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ASSESSMENT OF THE EFFECTS OF SOLID WASTE DUMPSITE ON GROUNDWATER IN OSOGBO AND EDE METROPOLIS OSUN STATE, NIGERIA

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Abstract:
In Nigeria, the reliance on sanitary landfills is a common phenomenon in the disposal of waste materials. Lack of capital and appropriate technology for environmentally friendly waste management practices has left most places like Osogbo city in Nigeria to rely of landfills for solid waste disposal. And in most cases the landfills are not properly engineered and operated to accepted world standards. This project work assesses the effect of solid waste dumpsite on the ground water quality in Osogbo and Ede Metropolis. Eight (8) different samples were collected from wells located around the vicinity of dumpsite at Osogbo and Ede respectively. The analysis of physical, chemical and bacteriological parameters of the water samples collected shows that there are some level of contaminations on the ground water within the solid waste dumpsite and some of the samples were discovered to be acidic with PH ranges from 5.90-6.40 which rendered the sample unsafe for drinking and other domestic consumptions. Parameters like Iron, Manganese, Chromium, Copper, Zinc, are trace element and were found in minute amounts concentration of less than 100mg/l in all the water samples, which possessed no hazard effect to the quality of groundwater. However, most of the water sample tested for bacteriological does not fall within WHO 2006 recommendations. Therefore, the need for environmental awareness through enlightenment campaigns on solid waste handling, controlling and monitoring techniques with proper groundwater exploration for proper analyses.

Keywords:
Solid waste dumpsite, Metropolis, bacteriological parameters, hazard, monitoring techniques, exploration.

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1. INTRODUCTION

Wastes are materials that are not prime product (that is product produced for the market) for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption and of which he/she wants to dispose. Wastes may be generated

during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. It is also be as any unavoidable material resulting from an activity, which has no immediate economic demand and which must be disposed of (NISP, 2003). Waste is commonly classified into three. These are solid, liquid and gaseous wastes.

Solid waste is any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations. Solid waste can be classified into different types, depending on their source; household waste is generally classified as municipal waste; industrial waste as hazardous waste, and biomedical waste or hospital waste as infectious waste (US Law-Solid Waste Act 2, 1999).

Dumpsite also known as landfill is a disposal site where solid waste, such as paper, glass and metal is buried between layers of dirt and other materials in such a way as to reduce contamination of the surrounding land. Classical unlined sanitary landfills and open dumps are well known to release large amounts of hazardous and otherwise deleterious chemicals to nearby groundwater, surface water and soil also to the air, via leachate and landfill gas.

The risk of groundwater pollution is increasing both from disposal of waste materials and from widespread use by industry and agriculture of potentially polluting chemicals in theenvironment. Pollution can occur whether discrete, point sources, such as from the landfilling ofwastes. One of the dreaded consequences of rapid urbanization has been the problem of solid waste management, particularly in terms of environmental nuisance combined with the health hazard and its implications. Waste management has therefore become an endemic problem that characterizes Nigerian cities. Coupled with the lack of capital and appropriate technology for environmentally friendly waste management practices has left most state governments like Osunrelying on the use of landfills for solid waste disposal. And in most cases the landfills are not properly engineered and operated to accepted world standards.

Landfill practices because of its cost effectiveness have become the most favourable choice particularly in Osun state, after previous attempt at incineration failed. The untreated rubbish being placed in the landfill voids comprises biodegradable solids such as vegetable, paper and metal, inert solids such as glass and plastics and other unclassified materials constitute a great threat to underground water quality. Such contamination occur through leakage; which is formed when rain water infiltrates the landfill and dissolves the solute fraction of the waste and the soluble product formed as a result of the chemical and biochemical processes occurring within the decaying wastes. The resultant effluent will however impose their Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) on the ground water. Recent studies have shown that the COD and BOD of such wastes may be in the region at 12,000mg/L and 700mg/L respectively with the concentration of inorganic chemical substances like ammonia, iron and manganese varying according to the hydrology of the site and chemical and physical conditions within the site.

The international agencies like World Health Organization (WHO), Environmental Protection Agency (EPA) and United Nations Environment Program (UNEP) are engaged in developing new technologies for waste management and its disposal including its characterization. Management of Municipal Solid Waste for various cities and towns has been widely studied throughout the world. As the huge quantities of solid waste generated in the urban areas is the major problem, majority of researchers concentrated on this issue. Numbers of researchers have tried to find out new techniques for solid waste management. Zhu Minghuaet al (2009) studied the management practices carried out for the solid waste from Pudong New Area, China. He illustrated important aspects of waste management, such as the current status of waste collection, transport and disposal in Pudong area.

Sharholyet al (2008) reviewed the status of municipal solid waste management in Indian cities and reported that Municipal Solid Waste Management (MSWM) is one of the major environmental problems of Indian cities where improper management of Municipal Solid Waste (MSW) causes hazards to inhabitants.

Ogwueleka (2009), studied the municipal solid waste characteristics and management in Nigeria. He reported that the municipal solid waste management has emerged as one of the greatest challenges facing environmental protection agencies in developing countries including Nigeria. He concluded that solid waste management is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal.

Oyelola and Babatunde (2008) studied characterization of domestic and market solid waste at source in Lagos metropolis and concluded that waste management is an important element of environmental protection with proper characterization of municipal solid waste as fundamental for the planning of municipal waste management services.

STATEMENT OF THE PROBLEM

It has been postulated that the cause of the third world war could be water (Gore, 1992). Flowing from this postulation, it is argued that the inadequate amount of freshwater source and the lack of it will lead nations against each other. In Nigeria, the reliance on sanitary landfills is a common phenomenon in the disposal of waste materials. However, literature is sparse on the impact of these sanitary landfills on underground water. In view of this fact, this study therefore will focus on the effects of solid waste dumpsite on ground water in Osogbo and Ede metropolis of Osun State of Nigeria.

STUDY AREA

Osogbo is a capital city of Osun State in Nigeria, which lies on coordinates 7°46° North 4°34° East with an area of 47sq km. Osogbo city is the headquarters of both Osogbo Local Government Area (situated at OkeBaale Area of the city) and Olorunda Local Government Area (situated at Igbonna Area of the city). It is 88 kilometers North East of Ibadan, 100 kilometers South of Ilorin and 115 kilometers of North West of Akure. Osogbo shares boundary with Ikirun, Ilesha, Ede, Egbedore and Iragbiji and is easily accessible from any part of the state because of its central nature as shown in Figure 1.1. It is about 48km from Ife, 32 km from Ilesha, 46 km from Iwo, 48 km from IKire and 46 km from Ila-Orangun respectively. The City boasted of a

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population of about 156,694 people, according to the 2006 population and Housing commission census; the postal code of the area is 230.

