Environmental Audit Report of Taurus Oil and Gas Tank Farm Installation Located at Koko, Delta State, Nigeria

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Abstract

In order to guarantee sustainable growth and development, documented, periodic and proper evaluation of the process technology, raw materials in use, equipment performance, quality and quantity of wastes generated and their likely negative effects on the air, soil, underground and surface water vegetation, with the sole objective of facilitating management control of environmental practices and assessing compliance with company's policies and meeting regulatory requirement, environmental audit. , E.A, is one of the profound available enforcement tools used as agents to achieve all of the above. This paper reports the environmental auditing of the portable water and effluent discharges at Taurus oil and gas tank farm installation located at Koko, Delta State. The results show that the effluent from the separator has a high total hydrocarbon content (THC) with mean value of 26.90 Mg\L, Biochemical Oxygen Demand (BOD), mean value of 178.45 Mg\L and Chemical Oxygen Demand (COD), mean value of 263.51 Mg\L. These values are completely above statutory limits by the regulatory agencies for oil and gas installations in Nigeria and therefore require that control measures be taken to forestall pollution.

Keywords: Sustainable growth, Effluent, Environmental audit, Portable water, Enhancement.

1.1 INTRODUCTION

Refined petroleum products are stored and distributed from tank farms or terminals. 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 acceptable standards (American Petroleum Institute, 2014)
Waterways and land are polluted by oil and oily wastes caused by accidental discharges during loading, pipe line leakages, rust, corrosion and mystery spill and /or malfunctioning of operations (American Petroleum Institute, 2014)

Aquatic and terrestrial ecosystems, cultural and historical resources are affected by petroleum activities, hence the need to plan, protect and enhance prudently the environmental resources around installation (Chang & Lin, 2006). This necessitates the periodic review, and carrying out of environmental audit of existing action in order to ascertain compliance with environmental requirements (Godlewska et al; 2021).

The broad aims of this environmental audit are;

- ❖ To assess compliance with regulatory requirements[4] as well as company policies on environmental matters and sustainable development (Hassan, 2013)
- ❖ Facilitates management control of environmental practices as it applies to effluent and portable 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 portable water discharges.
- ✓ Transferring know-how to cost-effective environmental techniques, measures and procedures as well as giving timely warning of situations that may need improvement regarding the effluent and portable water discharges.
- ✓ Providing assurance that operations do not have unacceptable environmental effects NUPRC, 20

Environmental auditing has turned out to be an essential device in making sure sustainable development, specifically for industries which are susceptible to environmental degradation. The Taurus oil and gas tank farm installation, situated at Koko, Delta State, Nigeria, has been audited to assess its compliance with organisation rules and regulatory requirements regarding the release of portable water and effluent discharges.

The primary attention of this audit is the portable water and effluent discharges of the tank farm set up. The record will detail the size and analysis of the effluent traits, along with general hydrocarbon content (THC), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD).

Environmental auditing has end up a treasured device in managing environmental risks and ensuring compliance with laws and regulations. It's been increasingly adopted by means of industries that have a significant impact on the surroundings, inclusive of the oil and gas

industry. Environmental auditing has been described to be associated with systematic evaluation of an organization's environmental performance, with the intention of figuring out areas for enhancements and ensuring compliance with regulatory requirements (Rajagukguk & Khairandy, 2001).

In Nigeria, the oil and gas enterprise is a good sized contributor to the country's economic growth. The industry, however is associated with environmental risks, which includes oil spills, gas flaring, and discharge of pollution into the environment. Environmental auditing has been recognized as a crucial tool in handling the environmental impact of the industry (Chukwu et al., 2021).

Environmental auditing of the oil and gas installations in Nigeria has been the problem of numerous studies. Research have centered on issues related to environmental performance, regulatory compliance, and satisfactory practices for environmental management. Hassan & Kanhy (2013) recognized demanding situations associated with environmental auditing within the Nigerian oil and gas installations, which consist of confined assets, a lack of knowledge on environmental issues, and inadequate rules and enforcements.

The discharge of pollutant effluents from oil and gas installations into the environment has been a big subject of discussion in Nigeria. As a result, the Federal Ministry of Environment and the Nigerian Upstream Petroleum Regulatory Commission (2021) has issued pointers and requirements for Environmental pollutants manage in Nigeria. The recommendations set up limits for effluent discharges from oil and fuel installations, such as overall hydrocarbon content (THC), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD).

