Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2019, 6(9):37-42**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Effects of Animal-Skin Singeing with used Rubber Tyre on Soil Physicochemical Properties in Enugu, Nigeria

Offor C.B., Oluka S.I., Eze P.C.

Department of Agricultural and Bioresource Engineering, Enugu State University of Science and Technology, Enugu, Nigeria

Abstract Effects of local-meat singeing on the soil physicochemical properties were studied using Artisan slaughter house in Enugu State Nigeria as a case study. The composite soil samples and control soil samples were collected at depth of 0-20cm using soil auger, packed in labelled polythene and conveyed to laboratory for analysis. The procedures used for the soil analysis were in accordance with the International Soil Reference and Informative Center (ISRIC) standard, and the results obtained showed that the soil physicochemical parameters had pH range of 6.00-6.9(%); lead (Pb) range of 35.00-50.00mg/Kg; conductivity range of 4.09-5.70ms/cm; sand 95.606-95.614(%);silt2.194-2.204(%);clay2.190-2.192(%); total organic carbon 0.110-1.482(%); total organic matter 0.841-1.723(%); Iron 3598.2-3680.2mg/Kg; Sodium 773.8-778.3mg/Kg; and Magnesium 658.5-793.0mg/Kg. The analysis of variance (ANOVA) showed that the observed differences in pH, conductivity and moisture content were not statistically significant across different locations tested. It also showed that Sulphate, Lead and Phosphorus were not statistically significant ($P > 0.05$). Organic carbon and Organic matter observed were significant at 95%. Also, Sodium, Potassium, Magnesium, Silt and Clay were not statistically significant at 95% confidence levels. The observed result indicated that human activities within the abattoir have influenced the physicochemical soil of the abattoir. However, constant check on the activities at the abattoir should be put in place to avoid pollution of the environment.

Keywords Soil, land Pollution, physicochemical properties, moisture content

1. Introduction

Meat processing is usually carried out in a specialized environment known as abattoir or slaughter house. An abattoir is a place or building where animals are killed for their meat [1]. However, meat processing activities in Nigeria are mostly carried out in unsuitable buildings and by untrained personnel or butchers who are mostly unaware of sanitary principles [2]. Abattoir activities are aimed at optimizing the recovery of edible portions of the meat processing cycle for human consumption. However, significant quantities of secondary waste materials; blood, fat, organic and inorganic solids, salts and chemicals wastes are also generated during this process [3-4]. Various organs of cattle such as: muscle, blood, liver, kidney, viscera and hair have been found to contain heavy metals [5-6]. In ruminants, the first stomach or paunch contains undigested materials called paunch manure, which can contain long hairs, whole grain and large plant fragments. The faeces of livestock (animal manure) consist of undigested food, mostly cellulose-fiber, undigested protein, excess nitrogen from digested protein, residue from digested. It had also been reported that abattoir activities were responsible for the pollution of surface and underground waters, air quality as well as reduction quality of health of residents within the surrounding environment [7-9]. In the slaughter houses and slaughter slabs, the operators routinely burn scrap automobile tires as a source of fuel to remove the fur off the animal carcass [10]. The animal is completely charred, the black residue is washed off, and the animal is then prepared for transport to the markets. Some government funded facilities (usually referred to as abattoirs) use liquefied petroleum gas (LPG) to singe the meat; however, many unfunded facilities or operations who do not have the same resources utilize the scrap tires for the meat singeing process. Uncontrolled burning of waste scrap vehicle tyres for meat singe poses a serious public health and an environmental threat. Since a large number of decomposition products can be given off from the uncontrolled, open, waste tyre fires, its effect on soil, water and air is a major concern. Accumulation in the street dust due to the waste tyres is one of the major ways through which heavy metals may find their way into soils and water, enter the food chain and subsequently living tissues of plants, animals and human beings.

Water and soil pollution, according to the Environmental protection agency EPA [11], “for every million tires consumed by fire, about 55,000 gallons of runoff oil pollute the environment unless contained and collected”. If uncontained, this runoff can then be carried away by rainwater to local water sources contaminating them. Additionally, the remaining residue can cause two types of pollution; these are immediate pollution by liquid decomposition products penetrating soil, and gradual pollution from leaching of ash and unburned residues following rainfall or other water entry. Heavy metals are stable and persistent environmental contaminants since they cannot be biologically and chemically degraded or destroyed unlike many other organic toxic pollutants. Their effects on the environment and human health have been well-established. The metal contamination of the environment is a significant worldwide phenomenon. It deteriorates environmental status due to the uncontrolled and open tyre fires, which has become a popular practice. Such activities are gaining momentum these days and the Government has not officially banned them considering the environment and public health hazards. Besides, some people also use the tyre fires for cooking purpose.

