Jr. of Industrial Pollution Control 26 (2)(2010) pp 139-143

EFFECT OF OIL SPILLAGE ON ALAKIRI COMMUNITY IN OKRIKA LOCAL GOVERNMENT AREA OF RIVERS STATE, NIGERIA

FRANCIS D. UDOH AND NSIFIOK M. AKPAN

Department of Chemical & Petroleum Engineering, University of Uyo, Uyo – Akwa Ibom State, Nigeria

Key words : Oil Spillage, Alakiri Community, Parameters, Marine Environment, Nigeria

ABSTRACT

This study examined the effect of crude oil spillage on the marine water of Alakiri Community in Okrika Local Government Area of Rivers State, Nigeria. Water and Sediment samples were collected from three major creeks, the Alakiri Creek (sample point B - the spillage point), the Okari Creek (sample point C - the spillage movement point), and the Oputuro Creek (sample point A - the control point) to determine the physico-chemical parameters of the collected samples. Parameters examined include, among others: pH, Total Hydrocarbon Content (THC), dissolved oxygen, and heavy metals, etc. In comparing the mean values of the pH of 4.85 (for the polluted water) and 3.76 (for polluted sediments) with that of Federal Environmental Protection Agency/Department of Petroleum Resources (FEPA/DPR) limits, these values show a slight decrease from acceptable fish survival limit in the marine environment. The dissolved oxygen in the polluted water ranged from 3.00 mg/L to 3.27 mg/L with a mean value of 3.15 mg/L. These levels are below FEPA/DPR standards of 5.00 mg/L. High THC was observed both in sample B (1760 mg/L) and sample C (3200 mg/L), and these values are above the FEPA/DPR limit set for marine environment. The levels of heavy metals (except chromium and iron) in the water and sediment samples were generally low and found to be within the set limits established by FEPA and DPR. The mean value of oil and grease in the polluted water, however, was 2480 mg/L and this value is higher than the FEPA standard of 20 mg/L. What these results then call for, is the development of national systems for marine pollution management, in particular, oil spill preparedness in order to minimize offshore oil spillage and its effect on the ecosystem.

INTRODUCTION

Petroleum industry activities, if not always, have environmental consequences that result from activities inherent in the exploration, production, processing, and transportation of oil and gas. Perhaps the most environmentally degrading menace from the petroleum industry is oil spillage. The toxic nature of oil results in massive destruction of farmland with attendant adverse socio-economic consequences in the host communities. When this spill occurs at sea, the effect is as drastic as that on land. In the first instance, aquatic life which survives through the metabolism of oxygen absorbed on the surface tend to die because the oil film blocks the oxygen from being dissolved in

* **Address for correspondence : Email :** Francis Udoh, fdudoh@yahoo.com

the water surface. Secondly, the process renders the water in the immediate vicinity unfit for any form of use including fishing, agriculture and tourism.

Health deterioration is also another effect of oil spillage. Oil spill poses serious threat to health due to gases associated with crude oil that are discharged into the air. When inhaled, these gases destroy the lungs and affect the blood cells of mankind and animals. In a case study of effects of incessant oil spills from Mobil Producing Nigeria Unlimited on human health in Akwa Ibom State, Eka and Udotong (2003) maintain that there were reports of unprecedented increases in incidences of diseases including respiratory diseases, unknown human infections, biodiversity reduction and social disharmony.

This study examined the effect of crude oil spillage on the marine water of Alakiri Community in Okrika Local Government Area of Rivers State, Nigeria in order to determine the level of physico-chemical and physical degradation of the marine ecosystem.

MATERIALS AND METHODS

Data collection at each sampling point in the study area was in line with the recommended procedure and practices for environmental data collection in Nigeria (Department of Petroleum Resources, 1991). The limits and standards applicable to possible contaminants were determined from review of existing regulations, Federal Environmental Protection Agency (FEPA), Department of Petroleum Resources (DPR), National Environmental Standards Regulation and Enforcement Agency (NESREA), World Health Organization (WHO), and United Nations Environmental Protection Agency (UNEPA).

Water and sediment samples were taken from Alakiri oil spillage site at three locations in Okrika Local Government Area in Rivers State, Nigeria. This area is dominated by an extensive mangrove ecosystem and drained by a number of Creek lets. Three sampling points were identified within the study area: The Alakiri Creek (sample point B) is the point where the spillage occurred and spilling further into Okari Creek (sample point C), and moving outward from point B into Oputuro Creek (sample point A, the control point) empting into the Bonny estuary where these creeks obtain their source of inflow water.

