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Effects of Burning End-Of-Life-Tyres on Soil Quality in Bauchi Metropolis

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ABSTRACT

This study focused on analyzing the impact of burning end-of-life tyres on soil quality. To achieve that, soil samples were collected from areas where tyre burning was prevalent, specifically from marked points A, B, and C at varying depths (0-15 cm, 15-30 cm, and 30-40 cm). Each sample, weighing <2mm, was stored in polyethylene bags for laboratory analysis. The analysis included a comprehensive examination of the physical and chemical properties of the soil samples obtained from two distinct locations, labelled A1-A3 and B1-B3. Parameters studied included colour, texture, pH, electrical conductivity (EC), nutrient content (nitrate, sulphate, nitrogen, phosphate, phosphorous, copper, iron, magnesium, chromium, potassium, and zinc), total organic carbon (TOC), total organic matter (TOM), and microbial parameters (total viable count and fecal coliform). The results revealed important insights into the soil's characteristics. The reddish-brown color indicated certain physical and chemical traits, while the dark black color in some samples (A1-A3 and B1-B3) was attributed to end-of-life tire burning. Soil pH levels were within the acceptable range set by the WHO (pH 7.4-7.5). However, nitrate levels were elevated, suggesting soil quality concerns. TOC percentages indicated unhealthy conditions in burnt tyre-contaminated soil, while TOM percentages reflected good organic matter content. Notably, copper levels were significantly above recommended levels, indicating potential soil health issues. These findings underscore the link between tyre burning and heavy mineral content in the soil, emphasizing the importance of halting this practice to preserve environmental quality. Therefore, this study immediately recommends the stops community from burning of end -of-life tyres into the environment.

KEYWORDS: Burning; End-of-life-tyres; Soil quality; Bauchi Metropolis

I. INTRODUCTION

In recent years, transportation has significantly contributed to the escalation of technological development. Transportation is the movement of people and goods from one location to another. Throughout history, the economic wealth and military power of a people or a nation has been closely tied to efficient methods of transportation. These creates pollution that can be harmful to the environment.

Soil is said to be contaminated when burning activities of end-of-life-tyres takes place and releases hazardous substances into soil.These hazardous substances would affect soil quality within the burning point (Okaeanti, 2001). Burning of end-of-life-tyres is one of the major causes of soil contamination and affect soil quality positively or negatively (Etkin, 2000b). Burning of end-of-life-tyres causes damage to properties, farm lands, and surface earth. (Oghenero et al., 2005).

According to Nokyoo, (2010) In the 20th century, technology has improved and cars became less expensive, the demand for rubber tyres out spaced the supply, leading to Inventors creating the first commercial synthetic rubber. Thereby creating end-of-life-tyres as after consumption waste.

Burning end-of-life-tyres on soil releases hazardous substances such as Heavy metal that have been causes damage to soil properties.Abosede, (2013)recently studies after have shown how some of these physical and chemical parameters affect soil characteristics positively or negatively.Adelowo,and Oloke, J.K. (2001). It is well known that soil parameters for physical and chemical properties such as pH, colour, organic matter, organic nitrogen, texture, carbon/ nitrogen ratio, moisture content, water holding capacity, bulk density and mineral content (trace & bulk elements) of soil indicate the condition or status of soil (Olaitan and Lombin,

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2004; Aziz and Karim, 2016). Recent studies have shown how some of these parameters affect soil characteristics positively or negatively (Azlanet al., 2012; Aziz and Karim, 2016).

Soil sampling for atmospherically deposited pollutants will normally base on shallow sampling (0-2.5 or 0.5cm) on top soils. The soil which contained contaminants and which were subsequently ploughed into the soil need to be studied in samples of both top soil (normally 0-15cm) and samples from lower depths in the soil profile, 15-30cm (Okaeanti, 2001; Okop and Ekpo, 2012). The greatest part of the organic matter in soils occurs in the top soil (Olaitan and Lombin, 2004; Azlanet al., 2012).

Soil properties and composition change with depth. Consequently, the characteristics of sub soil could be different from those of the surface layer. The sub soil layer has been shown to be an important geochemical barrier against the migration of metals in the soil system, including penetration of soil. (Zacharyaszet al., 2012 and Alloway 2005).

