



International Journal of Engineering Technologies and Management Research

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IMPACT OF USED MOTOR OIL ON THE SOIL QUALITIES OF ORJI MECHANIC VILLAGE OWERRI, NIGERIA

Dr. Umunnakwe Johnbosco ^{*1}, Dr. Aharanwa Bibiana Chimezie ², Surv. Njoku Richard.E ³

^{*1} Department of Environmental. Management, Federal University of Technology, Owerri, Nigeria

² Department of Polymer & Textile Engineering, Federal University of Technology, Owerri, Nigeria

³ Department of Surveying & Geoinformatics, Federal University of Technology, Owerri, Nigeria

Abstract:

The study investigated the effects of used motor oil on soil physical and chemical variables and their particle size distribution. Two (2) replicate soil samples were collected from three radial coordinates 50 31.114N 70 02.703E, 50 31.165 N 70 2.670E and 5023.35N 6059.176E respectively from the auto-mechanic village and agricultural land which serves as control; at depths of 0-15cm and 15-30cm. Standard methods were adopted both for field and laboratory analysis, utilizing such instruments as Atomic Absorption Spectrometer (model FS 240 Varian), Jewniary, digital pH meter, Refractometer (model E- Line R.ATC-), lovibond instrument model Cm-21 and mercury-in-built thermometer. Twenty three (23) different soils parameters were analyzed comprising total organic carbon, heavy metals, soil texture and particle size (clay, sand and silt) organic carbon, exchangeable cations (Na, Ca and Mg), conductivity, salinity, nutrients (N, P, K), bulk density and organic matter. The result indicated a variation at the mechanic site and control point. The pH of the auto-mechanic soils were acidic with the range of 4.3- 5.0 in comparison with the control point which had a mean value of 5.6. Heavy metals had higher values in auto mechanic soils than in the control and their concentration decreased in this trend, Cu 0.940> Hg 0.211> Ni 0.093> Zn 0.051> Pb 0.021> Cd 0.015 > Ar 0.003; Hg 1.385> Cu 0.853> Ni 0.079> Zn 0.041> Cd 0.04> Pb 0.034> Ar 0.004. This showed that disposal of used motor oil on the soil affected the soil quality negatively. It is therefore; recommended that there should be a legislation to stop the indiscriminate dumping of spent oil and lubricants on the surface of the soil at Orji Mechanic village without treatment prior to disposal.

Keywords: Motor Oil; Orji; Soil; Disposal; Mechanic; Samples.

Cite This Article: Dr. Umunnakwe Johnbosco, Dr. Aharanwa Bibiana Chimezie, and Surv. Njoku Richard.E. (2020). "IMPACT OF USED MOTOR OIL ON THE SOIL QUALITIES OF ORJI MECHANIC VILLAGE OWERRI, NIGERIA." *International Journal of Engineering Technologies and Management Research*, 7(2), 1-12. DOI: 10.29121/ijetmr.v7.i2.2020.524.

1. Introduction

Soil is the most vital non-renewable natural resource, an actively living system which performs major environmental functions that consist of diversity of micro and macro fauna and flora, that play major role in maintaining the soil quality [1]. It is a complex mixture of mineral nutrients, organic matter, water, air, and living organisms determined by various environmental factors such as climate, parent material, relief, organisms, and time factors [2]. The disposal of used motor oil on land can lead to loss in soil quality by minimizing the abundance and variety of microorganisms in soil [3]. These changes affect the soil quality on a global scale and the degradation hampers economic growth and healthy environment [4]. Soil quality includes physical, chemical, and biological properties of soil that depend on the soil nutrient pools and reserves, which are modulated by land use and a number of other management factors [5].

In mechanic workshops, there are accidental or deliberate discharge of petrol, diesel, solvents, grease, and lubricants on the land and the atmosphere. Many of these petroleum products are organic and synthetic chemicals that can be highly toxic and hazardous to soil fauna and man [6]. Used oil is less viscous than unused oil; when disposed of into the soil, it adsorbs to the soil particles, reduces porosity and therefore reduces aeration of soil [7] and [8]. These have a way of affecting the soil quality: the physical, chemical and biological constituents/ parameters including heavy metal contamination.