Water samples were collected at low tides with a 2-litre plastic bucket and transferred to clean 2-litre polyethylene containers that were rinsed several times with the water at the point of collection. The sediment samples were collected from each sampling point (taken at a depth of about 10 cm into the river bed) using a stainless steel pack and transferred into polyethylene bags. The samples for dissolved oxygen were collected in brown bottles to avoid decomposition of oxygen and were analyzed within 24 hours of collection. Other physico-chemical parameters were analysed at a later period using refrigerated samples. The collected sediment samples were air-dried by thinly spreading on a clean laboratory surface at room temperature and brought to a relatively homogeneous state by thoroughly mixing the individual samples, and coarse materials (>2 mm) such as pebbles and plant debris were removed from the sediments by hand-picking. After sieving with 2 mm mesh, the samples were prepared for the various physico-chemical parameter determinations. The results obtained are depicted in Tables 1 through 6.

RESULTS AND DISCUSSIONS

The pH of the water samples ranged from 4.50 to 5.20 with a mean value of 4.85 as compared to the control sample with a pH of 6.60 (Table 1). The pH of the sediments ranged from 3.20 to 4.32 for water samples C and B respectively with a mean pH value of 3.76. In comparing the mean values of the pH of 4.85 (for the polluted water) and 3.76 (for polluted sediments) with that of FEPA/DPR Standards (Tables 2 & 6), these values show a slight decrease from acceptable fish survival limit. The changes in the pH values in the polluted area can most likely be due to the influence of crude oil presence in the marine water of the study area. Sheehan *et al*. (1984) maintain that changes in pH can drastically affect the structure and function of the ecosystem both directly and indirectly, for example, by increasing the concentration of heavy metals in the water through increased leaching from sediments.

The dissolved oxygen in the polluted water ranged from 3.00 mg/l to 3.27 mg/L with a mean value of 3.15 mg/L levels are below FEPA/DPR Standards and requirements of 5.0 mg/l, and definitely cannot support aquatic life. The low Dissolved Oxygen levels could be aggravated by the oil-film (from the spillage) preventing oxygen diffusion from the air. High oxygen depletion can be so severe as to affect fish life. Chapman and Kimstach (1992) noted that dissolved oxygen concentrations below 5.0 mg/L adversely affect the functioning and survival of biological communities and below 2 mg/L may lead to the death of

Table 1. Results of Physico-chemical parameters in the Collected water samples

Parameters	A (control sample)	B (polluted sample)	C (polluted sample)
pH	6.60	4.50	5.20
DO (mg/L)	5.71	3.27	3.00
Alkalinity (mg/L)	24	32.00	37.00
Turbidity	4.91	6.20	6.23
THC (mg/L)	ND	1760	3200
Ca (mg/L)	7.98	21.52	23.44
Mg (mg/L)	5.24	1.948	3.366
Cr (mg/L)	0.03	0.04	0.05
Pb (mg/L)	0.08	0.23	0.25
Ni (mg/L)	0.03	0.42	0.53
Zn (mg/L)	0.002	2.53	0.20
Fe (mg/L)	1.8	3.5	4.1

ND: Not Detected

Table 2. Results of the Physico-chemical Analysis of the Sediments

Parameter	pH	Org.	THC	Ni	Zn	Fe	Pb	Clay	Silt	Sand
Water Sample A	6.60	1.20	200	0.03	0.002	20.8	0.15	2.34	15.16	82.5
Water Sample B	4.32	3.96	800	0.22	0.48	46.0	0.34	7.2	54.00	38.8
Water Sample C	3.20	4.29	1200	0.26	0.64	62.6	0.42	8.7	96.8	14.50

Table 3. Mean and standard deviation of the physico-chemical parameters of the water samples

Parameter	Mean	Standard Deviation
pH	4.85	0.35
Alkalinity	45	2.83
DO	3.14	0.14
THC	2480	720
Ca	22.48	0.96
Mg	2.657	0.71
Cr	2.09	2.04
Pb	0.38	0.01
Ni	0.48	0.06
Zn	2.37	0.165
Fe	3.8	2.53

Table 4. Mean and standard deviation of the physico-chemical parameters of the polluted sediments

Parameter	Mean	Standard Deviation
pH	3.76	0.314
%Org	4.125	0.165
THC	1000	200
Ni	0.24	0.02
Zn	0.56	0.08
Fe	54.3	8.3
Pb	0.38	0.0016
Silt %	65.4	11.4
Sand %	26.65	12.15
Clay %	15.9	7.2

most fish. Thus, the Dissolved Oxygen content in the analyzed samples shows some amount of deviation from the normal or acceptable amount of oxygen which could make the survival of aquatic life extremely difficult if not in possible in the study area.