There are many systems of soil classification but the method chosen must be related to the reason for classifying one or a number of soils. Soils may be grouped quite simply according to particle diameter into sand, silt and clay (particle size classification) and these are shown in Table 1.

Table 1. Soils separates and their diameter ranges

Soil separate name	Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Diameter range (mm)	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.10	0.10-0.05	0.05-0.002	Less than 0.002

Source: Miller and Donahue (2002)

METHODOLOGY

Locational Street Map of The Stud

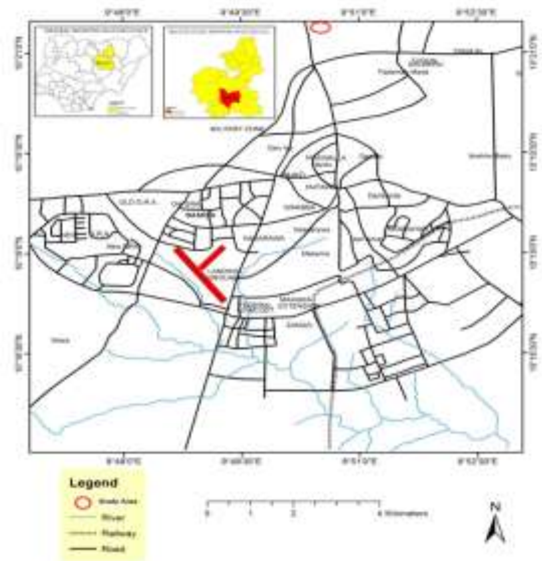

Figure 1: Street Map of the Study Area

Study Area:

Gubi area is located at the traverse between Kano and Maiduguri Road, serve as the burning point of end-of-life-tyres for the scavengers, who burn the tyres to access the inbuilt metal wire for commercial purpose.

The study area of this research located at Gubi area in Bauchi metropolis, is in the North Eastern geopolitical zone of Nigeria. It is located between Latitudes 10°16'30" - 10°2'0" North of the Equator and Longitudes 9°48'0" and 9°52'30"Eastof the Greenwich Meridian. It is on the northern edge of the Jos plateau, at an elevation of 616m. The topography of Bauchi metropolis is relatively flat in the Centre. The town lies over 609.6 meters above sea level; it occupies a total land area of 3, 604 hectares (Usman and Mohammed, 2022). The Bauchi Urban area according to the Bauchi State Urban Development Board has a radius of about 32km and comprises of only one local government area i.e., Bauchi. Bauchi town lies on the railroad from Maiduguri to Kafanchan (where it joins the line to Port Harcourt) and has road connections to Jos, Kano, Maiduguri and Gombe (Bauchi, 2015).

II. RESEARCH DESIGN

During conduct of this research, the experimental design was used to test the quality of soil. Simple stratified Sampling system: - was used for this study; the choice of this sampling system was informed by the simplicity and plain of the study area. Simple stratified Sampling system according to International Soil Reference and Information (ISRIC method, 2002) is a system that provides the researcher with straight forward data for ease of classification and analysis.This study therefore adopted the experimental design for the conduct of the studies (Martin-Saintzet al, 2016).

Soil Samples

a) The first soil sample were taken from the marked area A, and C;

b) the top soil, the medium and the bottom soil were taken for laboratory analysis from the end of end-of-life-tyres burning point;

c) According to International Soil Reference and Information Center (ISRIC method, 2002) <2mm of the soil samples were taken and store in polyethene bags,samples were collected at depth of 0-15,15-30 and 30-40 cm at three different points, to obtain a one sample representative of the study area (Wang etal., 2013). A total of six soil samples were obtained and labeled A1-3 and B1-3 respectively.

Laboratory Analysis

The collected soil sample from selected sampling point A and B representing the main source will be level and store in polythene bags, and taken to laboratory. The samples will be air dried. Ground using porcelain pestle and mortar and passed through a 2mm sieve. (Voutsaet al., 2006; Chen, and Ma, 2001) for the following laboratory analysis.

1.physical, chemical and biological pollutants.

Data Analysis

All the experimental data were analyzed using tables to compared with the permissible limits in soil prescribed by the World Health Organization standards and Food and Agricultural Organization (FAO) recommendations.