In Orji mechanic village, auto-mechanic repairs involve working with and spilling of oils, grease, petrol, battery electrolyte, paints and other materials which contain heavy metals [9]. This waste oil usually contains additives such as amines, phenols, benzene and is a mixture of different chemicals including petroleum hydrocarbons, chlorinated biphenyls, chlorodibenzofurans, additives, decomposition products and heavy metals that come from engine parts as they wear away. The improper disposal of these used motor oil, body parts, grease, battery electrodes has contaminated the soil which results in an increase in pollution incidents in the environment [10].

Pollution arising from the disposal of used engine oil is one of the environmental problems in Nigeria, and is more widespread than crude oil pollution which calls for urgent attention [11]. Contamination results from mishandling, deliberate disposal, spilling and leakage of petroleum products, such as gasoline, lubricating oils, diesel fuel, heating oils, used or spent engine oils.

In Nigeria, pollution problems associated with incidents of oils spills around automobile-repair workshops, resulting in metal contamination of topsoil, have been the subject of many reports [12]; [13]

Table 1: Summary of Activities at Mechanic Workshop Villages and Pollution

S/N	Environmental Aspect	Environmental Activity (Soil/Land)
1.	Servicing of vehicle engines.	Discharging dirty oil engine on the ground
2.	Repair of transmission system	Spilling of transmission oil on the ground
3.	Repair of fuel tanks	Pouring of petrol and diesel on bare grounds
4.	Repair of charging of batteries	Pouring of electrolyte on the ground. Discarding lead plates on waste dumps on site.
5.	Repair of braking system	Spilling of brake fluid on bare ground.

6.	Repair of clutch systems	Spilling of clutch fluid on ground.
7.	Overhauling of vehicle engines.	Discharge of engine oil, sludge and interior scrapings on the ground.
8.	Panel beating of vehicle bodies and scraping of old vehicle body coats.	Scraping of old vehicle body coats. Metal bits, metallic colour coats and dusts are scraped to bare ground.
9.	Grinding, threading, wiring and other working of metal parts during repair.	Metal bits are filed onto bare ground, waste wires and solders are dropped.
10.	Greasing and oiling of parts	Greases and oils spill on the ground.
11.	Welding and soldering of vehicle parts	Discarding of waste solder and electrodes on soil dumps.
12.	Spray painting of vehicle bodies, rims and other vehicle parts.	Accidental spills of paints on the ground. Waste product of spraying a mass on dumpsite.
13.	Rainfall.	Washing dirt from roofs and bogged vehicles onto the ground.
14.	Washing of vehicles and parts.	Contaminated wash water containing hydrocarbons, acids, soaps and other chemicals poured on the soil.

Source: Adelekan & Abegunde, (2011) In Heavy Metals Contamination of Soil and Groundwater at Automobile Mechanic Villages in Ibadan, Nigeria.

2. Study Area

Orji is a village part of the ancient kingdom of Uratta in Southeast Nigeria and is located within the coordinates $5^{\circ}31' \text{ } 39''\text{N } 7^{\circ}3' \text{ } 50''\text{E}$ in Owerri North Local Government Area of Imo State. (Fig.1). The Orji mechanic village was established in the year 1987 and has a land area of 0.41km^2 [14]. Orji, which is a part of Owerri North Local government has a population of 175,395 at the 2006 census. Wikipedia, (2015). Geographically, Orji covers a land area of $408,725\text{m}^2$ [15] The town occupies the western periphery of the mother-clan, Uratta. Orji is bounded on the west by Umuodagu and Umunjam villages and in the east by Owaelu and Okwu; on the north by Obazu; and on the South by Owerri town.[15].

The rainfall distribution pattern is reminiscent of the scenario in Southern Nigeria. The rainfall regime is bimodal and peaks in July and September with little dry season known as August break in-between. The rainy or wet season begins about February or March and last till October or early November. This is typically an equatorial tropical rainforest climate type.

Rainy (wet) season is characterized by relatively high temperature (33°C) and high relative humidity, while chilly and dry harmattan wind is experienced in dry season. This lowers environmental temperature appreciably, especially in the months of December and January. The study area records average maximum and minimum temperatures of about 32°C and 25°C respectively and annual mean rainfall of about 2000mm . The rainfall trends for Orji- Owerri by surrogate data within 30-year period 1976-2005 has been analysed by [16].



