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CHARACTERIZATION OF MATERIALS FROM ABA WASTE DUMPSITES

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ABSTRACT

The leachate quality from two major dumpsites in Aba (Umuigwe Osisioma and Ogbor) was analysed for its physiochemical parameters. Standard methods for analysis of physiochemical parameters were used in this assessment. It was realized that leachate from both dumpsites had high Biological Oxygen Demand (BOD) of (65mg/l), ammonia (32.15mg/l), sulphates (48.30mg/l), Total Dissolved Solids (TDS) – 120mg/l) and COD concentration of (68mg/l). Hence leachate from Umuigwe Osisioma dumpsite showed 20% higher concentrations of these pollutants. Thus, the high BOD, COD, ammonia, shulphate and other parameters level possibly indicate that both dumpsites receive wastes that are basically organic in nature.

Keywords: Leachate, dumpsites, Umuigwe Osisioma, Ogbor, BOD Concentration.

1.0 INTRODUCTION

The United State Environmental Protection Agency (USEPA) defined solid wastes as any useless, unwanted or discarded materials that arise from man's activities and cannot be discarded through sewer pipe. The non-free flowing or sticky nature of the solid waste gives rise to the accumulation of solid wastes. Some habitable parts of the earth surface with accumulated solid wastes are called refuse dumps but a designated place for dumping is known as dumpsites.

Municipal solid wastes from various sources such as industrial, domestic and educational wastes can be of diverse in nature. The disposal of most wastes in landfills is done after proper waste management functions such as recycling, reuse; sources reduction and treatment operation have been completed in developed countries, (Edward, 2001).

However, the above practice is not prevalent in developing countries (Cunningham's et al., 2005). This results to the development of open dumps of different materials ranging from perishable food wastes to toxic hazardous chemicals which pollute and cause poor aesthetic quality of the environment. Leachate from waste dumpsite can decompose and also increase in volume if exposed to rainfall. Leachates have the potential of polluting ground water, consequently due to the above situation in developing countries such as Nigeria, and hence there is need to investigate the quality of leachate released from Aba dumpsites.

Soils intensively affected by human activities might present special features such as mixed horizon, foreign materials and thin deposit, (Civeria and Lavado, 2008). Usually these soils are poor in organic matter and fertility with reductions in their most important physical properties such as structural stability and water reaction. Eventually, these characteristics might have a determinate effect on the soil by either affecting plant growth or submitting the particular environment to erosion process (Akaezel, 2001). Consequently, deteriorated soils in populated cities do not tolerate agricultural or recreational uses and turned those environments into places with low probability of community progress. So many waste dumpsites are located at various parts of Aba municipalities and it's environs, apparently based on other reasons than convenience. Some of these sites are indiscriminately located at streams, valleys, open fields, water lands and in abandoned borrow pits. Studies by Aluko, (2001), (Akinbiyi, 1992) have shown that there is an unconditional water rest aquifer underlying most area of Aba and its environs upon which all depend for their various needs including drinking water. Their intensive

properties and the rehabilitation techniques have not yet been sufficiently relieved (Aluko 2001 and Akinbiyi, 1992). When solid wastes are disposed off on land in an open dump or in improperly designed condition, it causes so many impacts on the environment. The unsightly accumulation of these wastes generally reduce the aesthetic value of the urban environment, destroy the land scape and to an extent pulsate the Aba environ. It also increases the breeding conditions of some disease vectors and pathogens which invariably increases the morbidity (malaria, dysentery and diarrhea) and mortality (Civeria and Lgbado, 2008) as well as the cost of medical expenditure among the local residents (Ejeona and Umah, 2000).

Generally, the practices at dumpsites are not effective. Dumping is unrestricted to industrial, agricultural, domestic and medical wastes and up in one site. Dumpers do not always have easy access to the site at any time of the day, therefore reducing the dumping of restricted materials, such as car batteries and metals scavengers have free access to the dump, and they mix up the waste as they dug into it to salvage any valuable material. As a result of poor control, medical and hazardous wastes end up at municipal dumpsites even though they have their own special dumping areas.