III. RESULTS

Table 2: physical and chemical properties of burnt end-of-life-tyres contaminated soils samples parameters

S/N	Parameters	Sample A1	Sample A2	Sample A3	Sample B1	Sample B2	Sample B3	WHO/FAO 2002/2011 STD
1	Colour	Dark black	Dark black	Dark black	Dark black	Dark black	Dark black	
2	Texture	Silty loamy	Silty loamy	loamy	Silty loamy	Silty loamy	loamy	
3	Ph	7.4	7.5	7.4	7.5	7.5	7.4	6.0-7
4	E. Conductivity (µS/cm)	225	226	228	212	215	211	250-750 µS/cm
5	Nitrate NO3 (mg/L)	61.5	61.4	61.8	57.2	55.1	53.3	10-50
6	Sulphate SO4 (mg/L)	24	24	25	18	20	21	100-200
7	Nitrogen N (mg/L)	13.9	13.9	14.0	12.9	12.5	12.0	10-50
8	TOC %	24.91	25.71	24.88	5.00	5.87	5.94	2-5
9	TOM %	42.85	44.22	42.79	8.44	10.09	10.22	10-50
10	Phosphate PO4	0.73	0.60	0.88	0.68	0.64	0.66	0.1-9

	(mg/L)							
11	phosphorous P (mg/L)	0.24	0.26	0.29	0.22	0.21	0.21	10-50
12	Copper Cu (mg/L)	56.52	55.55	55.43	67.51	67.01	67.28	100
13	Iron Fe (mg/L)	28.40	28.93	29.23	26.34	26.43	26.26	1-50
14	Magnesium Mg (mg/L)	0.030	0.020	0.023	0.0380	0.009	0.001	10-100
15	Chromium Cr (mg/L)	0.435	0.440	0.463	0.466	0.498	0.482	1.0
16	Potassium K (mg/L)	988.6	1349.0	1352.8	2193.2	2912.8	2476.4	100-400
17	Zinc Zn (mg/L)	5.40	4.45	6.30	5.36	4.95	4.15	0.5-7
18	Total viable count (cfu)/ml	600	760	710	900	848	665	600 to 900 cfu/Ml
19	Fecal Coliform (cfu)/ml	ND	ND	ND	ND	ND	ND	

Note: Mg/l = Milligram per liter, cfu = Colony forming units, µS/Cm = Micro-Siemens per centimeter, ND "Not Detected"

IV. DISCUSSION

Colour of soil

The actual colour of the soil is an important indicator of certain physical and chemical characteristics as a reddish brown. The dark black colour of soil samples A1-A3 and B1-B3 was due to the burning of end-of-life-tyres and heavy contamination by carbon black which is dark black in colour that formed the tyre (Murray 2006; Sharma, 2011). The dark black colour of samples A1-A3 and B1-B3 contaminated the colour of the soil in the study area of burning end-of-life-tyres which change the colour of the soil from brown to dark black which change the nature and conditions of the soil (Montgomery, 2008)

Soil Texture

The results of the identification of soil classes by texture are found in Table 2Samples A1-A3 B1-B3 being aggregated, moderate pressure needed to break aggregates after drying and forming smooth medium ribbon while texture of the soil is classified as silty clay loam. Sample being aggregated, forming soft clods after drying, gritty and no ribbon formation while texture of the soil classified as sandy loam (Olaitan and Lombin, 2004; Ibitoye, 2006). Soil texture is determined by the size of the soil particle. It refers to the proportion of sand, silt and clay in a soil. In a more general way, texture may be used to describe how a soil feels or behaves on environment (Olaitan and Lombin, 2004)
Soil texture and organic matter content are two important factors which determine the amount of water a soil can hold.

Soil pH values

This was done after calibration of the pH meter with buffers of pH 4.0 and 7.0.20g of air-dried soil (passed through 2mm sieve) was weighed into a 50ml beaker. 20ml of distilled water was added and was allowed to stand for 30 minutes during which stirring was carried out. The electrode of the pH meter was inserted into the partly settled suspension and the pH measured. Result was reported as soil pH measured in soil (APHA, 2000 and Bates, 2004).

