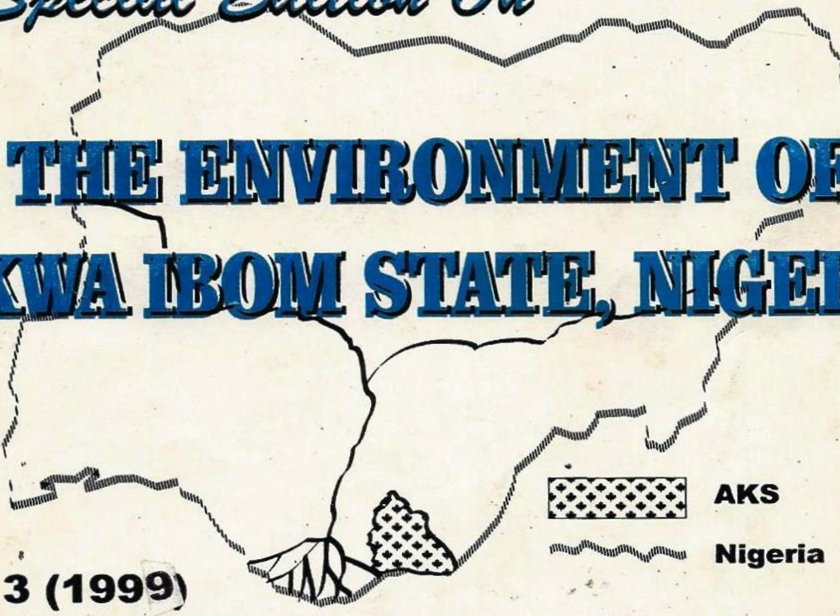
TROPICAL JOURNAL OF ENVIRONMENTAL SCIENCE & TECHNOLOGY (TROJEST)

A Special Edition On

THE ENVIRONMENT OF AKWA IBOM STATE, NIGERIA



Vol. 3 (1999)

EDITOR-IN-CHIEF: DR. ETIM ISAAC UDOESSIEN

ETILIEW INT'L PUBLISHERS
PUBLISHING YOUR LIBRARY MATERIALS

ETILIEW INTERNATIONAL PUBLISHERS; APPLIED SCIENCE

Tropical Journal Of Environmental
Science & technology

Vol. 3 (1999)

Environmental Monitoring and Assessment of the Impact of Mobil Producing Nigeria Unlimited (MPNU) Oil Spill of 12th January, 1998 on Eastern Obolo LGA, Nigeria

by

I. R. Udotong, K. E. Akpabio and M. P. Bassey
Dept. Of Botany & Microbiology University of Uyo, P. M. B. 1017, Uyo, Nigeria

ABSTRACT

The Microbiological and Physico-chemical parameters of the surface water and seabed sediments obtained from fourteen (14) randomly chosen sampling locations in the coastal environment of Eastern Obolo, Southern Nigeria, were monitored and assessed after the 40,000 barrels Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998. The physico-chemical parameters assessed included pH, temperature, dissolved oxygen, salinity and turbidity as well as the total dissolved solids (TDS), total hydrocarbon (THC) and biochemical oxygen demand (BOD). Microbiological analysis of seabed sediments showed that total heterotrophic bacteria ranged from 4.7×10^6 to 6.5×10^6 cfu/g; total hydrocarbonoclastic bacteria ranged from 6.4×10^4 to 5.2×10^5 cfu/g while the percentage crude oil degraders ranged between 1.0 – 2.2% indicating significant crude oil input into all the sampling locations. Known crude oil degrading microorganisms isolated from both water and sediment samples were Bacillus megaterium, Pseudomonas aeruginosa, Flavobacterium sp. and micrococcus varians. The concentrations of heavy metals in surface water ranged between 0.06 ppm for vanadium to 30.20 ppm for iron. This study reveals that the said oil spill has greatly impacted the coastal environment of Eastern Obolo, Nigeria.