In Ibadan Nigeria, pathological wastes from the city's hospitals are dumped in an unregulated and haphazard manner in open dumpsites. Maintenance of the dumps also commence, there is no compacting and covering of waste (Agunwamba, 1999). As a result, waste is easily blown away by wind, making it an eyesore as plastics litter the area around the dump while the soil is being polluted to a great extent.

The uncontrolled manner in which solid waste is disposed off at most open dumpsites creates serious environmental degradation. The inadequate waste disposal translates into economic and other welfare issues (Zurbrugg, 2002). Soil is contaminated by having contact with solid waste and leachates. In this study heavy metal concentrations were determined in soil sample collected from dumpsites in Aba municipality. Accumulation of lead (Pb), Iron (Fe) and zinc (Zn) were found within the disposal site. Concentration of Zn, Pb and Fe were in surface soil sample up to 10 meters away from the dumpsites during floods, water mixed with leachate flows out of the dumpsite and get into Ogbor Rivers which passes through the town and serves as water supply to many communities.

Municipal solid waste management involved the application of principle of integrated soil waste management (15wm) to municipal wastes 15WM is the application of suitable techniques, technologies and management programmes covering all types of solid wastes from all sources to achieve their objectives, (Akaeze, 2001).

As a result of improper solid waste disposal in our various municipalities, soil properties are being polluted which results in poor agricultural production and soil contamination causing failure and instability, together with ground water contamination and deadly to aquatic lives and other problems resulting in infection disease to both humans and animals thereby risking the safety condition on any environment close to dumpsites.

The aims and objectives of this study therefore are:

1. To determine the characteristics and properties of materials from the municipal dumpsites.
2. To carry out laboratory analysis and investigation of the waste samples collected from different dumpsites.
3. To determine and recommend solution to tackle the negative impacts of Municipal Solid Waste (MSW) in our environment.
4. To carry out a comparative study of the two dumpsites in order to determine their organic and inorganic composition.

This study therefore is limited to the collection of the solid waste samples from two dumpsites from Umuigwe Osisioma dumpsite and Ogbor dumpsite all in Aba municipality and comparing the result obtained from both dumpsites with FEPA standard and analyzing samples properties and characterization.

1.1 Description of the Study Area

Aba is located in Niger Delta Region in Nigeria and is located between latitude 5.07^{o}N 7.22^{o}SE and longitude 5.177^{o}N 7.367^{o}E, the city has road intersections connecting Port Harcourt, Owerri, Umuahia, Ikot Ekpene and Ikot Abasi. The indigenous people of Aba are Ngwa's. The town has been estimated to be a major economic contributor to the country Nigeria in areas such as textiles, pharmaceuticals, plastics, timbers, cosmetics, shoe manufacturing industries and the

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Ariaria International market. The city has the biggest market in West Africa. Additionally, the city also has brewery, distillery and other famous handicraft. According to Abia State Environmental Protection Agency (ASEPA), these activities generate much waste which makes it difficult for the agency to manage, coupled with the poor funding by the state government. The two dumpsites are located in Umuigwe Osisima before new park along Aba Enugu Expressway and Ogbor hill. Both are open land fills covering 7 to 9 hectares of land each.

These dumpsites affects human health and groundwater qualities, poor crop yield and aquatic lives including air and noise pollution to the area. It has been discovered that most of the dumpsites in Aba do not function well as a result of poor management practice. However, investigations show that improper dumping of refuse is one of the major problems affecting our environment and soil quality. Most importantly, high densities of dumps lead to greater soil contamination.

