ENVIRONMENTAL AUDIT REPORT OF UNIPETROL INSTALLATION LOCATED AT APAPA, LAGOS NIGERIA: CASE STUDY - EFFLUENT AND POTABLE WATER DISCHARGES

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Abstract
Environmental audit, EA, is one of the available enforcement tools used as agent of sustainable growth comprising a systematic, documented, periodic and objective evaluation of the process technology, equipment performance, raw materials in use, quality and quantity of wastes generated, and their effects on the air, soil, vegetation, underground and surface water, with the aim of facilitating management control of environmental practices and assessing compliance with company's policies and meeting regulatory requirements. This paper therefore reports the environmental auditing of the effluent and potable water discharges at Unipetrol's Apapa Installation. The results show that the effluent from the separator pit has high Total Hydrocarbon Content (THC), mean value is 13.13 Mg/l, Oil and grease, mean value is 25.82 mg/L, Biochemical Oxygen Demand (BOD), mean Value is 169.44 mg/L and Chemical Oxygen Demand (COD), mean value is 252.32 mg/L. These values were above statutory limits and therefore requires that control measures be taken to forestall pollution

Keywords: Environmental Audit, Effluent, installation, potable water.

Introduction

Refined petroleum products are stored and distributed from tank forms/ terminates.

These activities involve major facilities such as storage tanks, pumping equipment, water treatment equipment, loading systems, etc, which must be operated efficiently and according to accepted standards (Tolulope, 2004). Land and waterways are polluted by oil and oily wastes caused by accidental discharges during loading, pipe line leaks, rust, and mystery spill and/or malfunctioning of operations (Oyewo, 1998). Aquatic and terrestrial ecosystem, cultural and historical resources are affected by petroleum activities, hence the need to plan, protect and enhance prudently the environmental resources around installations (Osibanjo et al, 1981) this necessitates the periodic carrying out of Environmental Audit of existing action in order to ascertain compliance with environmental requirements.

The broad aims of this Environmental Audit are to:

Assess compliance with regulatory requirements(DPR 2002, FEPA 1989) as well as company policies on environmental matters and sustainable development

Facilitate management control of environmental practices as it applies to effluent and potable water discharges.

Help local management to control the quality of existing operations and develop strategies for improvement in anticipation of future needs by:
Identifying and proffering measures to minimize actual or potential company exposure to environmental liabilities as it applies to effluent and potable water discharges.
Transferring know-how on cost effective environmental techniques, measures and procedures, as well as giving timely warning of situation that may need improvement regarding the effluent and potable water discharges.
Providing assurance that operations do not have unacceptable environmental effects.

Methodology

Study Area:

Effluent water sampling was carried out at five points using a Rutter Sampler. Separate samples were collected for the following determinations: Dissolved Oxygen, Biochemical Oxygen Demand, Heavy metals, Oil and grease (using glass bottles) and general Physico-chemical analysis (using 2 litre plastic bottles). Some in situ determinations were made at the time of sampling. They include using mercury in bulb thermometer and $_{P}$H using a $_{P}$H meter.

Samples were preserved in Ice chest cooler and samples for dissolved oxygen were fixed. Samples were collected from the only separator pit in the installation and also from other points within and outside the installation. Table 1 shows the water sampling stations. The borehole samples were first collected for Physico- chemical parameters and later for coli form test after steaming the pump head and allowing the pump to run for about 10 minutes. This was to ensure that a true and representative water sample was collected.

TABLE 1

Effluent and Water Sampling Stations for Unipetrol Apapa Installation Auditing.

S/N	SAMPLE CODE	SAMPLING STATION DESCRIPTION
1	UPSPT	Separator pit
2	UPEFLV 1	Effluent from gutter beside loading vent
3	UPEFLV 2	Effluent from gutter beside old loading vent
4	UPRC UP	Effluent water from receiving canal upstream (behind the installation)
5	UPRC DP	Effluent water from receiving canal-down-stream (behind the installation)
6	UPTW	Tap water near the canteen

Experimental Procedure

Effluent and Portable Water Discharge Analysis

The effluent and potable water were analysed for the following parameters: $_{P}$H, Electrical conductivity, Salinity, Oil and grease, total dissolved solid, Total Suspended Solids (TSS), Odour, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Nitrate, Chloride, Nitrite, sulphate, phosphate, Total

(a) pH

The pH of the effluent were determined using glass electode pH meter which was pre- calibrated using Buffer 4 and 9 (APHA 144)

(b) Electrical conductivity and Total Dissolved solids.

These were measured using lovibond conductivity meter (Type cm-21)

(c) Turbidity.