KEY WORDS: Hydrocarbonoclastic microorganisms, Heavy metals, oil spill, Eastern Obolo, Mobil Producing Nigeria Unlimited, seabed sediments. *Corresponding author.

INTRODUCTION

Mobil Producing Nigeria Unlimited (MPNU) began operations in Nigeria in 1955 as an oil exploration company then known as Mobil Exploration Nigeria Incorporated (MENI).

Presently, Mobil Producing Nigeria Unlimited is the second largest oil producing company in Nigeria. The discovery of crude oil and the subsequent exploration and production activities undoubtedly has had enormous impact on the environment. Oil drilling and production have been known to generate a variety of wastes that can impact the environment (Nwankwo and Irrechukwu, 1981).

The produced water from the exploration and production process have been found to contain hydrocarbon, volatile aromatic compounds (VACs), phenols, salts, heavy metals, naturally occurring Radioactive materials (NORMs) and air emission (Reis 1995; Stephenson, 1992).

Udotong (1995) characterized a petroleum exploration and production-derived waste stream from a Nigerian oil company and found it to also contain microbial communities. Apart from these, other environmental pollutants such as polychlorinated biphenyl (PCB) and organochlorines have also been identified as components of petroleum production wastes (Skaare et al, 1990).

Incidence of accidental crude oil spillage and subsequent contamination of the biota as a result of corrosion of petroleum pipelines, equipment failures, sabotage and accidental seeps have been reported to be rampant especially in riverine areas of Rivers, Akwa Ibom, Delta, Edo and Imo (Antai and Mgbomo, 1993). However, the most common sources of oil spillage arise from pipeline accidents and transportation of crude oil.

On 12th January, 1998, Mobil Producing Nigeria Unlimited (MPNU) reported the occurrence of a major oil spill due to ruptured high pressure 24″pipeline delivering crude oil from Idoho production platform to the Qua Iboe Terminal (QIT) tank farm. It was reported that about 40,000 barrels of Qua Iboe light crude oil had been spilled offshore Akwa Ibom coastal waters and it was reported by Mobil Producing Nigeria Unlimited management as the largest oil spill ever recorded in all her years of operation in Nigeria.

Hydrodynamic processes distributed the discharged crude oil, which was largely felt and observed by the neighbouring coastal communities. The crude oil spill had its attendant environmental impacts and problem in terms of socio-economic and ecological losses. It is noteworthy that of all the impacted areas, Eastern Obolo may have been the most devastated because the area is washed directly by the Atlantic Ocean and four estuaries. Moreover, the major occupation of the inhabitants is fishing.

This study was undertaken to monitor and assess the impact of the Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998 on Eastern Obolo in southern Nigeria, and to determine the extent of the impact on the environment and its inhabitants.

MATERIALS AND METHOD

STUDY AREA

Eastern Obolo lies within latitude 4°35′ to 4.45′N and longitude 7°50′ to 8°.00′E in the South Eastern Nigeria coastlines. Eastern Obolo is bounded in the south by the Atlantic Ocean and therefore is vulnerable to the negative impact that is usually a consequence of crude oil spillage (Fig. 1.0).

The environmental components and impact indicators employed in assessing the existing Eastern Obolo environment are the standard methods according to the Federal Environmental Protection Agency, FEPA (1992).

SAMPLE COLLECTION

A total of fourteen (14) sampling stations were randomly selected to represent the Eastern Obolo environment. The fast changing physico-chemical parameters of the surface water (pH, temperature, dissolved oxygen (DO); electrical conductivity, salinity and turbidity) from the designated sampling stations were determined in-situ using the ELE International water quality checker (ELE – 903, ELE International, England).