Soil pH is typically accepted to be maintained within a range of 6.0 to 7.5 for good soil condition, a pH of 7.4 and 7.5 falls within this acceptable range set by who. A pH of 7.4 and 7.5 considered slightly alkaline but still falls within the acceptable range for many soils standard. However. The acidity of samples A and B may be attributed to Aluminium toxicity due to soil contamination by burnt end-of-life-tyres from the surrounding environment (Adeleyeet al., 2005).
Therefore, it's essential to consider the specific pH requirements of the soil standard set by WHO and FAO acceptable limit. Soil pH adjusted using lime (to raise pH) or sulfur (to lower pH) based on pH needs on specific soil test results (Adeleye et al., 2005).

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ECSoil EC values

EC values between 250 to 750 µS/cm are considered within the normal range for most soils, EC values below 250 µS/cm. And EC values above 750 µS/cm may indicate elevated soil salinity, which can be detrimental to soil quality.

Based on the laboratory results provided (ranging from 211 to 228 µS/cm), they fall within the typical range of acceptable limit of healthy soils, suggesting that they are not excessively saline. However, it's essential to consider specific uses of the soil. when interpreting EC values for difference purposes, has different degrees of salinity for uses (Montgomery, 2008). Additionally, local factors and climate can influence acceptable EC levels for successful soil and Soil testing and consultation with local environment services and precise guidance (Montgomery, 2008).

Soil Nitrate (NO3) values

Nitrate levels are usually expressed in milligrams per liter (mg/L) of soil extract. The acceptable or safe range of nitrate in soil can vary depending on the specific land use, and local regulations. Nitrate levels on environment should typically be below 10-20 mg/L to minimize the risk of soil contamination and to ensure safety of the environment. While Nitrate levels above 20 mg/L can indicate the potential for nitrate leaching into ground, which can pose health risks and environmental degradation.

Based on the laboratory results provided (ranging from 53.3 to 61.8 mg/L), they all appear to be above the typical acceptable range for soils quality. High nitrate levels may require management practices. Local regulations and recommendations should be followed to address high nitrate levels in soil and to ensure sustainable soil practices and ecological balance.

Soil Sulphate SO4 values

Sulfate (SO4) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, can influence soil quality and balance ecological conditions. The specific guidelines for sulfate levels in soil can vary depending on the uses of the soil. Sulfate levels in soils are typically considered safe and suitable for environment when Sulfate levels above 200 mg/L may indicate excessive sulfur content, which can affect soil status condition.

Based on the laboratory results provided (ranging from 18 to 25 mg/L), they all fall within the typical acceptable range for soils conditions set by who and fao standards. These sulfate levels are generally suitable for most environmental condition. However, it's important to consider specific soil requirements when interpreting sulfate levels for environmental purposes, Soil testing and consultation with local experts can help optimize nutrient management for a specific soil condition.

Soil Nitrogen N (mg/L) values

Nitrogen (N) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are an essential parameter for assessing soil quality for healthy environment. The specific guidelines for nitrogen levels in soil can vary depending on the uses of the soil. And Nitrogen levels in soils are typically considered adequate for most soil condition when they are in the range of 10-20 mg/L. while Nitrogen levels below 10 mg/L may indicate a potential deficiency, which can affect the quality of the soil. while Nitrogen levels above 20 mg/L may indicate excessive nitrogen content, which can lead to environmental issues such as nitrogen leaching and groundwater pollution.

Based on the laboratory results provided (ranging from 12.0 to 14.0 mg/L), they all fall within the typical acceptable range for healthy soils. These nitrogen levels are generally suitable for most environment. Soil testing and consultation with experts can help optimize nutrient management for your specific soil conditions.

Soil TOC % values

Total Organic Carbon (TOC) is a crucial parameter in soil analysis, as it indicates the percentage of organic carbon present in the soil. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and acceptable limit related to soil quality and nutrient content, TOC percentages in soil can vary widely based on soil type, land use, and location. However, Soils with higher TOC percentages (typically above 2% to 5%) are considered to have good organic matter content, which can improve soil structure, and nutrient retention. Such soils are often healthier. And Soils with lower TOC percentages (below 2%) may benefit from organic matter additions to improve soil health and fertility. Based on the laboratory results provided, TOC percentages ranging from 5.00% to 25.71% are relatively high and indicated unhealthy condition of the soils of burnt end-of-life-tyre contaminated soil.

