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RE-ASSESSMENT OF THE EFFECTS OF LEACHATES ON THE PHYSICO-CHEMICAL PARAMETERS OF GROUND WATER AROUND OLUSOSUN AND SOLOUS DUMP-SITES IN LAGOS, NIGERIA.

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ABSTRACT

Leachate is any contaminated liquid that is generated from water percolating through a solid waste disposal site, accumulating contaminants, and moving into subsurface areas. Physico-chemical parameters and heavy metals concentration of leachate and groundwater from three bore holes located near landfills at Igando and Olusosun dumpsites in Lagos were re-assessed to ascertain the level of contamination on the groundwater quality. The bore holes location were at radial distances of 50m, 80m and 100m respectively away from the two landfill sites. The parameters determined are pH, Total Dissolved Solid (TDS), Total Hardness (TH), Sulphates (SO_4^{2-}), Nitrates (NO_3^-), Chlorides (Cl^-) and heavy metals, include Pb, Ni, Cd and Cr. Most of these parameters indicate traceable contamination but some were below the World Health Organization and the Nigeria Standard for drinking water quality (NSDWQ) limits for consumption. The concentration of Pb and Cd were found to be in considerable high levels in the groundwater samples particularly near the landfill site and absent in the control, likely indicating that groundwater quality are being significantly affected by leachate percolation. All parameters and heavy metals content were measured based on standard methods. It was found that the groundwaters were contaminated due to leachate from the landfills to a large extent and are not suitable for drinking, domestic and irrigation purposes unless treated. The extent of contamination decreased as the distances to the landfill increased.

KEYWORD*:* Leachate, Landfill, Groundwater, Heavy metals.

INTRODUCTION

Industrialization and urbanization have contributed greatly to groundwater pollution over the years without any regards to environmental consequences (Longe and Balogun, 2010). Access to safe clean water and adequate sanitation is a fundamental right and a condition for basic health (EPA, 2007). There has been an increasing concern about the environment in which man lives. Solid waste, mount of rubbish, garbage and sewage are being produced everyday by our urban society. In an attempt to dispose of these materials, man has carelessly polluted the environment. Some components of these waste including food, paper, metals, zinc and lead polythene bags, containing materials etc consume oxygen thereby changing the redox potential of the liquid present (Ugwu and Nwosu, 2009).

The solid waste placed in landfills or open dumps are subjected to either groundwater underflow or infiltration from precipitation or any other possibility of infiltration of water. During rainfall, the dumped solid waste receives water and the by-products of its decomposition move into the water through the waste deposition. The liquid containing innumerable organic and inorganic compounds are called leachate. This leachate accumulates at the bottom of the landfill and percolates through the solid and reaches the ground water (Mor *et al*, 2006). Leachate varies widely in composition depending on many interacting factors such as composition and depth of waste, availability of moisture and oxygen, landfill design, operation and age. The composition is primarily a function of the age of the landfill and the degree of waste stabilization. The stabilization of waste is suggested to proceed in five sequential or distinct phases (Al-Hashimi and Hussain, 2013) and the rate of progress through these stages is dependent on the physical (availability of free oxygen), chemical and microbiological conditions developed with the landfill and time (Al-Hashimi and Hussain, 2013).

Area near landfills and municipal disposal sites have a greater possibility of groundwater pollution because of the potential pollution source of leachate that originate from the decomposition of the organic wastes disposed at these site and finally percolate into local aquifer. Such contamination of the groundwater resources has a substantial risk to the natural environment and to the health of local residents who use the water resource for drinking and other domestic purposes (Thammani and Singh, 2009; Butt & Igbal, 2007). Several studies have been conducted in order to examine the health and environmental effects arising from waste dumps. Such studies showed that a link exist between the two (Nwanta and Ezenduka, 2010; Nguyen, 2011).

Leachate formation and concentration is a function of the type of waste, season, climate, time and management strategies (Afolayan *et al*., 2012). The concentration of a pollutant at any point removed (away) from its source vary throughout the year due to seasonal influences on recharge and release of the contamination. (Afolaya *et al*., 2012) therefore, continuous re-evaluation of the physico-chemical parameter of the leachates and the level of contamination of ground water sources are needful.