Surface water for other parameters were sampled using the one-litre ELE International water sampler (ELE Int'l England). Composite surface water samples were taken into sampling bottles

and acidified to pH 2.0 with Nitric acid for heavy metal analyses while samples for Total Hydrocarbons (THC) were collected into clean glass bottles. Samples for microbiological analyses were collected into sterile whirlpak bags and transported in ice-packed containers to the laboratory for analyses.
Seabed sediments were sampled from the designated sampling location (Table 1.0) using the Ekman-type grab sediment sampler. Composite samples were collected into sterile glass sampling bottles for microbiological, heavy metals and Total Hydrocarbon (THC) analyses.

SAMPLE ANALYSIS

The sampling and analytical procedures employed in the study involved the use of standard procedures (Table 2.0).

pH. This parameter was measured in-situ adopting the ELE International standard.

Temperature: This parameter was determined in-situ by dipping the thermometer into the test sample and taking the reading.

Total suspended solids (TSS): This was determined by adopting the procedures of the Association of Official Analytical Chemists (AOAC, 1975).

Turbidity, Conductivity, Dissolved Oxygen, Salinity: These parameters were determined in-situ adopting the ELE International Standard.

Microbiological Analysis: The microbiological analyses of the samples from the randomly chosen fourteen locations were carried out by adopting the procedures of the American Public Health Association (APHA, 1985) and Harrigan & McCance (1975).

Heavy metals: Analysis was carried out using Atomic Absorption Spectrophotometry (AAS) according to the AOAC (1975).

Total Dissolved Solids (TDS): This was determined by adopting the procedures of AOAC (1975) and APHA (1985).

Biochemical Oxygen Demand (BOD): This was determined using the standard filtration method of AOAC (1975).

RESULTS AND DISCUSSION

RESULTS

The results of the assessment of the different parameters used in the Eastern Obolo environment are shown on the Tables 3.0; 4.0; 5.0 and 6.0, respectively.

Physico-chemical parameters of the surface water assessed include Temperature, pH, turbidity, salinity, dissolved oxygen (DO), total dissolved solids (TDS) and total hydrocarbon (THC) (Table 3.0).

Table 4.0 shows the result of the concentration (ppm) of heavy metals such as copper, zinc, nickel, cadmium, vanadium, lead, manganese and chromium in the surface water.

The microbial counts of the seabed sediments from fourteen randomly sampled locations are as shown on Table 5.0 while the concentration of heavy metals and total hydrocarbon (ppm) in the sediments of the study area is as shown on Table 6.0.

DISCUSSION

From the various results obtained, it is obvious that the impact and effect of the Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998 on Eastern Obolo environment is tremendous and multi-dimensional.

Impact on Water Quality: The coastal waters of Eastern Obolo environment has been negatively impacted by the Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998. The aesthetic quality of the water has greatly deteriorated such that the water had traces of THC (between 4.5 and 8.2), high total dissolved solids (TDS) and low dissolved oxygen (DO).

With these and heavy metals content (0.06 ppm for vanadium and 185.14 ppm for manganese) in the surface water, there is a high probability of incidence of heavy metals poisoning with continuous consumption of the impacted water or resources therefrom. This was the case with the methyl mercury poisoning of Minimata Bay in Japan when the residents consumed fish contaminated with methyl mercury and died while pregnant women gave birth to deformed children (Udotong, 1995). The impact of water quality on the ecology and quality of seafood has been reviewed (Atlas and Bertha, 1983).

Impact on Fisheries and Mariculture: The impact of the oil spill was enormous on fisheries and mariculture in the Eastern Obolo coastal environment. The fishing boats and gears were greatly affected and there was gross decline in the quantity and quality of fish, shellfish caught as well as other edible seafood due to the depletion of aquatic resources as a result of the oil spill.

The reduction in catch per unit effort could have been due to the depletion of fish stocks (ITOPF, 1991). The fish and shellfish stocks will be depleted for a number of years after the oil spill as a consequence of damage to eggs/larvae and the destruction of spawning grounds. The decline in catch per unit effort and the destruction of spawning grounds had its attendant economic consequences on the fishermen and residents of the Eastern Obolo coastal environment.

