

Impact assessment of tanker explosion in a Nigerian Niger Delta community, Okogbe

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ABSTRACT

A two – week post impact assessment of an oil tanker explosion site in Okogbe community in Rivers state of Nigeria was carried out to ascertain the soil environmental damage. An agricultural land in same community, in a distant outskirts from site was characterised as control. Levels of priority hydrocarbons, PAHs and BTEX, major soil nutrients and some heavy metals were assayed. Up to 0.09 mg/l PAHs in burnt soil were at 95% confident level significantly different from obtained levels (0.026 mg/l) for the control soil. Marked elevated Cu, Cd and Pb were also obtained. Burnt soil biota like the earthworm, millipede, some insects were sighted all over the site and this has agricultural implications. Results generally indicate hydrocarbon and some heavy metals soil contamination with a harsh nutrient condition that may be inhabitable for some microorganisms and plants to live on.

Key words: Okogbe community; Tanker explosion; Niger Delta; Heavy metals; Parched soil.

INTRODUCTION

Crude oil or oil is a naturally occurring flammable mixture of hydrocarbons of various molecular weights and other liquids organic compounds that are formed in geological formations beneath the earth's surface. Petrol is used in manufacturing a wide variety of materials^{1,2,3}. It is estimated that the world consumes about 88 million barrels each day⁴. At first, the oil was refined, it was made into kerosine for lightening. Gasoline and other products made during refining were thrown away because people had no use for them⁵. Petroleum provides almost 37% of the energy we use⁶. The hydrocarbons in crude oil are mostly alkanes, cycloalkane, and various aromatic hydrocarbons. Other organic compounds contain nitrogen, oxygen, sulfur, and trace amounts of metals such as iron, nickel, arsenic, copper and vanadium⁷. The exact molecular composition varies wide from fairly narrow limits⁶. An oil spill is the accidental petroleum release into the environment. Bad road network in Nigeria has raised the rate of oil spill due to oil tanker falls.

An oil explosion is a rapid increase in volume and release of energy in an extreme manner, usually with the generation of high temperatures and the release of gases. Explosion is caused by many factors among which are natural, astronomical chemical, electrical and magnetic, mechanical, vapour and nuclear. The properties of these explosions are force, velocity, evolution of heat, and initiation of reaction⁸. Oil explosion most times happen accidentally. Several explosions had taken place recently among which are the 2008 wegun pipeline explosion which occurred in Lagos Nigeria⁹, and the Hub oil explosion which took place in August 1999 in Calgary Alberta Hub¹⁰. Contaminants are unwanted chemicals in the environment which may be harmful to plants and animals, or humans. The effects of contamination on the environment are not limited to terrestrial ecosystems because the synthetic chemicals are not degraded by

the normal processes of life and from there, the pollution can travel through the roots of plants into any herbivore which consumes the plant until it reaches the highest organisms in the food web.

Soils consist of two parts, an organic part which can readily be burned away when the surface soil is heated to redness and, an inorganic part which remains fixed in the force, consisting of earthly and saline substances present. Compounds originating from crude oil include mineral oil, BTEX, PAHs, Phenolic compounds, heavy metals⁷, Chloroform, total trihalomethane and Phthalate esters. A petrol fuel tanker is a safe container for flammable fluids and requires leaking test¹¹. Though any storage tank for fuel maybe so called, the term is typically applied to part of an engine system in which the fuel is stored and propelled (fuel pump) or released into an engine. A tank truck is distinguished by its shape, usually a cylindrical tank upon the vehicle lying horizontally¹¹. Fuel tanks range in size and complexity from the small plastic tank to the multi-chambered cryogenic space shuttle external tank. Main risks of being involved in explosion include smoke inhalation, trauma and burns¹² and environmental havoc. Inhaling smoke can have a devastating effect on the delicate tissues of the respiratory system and their normal functioning, block the intake of oxygen in the lungs, and boost levels of the gas carbon monoxide which interferes with the ability of the blood to carry oxygen^{13,14}.

An oil spill due to tanker explosion was recorded in a Niger Delta community, Okogbe in Nigeria. A large area of the land and vegetation were seen burnt and hence, the need for impact assessment. This study seeks to assess the impact of an oil spill incident in Okogbe Community vis-à-vis basic nutrients profile and investigation into major contaminants within the area.