Turbidity of the samples were determined using nephelometric method (APHA 163A).

(d) Salinity:

Salinity of the samples were determined using Nariba water Kit.

(e) Oil and grease

A Homogenous sample was extracted with xylene after adjusting the pH to 1. The generation of oil and grease in the extract was determined using spectrophotometer.

(f) Total solids (TS)

Total solids of the effluent and potable water samples were determined using a gravimetric method. A well mixed sample was evaporated in a previously weighed evaporating dish and dried to constant weight at 105^0 C.

(g) Total Dissolved Solids. (TDS)

Determination of TDS was by first filtering the sample and a known volume of the filtrate was evaporated to dryness in an evaporating dish previously weighed.

(h) Total Suspended Solids (TSS) The difference in weight between total and dissolved solid gave the total suspended solid (TSS)

(i) Odour

A known volume of the water/effluent sample was examined through smelling to determine the Odour.

(j) COD

The Chemical Oxygen demand (COD was determined using the permanganate method as modified by Welcher (1975). It is a titrimetric method.

(k) BOD

Biochemical Oxygen Demand (BOD) refers to amount of oxygen required by living organism engaged in the utilization and stabilization of organic matter present in water and waste water. The BOD is conventionally reported as the five day value and is determined by 5-day incubation method (APHA 1989)

(l) Sulphate

Sulphate was determined by the turbidimetry method (APHA, 1975). Colloidal barium sulphate was formed by the reaction of sulphate with barium ion in a barium chloride – hydrochloric acid solution in the presence of glycerol and ethyl alcohol.

(m) Phosphate

Phosphate was determined by the Stannous chloride (APHA,1975). Phosphates in samples were reacted with ammonium molybdate in acidic medium to form

molybdo-molybdenium blue complex by stannous chloride. The intensity of color was measured using spectrophotometer at 690nm. The limit of detection is 0.05mg/L

(n) Total Hydrogen content (THC)

The effluent samples were extracted of using hexane/methylene chloride mixture after addition of internal standard. The extracts were concentrated and GC method was used in determing the total hydrocarbon.

(o) Heavy Metals

Metals were determined using Atomic Absorption Spectrophotometer (AAS) after samples were digested with HNO_3 and HCl mixture. Chromium hexavalent was determined using this method after extraction with MIBK.

(p) Microbal Analysis

The microbes in effluent and tap/drinking water samples were cultured using Maconkay broth. Colonies were counted with a counter.

Results and Discussion

The laboratory analysis results for effluent and portable water are as presented below. The effluent results were compared with DPR/FEPA limits while the potable water results were compared with WHO limits guiding it.

(i) pH.

The pH of effluent water samples range from slightly acidic to slightly alkaline (6.86 – 1.35) while the potable water was slightly alkaline (7.08) The mean value of the effluent and potable water is 7.10. the pH values of the effluent samples are in conformity with the compliance limits of 6.5 – 8.5 set by DPR/FEPA.

Also, the potable water pH conformed with WHO standard affecting the acceptability of water for domestic use.

(ii) Electrical Conductivity (EC)

The electrical conductivity of the effluent water samples varied widely. The least value of 13.13 us/cm was obtained at station UPRCDP while the maximum value of 14.84 us/cm was obtained at station UPRCUP. The electrical conductivity of the potable water (UPTW) was 134 us/cm

(iii) Turbidity

Whereas the potable water sample was not turbid, the turidity of the effluent water samples were generally low (0.72 NTU – 1.64 NTU), except the effluent water from station UPEFLV1 (12.74 NTU). The later is slightly higher than the DPR limit of 10 NTU while the former were lower and thus fall within the acceptable limits.

(iv) Salinity

Generally, the salinity values were very low when compared to the DPR limit, indicting conformity with acceptable standard. The value range from 20mg/L - 500 mg/L for the effluent samples and 15mg/L for the portable water

(v) Oil and Grease

All the effluent samples had high oil and grease content. This ranged from 16.4mg/L of (station UPRCDP to 39.30mg/L (station UPEFLV2). The values averaged 25.82mg/L and are respectively far above the maximum compliance limits of 10mg/L set by DPR

Total Dissolved Solids (TDS)

The dissolved solid values of all the effluent samples were within the DPR/FEPA acceptable limits of < 2000.mg/L and averaged 566mg/L. The potable water also had a low dissolved solid value of 94mg/L and falls within WHO's acceptable limit for potable water.

Total Suspended Solid (TSS)

Although less than 10mg/L of suspended solids were found in the potable water, the value from 10mg/L to 226mg/L (Mean = 76) were for effluent samples analysed.