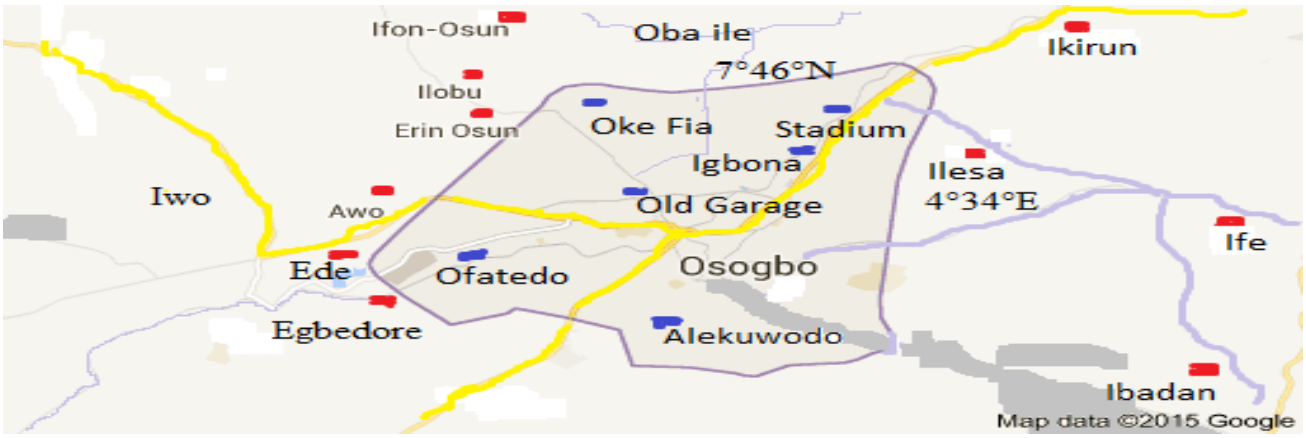

Figure 1.1: Map of Osogbo Showing the Neighbouring Towns

Ede is a town in Osun state, which is one of the most popular ancient towns in Yoruba land. It lies on approximately latitude 07° 40°North and longitude 04° 30°East. It also lies along the Osun River at a point on the railroad from Lagos, 112miles (180km) South West and at the intersection of roads from Osogbo, Ogbomoso and Ife as shown in Figure 1.2. It is has two local governments area namely Ede North and Ede South Local Governments. The population is put at 156,866 according to the 2006 Population Census.

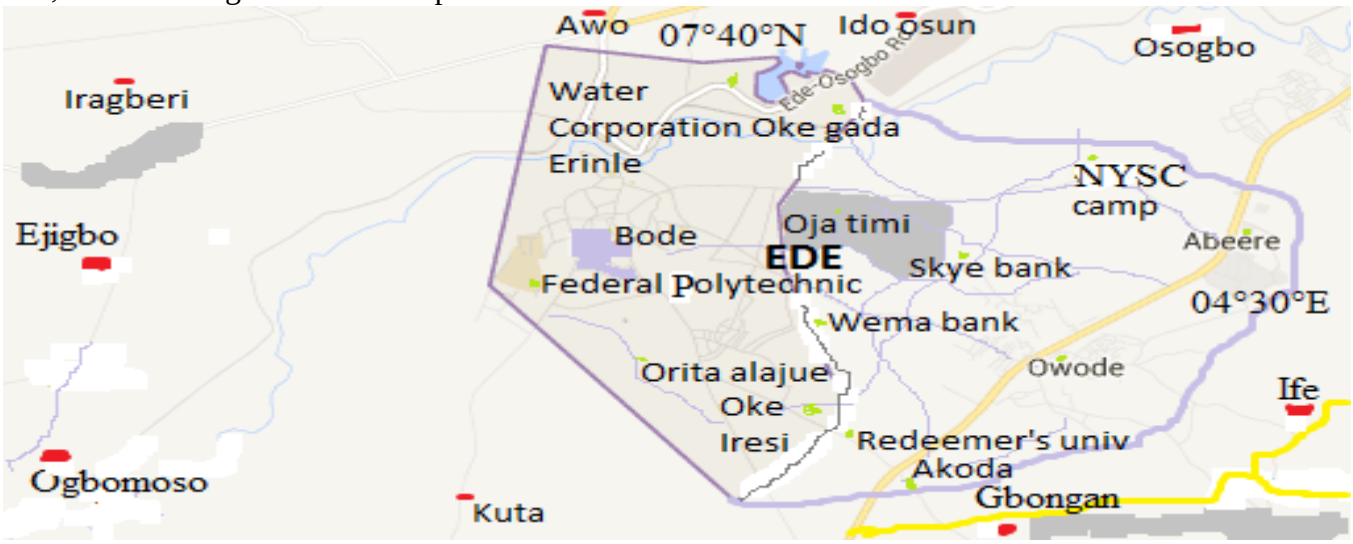

Figure 1.2: **Map** of Ede Showing the Neighbouring Towns

2. MATERIALS AND METHODS

Eight water samples were collected from wells around the vicinity of the dumpsite in Osogbo and Ede. In Osogbo study area, the dumpsite selected were the state major dumpsite at Ilu-tuntun in Osogbo along Iwo-Ibadan road and Oleyo dumpsite at Ita-akogun old radio station Osogbo as shown inPlates 1 and 2.

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Plate 1: Osun State Major Dumpsite at Ilu Tuntun Iwo-Ibadan Road, Osogbo

Plate 2: Oleyo Dumpsite at Old Station Road, Osogbo

In Ede study area, the two other selected dumpsites were located at Agbagudu Street, JagunOgala compound Ede and DauduOlagunju compound opposite the Wema Bank as shown in Plates 3 and 4.

Plate 3: Dumpsite at ItaOgala Compound in Ede

Plate 4: Dumpsite at DauduOlagunju Compound in Ede

The control samples were taken from the farthest distance away from the dumpsite at Onibu-Eja Estate and JagunOgala compound in Osogbo and Ede respectively, which serves as baseline for all the samples collected in the study areas. These samples were collected at a varying distance to measure and compare the effect of contaminants on the underground water in relation to the control samples collected. The varying distance of the samples collected were determined through the coordinates of the dumpsite and wells with the aid of Global Positioning System (GPS) device with distance calculated from equation 1 in reference to the bench mark dumpsite.