MATERIALS AND METHODS

Study area

Study site is the oil explosion site in Okogbe community of Ahoada West local government area of River state Nigeria. On the 14th of July 2012, a Thursday morning, on the East West Road at Okogbe community, a petrol tanker lost control and ran into a ditch, falling on its side; the ill fated tanker it was gathered, was trying to avoid a head on collision with a commercial vehicle at about 7 am when the accident took place. Over 98 persons including pregnant women, youths and children perished¹⁵. Several other persons sustained varying degrees of burns, injuries, and sympathizers took survivors to the hospital. These deaths and sustained injuries occurred when these persons were tapping fuel from the felled petrol tanker which suddenly exploded in flames and they were caught in the fire. The ranging inferno spread rapidly to the main road cutting off the route and also engulfed those in motorbikes carrying the scooped fuel in gallons. No fewer than five buses and scores of motorbikes were destroyed in the inferno, which also affected a filling station some distance away from the scene. The incident caused gridlock and the commuter vehicles from the Port Harcourt and Warri ends were stranded for hours. Most motorists, who could not bear the trauma were forced to make U-turns. Commercial vehicles from Yenegoa heading to Port-Harcourt were also forced to beat a retreat when the news filtered into the town. Men of the Nigerian police force and soldiers who arrived the scene helped in controlling traffic and restored sanity on the chaotic route.

Sample collection and preparation

A field reconnaissance survey of the study area was carried out. This was followed by sampling using soil auger in a randomised quadrant design. Control soil consisted of an agricultural area in a distant outskirts of Okogbe community. Compositing soils (0-20cm) in triplicates were transported wrapped in foil papers placed in coolers to the laboratory. Unstable parameters like pH and temperature were measured *in situ*.

Laboratory analysis

Standard, analar grade and non – expired reagents were employed as reported by Nwaichi et al. (2010) for analysis of PAHs, BTEX, NO₃⁻, PO₄³⁻, Cl⁻, P, Cd, Pb, K, Ca and Cu in 2mm screen soils.

Statistical analysis

Analysis of variance using spss Vs 14 was employed for comparison of means at the 95 % confidence level.

RESULTS AND DISCUSSION

Although the pH of the soils were within tolerable limit, a deviation from acidic (control) to alkaline (test) pH. The conducive temperature of the soils may have been influenced by the time of the sampling (morning). The reduced level of phosphorous may have arisen as a result of the explosion. There were burnt arthropods sighted at the site. There are hazardous chemicals which can arise from the presence of the contaminant species. These changes can manifest in the alteration of the metabolism of endemic microorganisms and arthropods resident in a given soil environment. Even if the chemical effect on lower forms is small, the lower pyramid levels of food chain may ingest alien chemicals, which normally become more concentrated for each consuming range of the food chain. Contaminated soil can also directly affects human health through direct contact with the soil ¹⁶ or via inhalation.

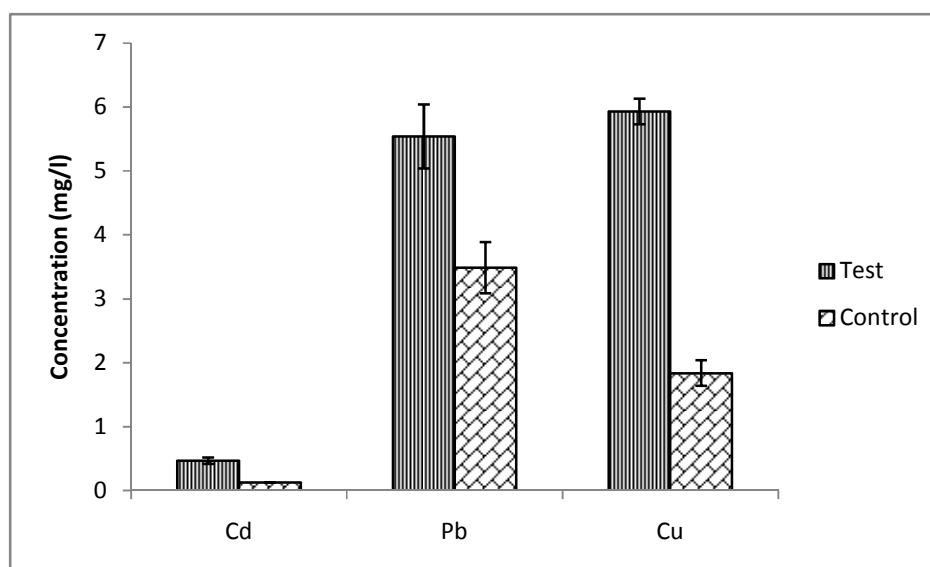
Table 1 Physicochemistry of explosion site and control