Impact On Biodiversity: The loss of biodiversity had been one of the major impacts of the oil spill of 12th January 1998 on the Eastern Obolo environment. The impact of the loss of biodiversity on the environment and socio-economic activities in the area had been manifold.

Loss of Benthic Fauna and associated impacts: It has been established that the planktons (phytoplanktons and zooplanktons) which form the basis of the marine food webs and many benthic animals are highly sensitive to oil pollution (Atlas and Bartha, 1993). Thus, the elimination of aquatic life in the coastal waters of Eastern Obolo as a result of the said oil spill has obvious short-term and long-term effect.

Loss of fish and sea animals: The pollution of the surface coastal waters of Eastern Obolo has adverse effects on the adult and juvenile fish as well as on some marine reptiles e.g. sea turtles. These organisms were also at the risk of exposure to dispersed and dissolved oil.

Effects of the oil spill on coastal wetlands and vegetation: Eastern Obolo is an entirely coastal wetland which has been described as a sensitive ecosystem (FEPA, 1992). The mangrove swamp vegetation of Eastern Obolo was greatly affected by the oil spill of 12th January 1998. The importance of mangrove vegetation to fisheries and mariculture is crucial and its destruction has serious economic consequences on the Eastern Obolo inhabitants.

Impact of the Oil Spill on Coastal Activities in Eastern Obolo: Recreational activities such as bathing, swimming, beating, diving, etc as well as routine harbour activities such as transport/ferry service and lumbering have been greatly affected and disrupted as a result of the impact of the oil spill of 12th January 1998. Tourist trade and socio-economic activities in the coastal environment of Eastern Obolo has been greatly affected.

Impact of the Oil Spill on Human Health: One of the most significant consequences of the Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998 is its impact on the health of the inhabitants of Eastern Obolo. This impact ranged from acute to subacute manifestations in these individuals involved in coastal or recreational activities. This health impact affected the respiratory system, gastro-intestinal tract, genito-urinary system, skin and musculo-skeletal systems as well as the central nervous systems. Most common manifestations were itchy eyes, stuffy nose, headache and dizziness, increased frequency of urination, itchy skin and chemical dermatitis.

On the whole, the oil spill of 12th January 1998 in Eastern Obolo had overall devastating effect on the biological environment. It is reported that while it may be possible to restore the physical characteristics of an oiled environment or habitat to near its pre-spill condition, the extent to which its biological recovery can be enhanced is severely limited. The biological recovery and restoration of Eastern Obolo coastal environment to its pre-spill stage is virtually impossible.

CONCLUSION

The Environmental Monitoring and Assessment of the coastal environment of Eastern Obolo after the Mobil Producing Nigeria Unlimited (MPNU) oil spill of 12th January 1998 has revealed that the environment has been greatly impacted. It is apparent that there have been ecological and environmental damages and this has affected the quality of the environment, the health and socio-economic activities of the inhabitants of the coastal environment of Eastern Obolo in southern Nigeria.

Therefore, mitigation and amelioration measures must put its priority on environmental conservation protection and restoration both on long-term and short-term bases. This environmental monitoring and assessment should be viewed as the basis for the present and future environmental damages of this and any other coastal environment that is highly vulnerable to oil spillage.

Table 1.0: Sampling stations within Eastern Obolo LGA

Sampling Station Number	Sampling Station Name
1.	Okoroete
2.	Iko Town
3.	Ama Nglas
4.	Emereoke I
5.	Ikonta
6.	Elile
7.	Okorombokho
8.	Edonwi
9.	Okoroinyang
10.	Emereoke II
11.	Obianga
12.	Amadaka
13.	Iwofe
14.	Elekpon