Figure1: Satellite Map of Orji

Source: Google

Dips in rainfall occur around the mid-periods between June and September. This mid-period is the mid-dry season also known as August-break because of the decrease in the amount of normal precipitation level within the period [17]. Normal mean annual rainfall for the 30-year period is between 2000mm-2500mm, below normal is less than 2000mm and normal mean annual precipitation is 2500mm upwards. The underlying geology or 'parent material' has a very strong influence on the development of soils. Orji shares sandy Benin Formation [18]. Imo Shale (Paleocene-Eocene) covers about 25% of the Owerri North axis. The study area falls within the rain forest belt and characterized by growth of tall trees amidst thick undergrowth. Oil palm trees are common while swampy areas have thick cover of raffia palm. The people of Orji- Owerri North Southeastern Nigeria are primarily dependent on arable agriculture and livestock rearing for their economic sustenance. Major crops grown in the area include; cassava, yam, maize, melon and pepper. Cash crops found in the area are oil palm, cashew and mango. But at present with the service brought by Owerri urban it has lost its primary rural pattern and is urbanizing.

3. Methodology

The field work started with a reconnaissance survey of the area using Food and Agricultural [19]. Samples of the soil were collected from the top soil, 0-15cm and from the sub soil, 15-30cm with the aid of soil auger, in three different radial co-ordinates covering two entire land uses; two profile points at the mechanic workshop (mechanic land use) and one at Federal University of Owerri (FUTO Agricultural Land Use) serving as the control. The samples were transported to the laboratory, air-dried, ground and sieved through 2mm mesh size sieve and subjected to physical, chemical and biological analysis. Soil Particle Size Distribution was analysed using Bouyoucos hydrometer method. The dried soil sample was dispersed with solution of sodium hexametaphosphate and sodium carbonate (8g/l) in a less than 2mm mesh size. 5ml of distilled water was added to enhance the texture and stirred while the content of the container was transferred quantitatively into a liter measuring cylinder and first reading was taken 40 seconds.

Textural triangle was used to obtain the sand, silt and clay fractions. Soil moisture content was determined by using an oven drying method (because of the reliability) in which samples were dried to constant weight at 105°C [20] and the differences in mass of wet and dry samples recorded and expressed in percentage. Soil bulk density was determined using the core method of Grossman and [21].

Exchangeable cations of Sodium, Potassium, Magnesium and Calcium ions were extracted according to the ammonium acetate extraction method [22] as modified [23]. Wet digestion method was used for determination of Organic Carbon and Organic Matter. Nitrogen was determined using Macro Kjeldahl method of [23]. Soil pH, temperature, conductivity were determined using multi-probe meter. For heavy metal analysis, 1 gram of sample was digested in 250ml conical flask by adding 30ml of aqua regia and heated on a hot plate until volume remains about 7-12ml. This is to enable the sample to be efficient for further processes. The digest was filtered using what-man filter paper and the volume made up to the mark in a 50ml volumetric flask, and was then stored in a plastic container for Atomic Absorption Spectrophotometer (AAS) analysis by thoroughly mixing the sample through shaking and 100ml of it transferred into a glass beaker of 250ml volume. The sample was aspirated into the oxidizing air-acetylene flame or nitrous oxide acetylene flame to facilitate absorption of radiation by atomic species during flame reactions. When the aqueous sample was aspirated, the sensitivity for 1% absorption was observed. Other parameters were determined using standard methods.

