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Impact Assessment of Refuse Dump Site on the Groundwater Quality of Orita-Aperin in Ibadan, Oyo state, Nigeria

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ABSTRACT

Ten groundwater samples were separately collected from each of eastern and western sides of Orita-Aperin abandoned refuse dump with the aim of determining the impact of Orita-Aperin refuse dump site on the groundwater quality. The water samples were analyzed for the following parameters using classical methods of analysis: pH, total alkalinity, total hardness, total solids, total suspended solids, total dissolved solids, chloride, sulphates and orthophosphates. The results of chemical analyses revealed that the level of total hardness (123.2 m/L ± 34.5); sulphate (1.917 mg/L ± 1.25) and chloride (99.6 mg/L ± 51.9) were higher in the groundwater samples at the western side than the level of total hardness (100.6 mg/L ± 44.15); sulphate (1.18 mg/L ± 0.72) and chloride (74.5 mg/L ± 38.86) at the eastern side of the dump. Although the level of these parameters at both sides fall below World Health Organization guideline values, but the pH of ground water at the eastern part (7.84 ± 0.24) was higher than the pH of water samples at western part (7.56 ± 0.48) although both values were within the range of 6.5-8.5 recommended as the pH of good drinking or potable water by World Health Organization. It becomes obvious that there is little or no contamination of groundwater in the area but routine analysis at interval from the area to assess any sudden increased in concentration of any parameter were hereby recommended.

KEYWORDS: Abandoned refuse dump site, groundwater quality, impact assessment, Orita-Aperin.

1. INTRODUCTION

Disposal of refuse is a priority problem within Ibadan metropolis due to poor management and illegal and wanton practice of dumping refuse at convenient locations. Many waste disposal sites are sources of environmental pollution because waste is still largely disposed without effective safety and control measures. Thus, groundwater environment is being assaulted with an ever-increasing number of soluble chemicals.[1] Groundwater is the water that occurs below the surface of the earth, where it occupies all or part of the void spaces in geological layers. It is also called sub-surface water, which flows overland and in rivers. Water is one of the most prizes resources of any nation and it occupies a prominent position among rural and urban dwellers. Commercial qualities of water come from surface and subsurface sources. Availability of surface water varies with season whereas groundwater can be obtained all the year round.[2] The volume of groundwater greatly exceeds that of all fresh water, lakes and reservoir combined which occurs in several geological formation aquifers at various depth. [2, 3]

The growth of man's agricultural, industrial and urban activities has caused the appearance of many environmental problems which share common disturbing characteristics. The increase of awareness of pollution and its effects has emphasized the importance of water quality management in maintaining our natural waters in a fit state for various purpose (e.g. for use as drinking water, for recreation or to assure the viability of the native biota.3 The quality of any water depends very much on its physical, chemical and biological characteristics. Water intended for human consumption must be free from organisms and from concentration of chemical substances that may be hazardous. Drinking water should be pleasant as circumstances permit, coldness, absence of turbidity, absence of colour and of any disagreeable taste or smell are utmost importances in drinking water supplies. Recreational water used for sport involving contact with the physical body of the sport men and women must be aesthetically acceptable, must not contain substances that are toxic upon ingestion or irritating to the skin and must be reasonably free from pathogenic organisms, colour, odour, hydrogen ion concentration (pH) and toxic metal ions.[4,7] The quality of water needed for industrial use depends grossly on the type of industrial process for which the water is needed. The quality for different industrial processes differs from one and another. Agricultural activities, mainly irrigation requires water that is reasonably free from pathogenic organism, pH and specific ion, so as to give high yield of product as different type of soil can retain different amount of water.

Thus, any substance that gives unfavourable alteration, undesired changes in the physical, chemical and biological character of the water is termed pollutant. According to (Sridhar and Ademoroti, 1984), it is said that "in some parts of Lagos, the most industrialized city in Nigeria, some of the waters showed highly acidic pH as low as 3.4.[5] In developing countries, most especially in Nigeria, there is an increasing deterioration of natural water, soils and air. A variety of wastes originating from domestic and industrial sources find their way into these systems due to lack of legislation and basic infrastructure such as sewage and hygienic disposal. It has been recognized that measures for groundwater protection should focus on the best possible safety provisions for future waste disposal sites. [6, 7] Thus, this research work investigated the impact of abandoned refuse dump site on the groundwater quality surrounding Orita Aperin, a residential area where people depend on wells for their domestic water supply in Ibadan, Oyo state and therefore evaluate the possible health consequences of selected water parameters by comparing the results obtained with those of drinking water standards set by statuary bodies such as World Health Organisation (W.H.O).