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$$D = \sqrt{[(\Delta N)^2 + (\Delta E)^2]} \text{——————————} 1$$

$\Delta E = E_2 - E_1$

$\Delta E = E_3 - E_1$

$\Delta N = N_2 - N_1$

$\Delta N = N_3 - N_1$

Where,

D = Distance (m)

ΔE = Difference between Eastings of the two points

ΔN = Difference between Northings of the two points

The samples were collected using a 5-litre white plastic containers screw capped that have been sterilized in other to avoid contamination by any physical, chemical or microbial means. Samples were properly labeled with details of the sources, date of sampling, time of sampling and address and were taken to the laboratory before 24hours from the time of collection. The samples collected from each and wells were analyzed for physical, chemical and bacteriological parameters of water. The qualitative analyses were carried out at the Osun State water works laboratory. The physio-chemical parameters were assessed on these samples such as colour, turbidity, temperature, pH, acidity, alkalinity, calcium hardness, total hardness, magnesium hardness, chloride nitrate, total iron, manganese, sulphate, phosphate silica, dissolved oxygen(DO), chemical oxygen demand (BOD) chemical oxygen demand (COD), total solid (TS), soluble solid(SS), total dissolved solid (TDS) and chloride residual. The bacteriological test analyses were carried out for organisms, aerobic mesopholic, yeast and mould, coliform, E-coli and salmonsalla.

3. RESULT AND DISCUSSION

Results obtained from the coordinates and distances of points of samples collection to dumpsite, Physical parameters, Chemical analysis and Bacteriological test were compared with World Health Organization (WHO) standard as presented in Tables1-9 respectively. The corresponding plot of colour, temperature, turbidity, pH, total solids, chloride ions, total hardness, calcium hardness, magnesium hardness and Most Probable Number of bacteria coli form on the collected water samples are presented in Figures1-10 respectively.

The World Health Organization (WHO) 2006 standard requirement for potable water is presented in the Appendix 1. The water samples analysis for physical, chemical and biological parameters of groundwater quality were analysed and results discussed below.

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PHYSIO-CHEMICAL PARAMETERS

Colour
The desirable colour according to the WHO 2006 standard (UNICEF, 2009) is 15 (H.U) in which sample C, D, E and H which range from 10-15 falls within the allowable range of WHO as shown in Appendix I and sample A, B, D and G having value to be 20 exceed the allowable standard.

Temperature
The temperature range of groundwater sample in Ede and Osogbo metropolis is virtually constant throughout and ranged between 26.4° C and 29.6°C. This depends on the environmental condition at the time of collection of samples. And also it was been deduce control samples in Ede and Osogbo has the least value of 26.5° C and 26.4° C.

Turbidity
Turbidity (in NTU) ranges from 5.96-8.60 for samples collected in Ede and 3.90-7.20 for samples collected in Osogbo. The WHO 2006 (UNICEF, 2009) allowable is 5 NTU but from the result sample F which is the control sample in Osogbo and H falls within the desirable standard of the WHO 2006 (UNICEF, 2009) while sample E & G and all the samples in Ede (A,B,C,D) falls above the allowable standard, this is an indication that there could be microbial contamination which can cause significant damage to human and turbid water is more expensive to treat.

pH
The pH of all the water samples ranges from 5.90-7.40 and allowable WHO 2006 standard (UNICEF, 2009) range of 6.5 – 8.5 as presented in Appendix I. From Figure 4.4, both the control samples D and F in Ede and Osogbo including sample B and H falls within allowable standard, all other samples A, C, E and G falls below the range and it can be concluded they were acidic in nature which can adversely affect its use for domestic uses. Also, it was discovered that all samples closer to the dumpsite are more acidic in comparison with the samples farther away from reference dumpsites.

Total solids
The total dissolve solid ranged from 144-212 mg/l from Figure 4.5, all the water sample falls within the allowable range since the maximum permissible limit is 500 mg/l. However, water that contains less than 500 mg/l of dissolved solid is generally satisfactory for domestic use and many industrial purposes.

Chloride Ions
Water that contains less than 150mg/l chloride is satisfactory for most purposes. The Chloride content for all samples ranges from 7.50 – 17.50 mg/l, all the sample lies within the maximum permissible limit of 200 mg/l of WHO 2006 standard (UNICEF, 2009).

Total Hardness
Water hardness is the traditional measure of the capacity to react with soap; hard water requires considerable more soap to produce lather Hardness is one of the very important properties of

ground water from utility point of view particularly for domestic purposes. From Figure 4.7, water hardness ranges from 142–294 mg/l, all the analysed samples are within the maximum allowable limit of 500 mg/l recommended by WHO 2006 (UNICEF, 2009). It can also be concluded that all the water samples were soft water.

Calcium Hardness

The Calcium hardness for the water samples varies from 84.00-102.00 mg/l for samples collected from Ede and 84.00-192.00 mg/l for samples collected from Osogbo which falls within the 200mg/l maximum permissible level for WHO2006 standard(UNICEF, 2009) as presented in Appendix I.

Magnesium Hardness

The magnesium hardness for the water samples varies from 46.00-92.00mg/l for samples collected from Ede and 66.00-78.00mg/l for samples collected from Osogbo which falls within the 150mg/l maximum permissible level for WHO 2006 standard(UNICEF, 2009) as presented in Appendix I.

Other parameters like Iron, Manganese, Chromium, Copper, Zinc, are trace element and were found in minute amounts concentration of less than 100mg/l in all the water samples in Ede and Osogbo metropolis. The World Health Organization 2006 (UNICEF, 2009) recommends that the iron content of drinking water should not be greater than 0.3mg/l see Appendix 1 because iron in water stains plumbing fixtures, stains cloths during laundering, incrusts well screens and clogs pipes.Indications of the presence of Iron include taste,discoloration, deposits and growth of Ironbacteria.All the water samples in the study sites fall within the range of the allowable limit of WHO and ranges from 0.01-0.07mg/l and 0.01-0.08mg/l for Ede and Osogbo respectively. Manganese concentrationsranging from 0.05 to 0.5 mg/l are usually allowable for WHO but for sample B, D, and H trace of manganese was not detected while, 0.001, 0.003, 0.002, 0.001, 0.006 are for sample, A, C, D, F and H respectively. Chromium recorded in the samples fall within the WHO 2006 guideline except for samples B and D with recorded values 0.08mg/l and 0.06mg/l respectively.WHO 2006 (UNICEF, 2009) recommends a maximum limit of 0.05mg/l.Indications of the presence of copper includesastringent taste, discoloration and corrosion ofpipes, fitting andutensils. Copperrecorded for samples from the study dumpsites varies with, 0.003mg/l, 0.002mg/l, 0.001mg/l, 0.004mg/l, 0.005mg/l and 0.001mg/l from samples A, C, D, E, G and H respectively. For control sample F and B no record of copper was detected. WHO recommends maximumlimit 2.0mg/l in which all samples in Ede and Osogbo satisfied the allowable standard recommended by WHO 2006(UNICEF, 2009).Zinc qualities includes (Astringent taste),opalescence and sand like deposit. Zinc recorded for samples in Ede and Osogbo metropolis ranges from 0.001-0.04mg/l which falls within the desirable limit of 3.0mg/l of WHO 2006 standard (UNICEF, 2009).