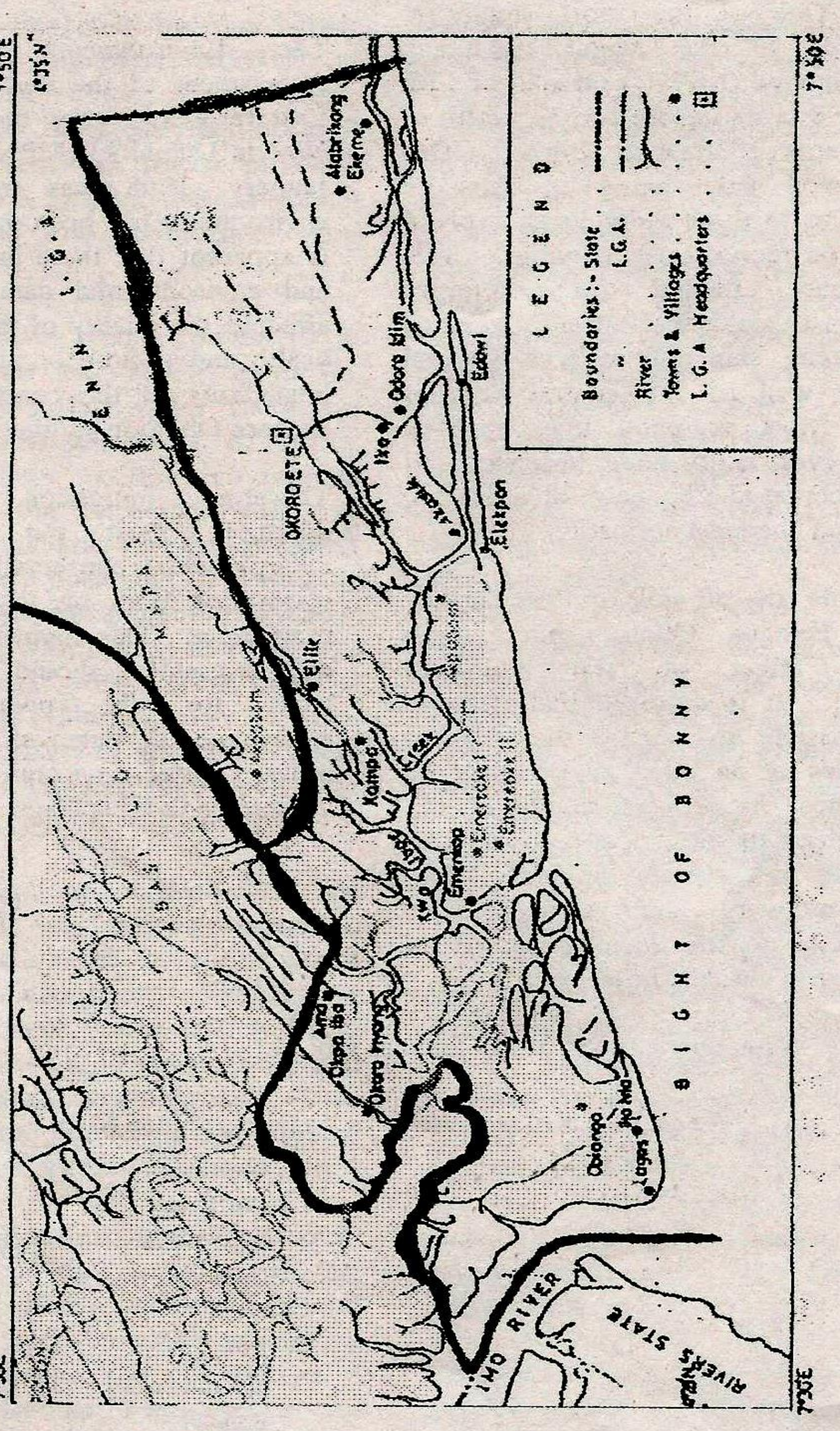


Fig. 1.0: Map of Eastern Obolo Local Government Area

Table 2.0: Analytical procedures employed in the study parameters

Parameters	Methods Used
Sampling	Grasshoff (1983)
PH	In-situ (ELE International)
Temperature	-Do-
Total suspended solids	AOAC –1975
Turbidity (FTU)	In-situ (ELE International)
Conductivity	-do-
DO	-do-
Salinity	-do-
Total suspended solids (TSS)	AOAC 1975
Microbiological Analysis	APHA, 1985, Harrigan & McCance, 1975
Heavy metals	AOAC, 1975 (Atomic absorption spectrophotometry)
Total dissolved solids (TDS)	AOAC, 1975 (APHA, 1985)
BOD	AOAC, 1975