Soil TOM % values

Total Organic Matter (TOM) percentage in soil is a crucial parameter that indicates the overall organic material content, which includes organic carbon, in the soil. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) primarily focus on guidelines related to soil quality and nutrient content for environmental purposes, they often emphasize parameters like organic carbon content (TOC) rather than total organic matter (TOM) therefore Soils with higher TOM percentages typically have better organic matter content, which is beneficial for soil health, structure, and nutrient availability. And Soils with lower TOM percentages may benefit from organic matter additions to improve soil fertility and overall quality.

Based on the laboratory results provided, TOM percentages ranging from 8.44% to 42.85% are relatively high and indicative of soils with a good organic matter content. These values suggest that the soils have a healthy level of organic material, which can be beneficial for soil quality. However, as always, specific acceptable limit may vary based on local conditions and requirements, so it's advisable to consult with local experts for more guidance on soil management.

The organic matter results of samples A1-A3 and B1-B3 are similar to that obtained by Edori and Iyama (2017). The impact of burning E waste on soil quality. This is because the samples were obtained from different geographical location, in Port Harcourt the organic matter content of samples are higher.

Soil Phosphate PO4 (mg/L) values

Phosphate (PO4) levels in soil, expressed in milligrams per liter (mg/L) of soil extract, are an important parameter for assessing soil fertility and nutrient availability on soil. While the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) primarily focus on guidelines related to human health and environmental quality, phosphate levels in soil are relevant for difference purposes. Phosphate levels below 0.1 mg/L may indicate a potential deficiency, And Phosphate levels above 10 mg/L may indicate excess phosphate, which can lead to environmental degradation, such as soil pollution.

Based on the laboratory results provided (ranging from 0.60 to 0.88 mg/L), they all fall within the typical acceptable range for healthy soils. These phosphate levels are generally suitable for most soil conditions. However, it's important to consider specific requirements when interpreting phosphate levels for different purposes, Soil testing and consultation with experts can help optimize nutrient management for your specific soil conditions.

Soil phosphorous P (mg/L) values

Phosphorus (P) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are an essential parameter for assessing soil fertility and nutrient availability for plant growth. While the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) primarily focus on guidelines on difference purposes.

Phosphorus levels in soils are considered sufficient range of 5 to 50 mg/L. These levels can vary depending on soil requirements and soil types. While Phosphorus levels below 5 mg/L may indicate a potential deficiency, which can course soil pollution. And Phosphorus levels above 50 mg/L may indicate excess phosphorus, which can lead to environmental issues, such as water pollution.

Based on the laboratory results provided (ranging from 0.21 to 0.29 mg/L), they all appear to be below the typical acceptable range for soils conditions.

Soil Copper Cu (mg/L) values

Copper (Cu) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are a parameter relevant to soil quality and can have implications for environment. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) do provide guidelines and acceptable limit for various aspects of soil quality and nutrient content, including trace elements like copper.

Copper is considered an essential micronutrient, but excessive copper levels in soil can be toxic environmental conditions implications. And the recommended copper levels in soils can vary depending on the specific uses of the soil However, typical safe ranges for copper in soils are often in the range of 2 to 20 mg/L.

Based on the laboratory results provided (ranging from 55.43 to 67.51 mg/L), they all appear to be significantly above typical recommended levels for healthy of soils. These elevated copper levels may indicate a potential risk of copper toxicity and could have environmental implications. It's crucial to assess the source of copper and take appropriate measures to mitigate any potential negative effects. Consulting environmental experts is advisable to address this issue and ensure sustainable soil management practices.

Soil Iron Fe (mg/L) values

Iron (Fe) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are a parameter relevant to soil quality and can influence plant growth and nutrient availability. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) do provide guidelines and recommendations for various aspects of soil quality and nutrient content, including the presence of essential micronutrients like iron. Iron is an essential micronutrient, and adequate iron levels in soil are necessary for healthy and good for environmental conditions

However, typical safe ranges for iron in soils are often in the range of 1 to 50 mg/L.

Based on the laboratory results provided (ranging from 26.26 to 29.23 mg/L), they all fall within the typical acceptable range for iron in soils. These iron levels are generally suitable for most soil and suggest that the soil is not deficient in this essential micronutrient. However, specific soil requirements should be considered to ensure optimal nutrient management for your particular soil conditions.