Odour

With the exception of the potable water sample, all the other samples (effluent) had objectionable Odour.

(ix) Chemical Oxygen Demand (COD)

The COD values of the effluent samples were far much higher than DPR limit of 40mg/L. The range is from 85.70mg/L to 365.20mg/L, mean value = 252. 32 and this call for control action. However, the portable water sample had far lower COD value of 25.90mg/L.

Biochemical Oxygen Demand (BODs)

The nitrate content of effluent samples varied widely. Except at station UPSPT with value within DPR limit (12.14mg/L), all the stations had values higher than the DPR limit, and range from 21.85mg/L to 303.42mg/L.

(x) Sulphate ($S04^{2-}$)

Sulphate was undetected at stations UPEFLV 1, UPEFLV 2, and in the potable water sample. Very low sulphate values were detected in all the other samples and these range from 0.08mg/L to 0.90mg/L averaging 0.28mg/L All sulphate values are thus within DPR/FEPA and WHO permissible limits respectively.

(xi) Phosphate ($P04^{3-}$)

Phosphates were detected in all the samples. The least phosphate value was detected in the potable water sample (0.64mg/L) while the effluent samples had values ranging from 1.66mg/L to 3.78mg/L and averaged 2.57mg/L.

(xii) Total Hydrogen Content (THC)

None was detected in the potable water sample. However, in the effluent samples, the least THC value of 4.56mg/L was obtained at station UPRCDP while the highest value of 22.04mg/L was obtained at UPSPT. The mean value for the effluent samples is 13.13mg/L

(xiii) Exchangeable cations, EC (Na^+, Ca^{2+}, Mg^{2+}, K^+)

All the cations analyzed for namely, Na^+, Ca^{2+} , Mg^{2+} , K^+, were detected in varying degrees in all the effluent samples and in the potable water. The EC values were Na^+ - 6.20mg/L, Ca^{2+} - 1.11mg/L, Mg^{2+} - 1.98mg/L and K^+ - 0.89mg/L . The effluent samples had the following range of values:

Na^+ - 31.20mg/L – 868.10mg/L (mean =236.72mg/L)
Ca^{2+} - 12.43mg/L – 82.25mg/L (mean = 29.86mg/L)
Mg^{2+} - 5.00mg/L – 206.90mg/L (mean = 57.5mg/L)
K^+ - 5.80mg/L – 31.24mg/L (mean = 19.94mg/L)

(xiv**) Heavy Metals (** Fe, Cu, Zn, Cr, Ni, Cd, Pb, V and Cr.

Ni, Cd, Pb, V and Cr were generally undetected in all the effluent samples (and the portable water). More so, Zn was also undetected in the effluent samples for stations UPSPT and UPRCDP, while Cr was undetected in effluent samples for stations UPSPT, UPEFLV2, and UPRCDP. Fe was detected in all the effluent samples in values ranging from 0.73mg/L to 5.07mg/L, and averaging 3.81mg/L. Cu was also detected in all the effluent samples and the values ranged from 0.10mg/L to 6.08mg/L, mean value 1.36mg/L. In the three effluent samples Zn was detected, the values ranged from 0.06mg/L to 2.23mg/L and averaged 0.61mg/L while the Cr values for the effluent samples where it was detected were 0.26mg/L and 0.38mg/L (stations UPEFLV2, and UPRCUP). However, all the metals were generally undetected in the potable water sample.

Table 2: Microbial Ratio for the Effluent And potable water samples At Unipetrol's Apapa Installation

Microbial Ratio

S/NO	**SAMPLE CODE/IDENTITY**	**FUNGI CFkkU/G**	**BACTERIA**
1	UPSPT	$1.65X10^4$	150
2	$UPEFLV^1$	$1.30X10^5$	450
3	$UPEFLV^2$	$3.90X10^3$	90
4	UPRCUP	$1.30X10^3$	250
5	UPRCDP	$3.10X10^3$	70
	Effluent Mean	$3.11\ X10^4$	202
6	UPTW	110	7

Conclusion

The study, carried out in this work is the environmental auditing of effluent and potable water discharges at Unipetrol's Apapa installation. In particular the study revealed high THC, oil and grease, BOD and COD values in the effluent samples. This calls for control action by Unipetrol prior to discharge of the effluent. Oil and grease must generally be removed from waste- water since these materials can foul instruments and equipments, interfere with other processes (particularly gravity settling), they are very damaging to the environment and could cause significant pollution problem to a receiving body of water. Above all, there is need for Unipetrol to contain the spread of the effluent discharge behind the installation. This they could do by constructing channels through which the discharged effluent will run into the already existing canal.

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