Studies have shown that effluent discharges from oil and gas installations in Nigeria exceeded regulatory limits in most instances. For instance, Lawal et al. (2017) suggested that effluent discharges from decided on oil and gas centers in Nigeria had high concentrations of pollutants inclusive of BOD, COD, and Oil and Grease (O&G).

2.1 THE STUDY AREA:

Koko is the major town in and the headquarters of Warri North Local Government Area of Delta State, South South Nigeria.

Koko is one of the Niger Delta regions with a rich history and is known for its unique cultural heritage, natural resources and vibrant economy.

Fig 1.0 Map of Koko

Koko has:

Latitude $6^0\,0\,10''$ North

Longitude: $5^0\,27\,56''$ East

The presence of the Nigerian National Petroleum Corporation (Ltd NNPC) depot and other petrol chemical companies has significantly contributed to the town's economic growth.

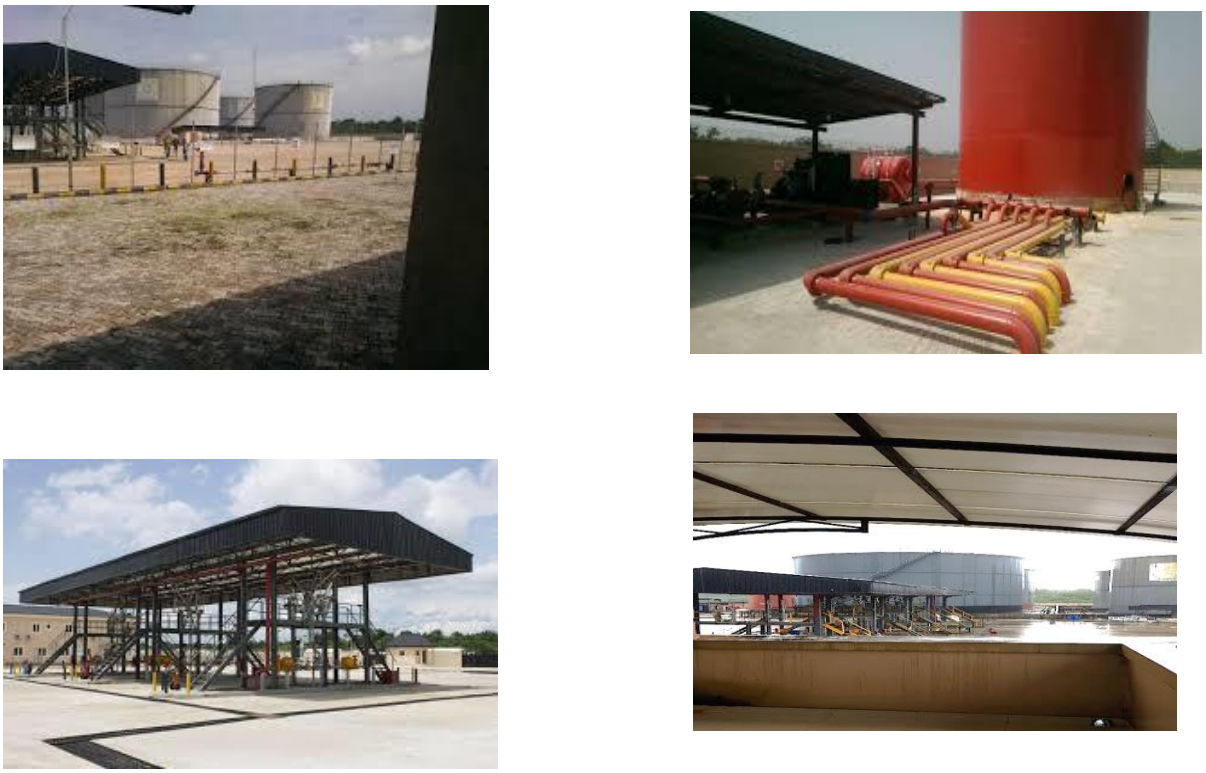

Fig 2.0: Taurus Oil and gas tank farm installation.

2.2 MATERIALS AND METHODS

Effluent water sampling was carried out at five points using 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 physio-chemical analysis (using 2 liters plastic bottles). Some in situ determinations were made at the time of sampling. These include using mercury in bulb thermometer and pH using a pH meter.
Samples were preserved in Ice chest cooler and samples for dissolved oxygen was fixed.
Samples were also collected from the only separator pit in the installation and also from four other points within and outside the installation.