Table 3.0: Physico-chemical parameters of surface water

Station	Temp.	pH	FTU Turbidity	Cond us/cm	Salinity ppt	DO mg/l	TDS mg/l	THC
1	30.1	6.3	5.0	12.7	11.3	6.5	1940	5.4
2	30.5	6.8	2.9	10.3	7.0	6.2	1824	4.5
3	31.2	6.5	4.6	12.5	13.7	5.7	1863	5.5
4	31.1	6.5	2.4	18.5	13.0	5.6	1860	8.2
5	30.4	6.1	6.2	13.8	15.5	5.9	1820	4.8
6	31.2	6.3	5.5	12.7	13.6	5.3	1990	5.3
7	31.4	6.6	3.5	8.0	12.4	6.2	1821	5.5
8	30.7	6.5	2.6	18.0	6.3	4.8	1980	5.4
9	30.5	5.7	6.3	13.6	15.4	6.2	1960	6.3
10	30.5	6.7	4.4	11.9	13.0	6.5	1945	5.4
11	30.3	6.4	3.6	9.2	12.1	6.2	1920	5.5
12	31.7	5.6	2.5	10.3	15.6	6.3	1990	6.1
13	30.1	6.4	3.8	9.0	12.6	5.8	1840	6.3
14	30.4	6.3	4.4	9.5	6.9	6.3	1860	8.2

Table 4.0: Concentration (ppm) of heavy metals in surface water

Station	Cu	Zn	Ni	Cd	V	Pb	Mn	Cr
1	6.30	25.40	6.09	0.85	0.60	0.71	173.12	1.61
2	6.52	20.50	6.10	0.89	0.68	0.60	178.21	1.52
3	4.90	18.20	5.60	0.89	0.50	0.30	179.13	1.70
4	6.50	18.20	4.55	0.85	0.55	0.180	145.30	1.55
5	6.32	18.10	4.52	0.86	0.56	0.72	173.10	1.65
6	6.42	16.20	5.58	0.80	0.62	0.59	178.20	1.57
7	4.70	15.01	6.13	0.85	0.06	0.31	179.10	1.67
8	5.60	18.12	5.30	0.86	0.51	0.24	185.10	1.68
9	4.72	18.13	6.12	0.87	0.09	0.32	179.12	1.69
10	6.32	18.13	6.12	0.87	0.63	0.71	178.21	1.66
11	6.30	25.44	5.13	0.82	0.55	0.181	173.21	1.56
12	6.43	20.54	5.44	0.85	0.61	0.172	145.10	1.62
13	5.55	15.04	6.07	0.86	0.51	0.31	185.14	1.49
14	5.58	16.01	6.00	0.81	0.06	0.27	170.22	1.62

Table 5.0: Microbial count of seabed sediments of study area

Station	Total heterotrophic microorganism	Total hydrocarbon utilizing microorganism	% crude oil degraders
1.	5.7×10^6	7.8×10^4	1.4
2.	6.5×10^6	7.2×10^6	1.1
3.	6.2×10^6	7.0×10^6	1.1
4.	5.0×10^6	1.1×10^5	2.2
5.	5.8×10^6	8.5×10^6	1.5
6.	6.2×10^6	5.2×10^5	1.0
7.	6.2×10^6	1.1×10^5	1.8
8.	5.0×10^6	7.0×10^6	1.4
9.	4.7×10^6	6.4×10^6	1.4
10.	5.6×10^6	7.7×10^6	1.4
11.	6.5×10^6	7.8×10^6	1.2
12.	6.2×10^6	8.4×10^6	1.2
13.	6.0×10^6	7.4×10^6	1.2
14.	6.5×10^6	7.3×10^6	1.1