Automobile tires are mainly comprised of chemicals such as synthetic and natural rubber, aromatic oils, silica, sulfur and sulfur compounds, phenolic resins, petroleum waxes, carbon black, fatty acids, steel wire, and other materials [12]. Once these materials are ignited, they emit chemicals such as carbon monoxide, sulfur oxides, nitrogen oxides, particulate matter – such as volatile organic compounds (e.g., benzene, toluene, xylene), dioxins/furans, polycyclic aromatic hydrocarbons (PAHs, e.g., benzo-a-pyrene), polychlorinated biphenyls (PCBs), 1,3-butadiene, and heavy/toxic metals/metalloids (e.g., arsenic, mercury, cadmium, chromium, etc.) [13]. When these tires are used for meat singeing, these emitted chemicals can adulterate the meat and hide; rendering the meat hazardous and unwholesome for human consumption [10]. Not only can human exposure to these chemicals occur through ingestion of contaminated meat, water, or vegetables grown in contaminated soil; it can also occur through inhalation (i.e., indoor and/or outdoor air polluted with the tire-fire smoke). These exposure scenarios can ultimately cause acute (short-term) and chronic (long-term) health risks to the community and pose occupational risks to the meat processing operators. Several reports have shown that these afore-mentioned chemicals have toxicological and public health implications. Examples of those implications include possible increased cancer rates, birth defects, along with various respiratory, cardiovascular, and neurological effects [14].

Uncontrolled burning tyre fires usually have major environmental impacts, which include air pollution, black smoke and other substances such as volatile organic compounds, dioxins and polycyclic aromatic hydrocarbons are released into the atmosphere. Water pollution, the intense heat allows pyrolysis of the rubber to occur, resulting in an oily decomposition product which is manifested as an oil runoff. This runoff can be carried by water, if water is used to put out the fire. Other combustion residues (such as zinc, cadmium and lead) can also be carried by fire water off the site. Soil pollution, residues that remain on the site after the fire can cause two types of pollution; these are immediate pollution by liquid decomposition products penetrating soil, and gradual pollution from leaching of ash and unburned residues following rainfall or other water entry. Almost all industries in Nigeria generate wastes which, in most cases, are disposed of without due regard to sound environmental management practices. This practice is common with small scale and even some large-scale industries. Most of wastes generated are either useful or harmful to humans. in more developed areas of the world, regulations are in place such as the Clean Air Act which minimizes the amount of emissions being released by businesses as well as the fact that technology exists that can help clean and filter the emissions before they are released into the air. On the other hand, in less developed areas of the world, environmental regulations and technology of this magnitude may not exist thus, exposing those citizens to more of the environmental and health related effects of uncontrolled tire burning. Most wastes especially the solids are carried to the rivers and streams through surface runoffs while some drain into the soil. In many parts of the world, human activities such as animal production and meat processing impact negatively on soil and natural water composition. This leads to pollution of such soils, natural water resources and the entire environment [15].

2. Materials and Method

2.1. The Study Area

Artisan market slaughter house is located inside the Artisan market in Asata Layout of Enugu metropolis in Enugu North Local Government Area of Enugu State of Nigeria. It has been in existence for over 23 years since the creation of the market 60 years ago. It has an area of 106km^2 with coordinates 60 30'N and 70 27' E. The area of land used for meat singeing is 648sqm [16]. The Artisan slaughter house is specially meant for goats and sheep. However, other animals like (cows, pigs, fowls, goats and sheep) are also slaughtered there.

Figure 1: The animal singeing site of Artisan market in Enugu metropolis, Nigeria

2.2. Sampling

Four sampling stations namely; A1, B2, C3 and D4 where mapped out around the slaughterhouse at 9.5 meters from each other. Composite soil samples were collected at depth of 0-20cm (affected areas) using soil auger. A control soil sample was also collected 10m north, away of the slaughterhouse (unaffected area). These soil samples were collected and packed in labelled polythene bags sealed and conveyed to laboratory for preparation and analysis.

2.3. Determination of the Physicochemical Parameters

A number of physicochemical parameters of the contaminated soil samples were determined. They included pH, conductivity, moisture content, nitrogen, phosphorous, sulphate. Others are, total organic carbon/matter, sand, silt, clay, magnesium, lead, iron, sodium and potassium. The pH was measured using Hach pH meter (Model EC1O); conductivity was measured using conductivity meter (Model CO150); the particle size was determined using the oscillatory sieve shaker of model KJ-201BD; the moisture content was determined using Mettler Toledo weighing balance of model HK-DC-3265; sulphate and nitrogen were determined using Barium chloride (Turbidimetric) and the Cadmium reduction methods respectively. Also, the organic carbon was determined using the method of Walkley and Black principle and the phosphate was determined using the spectrophometeric method. All analyses were in accordance with ISRIC, 2002.

