Original Research Article

Analysis of Physiochemical Properties of dumpsite soil from federal University of Technology, Owerri (FUTO)

ABSTRACT

Aim: To assess the physiochemical properties of Dumpsites soils from Federal University of Technology Owerri (FUTO)

Study Design: This was a simple randomized sampling study technique.

Methodology: Soil samples were obtained from three different dumpsites located within the school namely Girls' hostel dumpsite, Ihiagwa dumpsite and Eziobodo dumpsite. The soil's physicochemical characteristics were ascertained by air drying it and then sieving it through a 2 mm sieve. The Bouyoucos hydrometer method was used to determine the soil's texture. A pH meter was used to measure the pH of a 1:2.5 soil-water extract, and a conductivity meter was used to measure the extract's electrical conductivity (EC), organic carbon using the wet oxidation method, and Walkley and Black. Available phosphorus by Bray and Kurtz method; total nitrogen by micro Kjeldahl procedure, as explained by Horneck and Miller (20). Following extraction with ammonium acetate, exchangeable bases were identified. At the Soil Science Laboratory, potassium (K) was measured using a flamephotometer, while calcium (Ca) and magnesium (Mg) were assessed using the EDTA titration method.

Results:

Results obtained from the study, revealed that values between waste dumpsite and control site were significantly different. Findings showed that the pH value in sampled soils from studied dumpsites ranged from 6.38±0.10 and 7.11±0.10 while the mean pH value for controlled site was 39.8±0.08. Data obtained show that the values of pH; Cation Exchange Capacity (cmol+kgG1); Calcium (mEq/ 100 g); 4.50; 4.24; 4.76, Potassium (mEq/ 100 g) 0.59; 0.48; 0.79 and Nitrogen (mEq/ 100 g) were. 0.98; 1.84; 0.73 respectively among the sampled dumpsites. Furthermore; Results showed that there was an increase in the pH, potassium, nitrogen content value at each dumpsite than their corresponding control. The mean soil porosity indicated higher porosity in the control sites. The soil particle size distribution indicated that the control site is sandier than the various dumpsites and the dumpsites on the other hand had more slit and clay component than the control site.

Conclusion: According to the study, trash from the dumpsite under investigation may have an impact on the distribution of grain sizes or the soils beneath them. It also showed a significant contribution to elevated pH, EC, OC, OM, Av. P, ON, basic cations, and CEC values. The soil at the study site has a higher proportion of sand fraction and a lower percentage of clay fraction, as evidenced by the relative increase in the pollutant leaching potentials of municipal solid waste.

Keywords: Dumpsite, Physiochemical Properties, Federal University of Technology (FUTO)

1. INTRODUCTION

The effects of industrialization, globalization, and climate change expose soils to pollution [1]. Heavy metal contamination of the environment is a result of fast urbanization and industrialization, and the rates at which these metals are transferred through soil, water, and air have been steadily rising up to this point [2]. Exploration, production, transportation, and oil spills are known to pollute the environment with crude oil, which comprises both organic and inorganic substances. High pollutant concentrations in the soil can have an impact on the microorganisms that live there [3]. A significant part of agricultural food production, soil can act as both a source and a sink for harmful pollutants [4]. Solid waste management is one of the biggest issues Nigeria is currently facing [5].