BACTERIOLOGICAL TEST

Most Probable Number of Bacteria Coliform

Bacteriological test analysis of the water samples were carried out, as shown in Figure 4.10 indicates that none of the water sample analysed met the WHO 2006 guideline limit including the control samples Ede and Osogbo. Coli form bacteria must not be detectable in any 100 ml

sample of all water intended for drinking from Appendix I. Since water is essential to life there is need to have unpolluted pure water. By implication, due to the distance the samples (A, C, E, and G) closed to the dumpsites were more contaminated to the other samples (B, D, F, H) farther away from the reference dumpsites and however, all samples are not safe for drinking in line with microbial standard of WHO 2006 (see Appendix 1).

Table1: Dumpsite Location at DauduOlagunju Compound Opposite Wema Bank, Ede

Reference	Distance(m)	ΔNorthing(N)	ΔEasting(E)	Northing(N)	Easting(E)
Dumpsite				855214	658595
Sample A	21.38	-4.00	-21.00	855210	658574
Sample B	86.98	-29.00	-82.00	855185	658513

Table 2: Dumpsite Location at Agbagudu Street JagunOgala, Compound Ede

Reference	Distance(m)	ΔNorthing(N)	ΔEasting(E)	Northing(N)	Easting(E)
Dumpsite				854315	657974
Sample C	22.361	-20	-10.00	854295	657964
Sample D	93.005	89	27.00	854404	658001

Table 3: Dumpsite Location at Ilu Tuntun Iwo- Ibadan Road, Osogbo

Reference	Distance(m)	ΔNorthing(N)	ΔEasting(E)	Northing(N)	Easting(E)
Dumpsite				861704	664416
Sample E	240.05	148	-189	861852	664227
Sample F	285.36	90	-268	861795	664148

Table 4: Dumpsite Location at OleyoIta-Akogun Area,Osogbo

Reference	Distance(m)	ΔNorthing(N)	ΔEasting(E)	Northing(N)	Easting(E)
Dumpsite				859095	671932
Sample G	17.49	9	15	859104	671917
Sample H	40. 50	22	34	859117	671966

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Table 5: level of water table in sample well

Samples	Description of sample location	Distance of samples from reference dumpsite (metres)	Depth of Water Level (metres)
A	DauduOlagunju compound, Ede	21	5
B	DauduOlagunju compound	87	5.5
C	JagunOgala compound, Ede	22	4
D	JagunOgala compound, Ede	93	4
E	OnibuEja community Osogbo	240	8
F	OnibuEja community Osogbo	285	30
G	OleyoOsogbo	18	4
H	OleyoOsogbo	41	18

Table 6: Results of Physio-Chemical Parameters from Ede Dumpsites

Parameters	**Water Samples**				
	Clear well	**A**	**B**	**C**	**D control**
Appearance	Clear	Clear	Clear	Clear	Clear
Colour (H.U)	15.00	20.00	20.00	15.00	20.00
Taste and Odour	Unobjectionable				
PH	7.1`	6.0	6.8	6.2	7.0
Turbidity (FTU)	2.51	7.8	5.96	8.60	6.40
Temperature (^{0}C)	26.4	29.20	26.30	29.60	26.50
Dissolved Oxygen	5.2	2.10	4.20	2.84	4.60
Total alkalinity (mg/l)	78.00	136.00	166.00	144.00	158.00

Total hardness (mg/l)	120.00	174.00	142.00	168.00	152.00
Calcium hardness (mg/l)	84.00	96.00	76.00	102.00	84.00
Calcium ions (mg/l)	33.60	38.40	30.40	40.80	33.60
Magnesium hardness (mg/l)	36.00	78.00	66.00	66.00	68.00
Magnesium ions (mg/l)	9.00	19.50	16.50	16.50	17.10
Chloride ions (mg/l)	2.50	15.50	9.50	17.50	7.50
Iron (mg/l)	0.01	0.05	0.03	0.07	0.04
Silica (mg/l)	0.462	2.864	1.618	2.160	1.714
Nitrate nitrogen (NO_3^{2-}) (mg/l)	0.05	3.600	0.596	2.984	0.634
Nitrate nitrogen (NO_2^{2-}) (mg/l)	0.001	1.316	0.106	1.086	0.146
Copper (mg/l)	0.00	0.003	0.000	0.002	0.001
Manganese (mg/l)	0.001	0.001	0.000	0.003	0.000
Aluminum (mg/l)	0.00	0.041	0.011	0.036	0.018
Lead (mg/l)	–	–	–	–	–
Arsenic (mg/l)	–	–	–	–	–
Chromium (mg/l)	0.000	0.026	0.08	0.018	0.06
Conductivity	125.00	304.00	139.00	326.00	141.00
Sulphate (mg/l)	2.00	14.00	2.00	18.00	4.00
Zinc (mg/l)	0.001	0.016	0.003	0.009	0.007
Carbonate (mg/l)	78.00	136.00	142.00	144.00	152.00
Bicarbonate (mg/l)	24.40	105.9	24.40	89.50	36.60
Flocculation (PPM)	5.00	20.00	20.00	15.00	20.00
Chlorine residual (mg/l)	0.25	–	–	–	–
Total acidity mg/l)	–	–	–	–	–
Total solids (mg/l)	118.80	162.00	186.00	149.00	173.00
Total filterable solids (mg/l)	0.80	42.00	33.00	11.00	16.00

Total non-filterable solids (mg/l)	118.00	120.00	153.00	138.00	157.00

Table 7: **Results** of Physio-Chemical Parameters from Osogbo Dumpsites

Parameters	**Water Samples**			
	E	**F control**	**G**	**H**
Appearance	Clear	Clear	Clear	Clear
Colour (H.U)	15.00	12.00	20.00	10.00
Taste and Odour	Unobjectionable			
PH	5.9	7.2	6.4	7.4
Turbidity(FTU)	5.60	4.80	7.20	3.90
Dissolved Oxygen	4.10	5.80	3.60	6.20
Temperature ^{0}C	28.70	26.40	28.1	26.60
Total alkalinity (mg/l)	158.00	86.00	176.00	94.00
Total hardness (mg/l)	246.00	182.00	294.00	176.00
Calcium hardness (mg/l)	192.00	120.00	148.00	84.00
Calcium ions (mg/l)	76.80	48.00	59.20	33.60
Magnesium hardness (mg/l)	54.00	62.00	46.00	92.00
Magnesium ions (mg/l)	13.50	15.50	11.50	23.00
Chloride ions (mg/l)	12.50	10.50	17.50	9.00
Iron (mg/l)	0.06	0.02	0.08	0.01