3. Results and Discussion

Table 1: Results of the Physiochemical Properties of the soil

Parameters	**SS1A**	**SS2B**	**SS3C**	**Mean Value**	**SS4D Control**
pH	6.00(1.02)	6.80(1.02)	6.60(1.04)	6.47	6.95(1.02)
Conductivity(ms/cm)	5.70(0.98)	4.09(1.01)	5.41(1.03)	5.06	3.89(1.09)
Moisture Content (%)	5.4(0.91)	2.6(1.00)	11.1(1.30)	6.36	1.5(1.001)
Sulphate (mmol/kg)	76.60(2.14)	78.29(2.03)	75.67(2.35)	76.85	102.19(3.06)
Nitrogen (%)	0.1879(0.08)	0.2165(0.01)	0.3188(0.03)	0.2410	0.4465(0.01)
Phosphorous(mg/kg)	47.02(2.11)	18.9(2.02)	54.40(1.63)	40.10	24.16(2.68)
Organic Carbon (%)	0.614(0.09)	0.110(0.01)	1.012(0.06)	0.578	1.482(1.03)
Organic Matter (%)	1.231(0.18)	0.841(0.03)	1.432(0.04)	1.168	1.723(1.02)
Sand (%)	95.606(3.02)	95.614(3.04)	95.614(1.95)	95.611	95.622(3.08)
Silt (%)	2.204(1.01)	2.196(1.04)	2.194(1.20)	2.198	2.190(1.06)
Clay (%)	2.190(1.03)	2.190(1.02)	2.192(1.21)	2.190	2.190(1.07)
Lead (mg/kg)	50.00(2.01)	46.00(1.20)	35.00(1.01)	43.00	29.00(0.20)
Sodium(mg/kg)	778.3(1.10)	863.3(1.20)	773.8(0.90)	805.1	605.1(2.10)
Potassium(mg/kg)	573.8(3.82)	583.3(3.83)	697.3(2.30)	618.1	538.3(3.82)
Magnesium(mg/kg)	658.5(3.04)	739.8(4.04)	793.0(4.61)	730.4	845.4(2.60)
Iron(mg/kg)	3614.8(6.26)	3598.2(3.01)	3680.2(6.04)	3631.0	3475.3(6.12)

Note: SS = Soil Sample, 0 – 20cm depth. Values in brackets are the standard deviation of each value.

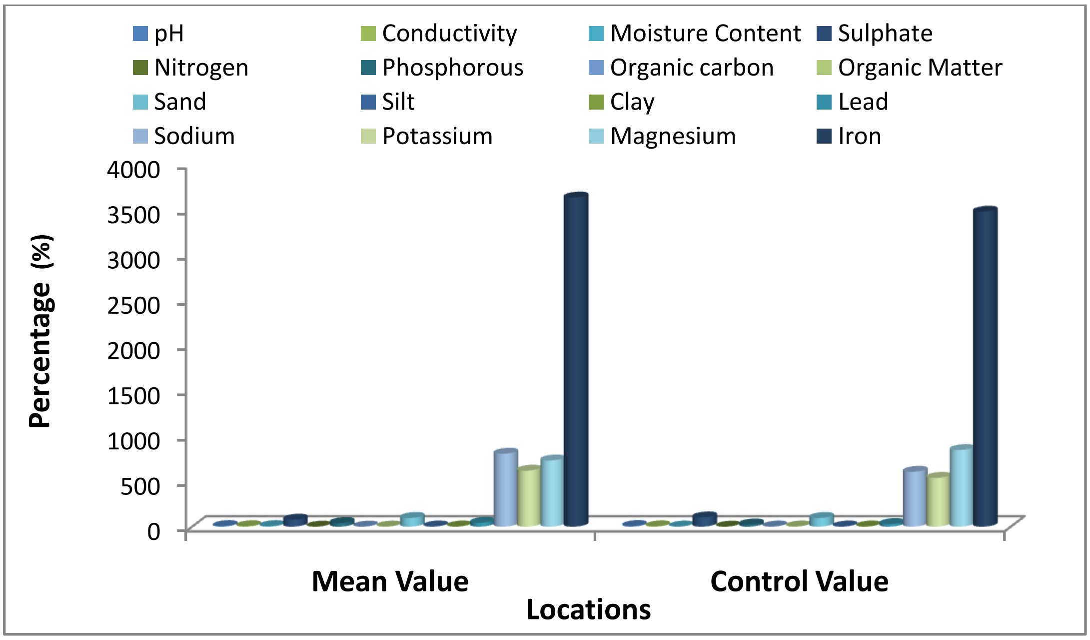

Figure 2: Chart showing the studied samples of both the affected sites and the control site