Table 1 : Shows the water sampling stations.

S/N	SAMPLE CODE	SAMPLING STATION DESCRIPTION
1.	TOGTF – SPT	Separator Pit
2.	TOGTF – EFL V_1	Effluent from gutter beside loading Vent
3.	TOGTF – EFL V_2	Effluent from gutter beside old loading Vent
4.	TOGTF – RC UPS	Effluent water from receiving carnal upstream (behind the installation)
5.	TOGTF- RCDS	Effluent water from receiving carnal-downstream (behind the installation)
6.	TOGTF – TW	Tap water near the canteen

2.3 EXPERIMENTAL PROCEDURE

2.3.1 Effluent and Portable Water Discharge Analysis.

The effluent and portable water were analyzed for the following parameters: pH, Electrical conductivity, Salinity, Oil and grease, Total Dissolved Solids, Total Suspended Solids(TSS), Odor, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Nitrate, Chloride, Nitrite, Sulphate, Phosphate, Total Hydrocarbon Content (THC), Exchangeable cations (Na^+ , Ca^{2+} , Mg^{2+} and K^+); Heavy Metals (Fe, Cu, Zn, Cr, Cd, Pb, V and Cr) and Microbal ratio.

Table 2 : Measured Parameters

S/N	PARAMETERS	EXPERIMENTAL PROCEDURE
1.	pH	The pH of the effluent were determined using glass electrode pH meter which was calibrated using Buffer 4 and 9 (APHA 144)
2.	Electrical Conductivity and Total Dissolved Solids	These were measured using the HI9811 -5 conductivity meter
3.	Turbidity	Turbidity of the samples were determined using the Nephelometer /Turbidimeter Confab Model 850 – employing

		the Nephelometric method (AP 653)
4.	Salinity	Salinity – The weight of all dissolved salts in water in the ratio of parts per thousand was determined using the Salinometer.
5.	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 the Spectrophotometer.
6.	Total Dissolved Solids (TDS)	Determination of TDS was first by filtering the sample and a known volume of the filtrate was evaporated to dryness in an evaporation dish previously weighed.
7.	Total Suspended Solids (TSS)	The difference in weight between total and dissolved solid gave the total suspended solid (TSS).
8.	Odour	A known volume of the water/ effluent sample was examined through smelling to determine the odour.
9.	Chemical Oxygen Demand (COD)	The chemical Oxygen demand (COD) was determined by the digestion of the water sample in a sealed viral with potassium dichromate and sulphuric acid at 150^{o} C for 2 hours
10.	Biochemical Oxygen Demand (BOD)	Two samples were examined. One of the samples was tested immediately for dissolved Oxygen, and the second one was incubated in the dark at 20^{o} C for 5 days and then tested for the amount of dissolved Oxygen remaining.
11.	Sulphate	Sulphate was determined by the turbidimetry method. Colloidal barium sulphate was formed by the reaction of sulphate with barium ion in a barium (iv) chloride -hydrochloric acid solution in the presence of glycerol and ethyl alcohol.
12.	Phosphate	The spectrophotometric detection of a colour edphosphomolybdate complex was employed.
13.	Total Hydrogen Content (THC)	The total Hydrogen content was determined using a simple titration (oxidimetry) method using a methylene blue – platinum colloid reagent.
14.	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 Methyl Isobutyl Ketone (MIBK)
15.	Microbial Analysis	The microbes in effluent and tap/drinking water samples were cultured using MaconKay broth. Colonies were counted with a counter.

3.1 RESULTS AND DISCUSSIONS

The laboratory analysis results for effluent and portable water are as presented below. The effluent results were compared with Nigerian Upstream Petroleum Regulatory Commission /FEPA. Portable water results were compared with WHO limits guiding them.