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Silica (mg/l)	2.160	1.134	2.006	1.462
Nitrate nitrogen (NO_3^{2-}) (mg/l)	1.500	0.893	1.752	0.794
Nitrate nitrogen (NO_2^{2-}) (mg/l)	0.332	0.173	0.412	0.162
Copper (mg/l)	0.004	0.000	0.005	0.001
Manganese (mg/l)	0.002	0.000	0.006	0.000
Aluminum (mg/l)	0.006	0.000	0.009	0.000
Lead (mg/l)	–	–	–	–
Arsenic (mg/l)	–	–	–	–
Chromium (mg/l)	0.000	0.001	0.002	0.000
Conductivity	464	134	423	146
Sulphate (mg/l)	15.00	2.00	12.00	1.00
Zinc (mg/l)	0.080	0.004	0.040	0.002
Carbonate (mg/l)	158.00	86.00	176.00	94.00
Bicarbonate (mg/l)	122.00	24.40	105.90	36.60
Flocculation (PPM)	15.00	12.00	20.00	10.00
Chlorine residual (mg/l)	–	–	–	–
Total acidity mg/l)	–	–	–	–

Total solids (mg/l)	268.40	144.00	212.00	152.00
Total filterable solids (mg/l)	0.40	14.00	32.00	23.00
Total non-filterable solids (mg/l)	268.00	130.00	180.00	129.00

Table 8: Results on Bacteriological Test from Ede Dumpsites

Samples No	**Description of samples**	**PH**	**C/R**	**Colonies per CC growing on Nutrient Agar at 37°c in 24 Hours**	**Presumptive Result on Coliform Organism at 48hrs of Incubation at 37°c**			**Most Probable Number of Bacteria Coliform per 100ml of Water Sample**
					50ml	**10ml**	**1ml**	
	Clear well	7.2	Nil	0	1	2	2	0
A	DauduOlagunju	6.0	Nil	146	1	5	3	170
B	DauduOlagunju	6.8	Nil	76	1	2	2	130
C	Jagunogala compound	6.2	Nil	205	1	5	5	180^{+}
D control	Jagunogala compound	7.0	Nil	112	1	5	1	142

Table 9: Results on Bacteriological Test from Osogbo Dumpsites

Samples No	**Description of samples**	**PH**	**C/R**	**Colonies per CC growing on Nutrient Agar at 37°c in 24 Hours**	**Presumptive Result on Coliform Organism at 48hrs of Incubation at 37°c**			**Most Probable Number of Bacteria Coliform per 100ml of Water Sample**
					50ml	**10ml**	**1ml**	
E	Onibueja community	6.0	Nil	162	1	5	5	180^{+}

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F control	Onibueja community	7.1	0.25	76	0	0	0	130
G	Oleyoita-akogun	6.2	Nil	111	1	5	2	147
H	Oleyoita-akogun	7.0	Nil	47	0	2	2	25

