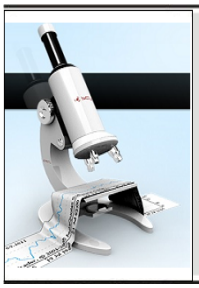

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Comparison of physicochemical qualities of diesel and mechanic workshop polluted soils amended with cowpea chaff

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Abstract
Physicochemical qualities of diesel and mechanic workshop polluted soils amended with cowpea chaff were studied for 56 days. The organic carbon, nitrogen and phosphorus were higher in mechanic polluted soil (MPS) compared to diesel polluted soil (DPS) amended with cowpea chaff. The pH, organic matter content and moisture were higher in DPS compared to MPS. There were no significant differences in pH, organic carbon, nitrogen, phosphorus organic matter content and moisture between OFS, DPS and MPS at 5% probability level. The result of this study shows that the physicochemical properties of diesel polluted soil amended with cowpea chaff was better than mechanic workshop soil amended with same cowpea chaff.

Keywords: physicochemical, diesel, mechanic workshop polluted soil, cowpea chaff.

1. Introduction
The past 200 years has seen a rapid increase in population resulting in the need for greater fuel demand, chemicals, fertilizers, pesticides (Chakrabarty *et al*., 1998). According to Stephen *et al*. (2011), a high percentage of chemicals are released into air, water and soil representing a potential environmental hazard.
Hydrocarbon spill is a serious threat to the ecology (Stephen *et al*., 2013a). Dorn *et al*. (1998) reported that hydrocarbons contain substances that are toxic to the flora and fauna found in the ecosystem. Stephen *et al*. (2013b) reported that diesel pollution is on the increase in Nigeria as well as other developing countries. Petroleum products such as lubricating oil, petrol, and diesel are used in various forms in mechanic workshops. These products tend to harden and change the colour of the soil. It may also have adverse effect on the soil microbiota as well as the physicochemical qualities of the soil and at such there is a need to reclaim the soils using cheap, available and biodegradable products.
Stephen *et al*. (2013a, 2013c) reported the use of cowpea chaff in biodegradation of diesel contaminated soil and mechanic workshop polluted soils in Anyigba, Nigeria. According to the investigators, cowpea chaff, a waste agricultural product can be used to enhance biodegradation of diesel polluted soil and also reclaim mechanic workshop polluted soil. This study however, was undertaken to compare the effect of cowpea chaff on the physicochemical qualities of diesel contaminated soil and mechanic workshop soil amended with cowpea chaff.

2. Materials Required:
2.1Sample collection
The experimental design consisted of nine perforated earthenware pots containing 9kg of soil each. Three pots served as control (without diesel or mechanic workshop polluted soil), another three pots were contaminated with one litre of diesel each (DPS) to achieve 11.11% pollution level and the last three pots contained mechanic workshop polluted soil (MPS) collected from mechanic workshop soil opposite First City Monument Bank in Anyigba, Nigeria. 500g of ground cowpea chaff was incorporated into DPS and MPS and thoroughly mixed to achieve 5.6% amendment level. The pots were perforated to increase aeration and to avoid water logging. The pots were exposed in the Botanical garden of Kogi State University, Anyigba, Nigeria. Samples were collected bi-weekly for a period of 8 weeks in the rainy season (May-June, 2012).

2.2 Laboratory / statistical methods

pH of the soil was determined at ambient temperature using glass electrode pH and conductivity meter (Hannia, Italy) in 1:1 water to soil ratio. Nitrogen was determined by the micro Kjeldahl method (Ibitoye, 2006). Phosphorus was determined by the Murphy and Riley (1962) method. The ignition method of Akinsanmi (1975) was used to determine the organic matter content while moisture content was determined using the dry weight method outlined by Ibitoye (2006). Descriptive statistics and analysis of variance (ANOVA) was performed using procedure of SPSS version 16 (2007). Experimental precision achieved was reported at $p \leq 0.05$ level.

3. Result

Table 1 shows the mean physicochemical properties of the soil samples analysed. The pH ranged from 7.06 ± 0.70 to 7.34 ± 0.18. The soil samples were weakly alkaline. There were no significant differences ($p<00.05$) in the pH between the oil free soil (OFS), diesel polluted soil (DPS) and mechanic workshop soil (MPS) amended with cowpea chaff.

The highest organic carbon was observed in mechanic workshop polluted soil. The organic carbon ranged from 1.15± 0.19% -2.32±2.12%. There were no significant difference ($p<0.05$) in the organic carbon between OFS, DPS and MPS.