Soil Magnesium Mg (mg/L) values

Magnesium (Mg) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are a key parameter for assessing soil quality and nutrient availability. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and acceptable limits for various aspects of soil quality, including the presence of essential macronutrients like magnesium. And the limited magnesium levels in soils can vary depending on the specific soil conditions. However, typical adequate ranges for magnesium in soils are often in the range of 10 to 100 mg/L.

Based on the laboratory results provided (ranging from 0.001 to 0.038 mg/L), they all appear to be significantly below typical recommended levels for magnesium in soils. These low magnesium levels may indicate a potential deficiency for most soil condition, it may be necessary to consider magnesium supplementation through fertilization to improve soil fertility and support healthy of the soil. Consulting experts and conducting comprehensive soil testing is advisable to determine the most appropriate magnesium management practices for your specific soil conditions. Magnesium appears in the samples and biotransformation and bioaccumulation of these can lead to undesirable on soil.

Soil Chromium Cr (mg/L) values

Chromium (Cr) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are a parameter that can be important for assessing soil quality and potential environmental contamination. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and acceptable limit for various aspects of soil quality, including the presence of trace elements like chromium.

Chromium is a trace element, and it is naturally occurring in soils, elevated levels of certain forms of chromium, such as hexavalent chromium (Cr (VI)), can be toxic and pose environmental risks. And the limit levels for total chromium in soils can vary depending on local regulations, but typical safe ranges for total chromium are often below 1 mg/L.

Based on the laboratory results provided (ranging from 0.435 to 0.498 mg/L), they all fall within the typical acceptable range for total chromium in soils. These chromium levels are generally considered safe and should not pose significant risks to the environment. However, it's important to note that the specific form of chromium (Cr (VI) or Cr (III)) and its bioavailability can influence its impact on the environment. Local regulations and soil testing may provide more detailed guidance on chromium management in a specific area to ensure the safety and environmental protection.

Soil Potassium K (mg/L) values

Potassium (K) levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are an essential parameter for assessing soil quality and nutrient availability for plant growth. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and recommendations for various aspects of soil quality, including the presence of essential macronutrients like potassium.

However, typical adequate ranges for potassium in soils are often in the range of 100 to 400 mg/L.

Based on the laboratory results provided (ranging from 988.6 to 2912.8 mg/L), they all appear to be significantly above typical limit levels for potassium in soils. These elevated potassium levels may indicate an excess of potassium in the soil, which can affect nutrient balance and potentially impact soil health.

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It's important to consider the potential sources of high potassium in the soil, depending on the specific soil requirements, it may be necessary to adjust potassium management practices to avoid nutrient imbalances. Consulting environmental experts and conducting comprehensive soil testing can help determine the most appropriate potassium management strategies for your specific soil conditions.

Soil Zinc Zn (mg/L) values

Zinc (Zn) concentrations levels in soil, typically expressed in milligrams per liter (mg/L) of soil extract, are an important parameter for assessing soil quality and nutrient availability within a specific soil. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and recommendations for various aspects of soil quality, including the presence of essential micronutrients like zinc.

Zinc is an essential micronutrient, and adequate zinc levels in soil are necessary for healthy soil. It’s The recommended zinc levels in soils can vary depending on the specific conditions or status of the soil.

Based on the laboratory results provided (ranging from 4.15 to 6.30 mg/L), they all appear to be within or close to the typical recommended range for zinc in soils quality. These zinc levels are generally suitable for most favorable environment and suggest that the soil has an adequate supply of this essential micronutrient to support healthy the soil.

However, it's essential to consider specific soil requirements and local recommendations to ensure optimal nutrient management for a particular uses and soil conditions. Soil testing and consultation with local experts can help fine-tune nutrient management practices as needed.

Total viable count (cfu)/ml values

Total viable count (TVC), expressed in colony-forming units per milliliter (cfu/mL), is a measure of the total number of viable microorganisms (bacteria, fungi, etc.) present in a given sample. TVC is an important parameter for assessing soil health and microbial activity.

The specific acceptable TVC values can vary depending on the context and the type of soil or environmental sample being analyzed. For soil, acceptable TVC levels can vary widely depending on factors such as land use and local conditions. However, in soils, TVC levels can typically range from hundreds to thousands or even millions of cfu/mL, depending on factors like soil type and management practices.