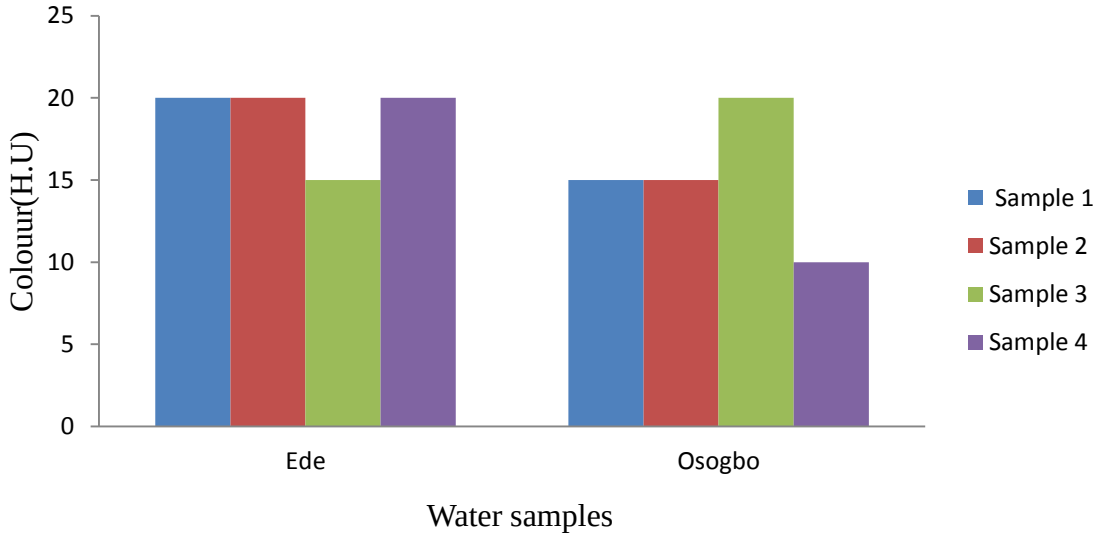

Figure 1: A Plot of Colour on the Collected Water Samples at Osogboand Ede

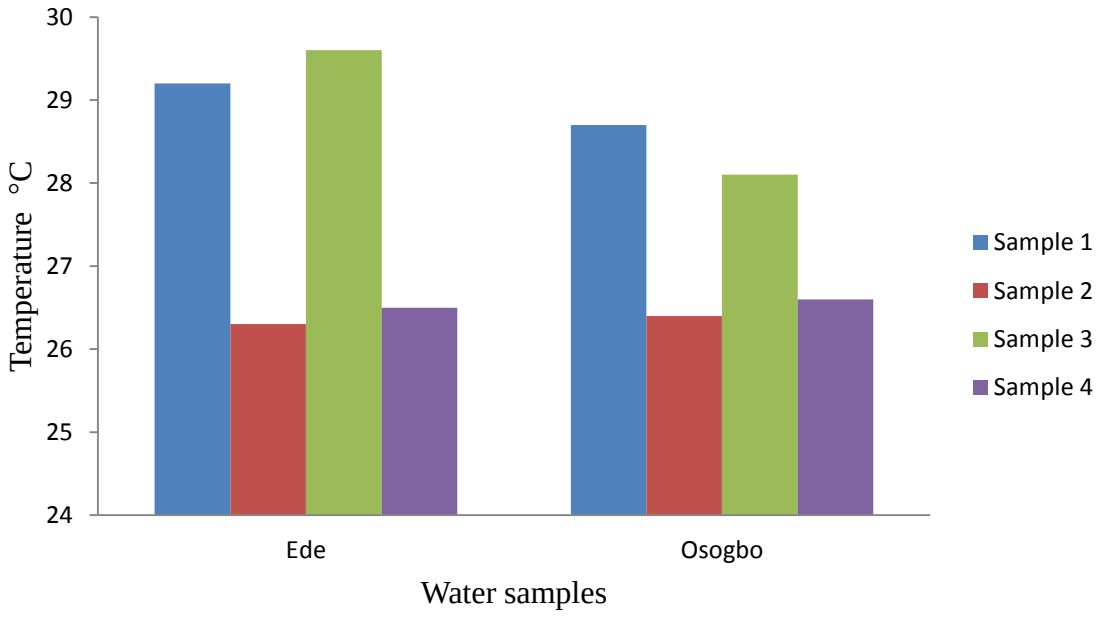

Figure 2: A Plot of Temperature on the Collected Water Samples at Osogboand Ede

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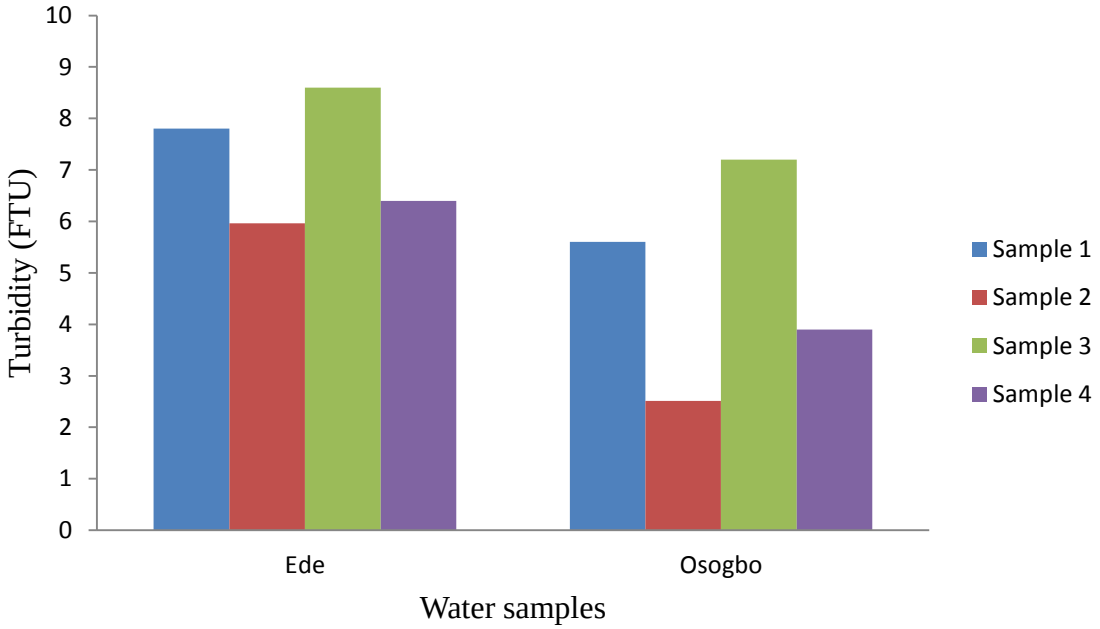