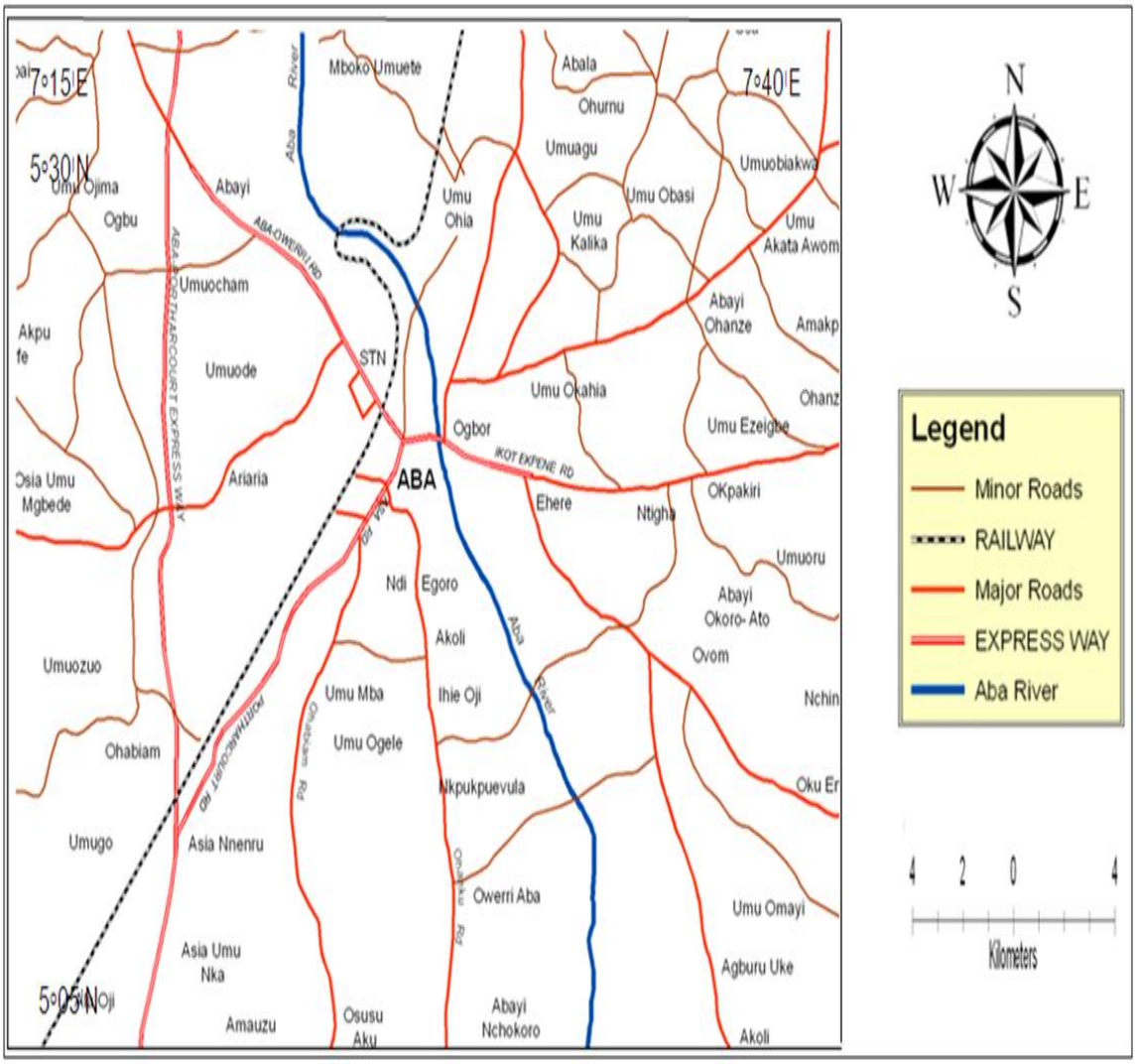

FIG. 1 – MAP OF THE STUDY AREA IN ABA

2.0 Materials and methods

2.1 Site Description

This study was carried out in waste dumpsites in Aba municipalities, the commercial city of Abia State. The town is located in the South Eastern region of Igbo speaking tribe of Nigeria; the city has two climatic conditions in a year, the dry season and rainy season. The dry season starts from October to March while the

