water and organisms. Industrial effluents, Agricultural run-offs, animal and human excretions, geologic weathering and domestic waste contribute to the pollution level of both soil and water bodies in the study area. The discharge of industrial effluents of oil exploration and exploitation in the areas lead to environment pollution. Hence the increased in concentration of inorganic, physiochemical and metal constituents (PH, conductivity, Alkalinity, Phenol, Nitrogen, Chloride, Total hydrocarbon, Total organic compound, organic matter, Copper, SO^{2}_{4}, NO_{2} , PO^{3-}_{4}, Mg, Ca, Na, K, Zn, Ni, Mn and Fe) of the soil can have toxicological effect on human and aquatic environment. These environmental pollutants which are environmentally mobile tend to accumulate in organisms, and become persistent because of their chemical stability (Emoyan *et al.,* 2005; Helen, 1997; Obot *et al.,* 2008). The present study investigates hydrocarbon effect of soil qualities on human and aquatic environment of the study area.

***Corresponding author: Nte Felix, U.,** Department of Physics, University of Port Harcourt, Choba, Rivers State, Nigeria.*

Study area

Soil samples used for this study were collected from Idu-Ekpeye Community (at N 5.08330011367798, E 6.55000019073486) environment in Ahoada West Area, Rivers State, Niger Delta Region of Nigeria.

MATERIALS AND METHOD

Randomly soil samples were collected from the study area, where some oil and gas companies are located. The soil samples were obtained with a hand auger from topsoil to a maximum depth of 30cm, this is the A-horizon of soil profile where leaching effect may be seen. Samples were collected 20m apart per location. Soil samples were air dried at room temperature, ground and sieved through a set of nylon sieve (12mm – 2mm sieve). The soil samples that fell below the sieve were used for solution preparation. Precaution was taken to picked large stones and root of plants out before mixing and sieving of soil samples. 2.0g of sieved soil samples were weighed into a 100cm flask, and were treated with H_2SO_4, HNO_3, and HCL. The contents were digested slowly and were allowed to cool for some minutes, filtered into a $100cm^3$ volumetric flask and diluted with distilled water (Allen *et al.,* 1974). In addition to samples, standard were also prepared for metals parameters following the same procedure. Prepared solutions were analyzed with Atomic Absorption Spectrophotometer in order to determine metals which include Ni, Pb, Zn, Fe, Cu, Mn, Hg, Cr, K, Na, Ca and Mg. each metals has different wave lengths. PH meter was used to analyze PH in the sample. Conductivity was determined using

the conductivity meter. Determination of Total Hydrocarb on (THC), TOC, PO^{3-}_4, NO_2, SO^2_4, Cl, organic matter and Akalinity were carried out according to standard method.

Table 1. IMS 1 (mg/kg)

S.NO	Parameters	Sample 1	Sample 2	Sample 3	Average
1.	PH	5.39	5.36	5.37	5.37
2.	Conductivity	67.00	59.00	69.00	65.00
3.	Alkalinity	120.00	120.00	120.00	120.00
4.	Organic Matter	3.31	2.84	3.57	3.24
5.	Nitrogen	0.078	0.088	0.086	0.084
6.	Phenol	48.75	45.46	44.92	46.38
7.	Chloride	400.00	400.00	400.00	400.00
8.	Sulphide	ND	ND	ND	ND
9.	THC	2400.00	2600.00	2200.00	2400.00
10.	TOC	2.57	2.60	3.10	2.76
11.	Copper	2.13	1.96	2.06	2.05
12.	SO^2_4	688.05	688.08	688.14	688.89
13.	NO_2	44.10	44.09	44.16	44.12
14.	PO^{3-}_4	12.07	12.62	12.45	12.38
15.	Mg	48.00	50.15	50.20	49.45
16.	Ca	170.20	170.20	170.20	170.20
17.	Na	19.04	20.02	18.09	19.05
18.	K	22.10	23.10	20.10	21.80
19.	Ng	ND	ND	ND	ND
20.	Cr	ND	ND	ND	ND
21.	Zn	140.46	140.44	140.57	140.471
22.	Pb	ND	ND	ND	ND
23.	Ni	10.55	10.55	10.55	10.55
24.	Mn	18.97	17.96	18.92	18.55
25.	Fe	67.00	66.80	67.05	66.95

Table 2. IMS 2 (mg/kg)