The organic matter content ranged from 2.01± 0.32% - 2.51±0.67%. DPS had the highest organic matter content compared to MPS and OFS. There were no significant differences in the treatments at 5% probability level.

The highest moisture content was observed in DPS (33.64±18.14%) followed by MPS (19.81±11.06%) while OFS (17.60± 7.61%) had the least moisture content. There were no significant differences between OFS, DPS and MPS at 5 % probability level.

Table 1: Physicochemical characteristics of soil analysed (Mean ± Standard error of mean)

Parameters	OFS	DPS	MPS
pH	7.14±0.42a	7.34±0.18a	7.06 ±0.70a
Organic carbon (%)	1.15±0.19a	1.45±0.39a	2.32±2.12a
Organic matter content (%)	2.01±0.32a	2.51±0.67a	2.36±0.94a
Moisture (%)	17.60±7.61a	33.64±18.14a	19.81±11.06a
Nitrogen (%)	0.25±0.04a	0.32±0.08a	4.03±8.32a
Phosphorus (ppm)	10.17±0.88a	6.02±1.70a	7.70±4.82a

a: means denoted by same alphabet along the same column are not significantly ($p<0.05$) different.
OFS: oil free soil, DPS: diesel polluted soil amended with cowpea chaff, MPS: Mechanic workshop soil amended with cowpea chaff, %: percentage, ppm: part per million

The phosphorus content was higher in OFS (10.17 ± 0.88ppm) compared to MPS (7.70 ± 4.82ppm) and DPS (6.02 ± 1.70ppm). There were no significant differences between OFS, DPS and MPS at 5 % probability level.

4. Discussion

The soil samples were weakly alkaline. The range of pH observed in this study has been reported to favour the reclamation of hydrocarbon polluted soil by soil microbiota (Bossert and Bartha, 1994, Stephen and Egene, 2012, Stephen *et al*., 2013a, Stephen and Temola, 2014). This may be due to the amendment of the soil and metabolic activity of microorganisms in the soil (Stephen and Temola, 2014).

The organic carbon was higher in MPS than DPS and OFS. Mechanic workshop polluted soil is most likely to contain varying hydrocarbon products such as diesel, petrol, grease, automated transmission fluid as well as spent lubricating oil compared to soil polluted with only diesel. The lower organic carbon observed in OFS may be due to the absence of both diesel and the various hydrocarbon products in MPS (Stephen *et al*., 2013c).

The organic matter contents were low in all treatment. However, the organic matter content was higher in DPS than MPS. This may be due to the ability of hydrocarbon degrading organisms in the diesel polluted soil to utilise the single carbon source (diesel) to degrade and incorporate the cowpea chaff into the soil. The various hydrocarbon sources and their different concentrations in MPS may be a limiting factor in the degradation and incorporation of the cowpea chaff (Ijah and Abioye, 2003).

The moisture content was high in all treatments. This may arise from the rains since this study was carried out in the rainy season (May-June, 2012). This is in agreement with Stephen and Egene (2012) who observed high moisture content in spent lubricating oil polluted soil during the rainy season.

The nitrogen content was higher in MPS than OFS and DPS. This may be due to the various components of hydrocarbons in the MPS with their different nitrogenous compounds. This is in agreement with Ijah and Abioye (2003) and Stephen and Ijah (2011). According to these authors, nitrogen contents increases in soil polluted with hydrocarbons.

The phosphorus concentration was higher in OFS than DPS and MPS. This result contradicts that of Ijah and Abioye (2003) and Stephen *et al*. (2013c). These authors reported higher phosphorus concentration in soil polluted with hydrocarbon compared to oil free soil. However, this result is in agreement with Stephen *et al*. (2013b). The higher phosphorus content in the oil free soil may be due to the existence of reduced condition in the soil that made phosphorus soluble and brought some into solution (Ayotamuno *et al*., 2006).

5. Conclusion

The result of this study show that diesel polluted soil amended with cowpea chaff had lower organic carbon, nitrogen and phosphorus compared to mechanic workshop polluted soil amended with same cowpea chaff. This is an indication of higher metabolic activity in the diesel polluted soil than mechanic workshop polluted soil which contained more than one hydrocarbon pollutant. Therefore, one can conclude that cowpea chaff can be easily degraded and incorporated in soil polluted by only diesel oil better than soil polluted by multiple hydrocarbon products as found in mechanic workshop polluted soil.

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