Higher TVC levels are often associated with healthier soils, as they indicate a more active microbial community, which can be beneficial for nutrient cycling and soil health. And TVC levels can be influenced by factors like organic matter content, moisture, and temperature. Based on the laboratory results provided (ranging from 600 to 900 cfu/mL), they all fall within a typical range for TVC in soil. These TVC levels suggest the presence of a viable microbial community in the soil, which is generally indicative of soil health and activity. However, specific recommendations may vary based on local conditions and land management goals.

Fecal Coliform (cfu)/ml values

The abbreviation "ND" typically stands for "Not Detected" when analyzing microbial parameters like fecal coliforms in soil samples. In this context, it means that no fecal coliform bacteria were detected in the samples, indicating that the tested samples are free from this type of bacteria.

The presence of fecal coliforms in soil can indicate contamination with fecal matter and may suggest potential health risks, especially if these samples are associated with agricultural or recreational areas. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide guidelines and recommendations related to the presence of fecal coliforms in soil to ensure safe environmental practices.

Detection of fecal coliforms in soil samples may indicate potential contamination from human activities or animal feces. While The presence of fecal coliforms can be a concern for soil quality, And Regular monitoring and testing for fecal coliforms are essential to assess and manage potential health risks associated with contaminated soil.

If fecal coliforms are detected in soil samples, appropriate measures should be taken to investigate and address the source of contamination to ensure public health and environmental safety.

V. CONCLUSION

Base on the research conducted on soil quality as a result of burning of end-of –life- tyres at Gubi, in Bauchi metropolis, it is established that the relationship between burning of the end-of-tyres and the presence of heavy metal and other pollutant in Gubi Area to ensure that these maximum permissible levels are not exceeded,

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determination of the levels of these substances in environmental samples was done and remedies proffered where they exceed maximum permissible levels.

The formation of substances such as ashes and organic matter due to burning might improve soil properties and quality. On the other hand, the burning leads to increase in the soil's heavy metals, which might become toxic to organisms in the soil if their permissible level is exceeded by the permissible limit set by WHO and FAO. The Burning end-of-life-tyres generate high temperatures that can alter the physical structure of soil, leading to changes in its thermal properties which release acidic gases, which can lower the pH of the soil and make it more acidic, the intense heat from the fires can destroy organic matter in the soil, affecting its fertility. High temperatures can harm soil microorganisms, impacting the soil's ability to break down organic matter and cycle nutrients and the Changes in pH and the release of contaminants can affect the availability of essential nutrients in the soil and heavy metals. The Burning of end-of-life-tyres can release these contaminants into the soil, potentially leading to soil pollution.

Recommendations

Based on the soil analysis results and findings, arrived at the following recommendations are proffered:

1. Immediate stoppage of the burning activity should be stopped by the relevant organization.
2. Immediate evacuation of the suit, ashes and particulates part over should be evacuated.
3. bio-remedial treatment should be affected to regain the natural state of the area.
4. Strict surveillance should be put in place to prevent further contamination of the area.
5. Stringent regulatory framework should be put in place for control purpose and ensure compliance.
6. Designated dumping site should be provided for end-of-life-tyres.
7.the concept of reuse, recycle and reduce should be applied since end-of-life-tyres has some other useful values.

REFERENCES

[1]. Abosede, E.E. (2013). Effects of Burning Waste Pollution on Some Soil Physical Properties, Journal of Agriculture and Veterinary Science, 6 (3): 14-17.

[2]. Adeleye, E.O., Adeleye, A.A. and Ojeniyi, S.O. (2005). Effects of Wood Ash Manure on Soil pH, Nutrient Status in the Southwestern Nigeria, Journal of Applied Sciences 8(2): 4719-4727.

[3]. Adelowo, O.O. and Oloke, J.K. (2001). Biotreatment of Environmental Pollutants: The Potentials of Microbial Biosurfactants, Proceedings of Workshop on Environmental Pollution and The Applicability of Remediation Technologies in African Countries, 16-19 July, p77.

[4]. Ademoroti, C.M.A. and Asia, I.O. (2002). The Application of Physicochemical Method in the Treatment of Aluminium Extrusion Sludge, African Journal Scence 3(2): 609-623.

[5]. Ademoroti, C.M.A. (2006). Environmental Chemistry and Toxicology, Foludex Press Ltd, Ibadan, pp175-189.