Figure 3: A Plot of Turbidity on the Collected Water Samples at Osogbo and Ede

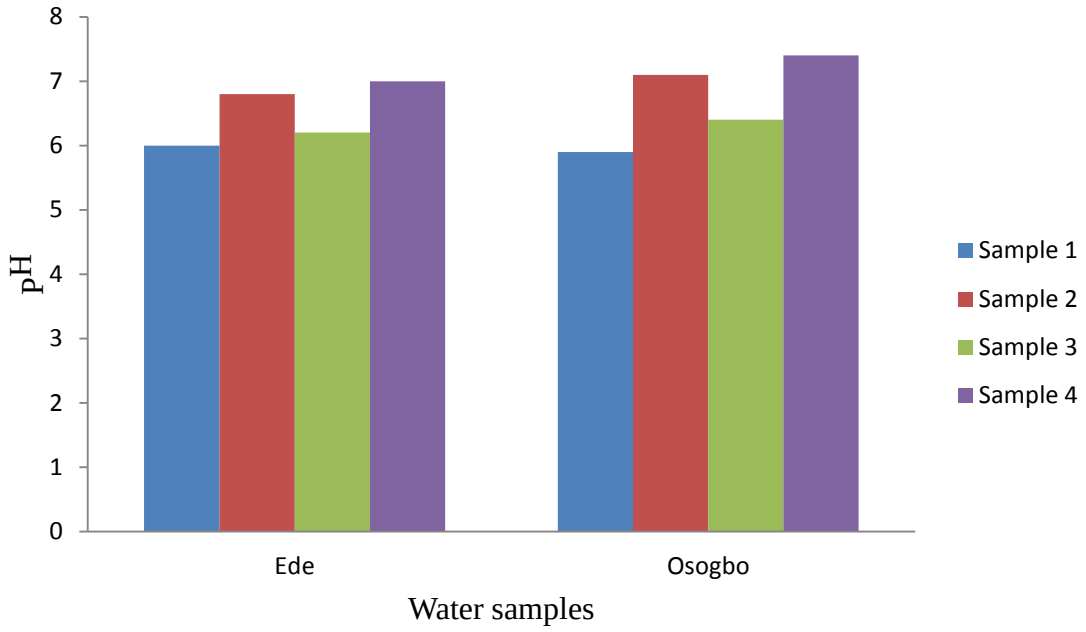

Figure 4: A Plot of pH on the Collected Water Samples at Osogboand Ede

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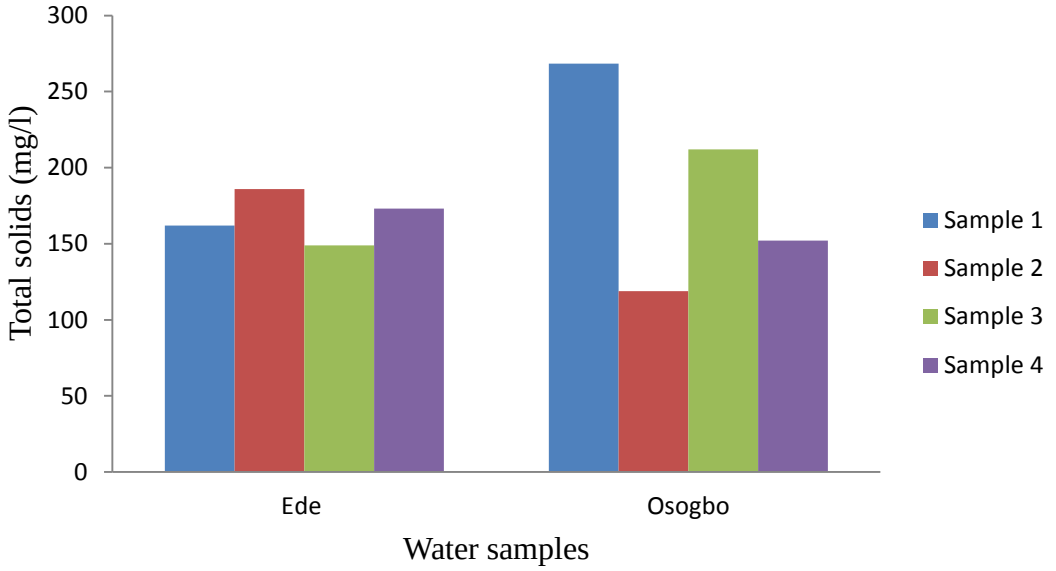

Figure 5: A Plot of Total Solids on the Collected Water Samples at Osogboand Ede

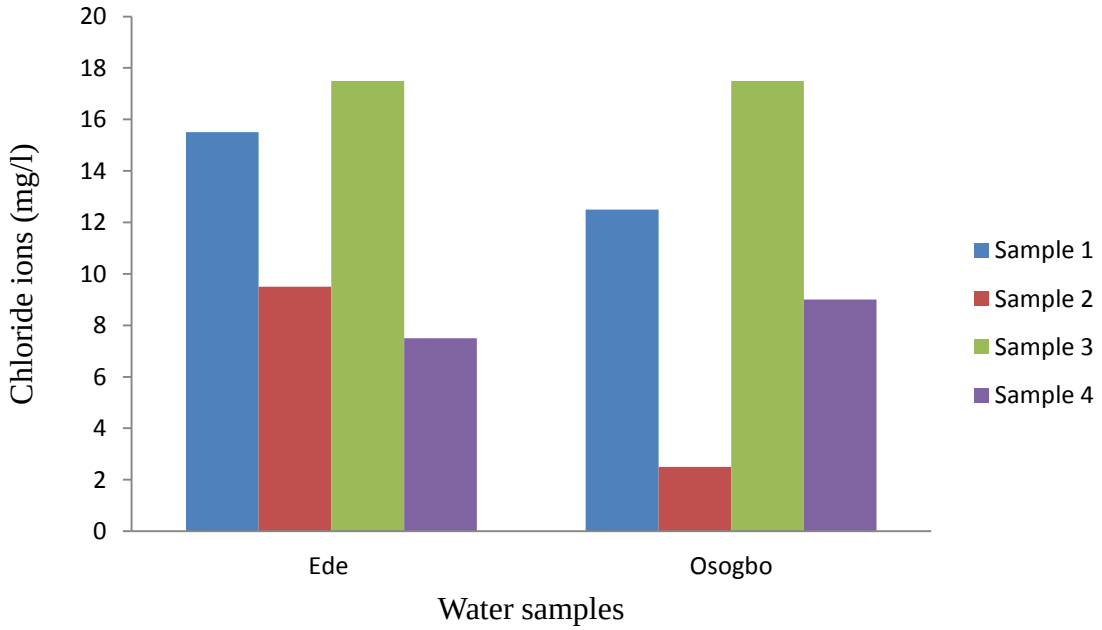

Figure 6: A Plot of Chloride Ions on the Collected Water Samples at Osogboand Ede

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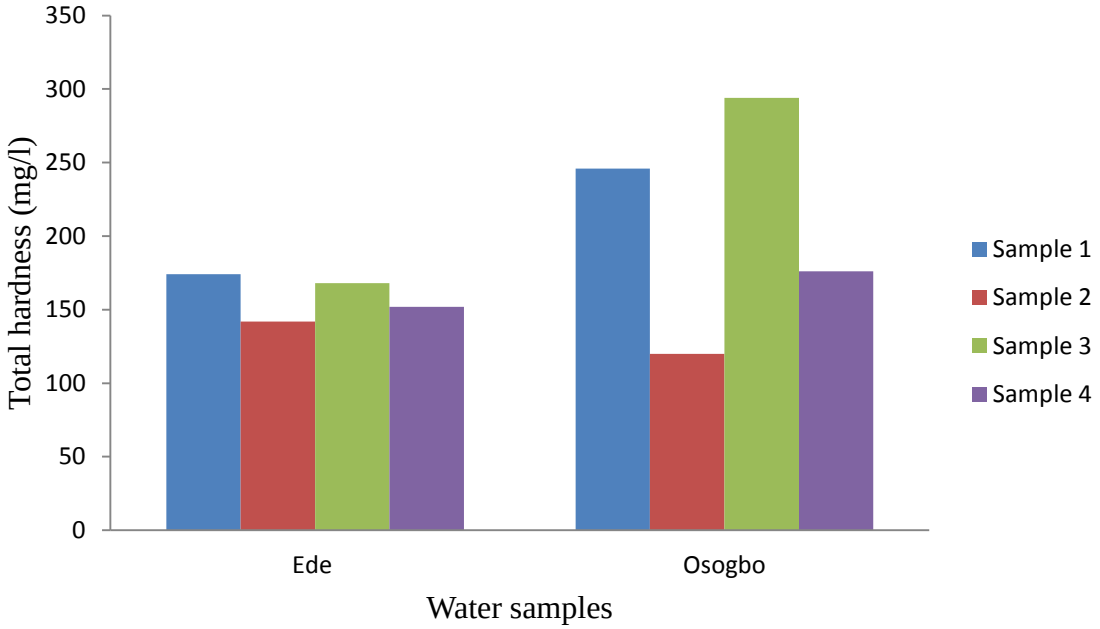

Figure 7: **A** Plot of Total Hardness on the Collected Water Samples at Osogboand Ede