In the present study, the impact of leachate migration on groundwater quality was estimated from Igando solous and Olusosun landfill sites, Lagos, Nigeria. Various physico-chemical parameters and heavy metals were analyzed in leachate and groundwater samples to understand the possible link of ground water contamination.

MATERIALS AND METHODS

Study Area

The Olusosun dumpsite is a 42 hectares dumpsite in Ojota Lagos, Nigeria on latitude $6^0 20^0$ N and Longitude 3^0 20^d E. The site receives up to 10,000 tons of rubbish each day (LAWMA, 2011). Olusosun landfill is located on the outskirts of Lagos but is surrounded by commercial and residential areas. Around 1,000 homes exist at the site in shanty towns, occupied by residents who work at the dump.

The Solous landfill is situated at Igando in Alimosho Local Govt. Area of Lagos state Nigeria. It lies approximately between longitude $3^0$13'30"E to 3^0 17^0 15"E and latitude 6^0 28^0N to 6' 42^0N. As a result of urbanization, the landfill is now surrounded by residential, commercial and industrial activities (LAWMA, 2011).

The studies were carried out on the landfills at Igando and Olusosun dumpsite located between latitude 6'28 ^{0}N to 6' 42 ^{0}N and longitude and respectively. Three existing boreholes with average depth of 60 metres located within the distance 50 m, 80 m and 100 m radically away from the centre of the two landfill were used as sampling points for groundwater quality testing for each borehole, a control sample was taken from a bore hole about 200 m away from the landfills. 5 litres of the groundwater samples were collected into plastic container. The containers were cleaned using 1 mol/L of nitric acid. They were then left to dry for 2 days followed by thorough rinsing with distilled water before use. Since the landfills are not equipped with a leachate collection system, the leachate accumulating at the base of the landfill were sampled randomly from four different locations within the landfills and were mixed prior to analysis.

The leachate and groundwater samples were immediately transferred to the department of Chemical Science Laboratory, Yaba College of Technology and were stored in the refrigerator at 4 ºC. The analyses were carried out using the standard procedure prescribed by the American Public health Association APHA (APHA, 1994).

All the samples were analysed for some selected relevant physico-chemical parameters and heavy metals. The physico-chemical parameters examined in the leachate and groundwater samples include total dissolved solid (TDS), Total hardness (TH), Chloride and sulphate. Estimation of COD for leachate was done by reflux titrimetry, while BOD was calculated using oxygen determination by Winkler titration. Sulphate was determined using UV/Vis spectrophotometer. Concentration of cadmium (Cd), Lead (Pb), Chromium (Cr) and Zinc (Zn) were determined using atomic absorption spectrometer (AAS). The results obtained for the two landfills dumpsite are presented in Tables 1 and 2 respectively.

RESULTS AND DISCUSSION

The result of physiochemical and heavy metals analyses of the leachate and the neighourhood groundwater of Solous and Olusosun Landfills are presented in Tables 1 and 2 respectively. The pH values obtained at the two sites studied were in agreement with WHO standard showing that the samples were slightly alkaline. These results are in conformity with the work of Bozkurt and Kurtulus,(2008).

The electrical conductivity (EC) is an indication of the amount of ionic materials dissolved in the water. It was discovered that the EC are within the acceptable limits of NSDWQ standard at the sites with the exception of GW1 and GW2 which are slightly higher. Total dissolved solids are higher than the acceptable limit for potable water at the two sites. The highest values were obtained at GW1 of both sites; these may be due to their location close to the dumpsite yard. The groundwater pollution from garbage in the vicinity of the dump site is detectable through increased TDS concentration of the water. The BOD and COD indicate the organic content in the leachate and the groundwater. The BOD values at Solous dump site are lower than standard values while that of Olusosun dump site are higher: an indication that the groundwater is polluted by the landfill leachate. The results show that the groundwater is more polluted with more of non-biodegradable chemical pollutant. This is in agreement with the report of Raju, (2012). These shows that there is higher contamination of the groundwater by the leachate, similar results have been reported by Longe and Balogun, (2009). The Nitrate values of the samples were found to be above the stipulated limit of 50 mgl^{-1} by WHO and NSDWQ except at GW3 of both sites. Nitrate is the end product of the aerobic decomposition of organic nitrogenous matter. This result is also supported with the literature of John, (2014). The concentrations of the sulphate were within the recommended values of 400mgl^{-1}. Thus it will not adversely affect the use of these groundwater for domestic purposes.

