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Effects of Oil Spillage on Groundwater Quality In Nigeria

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Abstract: - The purpose of the study was to ascertain the effect of oil spillage on groundwater quality in the oil producing Niger Delta region of Nigeria. The study was carried out in Abacheke community in Egbema Local Government area, Imo state.Water Samples were collected forquality analysis in boreholes/wells at three locations A, B, C. Locations A and B are areas with history of spillage while C is a location downstream with no history of oil spillage. The following parameters were tested for; physical parameters (temperature and turbidity), inorganic constituents (Conductivity, PH, TDS, DO, BOD, Mg, and P) and organic constituents (Total hydro-carbon)The results showed the some parameters exceeded the WHO permissible levels. Comparatively, Sample C had a lower value of hydrocarbon content (0.6 mg/l) while Samples A and B values were 0.9mg/l and 1.1mg/l respectively.The Turbidityvalue for sample C was 5 NTU compared to values of 14 and 18 NTU from samples A and B respectively. Results of PH test also showed that samples A and B were more acidic (5.56 and 5.98 respectively) than Sample C. The higher level of Turbidity and Total hydro-carbon for samples A and B isan indication of oil pollution which is attributable to incessant spillage. It is therefore necessary that appropriate treatment be carried out on the water samples to avoid adverse health effects.We also recommend that comprehensive groundwater monitoring should be carried out in the Niger Delta area and cleanup exercises carried outwhenever there is an oil spill to prevent infiltration of oil into the ground water.

Key Words: *- Oil, Spillage, groundwater, potable, pollution.*

I. INTRODUCTION

Oil exploration in Nigeria began shortly after independence in 1960. The oil sector has generated vital revenue that has contributed significantly to the country's growth (Anazie 2012). Irrespective of its significant contribution towards the country's economy, one should not lose sight of the fact of the tremendous hazards involved in its operations (Awosika, 1985)[1]

Oil spill is the release of liquid petroleum into the environment, especially marine areas to human activity and is a form of pollution (Vidal, 2003)[2]. It has been a major occurrence in Nigeria. The country recorded about 1020 incidents of oil spillage, which culminated in the loss of about 1,359,715 barrels of crude oil to the waste land and water of Niger Delta (Opafunso and Apena, 2000)[3]. Oil spillage in recent times has been a threat to human life, marine life, wild life and micro-organisms in the soil. It has seriously threatened human existence, especially those in the Niger Delta region of the country. Oil spillage is also a major threat to surface and ground water resources of the affected areas through infiltration and seepage, thereby reducing the quality of the affected resources. Oil spills on land are more readily containable but is also deadly due to infiltration which could percolate the underlying soil layers and thereby contaminating the groundwater (Anderson et al 2005)[4].

The major causes of oil spill in Nigeria are corrosion of pipelines and tankers (accounting for 50% of all oil spills), sabotage (28%) and oil operations (21%) with 1% of the spills being accounted for by inadequate or non-functional equipment (Nwilo et al, 2007)[5]. Many of the oil pipelines have been in place for over 30 years.area UNEP (2006)[6] summed the impact of oil spillage in the Niger Delta as follows; high mortality of aquatic animals, impairment of human health,loss of biodiversity in breeding grounds, vegetation hazards, loss of potable and industrial water resources, reduction in fishing and farming activities, poverty and rural unemployment. Virtually every aspect of oil exploration and exploitation has deleterious effects on ecosystem stability and local biodiversity.

Groundwater is a major source of water to many communities in Nigeria.Prolonged consumption of oil polluted water has adverse effect on the health of the consumers. Water with high level of hydrocarbon content may have negative effect on the kidney and liver of the consumers. Also poor reproductive system, leukemia, increased blood pressure and reduced blood clotting are associated with oil polluted water. It is important to note that groundwater pollution from oil spill is not always amenable to total clean up. It is therefore safer and wiser to prevent its occurrence.

This study was carried out in Egbema Local Government area, Imo state. Oil was discovered in Egbema territory in 1973 when Shell found oil in the area. Shell Petroleum and Development company, Cheveron Nigeria Ltd and Agip oil company Ltd are the major players in the oil extractive industry in Egbema having secured the oil mining licence (OML) covering the entire Egbema land(Abbey and Anthony, 1974)[7]. From 1973 to 2007, twenty incidents of oil spill were recorded in Egbema [8]. This has led to adverse environmental effects. The most profound and adverse impact of oil pollution in Egbema with far reaching implications on all other aspects of our traditional lifestyles and livelihoods had been the total loss of biodiversity and destruction of habitats largely due to soil degradation (Ogboghodo et al, 2004)[9].

The study was focused on assessing groundwater quality in the study area with a view to ascertaining the nature and extent of the impacts of oil spillage.The analysis was based on World Health Organisation standard for potable water.