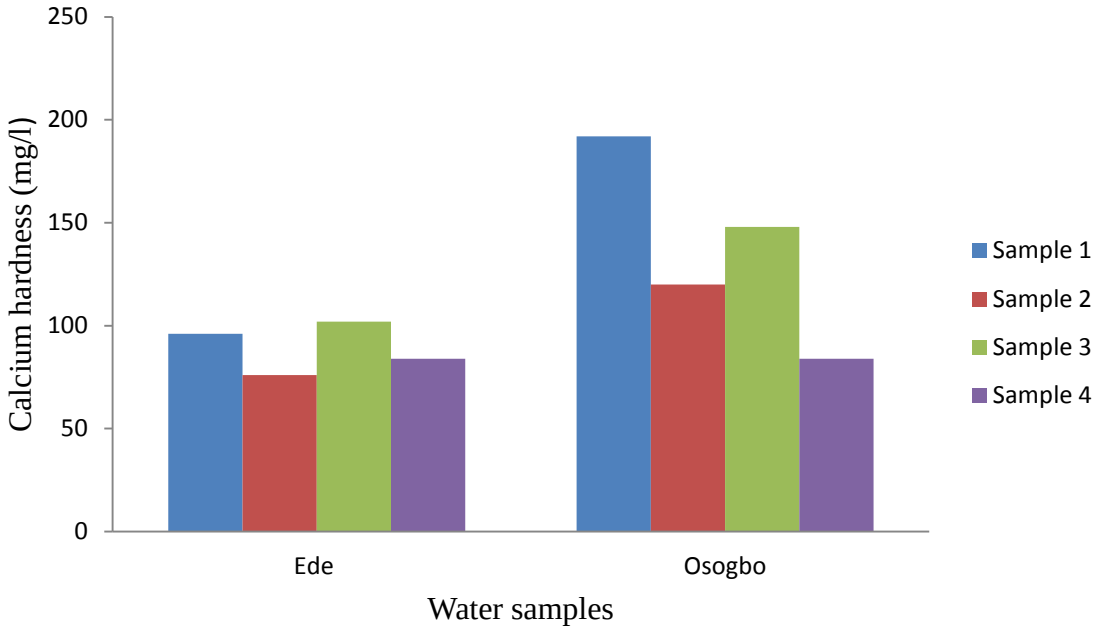

Figure 8: A Plot of Calcium Hardness on the Collected Water Samples at Osogboand Ede

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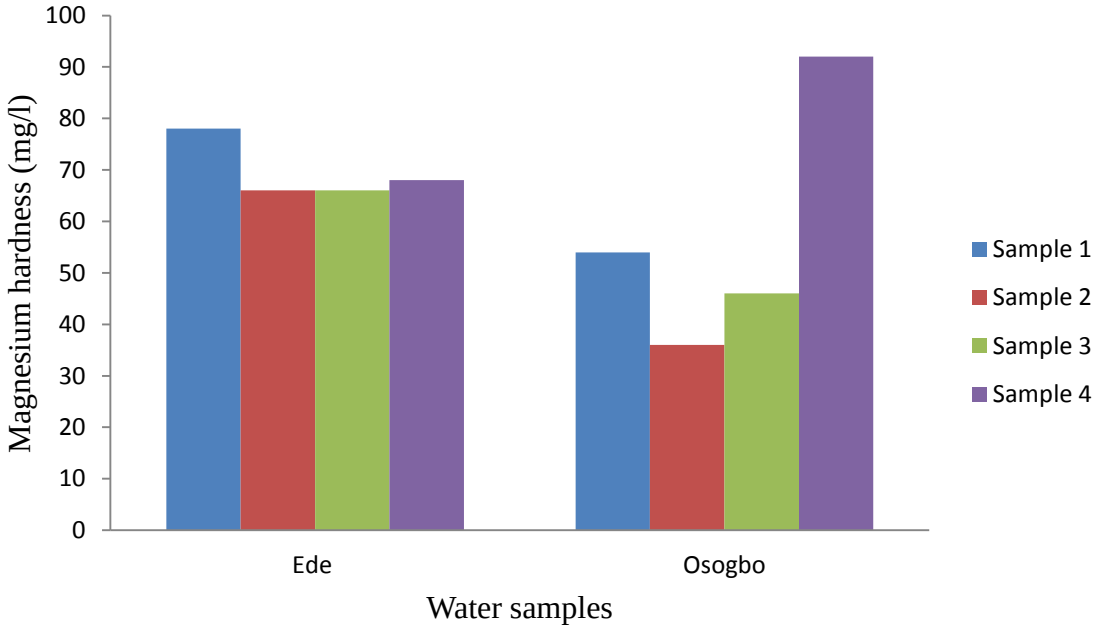

Figure 9: A Plot of Magnesium Hardness on the Collected Water Samples at Osogboand Ede

4. CONCLUSION

Investigation into the assessment of solid waste of the selected dumpsites in Ede and Osogbo indicated that most dumpsites pre-existed the residential houses and buildings in the study area. With the development rate and increasing population in those areas solid waste dumpsite has adverse effect on the populace and causes damage to public health. Sample wells in Ita-Ogala dumpsite was found to be uncovered, which is more close to contamination but the well still being used for domestic purposes.

Generally, the analyses indicated that there are some levels of contaminations on the ground water within the solid waste dumpsite for physical, chemical and bacteriological tests. Sample A, C, E and G were discovered to be acidic which rendered the samples unsafe for drinking and other domestic consumptions. Parameters like Iron, Manganese, Chromium, Copper, Zinc are trace element and were found in minute amounts concentration of less than 100mg/l in all the water samples in Ede and Osogbo metropolis which possessed no hazard effect to the quality of groundwater.

The presence of large quantities of mixtures of potentially hazardous chemicals in solid waste dumping sites close to residential area has increasingly caused some significant groundwater and public health concerns. Therefore, there is an increase in risk to public health with groundwater located near solid waste dumping site, which requires adequate monitoring processes. Based on the conclusion drawn, the following recommendations are made: There is need for environmental awareness through enlightenment campaigns on solid waste handling, controlling and monitoring techniques in Ede and Osogbo that geared towards achieving quality

environmental condition, solid waste should be recycled instead of taking to dumpsites for other environmental friendly benefits, exploration of groundwater should be deep and proper analysis should be encouraged at both government and individual levels to know the side effects associated with groundwater before it is consumed, people should be encouraged to use waste bins and other facilities provided by waste managers for disposing of their waste, the involvement of individual and private sector through NGOs would improve the efficiency of Municipal Solid Waste Management, Littering of Municipal Solid Waste should be prohibited in Ede and Osogbo environment through enforcement of law,house-to-house collection of Municipal Solid Waste should be organized through methods like collection on regular pre-informed timing and scheduling, the use of soda ash should be injected to the well to correct the acidity of the water samples and also calcite neutralizer could be adopted to neutralize acidic water.

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