Regularly, municipal solid garbage is dumped on unrestricted areas, water bodies, sewers, and roadways. One of the municipal solid wastes (MSW) that has a monetary value in Nigeria is metal scrap [6]. All types of scraps from abandoned cars, machinery, and electrical gadgets are disassembled in the haphazardly located scrapyards in Nigerian cities and rural areas [7]. Heavy metals, polycyclic aromatic hydrocarbons, and other harmful elements that negatively impact the ecology are present in many of these trash items [8]. These harmful compounds can be inhaled, consumed, or come into touch with the skin [9]. Through their interactions with soil constituents, heavy metals found in solid municipal wastes bioaccumulate and persist in the soil, where they subsequently enter the food chain and are ingested by humans [10]. Anthropogenic activities like the release of household and industrial waste, mining, smelting, and vehicle emissions are the main causes of the elevated levels of metals that build up in the soil and have an impact on surrounding ecosystems [11]. Another well-known cause of heavy metal contamination in soils is weathering of natural rock. However, compared to natural sources, human sources contribute more metals to soils [12]. The production of scrap metal, plastic, rubber, and other consumer goods, as well as the burning of waste that contains these elements, all contribute to the release of heavy metals into the environment. When burning, the metals volatilize and are discharged into the atmosphere. Depending on their density, these volatilized metals become mobile and can travel great distances to deposit on soil, vegetation, and water [13]. Because the deposited metals are permanent and non-biodegradable, they can seriously poison people through their skin, food, or breathing. Acute exposure to these harmful metals causes rashes, gastrointestinal disorders, nausea, anorexia, vomiting, and several deaths. Because the environment serves as a direct container for waste products produced within it, heavy metal poisoning of the ecosystem is a significant social issue [14]. In the meanwhile, both humans and animals require zinc and copper for metabolic processes [15]. The soils found in urban waste dumps are sufficiently rich in organic matter to be suitable for surface feeder plants [16]. According to reports, open dump sites serve the dual purposes of safely disposing of trash and concurrently enhancing the chemical characteristics of the soils that make up fruitful agricultural fields [13]. Nigeria's waste management strategy is relatively subpar [17]. Indiscriminate waste dumps and scrap dumpsites occupy almost every vacant plot of land especially along major roads and streets. This presents study aims to analyse the physiochemical properties of dumpsites around federal university of technology, Owerri (FUTO)

2. material and methods

2.1 Study Area

= Sample titre value
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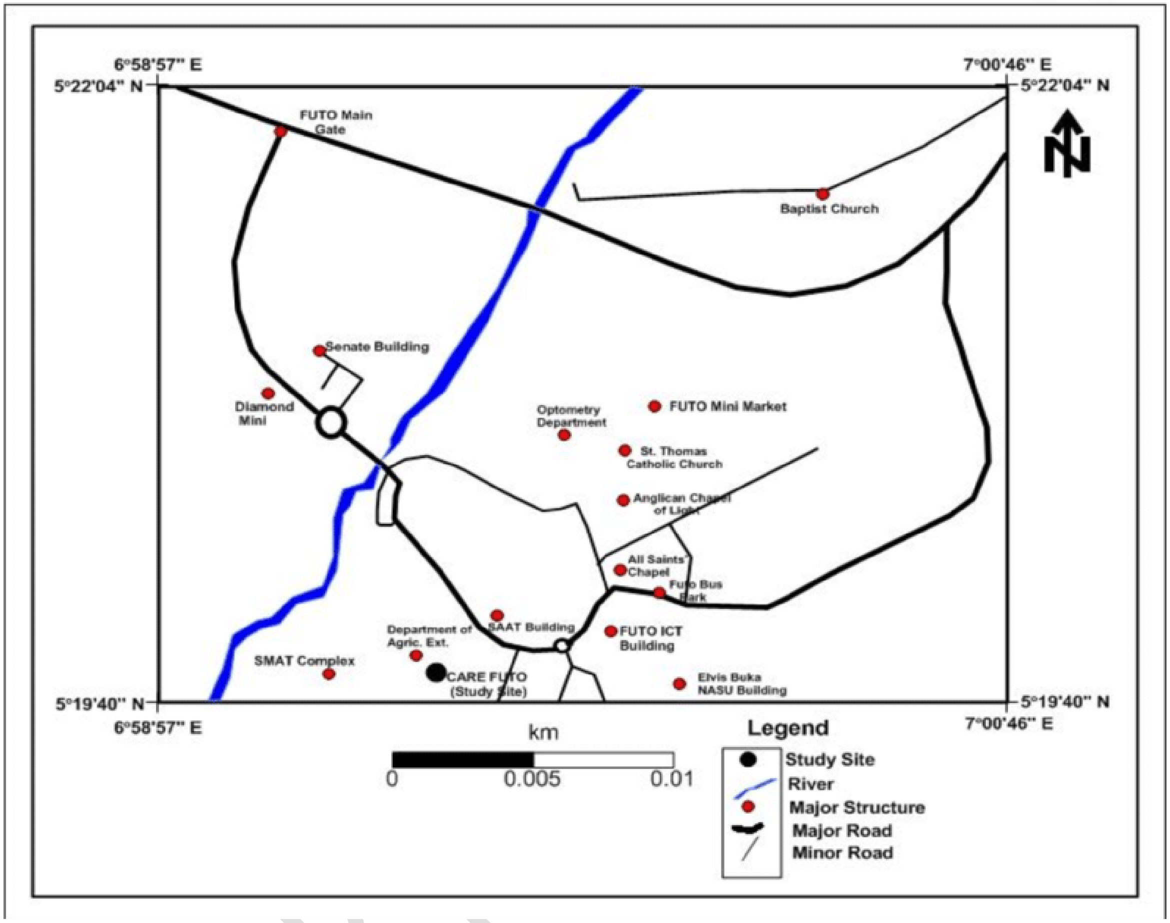