The above results in Table 1 and Figure 2, showed the quantity of phosphorous at mean value in soil sample 40.10(mg/kg) from the study site compared to control sample in the same site. This shows that mismanagement of phosphorus in the soil can pose a threat in soil nutrient [17]. Excess phosphorus lead to depleting oxygen, which results in eutrophication [17]. Lack of Nitrogen as seen in Table 1 and Figure 2 in the soil samples at mean value of 0.2410 %, may result to high carbon content such as ashes dust in the soil [18]. It can also be seen that Organic Carbon in the soil samples collected at the various specified locations at mean value have very low values of total organic carbon (TOC) in the site. This can be attributed to the natural topography of the site and also dead micro-organisms in the soils tested showing waste generated had more influence on organic matter content, [19], since total organic carbon is the amount of carbon found in an organic compound and may also refer to the amount of organic carbon in soil, or in a geological formation sample [20]. Again, the total organic

matter (TOM) samples in Table 1 and Figure 2, have similar trend like that of TOC in the same Table 1 and Figure 2 for Organic matter since soil organic matter is component of soil consisting of plant and animal residues decomposition [20]. The difference shows that the total organic matter values is higher than that of the total organic carbon. The value of potassium in Table 1 and Figure 2, at mean value618.1 (mg/kg), shows how much Potassium can be detrimental to plant growth as it interferes with the uptake of other substances and important nutrients [20]. The highest concentration of Iron in the results was noticed at various locations at mean value of 3631.0 (mg/kg) and control value of 3475.3 (mg/kg) which indicate the high conductivity experienced at both locations and this shows that the test site is around an abattoir [10].
From the statistical analysis conducted on the samples, it showed that the observed differences in pH, Conductivity, and Moisture content were not statistically significant across the different locations tested ($P > 0.05$). But for parameters such as sulphate, lead and phosphorus, the observed differences (between distance/point of collection) was statistically significant across the different locations tested ($P < 0.05$). The analysis of variance for properties like sodium, potassium, magnesium, silt and clay showed that all parameters observed did not vary significantly both between the properties and as distance of sample collection increased. The calculated F-values were lower than the critical values showing that their observed differences were not statistically significant at 95% confidence levels ($P > 0.05$). Also, the Organic carbon and Organic matter were analytically observed and the observed difference in the tested parameters were statistically significant at 95% confidence interval ($P < 0.05$). This also implies that the activities of the abattoir had great effect on the organic matter and organic carbon of the tested locations and the variations between both parameters and variations within locations were very significant.

4. Conclusion

From the research carried out, it can be concluded that all parameters tested showed variation across all sample locations. The tested samples with depths of 0-20cm had ranged values for parameters such as Lead; 35.00-50.00mg/Kg, Conductivity; 4.09-5.70ms/cm, Sand; 95.606-95.614(%), Silt; 2.194-2.204(%), Clay; 2.190-2.192(%), Total organic carbon; 0.110-1.482(%), Total organic matter; 0.841 -1.723(%), Iron; 3598.2-3680.2mg/Kg, Sodium; 773.8-863.3mg/Kg, and Magnesium; 658.5-793.0mg/Kg. From the results, it was observed that human activities within the abattoir have influenced the physicochemical speciation of the abattoirs.
For the statistical analysis, organic carbon and organic matter were statistically significant at 95% confidence interval, while other properties such as the pH, conductivity, and moisture content, sodium, sulphate, lead, phosphorus, potassium, magnesium, silt and clay were not statistically significant at 95% confidence levels.
In conclusion, the result of the analysis obtained shows that the soil fertility, as determined by the physical and chemical of the soil samples in the site, has been affected by the impact of the effluent from the burnt tyre resulting into the inability of the soil to support plant growth.
Therefore, it is recommended that the activities at the abattoir should be monitored closely by relevant agencies in order to prevent full-blown environmental problems leading to soil mismanagement in the near future. Seminars and workshops should be organized to enlighten the public on the pollution level of the agricultural soil caused by usage of tyre in meat singeing and loss of soil fertility. Land management act and policy of the state should be monitored in the state to guide the land users on what activities to be carried out. Also, the National Soil Research Center (NSRC), should be established in the country to have soil data bank, to research on soil improvement methods that is indigenous, and monitoring the health of the soil resource base and also valuable resource for research and application for sensing soil quality.