rainy season is from April to September annually although it varies due to seasonal changes. Abia State has two important rivers namely, Imo River and Aba River (Ogbor River). These rivers flow through the Niger Delta Region, history of Abia State (2012). Aba has a period of dusty winds, cold and dry conditions known as "harmartan" which start from December to the month of February, though it changes depending on the season. The average mean temperature of the city is between 24 to 34 with relative humidity of 70% in dry periods and 90% in rainy periods with a projected population of four million (4,000,000) (NPC 2012). The residents are mainly traders, artisans and civil servant, the city does not have good road network for easy accessibility of the streets. The commercial nature of Aba leads to the generation of different forms of solid waste either from Ariaria international market, Abia State Polytechnic, Rhema University, School of Health Technology, Hospitals and other small companies. However, all these waste generated causes tremendous increase in waste volume in the city. Since 12 years ago, refuse has been dumped in Umuigwe Osisima which covers about 7 to 9 hectares of land as shown in Fig. 2 and Ogbor dumpsites in Aba. The sites are open with about 5 meters high above ground level and are uncovered, from the interview with the Abia State Environmental Protection Agency (ASEPA), up to 25 tones of waste are dumped in each of the sites daily. The components of this dump include: metal, organic materials (food waste), car batteries, plastics, industrial wastes, used papers, etc.

FIG. 2: OPEN DUMPSITE AT UMUIGWE OSISIOMA

2.2 Sample Collections

The solid waste samples were collected from both dumpsites. Five samples were collected at different locations in each dumpsite (Umuigwe and Ogbor). Umuigwe is located along Aba – Enugu Expressway and the other in Aba South local government area. The sites are located at about 2.5km apart. In general, 10 samples were collected from both dumps. Five samples from each dump site each. Several analysis were carried out on the samples in the University of Nigeria, Nsukka public health and environmental laboratory after subjecting the samples to oven drying, grinding and sieving.

After the samples were subjected to the following experimental analysis: Heavy metal content, BOD, COD, PH, Total nitrogen, manganese, organic matter content and sulphate.

2.3 Experimental Analysis

Heavy metal content from the sample were determined using digestive method as recommended by AOHA (1978). 10g of the dried sample were weighed and 150ml beaker of nitric acid added to the sample mixture. The samples were then heated, followed by the addition of

HM 05, and 3 to 5ml HCL 04 in drops and excess at intervals. HCL 04 was added to the solution filled with water up to 60ml mark. Standard solution of Iron (Fe), Zinc (Zn) and lead (Pb) were prepared. The concentrations of heavy metals were determined using atomic absorption spectrophometer.

In the determination of BOD, dissolved solid (DS), temperature and conductivity were metered in site. An atomic absorption spectrophotometer was used for the analysis after sample digestion using concentrated trioxonitrate (V) and the volume increases up to 50cl with deionized water. Dissolved oxygen was determined by Azide modification winkler's method. Finally the biological oxygen demand (BOD) was computed from the difference between initial and final dissolved oxygen. The chemical oxygen demand (COD) was determined according to APHA (1978).

The potential hydrogen, PH was measured electromentrically with a glass electrode pH meter in potassium chloride, KCL, using the grinded solid waste sample with a liquid suspension ratio of 1:2:5, Jones (2001).

Nitrogen was determined on the sample by Kjedah method using flask of norminal volume 50ml suitable for digestion as described by APHA (1978). Also manganese concentration was determined by atomic absorption spectrometry in the solid waste sample according to APHA (1978).

The concentration of organic matter was determined in the laboratory on the sample using dichromate wet oxidation method (Walkley and Black, 1934) but later modified by Osodeke (1977). The organic carbon was calculated as percentage organic carbon in grind and waste sample.

2.0 RESULT AND DISCUSSION

The results from the various analysis carried out on the solid waste samples collected from different location in the two dumpsites in Umuigwe Osisioma and Ogbor, Aba South Local Government Abia, Abia State are presented in Table 1 and 2 for the physio-chemical parameters.

Table 1 and 2 shows the physio-chemical parameters of Umuigwe Osisioma and Ogbor dumpsites while Table 3 shows the comparison of the two dumpsites and the recommended FEPA standard physiochemical parameters and also with that of FEPA standard, FEPA (2006).