S/NO	Parameters	Sample 1	Sample 2	Sample 3	Average
1.	PH	5.12	4.79	5.04	4.98
2.	Conductivity	30.00	30.50	29.50	30.00
3.	Alkalinity	120.00	120.00	120.00	120.00
4.	Organic Matter	11.84	12.51	12.90	12.40
5.	Nitrogen	0.182	0.182	0.182	0.182
6.	Phenol	32.71	35.12	31.86	33.22
7.	Chloride	400.00	400.00	400.00	400.00
8.	Sulphide	ND	ND	ND	ND
9.	THC	1800.00	1800.00	1800.00	1800.00
10.	TOC	4.04	3.52	3.63	3.73
11.	Copper	2.70	3.10	2.44	2.75
12.	SO^2_4	512.669	516.670	520.658	516.668
13.	NO_2	3.766	5.206	4.261	4.412
14.	PO^{3-}_4	8.05	7.74	8.93	8.25
15.	Mg	132.71	133.43	132.69	132.95
16.	Ca	639.80	640.88	627.62	636.10
17.	Na	127.00	129.10	128.34	128.15
18.	K	52.13	50.90	52.82	51.95
19.	Ng	ND	ND	ND	ND
20.	Cr	ND	ND	ND	ND
21.	Zn	90.24	92.13	91.00	91.10
22.	Pb	ND	ND	ND	ND
23.	Ni	25.18	24.92	26.87	25.70
24.	Mn	50.57	54.12	55.06	53.30
25.	Fe	96.40	96.38	93.42	95.40

RESULTS AND DISCUSSION

The physicochemical parameters of soil of the oil exploration and production companies' activities in the study area were investigated and the level of contaminants (pollutants) estimated. The results of the concentration of the soil samples analysis are as shown in Table 1 and Table 2. Table 1, IMS 1 (mg/kg) contained the average concentrations of THC (2400.00 mg/l), TOC (2.76 mg/l), Zinc (140.471 mg/l), Phenol (46.38 mg/l), Alkalinity (120.00 mg/l), conductivity (65.00 mg/l), PO^{3-}_4 (12.38 mg/l), SO^2_4 (688.89 mg/l) etc. Table 2, IMS 2 (mg/kg) on the other hand contained the average concentration of THC (1800.00 mg/l), TOC (3.72 mg/l), Copper (2.75 mg/l), Chloride (400.00 mg/l), Zinc (91.10 mg/l), Phenol (33.22 mg/l), Alkalinity (120.00 mg/l), conductivity (30.00 mg/l) PO^{3-}_4 (8.25 mg/l, SO^2_4 (516.668 mg/l) etc. For both IMS 1 and IMS 2 Sulphide, lead, Cr and Hg are not detected in the soil samples. From the results shown in Table 1 and Table 2, it is seen that the major pollutant in the study area is Total hydrocarbon (THC) with average value of 2400,00 mg/l and 1800.00 mg/l respectively. The high values of THC is as a result of exploration and production of oil companies activities in the study area. The total hydrocarbon (THC) is due to discharged effluents of oil companies in the area. Petroleum hydrocarbons have been observed to be toxic to both man and aquatic life (OBOT et al. 2008). Total organic compound (TOC), the concentration of TOC in the soil for both IMS 1 and IMS 2 2.76 kg/l and 3.72 kg/l respectively is high, hence indicate pollution in the soil. PH, the PH concentration of IMS 1 and IMS 2 5.37 kg/l and 4.98 kg/l indicate that the soil is acidic this is due to acid rain that resort from flaring of gas. It is not too good for cultivation of plants. The concentration of all the physiochemical parameters and metals analyzed such as Zinc, Nickel, Iron, Magnesium, Chloride, SO^2_4, NO_2, PO^3_4, K, Na, Mg, Ca etc. are very high, hence they indicate pollution of the soil in the study area. These are observed to be toxic to man and aquatic life. These high concentration of metals and physiochemical parameters are due to the discharge of effluents from the oil companies operating in the area.

Conclusion

This study has shown that the soil samples analyzed contain high concentrations of pollutants which are caused by exploration and exploitation of hydrocarbon activities in the area. The concentration of these pollutants can be dangerous to both human and aquatic life living in the area. The soil of the study area may constitutes a major health hazard to the local population living in the area and should be a cause of concern for oil companies operating in the area, government and private individuals. Hence constant monitoring of pollutants concentration level in soil in the study area should be a continuous process. Both government and private individuals should also monitor compliance of oil and gas companies operating (activities) in the area with Federal Environmental Protection Agency (FEPA) standard in Nigeria

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