4. Results and Discussions

Table 2: Results of the Physiochemical Parameters and their mean distribution

Parameters	Mech. Soil (1) 0-15 cm	Mech. Soil (1) 15-30 cm	Mech.1 Mean	Mech. Soil (2) 0-15 cm	Mech. Soil (2) 15-30 cm	Mech. 2 Mean	Control 0-15 cm	Control 15-30 cm	Control Mean	FMENV/ SPDC EIA/ JAPAN EVM standards
pH	5	4.9	4.95	4.8	4.3	4.55	5.8	5.4	5.6	6-8
Temperature	29	29.2	29.1	29	29.1	29.05	29.3	29	29.15	28-30
Conductivity, $\mu\text{s}/\text{cm}$	110	124	117	108	127	117.5	96	44	70	100
Salinity, mg/L	6649.4	5912.5	6280.95	7900.2	7241.9	7571.05	5991.1	5332.8	5661.95	-
Sodium, mg/L	5.219	6.287	5.753	3.873	5.176	4.5245	7.987	5.489	6.738	-
Calcium, mg/L	14.673	16.909	15.791	13.769	16.476	13.769	14.576	13.567	14.0715	-
Total Chloride, mg/L	3680.7	8808.2	6244.45	4373.1	4008.7	4190.9	3316.3	2951.9	3134.1	-
Nitrate(NO_3), mg/L	62.8	38.2	50.5	69.4	32.1	50.75	20.6	4.8	12.7	-
Nitrate-Nitrogen ($\text{NO}_3\text{-N}$), mg/L	14.8	8.4	11.6	4.4	1.4	2.9	4.7	1.1	2.9	-
Potassium, mg/L	5.879	4.687	5.283	8.456	5.589	7.0225	4.134	5.196	4.665	-
Phosphorus (P), mg/L	16.4	14	15.2	18	12.4	15.2	8.4	6.7	7.55	-
Iron, mg/L	0.038	0.046	0.042	0.024	0.029	0.0265	0.017	0	0.0085	
Manganese, mg/L	0.311	0.128	0.2195	0.221	0.118	0.118	0.078	0.016	0.047	900
Copper, mg/L	1.086	0.795	0.9405	1.379	0.327	0.853	0.382	0.286	0.334	20

Zinc, mg/L	0.049	0.053	0.051	0.058	0.024	0.041	0.032	0.028	0.03	10-120
Arsenic, mg/L	0.002	0.004	0.003	0.003	0.006	0.0045	0	0	0	5- 50
Cadmium, mg/L	0.013	0.018	0.0155	0.012	0.068	0.04	0.003	0.01	0.0065	0.01-1.4
Mercury, mg/L	0.166	0.256	0.211	0.872	1.898	1.385	0.067	0.007	0.037	0.1
Lead, mg/L	0.025	0.017	0.021	0.012	0.056	0.034	0.011	0.006	0.0085	0.01-20
Nickel, mg/L	0.078	0.108	0.093	0.069	0.089	0.079	0.018	0.016	0.017	25
Bulk density, g/mL	1.215	1.182	1.1985	1.19	1.163	1.1765	1.382	1.219	1.3005	-
Organic matter, %	8.5	3	5.75	9	9	9	2	5	3.5	-
Total Organic Carbon, %	7.59	8.69	8.14	11.8	12.42	12.11	0.69	2.76	1.725	-
Elevation (ft)	430.6		430.6	428.9		428.9	164.1		164.1	
Coordinates N	5031.114		5031.114	5031.165		5031.165	5023.35		5023.35	
E	7002.703		7002.703	7002.67		7002.67	6059.176		6059.18	

Source: Umunnakwe et al., fieldwork 2015

Table3: Particle Size Distribution for the Soil Samples

S/N	Mesh size (mm)	Mech. Soil (1) 0-15 cm	Mech. Soil (1) 15-30 cm	Mech 1 Mean	Mech. Soil (2) 0-15 cm	Mech. Soil (2) 15-30 cm	Mech 2 Mean	Control		Control Mean
								0-15 cm	15-30 cm	
1	4.75	-	-	-	2.37	8.18	5.275	-	-	-
2	3.35	-	-	-	0.2	0.23	0.215	-	-	-
3	1.18	3.69	1.16	2.425	15.53	16.39	15.96	-	0.32	0.32
4	1	2.78	8.22	5.5	9.81	6.59	8.2	-	2.58	2.58
5	0.425	54.53	43.2	48.865	42.03	35.92	38.975	60.45	61.72	61.085
6	0.3	15.22	13.51	14.365	10.14	8.4	9.27	18.2	10.12	14.16
7	0.212	17.19	16.47	16.83	11.64	10.63	11.135	18.42	18.94	18.68
8	0.125	3.4	3.63	3.515	2.82	2.84	2.83	2.45	4.43	3.44
9	0.106	1	1.12	1.06	0.97	1.11	1.04	0.24	0.73	0.485
10	0.075	0.75	1.1	0.925	1.83	1.74	1.785	0.08	0.38	0.23
11	0.053	-	-	-	0.08	0.05	0.065	-	-	-
12	<0.053	1.44	11.59	6.515	2.58	4.82	3.7	0.16	0.78	0.47
13	TOTAL	100	100	100	100	100	100	100	100	100