TABLE 1: *UMUIGWE OSISIOMA DUMPSITE PHYSIO-CHEMICAL PARAMETERS CONDUCTIVITY (S/CM)*

S/N	Parameters	Result
1	Temperature	24.50^{o}C
2	Iron (Fe)	38.60 mg/l
3	Lead (Pb)	0.01 mg/l
4	Zinc (Zn)	0.04 mg/l
5	Potassium (K)	0.01 mg/l
6	BOD	65.00 mg/l
7	COD	68.00 mg/l
8	pH	8.90
9	Nitrate	23.20 mg/l
10	Manganese	184.80 mg/l
11	Organic matter	107.00 mg/l
12	Sulphate	48.30mg/l
13	Ammonia mg/l	32.15
14	Cadmium mg/l	0.14
15.	Dissolved oxygen mg/l	5.62
16.	Total Dissolved solid mg/l	120

TABLE 2: OGBOR DUMPSITE PHYSIO-CHEMICAL PARAMETERS

S/N	Parameters	Result
1	Temperature ^{o}C	25.70^{o}C
2	Iron (Fe) mg/l	57.90 mg/l
3	Lead (Pb) mg/l	0.00 mg/l
4	Zinc (Zn)	0.01 mg/l
5	Potassium (K)	0.09 mg/l
6	BOD	30.00 mg/l
7	COD	52.00 mg/l
8	pH	8.30 mg/l
9	Nitrate	15.30 mg/l
10	Manganese	194.80 mg/l
11	Organic matter	50.00 mg/l
12	Sulphate	42.40mg/l
13	Ammonia mg/l	23.20
14	Cadmium mg/l	0.21
15	Dissolved oxygen mg/l	4.66
16	Total Dissolved solid mg/l	108

TABLE 3: COMPARISM OF RESULT FORM UMUIGWE AND OGBOR DUMPSITES PHYSIOCHEMICAL PARAMETERS WITH FEPA (1991) STANDARD

S/N	Parameters	Result from Umuigwe dumpsite	Result from Ogbor Dumpsites	FEPA standard for waste discharge into surface	Remarks
1	Temperature	24.50 ^{o}C	25.70 ^{o}C	<40	Low
2	Iron (Fe)	38.60	57.00	20	High
3	Lead (Pb)	0.01	0.01	<1	Low
4	Zinc (Zn)	0.04	0.01	<1	Low
5	Potassium (K)	0.01	0.09		
6	BOD	65.00	30.00	50	High
7	COD	68.00	52.00		
8	pH	8.90	8.30	6-7	High
9	Nitrate	23.20	15.30	20	High
10	Manganese	184.80	194.60	0.5	High
11	Organic matter	107.00	50.00		
12	Sulphate	48.30	42.40	500	Low
13	Ammonia mg/l	32.15	23.20	-	-
14	Cadmium mg/l	0.14	0.21	-	-
15	Dissolved oxygen mg/l	5.62	4.66	-	-
16	Total Dissolved solid mg/l	120	108	-	-

3.1 DISCUSSIONS

3.1.1 Umuigwe Osisioma Dumpsite

The characterization of waste components from dumpsites is very essential owing to the potential hazards it poses to both surface and underground water. From the result obtained from Umuigwe dumpsite, it was observed that most of the physiochemical parameters contained in our analyzed sample exceeded the (FEPA) for the discharge of effluent into surface water bodies. From the result in Table 3, the biochemical oxygen demand (BOD) and organic matter content is in excess according to FEPA regulatory limit. This indicates that the nature of waste that are disposed in that dumpsite is organic in nature. As industrial waste is characterized by low BOD, and high level of Nickel, lead, zinc, and potassium, ie heavy metals, then relating it to our result, all these metals are in lower concentration. Similarly, pH in this dumpsite exceeded the limit

set for discharge of waste in to surface water. All these attributes indicted that organic materials are undergoing decomposition as the dumpsite in majority composed of domestic than industrial waste. Iron and manganese concentration exceeds FEPA limit and these metals are associated with ground water formation terrain which could be lateritic in nature. The high concentration of iron and manganese creates serious problem when disposed in water, affect plumbing fixtures, support bacteria growth in distribution system, iron add taste to water and colour to laundry operations. The composition of the dumpsite is more of domestic than industrial waste according to our result therefore; the dumpsite is organic in composition.