The results of heavy metals analysis shows that most of these metals were detected and indicate the presence of toxic waste perhaps from disposal of battery cells, used aerosol can and other materials with certain degree of toxicity. These agreed with the report of other authors (Dissanayake *et al*, 2010; Akinbile and Alatise, 2011).

CONCLUSION

The effect of the concentration of pH, EC, TDS and heavy metals tested in groundwater near the studied landfills deteriorate the quality of drinking and other domestic purposes of the water. The extent of deterioration decreased with increase in the distance from the landfills. The observed elevation of Pb, Cd, Cr and Ni in leachate and the presence of some conventional contaminants above WHO and NSDWQ permissible limits in the groundwater sampled and absence in the control is an indication that the uncontrolled accumulating of leachates over time at the landfill base will represent a significant threat to the groundwater quality.

REFERENCES

Afolayan, O.S, Ogundele, F.O and Odewumi, S.G (2012). Spatial variation in Landfills Leachate solution in urbanized area of Lagos State Nigeria. *American International Journal of Contemporary Research 2,(8), 178 – 182*

Akinbile C.O. and Alatise M.O (2011). Qualitative analysis of bored groundwater for agricultural and municipal uses in Ondo State Nigeria. Journal of Agricultural Science and Technology P55 – 60.

Al-Hashimi, M.A and Hussain, H.T (2013). Stabilization Pond for Wastewater Treatment. European Scientific Journal, Vol. 9, No. 14, ISSN: 1857-7881

APHA (1994) Standard methods for examination of water and wastewater: 15th edition. Washington DC USA. American Public Health Association (1994).

Bozkurt, A., and Kurtulus C. (2008) Groundwater quality in korfez municipality (Kocaeli), Northwest of Turkey. Journal of Food, Agriculture and environment 6(3) SS1-SS3

Butt, I., and lgbal A, (2007): Solid waste management & associated environmental issues in Lahore Pakistan Geographical review 2(1):45 – 50

Dissanayake, P., Clemett A., Jayokody, P. and Amerasinghe P.(2010). Water quality Survey for kurunegala, Sr, Larika summary assessment of wastewater agriculture and sanitation for poverty alleviation in Asia.P1-4

John J.M (2014). Effect of domestic waste leachate on quality parameters of groundwater. Leonardo Journal of Science (24):28-38.

Longe E.O. and Balogun M.R. (2010). Groundwater Quality assessment near a municipal landfill, Lagos, Nigeria. Research J. of Applied Sci. Engineering and Technology 2,(1): 39 - 44

Majolagbe, A.O Kasali A.A and Ghaniyu I.D (2011). Quality assessment of groundwater in the vicinity of dumpsite in Ifo and Lagos southwestern in Nigeria Advances in Applied Science Research. 2(1) pp 289-298.

Mor, S., Vischer A., Ravindra K., Dahiya R.P., Chandra A, van Cleemput (2006) Induction of enhanced methane oxidation in compost; Temperature and moisture response waste manage 26(4): 381-388.

Nguyen P.T (2011). Assessment or Plastic waste Generation and its potentials recycling of household waste in can Tho City, Vietnam. Environmental monitoring and Assessment, 175 (1 – 4): pp 23 – 35

Nwanta, J.A and Ezenduka E. (2010). Analysis of Nsukka Metropolitan Abattoir Solid waste in South Eastern Nigeria. Public Health Implication. Achieve of environmental and occupational health 65 (1): Pp 21-26.

Raju M.V.S (2012). Contamination of groundwater due to Landfill leachate. International Journal of Engineering Research.1(2): 44 – 55

Siasu G.L (2010). Assessing the effect of a dumpsite to groundwater quality in Payatag, Philipines. American Journal of Environmental Sciences. 4(4): Pp 276 - 280.