Fig. 1. Map of Federal University of Technology Owerri (FUTO)

2.1 Collection of soil sample

The Federal University of Technology Owerri (FUTO) is a federal government university in Owerri West, Owerri, the capital of Imo State, Nigeria. The university is bounded by the communities of Eziobodo, Ihiagwa, Obinze, Okolochi and Emeabiam. It is the premier federal university of technology in the South-East and South-South parts of Nigeria.

The university is the oldest University of technology in Nigeria and was established in 1980 by executive fiat with the composition and appointment of the first provisional council by Nigeria's first Executive President, Shehu Shagari. It became the first of three such universities set up by the Federal Government of Nigeria which sought to establish a University of Technology in each geo-political region, particularly in a state which did not have a conventional university.

The dumpsite is an open dumpsite situated in Federal University of Technology Owerri (FUTO) and consisted of disposed papers, bottles, food remnants, plastics, tin cans, grasses, polyethene bags, leathers and some other biodegradables.

2.2 Collection of soil sample

Soil samples were obtained from three different dumpsites located within the school namely Girls' hostel dumpsite, Ihiagwa dumpsite and Eziobodo dumpsite. Samples were collected under the refuse pile at 0-15cm soil depth, using an auger borer. 15g of soil was collected. The soil was transferred into a sterile zip bag and taken to the laboratory for analysis of soil physiochemical properties

2.3 Analysis of soil physiochemical properties

The soil was air dried and sieved through a 2 mm sieve used for the determination of the physicochemical properties of the soil. The texture of the soil was determined by the Bouyoucos hydrometer method [18]. pH by using 1:2.5 soil-water extract and determined with a pH meter, electrical conductivity (EC) was determined on the extract for the pH using a conductivity meter, organic carbon by wet oxidation method, Walkley and Black [19]. Total nitrogen by micro Kjeldahl procedure, as described by Horneck and Miller (20) available phosphorus by Bray and Kurtz method. Exchangeable bases determined after extraction with ammonium acetate. Calcium (Ca) and Magnesium (Mg) were determined by EDTA titration method, while potassium (K) was by flamephotometer at the Soil Science Laboratory, federal university of technology Owerri (FUTO).

3 Results

3.1 Soil physicochemical

The physical and chemical characteristics of the studied sites were presented in Table 1. Soil *pH* ranges from 6.38-7.11 which is neutral with low EC indicating no salinity problem. The soils had low % OC which ranges from 0.44- 0.50 %. The N, P, K and CEC were higher in girls' hostel and Eziobodo dump sites

Table 1: Physical and chemical characteristics of soil from experimental sites at 0-15 cm depth

Soil/Dumpsite location	Girls Hostel Dump site	Eziobodo Dump site	Umuchima Dump site	Control
pH (1:2.5)	6.81± 0.10	6.38±0.10	7.11±0.10	3.98 ±0.08
EC (dS mG1)	0.40±0.02	0.43±0.00	0.63±0.01	0.18. ±0.02
OC (%)	0.44± 0.03	0.48± 0.00	0.50± 0.01	0.20 ± 0.03
<u>Texture</u>				
Sandy	62.5± 0.1	65.8± 0.02	68.3± 0.1	84.32 ± 0.13
Clay	15.8± 0.02	16.2± 0.05	15.4± 0.03	11.50 ± 0.05
Slit	21.7± 0.10	18± 0.02	16.3± 0.08	1.24 ± 0.10
N (mEq/ 100 g)	0.98 ± 0.00	1.84 ± 0.00	0.73 ± 0.00	0.03 ± 0.00
K (mEq/ 100 g)	0.59± 0.03	0.48± 0.01	0.79± 0.03	0.02 ± 0.01
Ca (mEq/ 100 g)	4.50 ± 0.08	4.24± 0.22	4.76 ± 0.00	1.29 ± 0.10
Mg (mEq/ 100g)	1.45±0.00	0.22±0.10	2.91±0.10	0.30 ±0.09
CEC (cmol+kgG1)	13.19±0.00	11.22±0.03	13.32±0.01	20.15±0.03