Table 3: Parameters and Discussed Results

S/N	PARAMETER	RESULTS AND DISCUSSION
1.	pH	The pH of affluent water samples ranged from slightly acidic to slightly alkaline (6.88 – 7.36) while the portable water was slightly alkaline (7.09). The mean value of the effluent and portable water was7. 10. The pH values of the effluent samples were in conformity with the compliance limits of 6.6 – 8.6 set by NUPRC / FEPA . Also, the portable water pH conformed with WHO standard affecting the acceptability of water for domestic use.
2.	Electrical Conductivity (EC)	The electrical conductivity of the effluent water samples varied widely. The least value of 14.03 us/cm was obtained at station TOGTF – RCDS while the maximum value of 15.74us/cm was obtained at station TOGTR – RC UPS. The electrical conductivity of the portable water. (TOGTF – TW) was 142us/cm.
3.	Turbidity	Whereas the portable water sample was not turbid, the turbidity of the effluent water samples were generally low (0.74NTU – 1.66NTU), except the effluent – water from station to GTF – EFL V1 (12.76NTU). The later was slightly higher than the NUPRC limit of 10NTU while the former was lower and thus fall within the acceptable limits.
4.	pH	The pH of affluent water samples ranged from slightly acidic to slightly alkaline (6.88 – 7.36) while the portable water was slightly alkaline (7.09). The mean value of the effluent and portable water was7. 10. The PH values of the effluent samples were in conformity with the compliance limits of 6.6 – 8.6 set by NUPRC / FEPA . Also, the portable water PH conformed with WHO standard affecting the acceptability of water for domestic use.
5.	Salinity	Generally, the salinity values were very low when compared to the Nigerian Upstream Petroleum Regulatory Commission limit, indicating Conformity with acceptable standard. The value ranged from 20 mg/L – 500mg/L for the effluent samples and 15mg/L for the portable water.
6.	Oil and Grease	All the effluent samples had high oil and grease content. This ranged from 17.02mg/L for (station TOGTF – RCDS to 40.31 mg/L (station TOGTF - $EFLV_2$). The values averaged 26.85Mg/L and are respectively far above the maximum compliance limits of 10mg/L set by Nigerian Upstream Petroleum Regulatory Commission.
7.	Total Dissolved Solids (TDS)	The dissolved solid values of all the effluent samples were within the NUPRC /FEPA acceptable limits of < 200mg/L averaged 577mg/L. The portable water also had a low dissolved solid Value of 96mg/L and falls

		with WHO's acceptable limit for portable water.
8.	Total Suspended Solids (TSS)	Although less than 10mg/L of suspended solids were found in the portable water, the Value from 10mg/L to 228mg/L (mean = 78mg/L) were for effluent samples analyzed.
9.	Odour	With the exception of the portable water sample, all the other samples (effluent) had objectionable odour.
10	Chemical Oxygen Demand (COD)	The COD values of the effluent samples were far, much higher than NUPRC limit of 40mg/L. The range is from 86.20mg/L to 370.10mg/L, mean Value of 254.23mg/L and this calls for control action. However, the portable water sample had far lower COD Value of 25.90mg/L.
11	Biochemical Oxygen Demand (BOD)	The nitrate content of the effluent samples varied widely. Except at station TOGTF – SPT with Value within NUPRC limit (12.14mg/L), all the stations had values higher than the NUPRC limit, and ranged from 21.96mg/L to 304.34mg/L.
12	Sulphate (SO_4^{2})	Sulphate was undetected at stations TTOGTF – EFLV and TOGTF – EFLV, and in the portable water sample. Very low sulphate Values were detected in all the other samples and these ranged from 0.09mg/L to 0.90mg. l averaging 0.29mg/L. The sulphate values are thus within NUPRC/FEPA and WHO permissible limits respectively.

Table 4: Microbial Ratio for the effluent and portable water Samples at Taurus Oil and gas tank farm installation.

Microbial Ratio

S/N	SAMPLE CODE/IDENTITY	FUNGI CFKKU/G	BACTERIA
1.	TOGTF – SPT	1.75×10^4	150
1.	TOGTF –EFLV1	1.40×10^5	450
2.	TOGTF – EFLV2	4.00×10^3	90
3.	TOGTF – RC UPS	1.40×10^3	250
4.	TOGTF – RCDS	3.22×10^3	70
	Effluent Mean	3.22×10^4	202
5.	TOGTF – TW	115	7

4.1 CONCLUSION

This study carried out the environmental auditing of effluent and portable water discharges of Taurus Oil and gas tank farm installation located at Koko, Delta State. Results revealed high Total Hydrogen Content (THC), oil and grease, Biochemical Oxygen demand

(BOD) and chemical Oxygen Demand (COD) values in the effluent samples. This calls for control action by Taurus prior to discharge of the effluent. Oil and grease must generally be removed from waste – water since these materials can foul instruments and equipment's, interfere with other processes (particularly gravity Settling), they are very demanding to the environment and could cause significant pollution problem to a receiving body of water.

Above all, there is need for Taurus 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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