Thamnani B. and Singh S.K.(2009).Groundwater contamination due to Bhalaswa Landfill Site in new Delhi, Intimation Journal of environmental science & Engineering(1):121-125.

Ugwu S.A and Nwosu J.I, (2009). Effect of waste dumps on groundwater in Choba using geophysical method; Journal of applied Science and Environmental Management. 13(1):85-89.

United States Environmental Protection Agency (EPA) Washington DC. 'The national water quality inventory: Report to congress for the 2002 reporting cycle. A profile" 2007 fact sheets No EPA 841 – F-07- 003

TABLE 1: Physico-chemical composition of Solous Landfill Leachate.

Parameter	NSDWQ	WHO	Leachate	GW_1 (50m)	GW_2 (80m)	GW_3 (100m)	Control
pH	6.5 – 8.5	6.5– 8.5	8.97	7.92	8.10	7.58	7.20
TDSmgl^{-1}	500	500	750	630	520	580	210
Temp ^0C	25-28	25-28	29.3	26.6	26.4	26.5	26.4
TH mgl^{-1}	500	500	2275	180.3	151.6	130	100
Cl^- mgl^{-1}	250	250	480	220	209	163	75
EC us/cm		300	580	410	320	225	150
SO_4^{2-} mgl^{-1}	400	400	415	380	330	310	100
NO_3^- mgl^{-1}	50	50	255.1	84.8	54	42	10
BOD mgl^{-1}	100	100	360.0	75	34	32	10
COD mgl^{-1}	250	250	700.0	133	65	62	20
Fe mgl^{-1}	0.2	0.1	6.5	0.2	0.1	0.1	ND
Pb mgl^{-1}	0.01	0.01	5.10	0.09	0.08	0.09	ND
Ni mgl^{-1}	0.1	0.1	0.012	0.012	0.008	0.007	ND
Cd mgl^{-1}	0.05	0.01	3.33	0.07	0.06	0.03	ND
Cr mgl^{-1}	0.05	0.05	0.05	0.05	ND	ND	ND

KEY:
BOD: Biochemical oxygen demand   **COD:** Chemical Oxygen Demand
TH: Total Hardness   **EC:** Electrical conductivity
TDS: Total Dissolved Solid   **NSDWQ:** Nigerian Standard for Drinking Water Quality

TABLE 2: Physico-chemical composition of Olusosun Landfill Leachate

Parameter	NSDWQ	WHO	Leachate	GW_1 (50m)	GW_2 (80m)	GW_3 (100m)	Control
pH	6.5 – 8.5	6.5– 8.5	7.89	7.46	7.79	7.93	7.55
TDS mgl^{-1}	500	500	990	550	680	510	110
Temp ^0C	25-28	25-28	28.5	26.2	26.0	25.I	26.0
TH mgl^{-1}	500	500	2538	160	120	110	50
Cl^- mgl^{-1}	250	250	410	119	103	95.5	50
EC us/cm		300	480	320	311	250	100
SO_4^{2-} mgl^{-1}	400	400	843	305	282	260	70
NO_3^- mgl^{-1}	50	50	98	72	60	38	10
BOD mgl^{-1}	100	100	220.2	216.0	117.1	111.3	10
COD mgl^{-1}	250	250	279.3	234.0	133.2	125.5	20
Fe mgl^{-1}	0.2	0.1	5.5	0.2	0.1	0.1	0.1
Pb mgl^{-1}	0.01	0.01	6.01	0.027	0.19	0.05	0.01
Ni mgl^{-1}	0.2	0.1	0.5	ND	ND	ND	ND
Cd mgl^{-1}	0.05	0.01	1.15	0.130	0.105	0.11	0.01
Cr mgl^{-1}	0.05	0.05	0.5	ND	ND	ND	ND

KEY:
BOD: Biochemical oxygen demand   **COD:** Chemical Oxygen Demand
TH: Total Hardness   **EC:** Electrical conductivity
TDS: Total Dissolved Solid   **NSDWQ:** Nigerian Standard for Drinking Water Quality