Reference

[1]. Hornby, A. S. (2006). Oxford Advanced Learner's Dictionary of current English (7th edition) (p. 1381). Oxford University Press.
[2]. Olanike, K. A. (2002). Unhygienic operation of a city abattoir in south western Nigeria: Environmental implication. AJEAM/RAGEE, 4(1), 23-28.
[3]. Red Meat Abattoir Association (2010) Red meat regulation and statistics. http://www.rmaa.co.za/slaughter-statistics/.

[4]. Steffen, Roberts and Kirsten Inc. (1989). Water and waste-water management in the red meat industry WRC Report No. 145 TT41/89. WRC, Pretoria.pp.36.

[5]. Kruslin, E., Hodel, C. M., & Schurgast, H. (1999). Progress in diagnosis of Chronic Toxic metal Poisoning by Hair analysis. Toxicol. Lett., 88, 84. http://dx.doi.org/10.1016/s0378-427(96)80302-X

[6]. Jukna, C., Jukna, V., & Suigzdaite, J. (2006). Determination of Heavy metals in Viscera and Muscles of cattle. *Bulgarian Journal of Veterinary Medicine, 9*(1), 35-41.

[7]. Patra, R. C., Swarup, D., Naresh, R., Kumar, P., Nandi, D., Shekhar, P., ... Ali, S. L. (2007). Tail hair as an indicator of environmental exposure of cows to lead and cadmium in different industrial areas. Ecotoxicology Environ., Safe., 66, 127-131. http://dx.doi.org/10.1016/j.ecoenv

[8]. Katarzyna, R. A., Monkiewicz, J., & Andrzej, G. (2009). Lead, cadmium, arsenic, copper and zinc contents in hair of cattle living in the area contaminated by a copper smelter in 2006-2008. Bull Vet Inst Pulawy, 53,703-706.

[9]. Odoemelan, S. A., & Ajunwa, O. (2008). Heavy Metal Status and Physicochemical Properties of Agricultural Soil amended by short term application of animal manure. *Journal of Chemical Society of Nigeria*, 30, 60-63.

[10]. Obiri-Danso, K., Hogarh, J.N. Antwi-Agyei, P. (2008). Assessment of contamination of singed hides from cattle and goats by heavy metals in Ghana African. *Journal of Environmental Science and Technology*, 2(8), 271-221.

[11]. Environmental Protection Agency (2013) Tire Fires, Human Health and Lead. http://www.epa.gov/osw/conserve/materials/tires/fires.html

[12]. RMA (2011) Assessment of Markets for Fiber and Steel Produced from Recycling Waste Tires. http://www.rma.org/publications/scrap-tire-publications/processing-publications

[13]. Reisman D.J., (1998) International Program on Chemical Safety; Environmental Health Criteria. Publisher WHO ISBN 924157078, 9789241572071; 159 p.

[14]. Environmental Protection Agency, Agency for Toxic Substances and Disease Registry ATSDR & Reisman D.J, (2014) Toxicology and Risk Assessment. http://www.epa.gov/ toxicology

[15]. Adesemoye, A. O., Opere, B. O., & Makinde, S. C. O. (2006). Microbial Content of abattoir waste water and its contaminated soil in Lagos, Nigeria. *African Journal of Biotechnology*, 5(20), 1963-1968.

[16]. Ministry of Land and Surveyor Enugu State (2017) Artisan Quarters Geographical Axeis.

[17]. Addis Wodaje and Abebaw A.M, (2015). Analysis of selected Physicochemical Parameters of Soils used for Cultivation of garlic (allium sativum l.)Science, Technology and Arts Research Journal., 3(4): 29-35.

[18]. Hill Tempest. D., (2015) Public Health Implications Associated with the Practice of Utilizing Tires to Singe Meat in Three Major Cities of Ghana; A concurrent mixed methods study, Electronic Thesis & Dissertations 1350 https://digitalcommons@georgiasouthern.edu

[19]. Adesodun Johnson (2017) Transmission and Storage Properties of a Tropical Loamy Sand Soil as influenced by Organic based and Inorganic fertilizer, Acta Agricultrae Scandinavica, Soil and Plant Science 65(1) 10.1080/09064710

[20]. Aariff Khan Ma and Kamalakar, J. (2012) Physical, Physico-chemical and Chemical Properties of Soils of Newly Established Agro-biodiversity park of Acharya NG Ranga Agricultural University, Hyderabad, Andhra Pradesh Int. J. farm Sci., 2(2): 102-116.