3.1.2 Ogbor Dumpsite

The result obtained from Table 2 shows that most of the physiochemical parameters analyzed are below while few exceeds the FEPA limit for the disposal of waste into surface water bodies. Here, the BOD and organic matter concentration when compact with FEPA standard. Were very high as shown on Table 3. This indicated that the nature of waste disposed in this dumpsite is inorganic in nature. Industrial waste is characterized by low BOD and high concentration of heavy metals, such as iron. This shows that the dumpsite is more of industrial than domestic waste materials. This industrial waste are sourced from seven up bottling company, hospitals, and other companies within that area thereby, making the dumpsite to be inorganic in nature. The release of methane and carbon-dioxide from this dumpsite contributes to the problem of greenhouse gases in the atmosphere.

Other emissions are generated by combustion engines used to power windrow turning machines and grinders. When this waste decompose partially, it leads to the production of leachate which contains BOD and phenol that exceeds acceptable discharge limits and posses toxic effects when absorbed into ground or passed through sand filters.

3.1.3 Comparism of Both Dumpsites with FEPA Standard

From the result obtained from the two dumpsites after comparing with FEPA standard, it shows that Umuigwe dumpsite is composed of domestic waste materials, thus, it is organic in nature while Ogbor dumpsite is composed of mainly industrial waste therefore inorganic in nature. This shows that Ogbor dumpsite is more toxic than Umuigwe dumpsite because of its waste sources. The overall results of both dumpsites are summarized shown in Figure 3.