Source: Umunnakwe et al., Fieldwork 2015

Table 4: Soil Erodibility Values (K values for different soils)

Soil Type	K-Factor
Clay Loam	0.30
Concretionary Clay	0.17
Sandy Clay	0.20
Sandy Loam	0.13
Sandy	0.02
Loam Sand	0.04

Source: Stone and Hilbron, 2002, Universal Soil Loss Equation Fact- sheet

Table 5: Soil Texture

S/N	Textural class Percentage (%)	Mechanic soil (1)	Mechanic Soil (1)	Mech 1	Mechanic Soil (2)	Mechanic Soil (2)	Mech 2	Control	Control	Control
		0-15 cm (%)	15-30 cm (%)	Mean	0-15 cm (%)	15-30 cm (%)	Mean	0-15 cm (%)	15-30 cm (%)	Mean
1	Pebble stone	0	2.57	1.285	8.43	0	4.215	0	0	0
2	Very coarse sand	3.69	1.16	2.425	15.53	16.39	15.96	0	0.32	0.16
3	Coarse sand	2.78	8.22	5.5	9.81	9.59	9.7	0	2.58	1.29
4	Medium sand	69.75	56.7	63.225	52.17	19.03	35.6	78.65	71.84	75.245
5	Fine sand	21.59	21.22	21.405	15.43	14.68	15.055	21.11	24.1	22.605
6	Very fine sand	0.75	1.1	0.925	2.91	1.79	2.35	0.08	0.38	0.23
7	Silt	1.44	11.59	6.515	2.58	4.82	3.7	0.16	0.78	0.47

Source: Umunnakwe et al., Fieldwork, 2015

5. Discussions of the Results

Table 3 shows soil particle size distribution. From the table, using Wentworth size classes with the diameter of mesh size (mm) on soil textures, the values of medium sand were high in all the stations and more in the control. The soil particle size distribution determined the soil texture which in turn affected the ease or difficulty at which soil particles were detached and transported in the soil erosion process (erodibility). Hence, particle size distribution was used to explain erodibility because different soils have different tendencies to its erodibility as reflected in k- value (see Table 4). According to [24], soils with higher percentage of sand were fragile in structure, well drained, well aerated and very erodible. Soil erodibility factor draws from soil properties, including texture, structure, permeability and organic matter and quantifies the cohesive character of a soil type and its resistance to dislodging and transport due to raindrop impact and overland flow shear forces [25].

pH values were more acidic in the auto-mechanic village than the control and decreased further in the sub soil, 15-30cm. A similar result was obtained by [26] for motor mechanic waste dumps around Port Harcourt.

Conductivity was higher in mechanic soil 2 than in mechanic soil 1 and both had conductivity values that were considerably higher than the control station. This finding is in-line with the study done by [27] for automobile dumpsites at Agbor and Abraka, Nigeria. The high conductivity may be attributed to the availability of definite amount of metal substances in the wastes at the auto-mechanic village whose contents were eventually leached into the underlying soils and hence led to an increase in the concentration of some ions such as sodium, calcium and others. The levels of total organic carbon in the soils of the auto-mechanic villages were higher than that of the control soils. This indicated the possible presence of organic matter content which normally increases following the addition of carbonaceous substances as was the case in this study due to the presence of used oil and other carbonated fluid in the auto-mechanic village. This might cause an increase in the presence of soil micro-organisms which are in the business of breaking down organic compounds in soils [28], The values of the TOC for the entire soils increased from 0-15cm and

15-30 cm in all stations. Result showed that heavy metals concentrations in the soil samples were higher in the auto-mechanic village than the control. A similar result was reported [15] from Okigwe, and Nekede mechanic villages in Imo state Nigeria, and by [29] from auto mechanic villages in Ibadan, Nigeria. These high levels observed may be connected with the large amounts of waste engine oil and other chemical fluids discharged in the vicinity of the auto mechanic workshop villages. Copper, mercury and nickel had the highest concentration in the values of the heavy metals analyzed from the soil samples collected. The values of Copper recorded for the auto-mechanic village were higher than the control stations due to electrical wires in addition to waste oil and only a limited number of plants have a chance of survival according to [29], on copper rich soils.