The Total Hydrocarbon Content of the polluted water was found to be 1760 mg/L for sample B and 3200 mg/L for sample C while there was no dictation of total hydrocarbon in sample A of the control area. It is likely that any crude oil that entered the creek was quickly carried away into the Bonny estuary by the strong wind current, speed and turbulence of the incoming water. Additionally, the direction of the water may account for the observed result since this is the point or source where water flows into the creeks. However, it was observed that the sediment from the control area contained hydrocarbon (Table 2). This highlights the important role of the sediment as a sink for toxic materials contained in the water body. Wakeman and Themelis (2001) maintain that contaminants from land base sources introduced into surface water rapidly become scavenged by suspended particles that tend to settle to the bottom where they become highly concentrated. In this regard, by examining the hydrocarbon content obtained from the analysis of the collected samples and comparing the results with the standards and limits established by FEPA (10 mg/L) and DPR (20 mg/L), one can easily

Table 5. Comparison of the mean values of the physico-chemical parameters of the polluted water samples with FEPA/DPR standards

Parameter	FEPA/DPR standards	Mean value
pH	6.5 - 8.5	4.85
Turbidity	15	6.215
Alkalinity	ND	45
Dissolved Oxygen	5.00	3.15
Oil/Grease	20	2480
Lead	0.05	0.38
Zinc	0.1	2.37
Chromiun	0.03	2.09

ND: Not Detected

Table 6. Comparison of the mean values of the physico-chemical parameters of the sediment samples with FEPA/DPR standards

Parameter	FEPA/DPR standards	Mean value
pH	6.5 - 8.5	3.76
%Org	ND	4.125
Ni	ND	0.24
Zn	1.0	0.56
Fe	1.5	54.3
Pb	0.05	0.38
THC	20	1000

ND: Not Detected

assess the extent of contamination of the environment by the Alakiri oil spillage.

The levels of heavy metals (except chromium and iron) in the water and sediment samples were generally low and found to be within the normal set limits by FEPA and DPR (Tables 1 and 2). The presence of chromium and iron in the samples, however, should be a major concern. This is because fish usually preys on algae and other planktonic and benthic organisms, and when there is bio accumulation of heavy metals in fish, there is likelihood of morbidity and mortality in man along the food chain.

The mean value of oil and grease in the polluted water was 2480 mg/L as against the FEPA set limit of 20 mg/L. The consequences of allowing oil to accumulate in the aquatic environment are numerous. Ugochukwu and Leton (2004) assert that oil film on the water surface reduces the amount of Dissolved Oxygen (DO) which, depending on the degree, affects both higher aquatic life forms, microbial activities (aerobic; which are more favourable for oil break-down), pollution of breeding ground for some fish species and when washed ashore, smother the roots of mangrove species and deprive them of oxygen.

CONCLUSION AND RECOMMENDATIONS

The results obtained from this study show that the pH values of both the water samples and collected sediments were higher than the FEPA and DPR limits and the changes in the pH values in the polluted area can most likely be due to the influence of oil spillage in the study area. The levels of dissolved oxygen in the polluted water were below FEPA/DPR standards. The low levels of dissolved oxygen could be aggravated by the oil-film from the spillage, thereby preventing oxygen diffusion from the air. The Total Hydrocarbon Content of both the polluted water and sediments were found to be higher than the FEPA acceptable limits of 10 mg/L and DPR standards of 20 mg/L. The levels of heavy metals except chromium and iron in the water and sediment sample were generally low and found to be within the limits set by FEPA and DPR. The mean value of oil and grease in the study area was higher than the FEPA standards.

From the foregoing, it can be adduced that the activities of major oil operators in Nigeria are such that unavoidable releases into the immediate environment are expected. This is particularly the case in the flow station where this study was carried out. In this regard, based on the results obtained from the study, it is recommended that:

- Regular environmental performance of oil field activities should be the hallmark of any meaningful environmental policy.
- Regulatory agencies such as the Federal Environmental Protection Agency (FEPA) and the Department of Petroleum Resources (DPR) should ensure the implementation of environmentally friendly programmes by the oil field operators.
- An increased public awareness of environmental pollution issues and the adverse effect of oil pollution to the environment should be made.
- The relevant oil exploration regulators in Nigeria should have well trained regional facility inspectors who should periodically go on-site to inspect facilities in line with the relevant regulations laws, and
- There should be a development of national systems for marine pollution management, in particular, oil spill preparedness in order to minimize offshore oil spillage and its effect on the ecosystem.

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