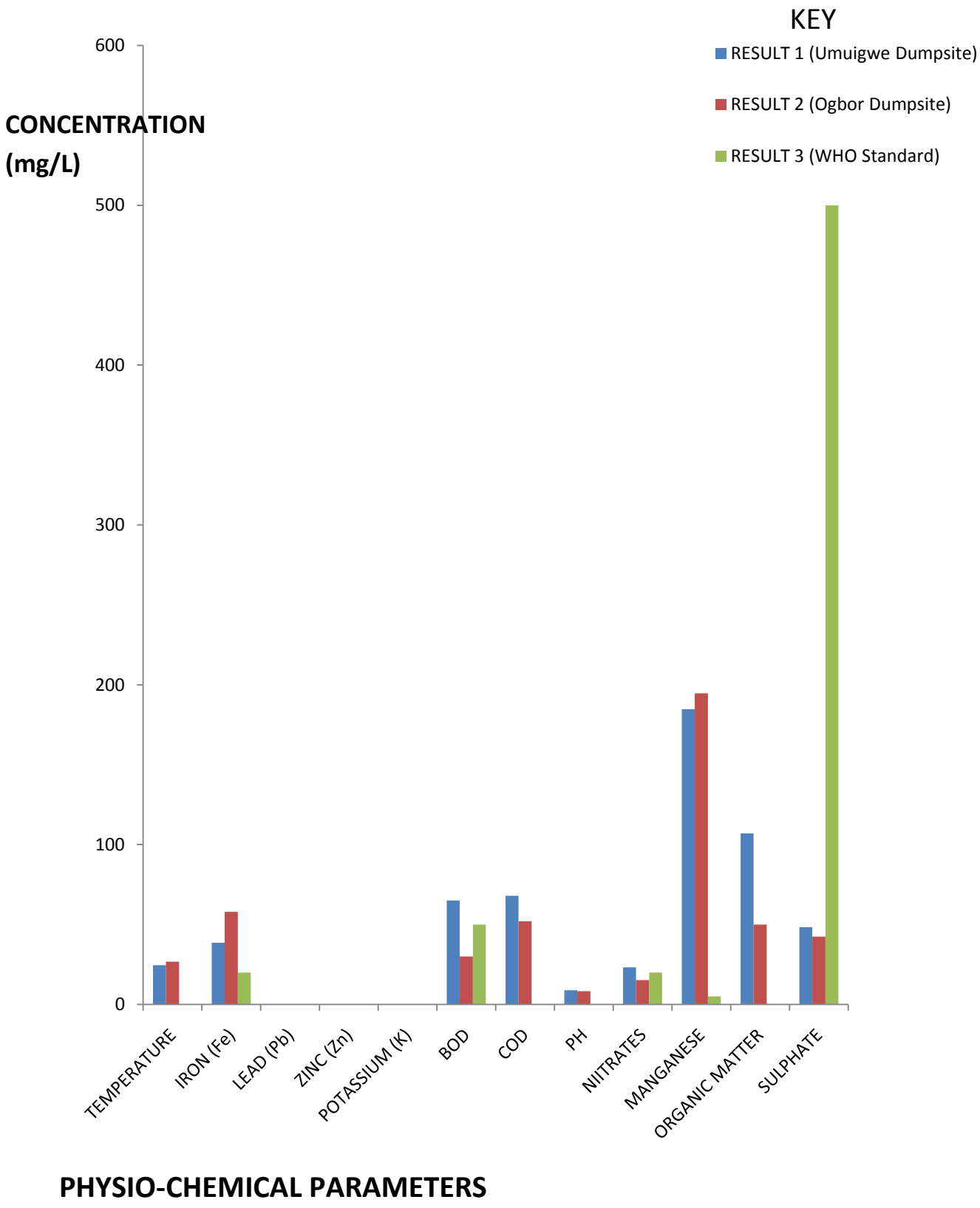

FIG 3: Graph of concentration in (mg/l) against Physio-chemical parameters.

4.0 CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

The following conclusions are made from the characterization of solid materials from the two dumpsites in Aba.

i. The physiochemical parameters such as pH, BOD, nitrogen, manganese, iron, organic matter, in Umuigwe dumpsite were observed to be very high showing that materials dumped there are organic in composition.

ii. The decomposition of those waste materials releases leachate with high BOD values exceeding FEPA regulatory limit for discharging waste into surface water bodies. This pollute the ground water, air, soil instability and causes foundation failures in structures and increases medical expenditure as people within the area faces health challenges. This soil pollution leads to reduction in crop yield due to soil instability and infertility.

iii. In Ogbor dumpsite, BOD, pH, organic matter, etc are observed to be in lower concentration. This shows that the major waste dumped in this dumpsite are industrial, thus, inorganic in nature and are very toxic to human habitation, crops and the entire environment.

iv. A comparative study of the physiochemical parameters shows that the two dumpsites receive waste from both industrial and domestic sources, (inorganic and organic sources) which are very toxic to the environment in Aba the commercial and industrial city of Abia State.

v. Conclusively, solid waste management has been a very serious problem in urban centers. Waste taken to dumpsites for disposal yield leachate which causes problems through contaminating the land and water resources nearby. Developing countries and cites like Aba have not been able to address these problems due to high cost involved. Thus, various solution to these include; an aquatic plant, ipomoea aquatic Forsk which reduces organic and toxic pollutants to a desired level. This plant is indigenous and tolerant to tropical climate toxic chemicals and is an economic and viable method of keeping the environment free from contamination.

4.2 RECOMMENDATION

i. The high level of pollutants in those dumpsites indicated that ground water is likely to be polluted by the leachate; therefore, an engineering landfill should be constructed for the management and treatment of leachate.

ii. Solid waste materials should be properly reclamated, recycled and treated before disposal to reduce contamination.

iii. Providing public information (workshops or seminars) on the importance of recycling of solid wastes before disposal.

iv. Making sure that the dumpsites are always covered to avoid flies and birds.

v. making sure that the dumpsites are fenced to avoid access of people dumping restricted materials.

Vi Creating a functional inspection agency that monitors and enforces the need to recycle solid wastes before disposal (National Inspection Agency for Solid Waste Recycling and Disposal.

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