II. MATERIALS AND METHODS

Studies were carried out in Abachekecommunity in Ohaji/Egbema Local Government Area of Imo State .Three samples A, B, and C were collected at strategic points for quality analysis. Samples.A and B were collected at the downstream section at locations with history of oil spillage while sample C was collected from the upstream section of the study area.Samples A and B were collected from public wells, while Sample C was collected from a public boreholeThe following parameters were tested for;physical parameters (temperature and turbidity), inorganic constituents(Conductivity, PH, TDS, DO, BOD, Mg, and P), and organic constituents (Total hydrocarbon)

Onsite measurement was carried out forPh, temperature, dissolved oxygen. The portablePH meter was used in measuring the level of acidity or alkalinity. Electrical conductivity, which is a measure of the ability of the aqueous solution to carry an electric current, was measured using a digitalconductivity meter. 200 ml of sample was placed in a 250 ml beaker, and the probe was inserted to read the conductivity in µS/cm. Total dissolved solid was estimated (in mg/l) by multiplying the conductivity by factor of 0.55.. The turbidity meter was used to measure turbidity. The cell was rinsed with distilled water and the sample poured to the cell mark and the most stable value read.

Calcium and Magnesium content was determined by heating 25 ml of water mixed with 1 ml concentration of Hydrochloric acid to reduce the original volume to 1/3 the original volume. After cooling 5ml of Ammonium Acetate was added and 2ml of Phenothroline solution was added. The entire solution was now transferred to a 25ml measuring cylinder and sent to spectrophotometer for reading at wavelength of 510 mm. Calorimetric method was adopted for phosphate determination. Stannous chloride solution was used.

The BOD was determined using Winklers solutions, starch indicator, concentrated hydrochloric acid and sodium triosulphate solution. The BOD5 was computed as

$$(DO - DO_5)\ P \qquad 1$$

Where DO = Dissolved oxygen concentration at zero time

DO5 = Dissolved oxygen concentration at 5days incubation period

P = Dilution factor

To determine total hydrocarbon, 1000mls of water was collected from the field and poured into a separatory funnel. 50ml of Xylems was added to it and shaken vigorously before the same quantity was added again. The solution was allowed to settle for about 15mins. Thereafter the oil and xylem (extracted) was collected and sent to Spectrometer for reading.

III. RESULTS AND DISCUSSION

Tables 1- 3 showresultsof tests on physical parameters, inorganic and organic constituents of the samples. The results were compared with WHO guidelines for potable water.

In case of physical characteristics, Samples A and B with history of oil spillage show high turbidity of 14 NTU and 8 NTU which exceeds WHO maximum value of 5 NTU.(Table 1). The pH values of samples A and B shows that the samples were relatively more acidic compared to sample C. The background level of phosphorus was not found because there is little potential for phosphorus to leach through the soil into the ground. Soil particles have a large capacity to fix phosphorus in forms that are immobile in soil. Most solids filter out soluble phosphorus and water passes through the soil profile into the ground.

The dissolved oxygen levels of samples A and B were quite low and cannot support desired aerobic organisms in the study area. This may upset the ecosystem encouraging development of septic conditions and subsequently produce anaerobic condition in the ground water. On the other hand the dissolved oxygen level of sample C could support aerobic organism in the study site. The difference in the value of dissolved oxygen in Samples A, B and C could be as a result of oil spillage which affected samples A and B locations. The BOD value of sample is also relatively higher than that of samples A and B The high concentration of Total hydrocarbon content (oil and grease) (Table 3) in samples A and B is an indication of oil pollution as a result of the spillage.

IV. CONCLUSIONS AND RECOMMENDATIONS

The effect of oil pollution on ground water was investigated by collecting water samplesfrom boreholes with history of oil spillage These samples were analyzed for physical and chemical properties. Results showedthat the Total Hydrocarbon Content (THC) for the oil polluted sites are higher than the value of THC from the control site where there was no oil spillage. This is a strong indication of pollution. Other indications of oil pollution are low dissolved oxygen levels and pH which exceed WHO Standard. Results of the study showed that the groundwater of the study area is contaminated as a result of oil spillage. The effects on the indigenes may depend on the extent of consumption and their previous health history. If treatment is not considered as soon as possible, there is no doubt that these health problems may cause low life expectancy and affect the productivity of the study area.It is therefore recommended that detailed medical test be carried out in the project area to ascertain the health of the people.

Comprehensive groundwater monitoring should be carried out and adequate treatment should be implemented. The Government should carry out cleanup exercise immediately there is spillage in order to prevent infiltration of oil into the groundwater. Oil spill prevention, containment and countermeasures should be put in place.

Table 1 Physical Parameters

Parameter	Unit	Max permitted level (W.H.O guideline)	Sample A	Sample B	Sample C
Temperature	Celsius	Ambient	25	24.9	25.5
Turbidity	NTU	5	14	8	5

Table 2 Inorganic Constituents

Parameter	Unit	Max. Permitted Level (WHO)	Sample A	Sample B	Sample C
Conductivity	µs/cm	1000	54.4	21.8	292.7
pH		6.5 - 8	5.98	5.56	6.56
TDS	mg/l	600-1000	30	12	161
D.O	mg/l	7-14	3	2	6.5
BOD	mg/l	0.8-5	2.0	2.4	2.668
Magnesium	mg/l	30	4.1	3.0	20
Calcium	mg/l	75	2.8	0.4	13.9
Available Phosphorous	mg/l	0.15	-	-	-

Table 3 Organic Constituents

Parameter	Unit	Max. Permitted Level (WHO)	Sample A	Sample B	
Total Carbon	Mg/l	0.007	0.9	1.1	0.6

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