S/N	Parameters	Test	Control
1	NO ₃ ⁻ - N(mg/l)	1.0±0.02 ^k	6.7±0.32 ^l
2	PO ₄ ³⁻ (mg/l)	0.43±0.02 ^s	0.58±0.08 ^h
3	pH	8.65±1.17 ^m	5.75±0.22 ⁿ
4	T (°C)	29.4±3.77 ^f	29.3±4.01 ^s
5	Cl ⁻ (mg/l)	57±5.07 ^c	15±0.99 ^d
6	P (mg/l)	0.14±0.01 ^a	0.19±0.01 ^b
7	K (mg/l)	107.41±6.33 ^x	24.37±3.33 ^y
8	Ca (mg/l)	884.24±20.11 ^e	10.30±2.03 ^f

Values are mean ± SE, n = 3. Different superscript letters row-wise denote significant different

Small amounts of nutrient elements are common in our environment and diet and are actually necessary for good health, but large amounts of any of them may cause acute or chronic toxicity (poisoning) ¹⁷. Elevated levels of Potassium (up 107.41 mg/l) and Calcium (up to 884.24 mg/l) were observed at the study site in comparison with control. Statistically significant ($P \leq 0.05$) decreases were recorded for major soil nutrients, nitrates and phosphates (table 1) which could portend danger for soil biota.

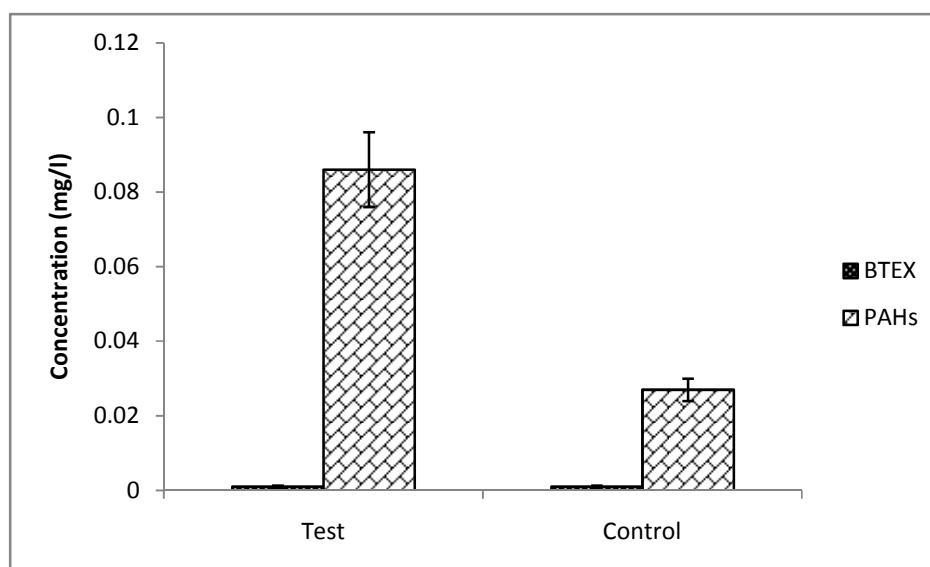
Fig. 1 Observed mean levels of some heavy metals (values are mean ± SE, n = 3)



Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Allergies

are not uncommon, and repeated long-term contact with some metals (or their compounds) may cause cancer¹⁸ and reduced quality of life¹⁹. Over 60% increases were observed for heavy metals monitored especially for Cadmium and Copper (Fig 1). Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues. Heavy metals may enter the human body via food, water, air, or absorption through the skin in agriculture, manufacturing, pharmaceutical, industrial, or residential settings. Industrial exposure is common in adults. Ingestion is the most common route in children²⁰. Children may develop toxic levels from normal hand-to-mouth activity (ie, coming in contact with contaminated soil or eating objects that are not food such as dirt or paint chips)²¹. Less common routes of exposure include a radiological procedure, inappropriate dosing or monitoring during intravenous (parenteral) nutrition, a broken thermometer, a suicide or homicide attempt²².

Fig. 2 Mean levels of studied hydrocarbons (values are mean \pm SE, n = 3)



Hydrocarbons are organic compounds composed only of the element carbon and hydrogen. The pollution by priority aromatics, PAHs²³ was indicated in the high levels observed. Low levels of BTEX observed may not indicate little or no hydrocarbon pollution but may have arisen due to high volatility of the BTEX family as access to the site could not be secured in less than one week of spill/ explosion occurrence.

The results generally indicate soil toxicity due to hydrocarbon spill. Also, harsh nutrient condition inhabitable for native soil microorganism and plants was observed and this could influence adversely the existing ecosystem.

Acknowledgements

The authors are grateful to Community Chiefs in Okobe community for security provided during study and to Mr. Felix for providing us with required information.

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