Cadmium was detected in all three soils but the concentration in the control soil was far lower than the auto-mechanic village. According to [30],[31] the presence of Cadmium could be due to the dumping of PVC plastics, nickel-cadmium batteries, motor oil and disposal sludge in the auto-mechanic village. The presence of cadmium in automobile waste dump soils have also been reported by [32] and [33]. The non-biodegradability of the heavy metals is responsible for their persistence in the environment [34]. Once mixed in soil, they undergo transformation into various mobile forms before ending into the environmental sink. The accumulation of cadmium in the environment presents some risks to human health as they can be accumulated on skin, blood, lungs, muscles fat, liver, tissues and organs where it is traceable to various health conditions [35]. Nickel (Ni) had concentration ranges 0.069- 0.108 for the mechanic soils. Nickel is known to accumulate in plants and with intake of too large quantities of Ni from plants grown on nickel rich soils (such as tea, beans, vegetables), there are higher chances of developing cancer of the lung, nose, larynx and prostrate as well as respiratory failures, birth defects and heart disorders[36]. Global input of Nickel to the human environment is approximately 150,000 and 180,000 metric tonnes per year from natural and anthropogenic sources respectively, including emissions from fossil fuel consumption, and the industrial production, use, and disposal of nickel compounds and alloys [37] which could be responsible for the higher concentration found in the auto-mechanic village. Lead derived mostly from exhausts of vehicles is still used as minor additives to gasoline and various auto-lubricants in Nigeria. It is estimated that about 2800 metric tons of vehicular gaseous lead emission is deposited in urban areas in Nigeria annually [38]. Lead is a very poisonous element and not suitable for crop cultivation on soils from mechanic workshops since its toxicity can result in significant illness and reduced quality of life [39]. In all, leaching of some variables of heavy metals more especially for the soils of the auto mechanic workshop village were identified as one of the significant impacts of spent oil lubricants on soil quality. The heavy metals decreased in concentration in the order as shown in Table 6, with Cu and Hg highest in concentration for the soils while Ar was the least abundant for the entire soils.

Table 6: Summary of Decreasing Trend of Metals in the Soil Samples

Layer	Soil Mechanic 1	Soil Mechanic 2	Control
0-15cm	Cu > Hg > Ni > Zn > Pb > Cd > Ar	Cu > Hg > Ni > Zn > Cd > Pb > Ar	Cu > Hg > Zn > Ni > Pb > Cd > Ar
15-30cm	Cu > Hg > Ni > Zn > Pb > Cd > Ar	Hg > Cu > Ni > Cd > Pb > Zn > Ar	Cu > Zn > Ni > Cd > Hg > Pb > Ar
Mean	Cu > Hg > Ni > Zn > Pb > Cd > Ar	Hg > Cu > Ni > Zn > Cd > Pb > Ar	Cu > Hg > Zn > Ni > Pb > Cd > Ar

Source: Umunnakwe et al., Field Work 2016

The bulk density values for the soil sample was lowest (1.15mg/l) at mechanic 2 station and at bottom depth (15-30cm) of the soil. The highest value was at control station (1.4mg/l). Soil bulk density is the ratio of the mass of solids to the total or bulk volume. This total volume includes the volume of both solids and pore space. The leaching of spent oil was more significant at Mechanic 2 station, this accounts for the lowest value of bulk density here (see Fig 2).The organic matter percentage was highest at Mechanic village 2 station (9mg/l), and lowest at the control (2mg/l). The high value at bottom depth (15-30cm) was attributed to leaching of the spent oil into the soil (see Fig.3). Cadmium had highest value at the bottom depth (15-30cm) and at mechanic 2 station where substantial quantities of the spent oil are discharged. Most heavy metals have higher concentrations at the subsurface of the soil due to leaching.