[6]. Anikwe, M.A.N. (2006). Soil Quality Assessment and Monitoring, New Generation Books, Enugu, pp15-18.

[7]. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

[8]. (2017). ANSI/ASHRAE Standard 55-2017: Thermal Environmental Conditions for Human Occupancy. Atlanta, GA: ASHRAE.

[9]. Bauchi. (2015). Encyclopedia Britannica. Retrieved October 17, 2015 from www.brittanica.com/place/Bauchi-Nigeria.

[10]. Bates, R.G. (2006). Electrometric pH Determinations, John Willey and Sons Inc. New York

[11]. Brady, N.C. and Weil, R.R. (2006). The Nature and Properties of Soils, 11thedn., Prentice Hall Inc., New Jersey, pp15-16.

[12]. Brady, N.C. and Weil, R.R. (2013). The Nature and Properties of Soils, Pearson Education Inc., India, p130.

[13]. Chawla, S. (2003). A Textbook of Engineering Chemistry, Dhanpat Rai & Co. (Pvt) Ltd, Delhi, pp21-22.: 2041-0492.b Retrieved November 21,2012, from http://www.ct.gov/dep/cwp/view.asp?A=2714&Q=324902

[14]. Etkin, D.S. (2000b). US Vessel Spills 1985-1999: A Statistical Review, Environmental Research Consulting, Winchester, M.A, Paper 4

[15]. FAO/WHO (2001/2011) Soil permissible limits as recommended by the Food and Agriculture Organization (FAO) for soil guidelines south Africa.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 05 May 2024, pp: 906-915 www.ijaem.net ISSN: 2395-5252

[16]. Ibitoye, A.A. (2006). Laboratory Manual on Basic Soil Analysis, 2nd edn, foladave Nig. Ltd Akure, Ondo State, Nigeria, pp6-35, 76.

[17]. Martin-Sans, J. P, Vaquero-Perea, C., Vazquez-Zayas, C., Quintana-Nieto, J. R., Gonzalaez-Huecas, C., Lopez-Lafuenta, A., and de Santiago-Martin, A (2016): Impact of Scrap Tyre Dump on Soil Contamination. 18 International Conference on Heavy Metals in the Environment

[18]. Murray, P.R.S. (2006). Advanced Chemistry, Pan Books, London, pp257-263, 342- 348 MDE-Scrap Tire Playgrounds (2012). Maryland Department of the Environment.

[19]. Mahlangu, Lucas, M.(2009): Waste tyre management problems in South Africa and the possible opportunities that can be created through the recycling thereof. Thesis South Africa

[20]. Nokyoo, C., (2010). Thailand Policy and Strategy for Waste Management: Waste & Hazardous Substances Management, Bureau of Pollution Control Department, Thailand.

[21]. Okaeanti, D. (2001). Methods for Assessing Contaminants in Soil and Water, Proceedingsof Workshop on Environmental Pollution and The Applicability of Remediation Technologies in African Countries, 16-19 July, pp14-17.

[22]. Oghenero, O.A., Ovie, A. and Helen, J. (2005). Integration of Nigeria's at -1 and Internet Technology in Automatic Detection of Oil Spillage, International journal of Science and Technological Research,2:161-162.

[23]. Roy C., Labrecque B. &Caumia B. (2000) "Recycling of scrap tyres to oil and carbon black by vacuum pyrolysis"; Resources, conservation and recycling, 2000, 4, 203-213.

[24]. RMA- Tire Safety - What is Inside a Tire(2012). Rubber Manufacturers Association. Retrieved November 11, 2012, from http://www.rma.org/tire_safety/tire_basics/what_is_inside_a_tire/

[25]. Sharma, P.D. (2010). Environmental Biology and Toxicology, Rastogi publications, Meerut, India, p58

[26]. TRIB-About Retreading (2012). Tire Retread and Repair Information Bureau. Retrieved November 4, 2012. http://www.retread.org/?page=AboutRetreading Usman, H.A, Mohammed, B.U. (2012). Solid Waste Management in Bauchi, Nigeria(Obstacles and prospects). Journal of Environmental Science and Resources Management, Vol. 4, 96-107. Retrieved from www.cenresinpub.org, 7 July, 2014.

[27]. Zacharyasz, P., Siepak, J. and Rosada, J. (2012). waste Contaminated Soil and Water Analysis and Biodegradations.