Table 6.0: Concentration of heavy metals and total hydrocarbons (ppm) in sediments of study area

Station	Mn	Cd	Cr	Ni	V	Cu	Zn	Pb	THC
1	176.30	0.70	1.40	5.70	0.62	6.15	18.40	0.300	20.5
2	148.20	0.72	1.53	6.25	0.59	6.10	27.50	0.251	31.1
3	150.25	1.27	1.68	5.85	0.46	5.60	20.20	0.290	50.2
4	175.20	0.82	1.72	5.75	0.55	5.54	21.22	0.244	36.4
5	150.20	0.75	1.65	6.10	0.61	5.50	19.20	0.342	69.7
6	142.50	1.25	1.67	5.85	0.48	5.42	25.60	0.274	67.63
7	135.26	0.72	1.55	5.30	0.57	6.12	14.36	0.273	48.9
8	154.40	0.70	1.46	5.20	0.62	6.18	14.21	0.150	53.5
9	151.34	0.88	1.50	5.17	0.51	6.40	19.36	0.1270	35.7
10	150.20	0.75	1.75	5.10	6.25	6.25	22.40	0.127	36.4
11	160.30	0.80	1.3	5.15	5.28	5.28	25.20	0.145	69.7
12	142.50	1.25	1.63	5.90	5.52	5.58	23.20	0.155	67.3
13	176.32	0.85	1.68	5.82	5.60	5.60	25.20	0.311	39.0
14	160.32	0.82	1.78	5.60	5.25	5.25	19.20	0.317	64.8

REFERENCES

American Public Health Association, APHA (1985). Standard Methods of Analysis of water and waste waters, A.P.H.A; Inc. New York.

Association of Official Analytical Chemists, AOAC (1975). Official Methods of Analysis (13th edition) AOAC Washington D.C.

Antai, S. P. and Mgbomo, E. (1993). Pattern of degradation of Bonny Light crude oil by *Bacillus* sp and *Pseudomonas* as isolated from oil spill sites. West African Journal of Biological and Applied Chemistry 38 (1-4): 16-20.

Atlas, R. M and Bartha, R (1981). Microbial Ecology – Fundamentals and Applications. Addison – Wesley Publishing Company, New Jersey, 560pp.

FEPA (1992). EIA Sectional Guidelines. Federal Environmental Protection Agency FEPA, Abuja, Nigeria.

Grasshoff, K. (1983). Sampling and Sampling Techniques in: Methods of seawater analysis. (K. Grasshoff, M. Ehractt, K. Krembring, eds) Verlag Chemie GmbH Germany.

Harrigan, W. F. and McCance, M. E. (1976). Laboratory Methods in food and Dairy Microbiology, Academic Press, London.

ITOPF (1991). Response to Marine oil spill. Technical report. International Tanker owners Petroleum Federation, London.

Reis, J. C. (1992). Coping with the waste stream from drilling for oil. Journal of Mechanical Engineering 6: 64-67.

Skaare, J. U.; Markussen, N. H; Haugen, S. and Holt, G. (1990). Levels of polychlorinated biphenyls, organo-chlorine pesticides, mercury, cadmium, copper, selenium, arsenic and zinc in the Harbour seal, Phocavitulina, in Norwegian Waters. Environmental Pollution 66: 309-324.

Stephenson, M. T. (1992): Component of Produced water: A Compilation of industry studies. Journal of Petroleum Technology 44 (5): 548-550; 602-603.

Thurber, N. E (1992): Waste management for land based drilling operations. Journal of Petroleum Technology (May, 1992).

Udotong, I. R. (1995). Petroleum exploration and production (E&P) derived waste stream management in the Nigerian oil Industry. Journal of Science, Engineering and Technology 2(2): 201-217.