EC: Electrical conductivity, OC: Organic carbon, N: Nitrogen, P: Phosphorus, K: Potassium, Ca: Calcium, Mg: Magnesium and CEC: Cation exchange capacity

3. Discussion

A collection of quantifiable characteristics known as indicators can be used to track the condition of soil. These indicators can be broadly classified as chemical and physical indicators, and changes in these indicators can be used to measure the overall quality of the soil [20] Several physicochemical characteristics of the waste dump soil were assessed in this investigation. The three dumpsites examined for this study yielded the following ph results: Umuchima 7.11, Eziobodo dumpsite 7.08, and Girls Hostel 6.97. This is greater than the [21] (4.8-7.66).

pH is a number between 1 and 14, with a *pH* of 1-6.9 being considered acidic, a *pH* of 7.1 to 14 being alkaline, and a pH of 7 being neutral. These were determined to be advantageous since water with a pH of 4.0 to 4.5 has been shown to be harmful to human health.

A number of variables pertaining to the breakdown and interaction of waste products with the environment may be responsible for the higher pH values found in the dumpsite soils. Paper goods, yard debris, and food scraps are examples of organic waste items that break down over time. The production of organic acids during this process may initially cause the waste's pH to drop. The soils used in this investigation have relative electric conductivities of 0.40, 0.43, and 0.63. The existence of ions in the soil at the dumpsite could be the cause of this outcome. The dumpsite's handling of metallic debris may also be to blame. Nonetheless, this shows that charge particles are moving, which is a positive sign for plant growth [22].

In contrast to studies by [23], the percentage of organic carbon (O.C.), or the carbon conserved in organic matter, ranged between 0.44 and 0.50%. Burning solid waste on the landfill may be the cause of the % O.C. values seen in the garbage dump. The Umuchima and Eziobodo dumpsites have the highest and lowest cation exchange capacities (CECs), respectively, with CECs ranging from 11.22 to 13.32. These results are comparable to [24] findings. These CEC results can be categorized as low, per Lancrop Laboratori (2013). Cation exchange capacity (CEC) is the quantity of exchangeable cations per unit mass of dry soil, which is a key factor in soil fertility. A low CEC value suggests that the soil can't keep cations in exchangeable form, which may be related to the soil's low clay concentration. Because of this, metal ion retention is minimal in every dump site that is being examined. This would suggest that the health of people and other animals that consume the water is at risk due to the high rates of heavy metals from the soils beneath the rubbish seeping into underground water.

The ladies hostel waste dumpsite had the highest phosphorus content, indicating that its impact on soil phosphorus levels was the most noticeable. On the other hand, the Umuchima waste dumpsite's phosphorus concentration was discovered, suggesting a relatively smaller influence on soil phosphorus in comparison to the other dumpsites. The large amount of phosphorus discovered may be connected to the trash's nutritional value, since household and agricultural waste comprise the majority of municipal waste. The girls hostel waste dumpsite has the greatest soil potassium levels, followed by Umuchima and Eziobodo. Indeed, a number of factors, such as the type and amount of waste released at the sites and the sources of the garbage, could be responsible for the variance in potassium concentration at waste dumpsites.

The study's disposal locations had nitrogen contents ranging from 0.7±0.00 to 1.84±0.00. Compared to the control, which was measured at 0.03 ± 0.00, the nitrogen level in the different disposal sites is higher. This outcome is consistent with the research conducted by [25]. The results of this study were also supported by [26], who discovered that the soil at the dumpsite had a greater nitrogen concentration than the control. Table 1 of the study's results showed that the physicochemical characteristics of the soil component were higher in the dumpsite soil than in the controlled site. The results obtained in the study were in accordance with the results of [27] which stated that solid wastes in dumpsites had a significant increase in most of the analyzed soil properties. This increase in concentration might be as a result of the decayed and mineral content of decomposable solid waste in dumpsite.

4. CONCLUSION

According to the study, the soils from the investigated dumpsites had hogher physical and chemical characteristics than the soils from the controlled location. According to the study, garbage from the dumpsite under investigation may have an impact on the distribution of grain sizes or the soils beneath them. It also dramatically raised the values of physiochemical characteristics. The soil at the study site has a higher proportion of sand fraction and a lower percentage of clay fraction, as evidenced by the relative increase in the pollutant leaching potentials of municipal solid waste. The study's overall findings indicate that the elevated proportion of sand fraction and low clay fraction near the dumpsites may expose the undersea to toxic contaminants made from solid waste.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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