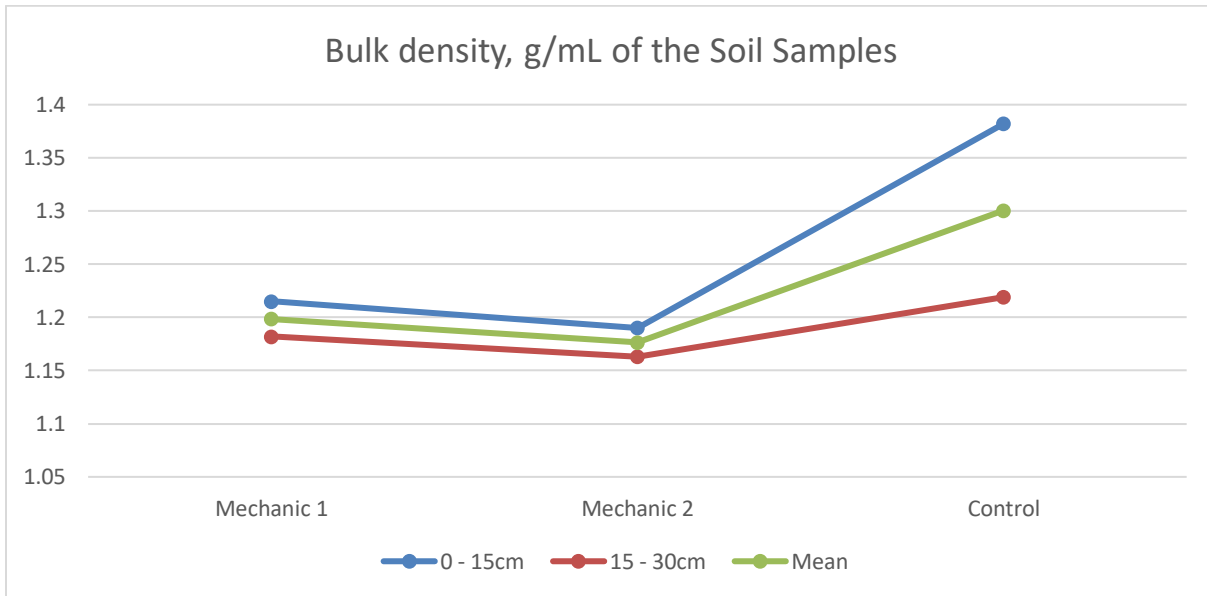


Figure 2: Bulk Density Values for the Soil Samples

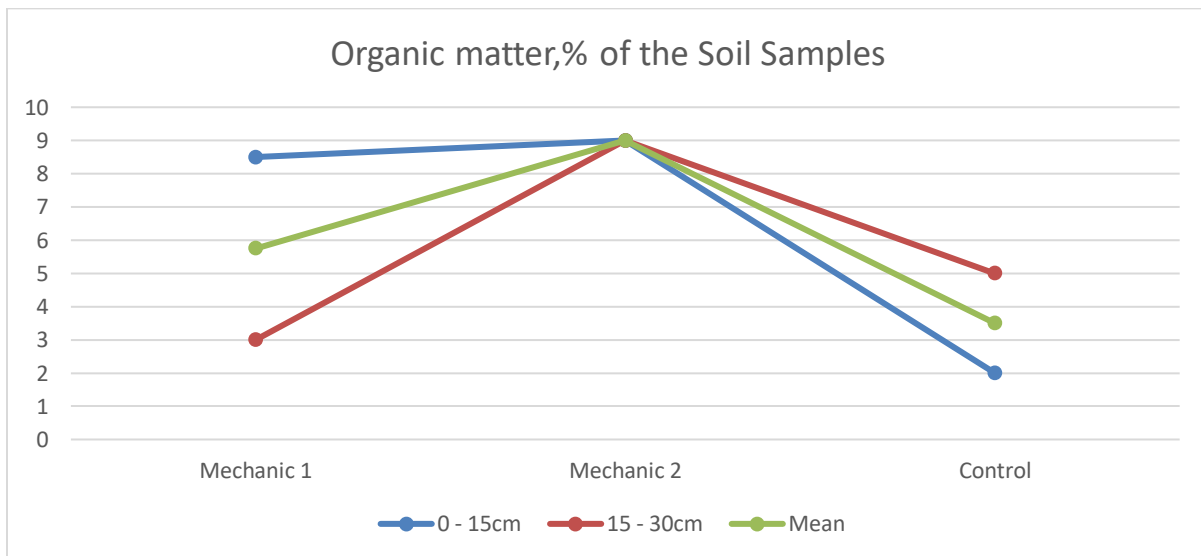


Figure 3: Organic Matter Values for the Soil Samples

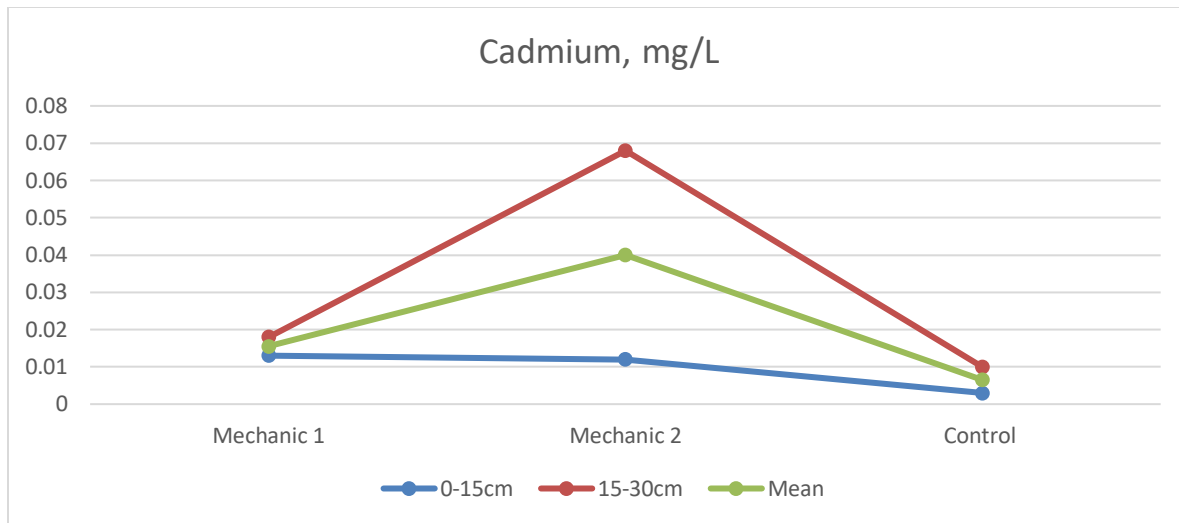


Figure 4: Cadmium Results for the Soil Samples

6. Conclusions and Recommendation

This study revealed significant higher values of the physico-chemical variables of the soils from the auto mechanic workshops than that of the control soils of the Federal University of Technology Owerri (FUTO) due mainly from the activities of auto-mechanic works such as servicing, maintenance and disposal of spent oils and lubricants. This can pose danger to the environment because of possibilities of pollution of the water resources at the vicinity through runoff. For the individual soils heavy metal parameters showed the following decreasing trend in terms of relative abundance: Cu > Hg > Ni > Zn > Pb > Cd > Ar; Hg > Cu > Ni > Zn > Cd > Pb > Ar; Cu > Hg > Zn > Ni > Pb > Cd > Ar for the mechanic soils 1, 2 and control site. This was further confirmed by statistical analysis and with the F ratio of 237571.299 established a significant relationship between spent oil lubricants and the levels of physico-chemical variables in the soil samples. Thus, illegal disposal of spent oil lubricants has resulted to the accumulation of heavy metals in comparison with the control station. Also, soil data generated from this research have really provided empirical needs for a sustainable soil planning and management in the vicinities of the study area for better livelihood devoid of pollution and contamination. It is therefore recommended that spent oil be disposed properly in an environmentally sustainable manner at Orji Mechanic workshop. Also, phyto-remediation measures of soil (i.e. use of plants to control pollution) should as a matter of urgency start at these locations. There should be constant monitoring and legislation to stop the indiscriminate dumping of spent oil and lubricants on the surface of the soil without adequate control on such soils.

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*Corresponding author.

E-mail address: jnboscokwe@yahoo.com