2. MATERIALS AND METHODS

2.1. Description of Study Area

The study area is Orita-Aperin, a residential quarter located within Ibadan Northeast Local Government Council Area of Ibadan City. The study area, Orita Aperin refuse dumpsite is located within longitudes 3°53^{1}E and 30°56^{1}E and latitude 7°21^{1}N and 7°24^{1}N. The area extent of the waste disposal site is about 0.26 by 0.22 km^{2}. It is owned and maintained by the Ibadan Solid Waste Management Authority. This site is bordered to the north and south by buildings, to the west by a mini-market and to the east by a banana plantation. The study area falls within the humid and sub-humid tropical climate of southwestern Nigeria with a mean annual rainfall of about 1230 mm and mean maximum temperature of 32°C

2.2. Water sample container.

Water samples of about 3 litres each were collected from the 20 wells into plastic bottles. In each case, the samples were collected with the rubber or plastic drawer. Samples were also properly labeled, noting the sampling points, time and date of collection. Plastic containers were used throughout the course of this work for both storage and sampling.

2.3. Prevention of sample contamination

Plastic containers which were the recommended sample containers were used throughout for both sampling and storage. Initially the containers were thoroughly cleaned and properly capped or corked after the collection of samples. Temperature measurement of the water samples were done in-situ on the field followed by determination of alkalinity which was done on the same day immediately the samples got to the laboratory.

2.4. pH measurement

The pH meter (Model 3150 (Jenway) which was used was first standardized in the buffer solution of 0.05 m pure potassium hydrogen phthalate of 4.0 pH value. The electrode was removed, rinsed and washed thoroughly with distilled water, blot dried and immersed in water samples AE1 - AE10 and AW1 – AW10 one after the other with successive rinsing with distilled water and blot drying after each sample.

2.5. Classical Methods of Analysis

Classical methods of analysis (i.e. gravimetry and titrimetry) was used for the determination of total alkalinity, total hardness, total solids, total suspended solids, chloride using silver nitrate solution method while instrumental methods were employed to analyse sulphate (using turbidimetric method (at 420nm) and Orthophosphate (by colorimetric method at 880nm). Calibration graph was prepared and distilled water (50 mL) was used as the blank to zero the instrument

3. RESULTS AND DISCUSSION

The results of the analyses of the samples collected were summarized in Table 1 and 2. For ease of identification, the samples collected were represented as sample AE1 to AE10 and AW1 to AW10 unless otherwise stated. The samples were collected from eastern and western sides of the dump site to determine the migration and direction of flow of the leachates from the dumpsite. The results were expressed in milligram per litre (mg/L). The results obtained from the two sides of the dump were compared and these were in turn compared to International standard like World Health Organization standard.

Table 1: Result of the groundwater analysis at the eastern side of Orita-Aperin abandoned refuse dump (concentration in mg/L (i.e. PPM)

Number/ parameters	pH	Total alkalinity	Total hardness	Total solids	Total suspended solids	Total dissolved solids	Chloride	Sulphate	Orthophosphate
AE1	8.00	90	58	286	72	214	44	0.95	0.0007
AE2	8.16	85	60	256	60	196	23	0.75	N. D
AE3	7.72	70	116	730	185	545	94	0.80	N. D
AE4	7.59	45	64	550	130	420	98	0.85	N. D
AE5	7.63	90	78	424	106	318	58	0.95	N. D
AE6	7.84	220	182	170	295	875	42	0.90	N. D
AE7	8.19	140	134	600	100	500	94	1.90	0.0001
AE8	8.14	190	166	622	155	467	164	3.10	0.008
AE9	7.60	65	90	544	136	408	82	0.60	N D
AE10	7.56	45	58	442	110	332	46	0.95	N. D
MEAN	7.84	104	100.06	562.4	134.9	427.5	74.5	1.18	0.0029
S. D	0.244	57.04	44.15	246.30	63.88	184.8	38.86	0.722	0.0036
MAX.	8.19	220	182	1170	295	875	164	3.10	0.008
MIN.	7.56	45	58	256	60	196	23	0.60	0.0001
W.H.O (mg/l)	65-8.5		500			1000	250	400	

Table 2: Result of the groundwater analysis at the western side of Orita-Aperin abandoned refuse dump (concentration in mg/L (i.e. PPM)

Number/ parameters	pH	Total alkalinity	Total hardness	Total solids	Total suspended solids	Total dissolved solids	Chloride	Sulphate	Orthophosphate
AW1	6.82	70	136	526	130	396	199	1.50	N. D
AW2	7.29	110	194	542	136	406	157	4.50	N. D
AW3	7.15	35	62	260	50	210	48	1.00	N. D
AW4	6.96	50	72	198	50	148	56	0.95	N. D
AW5	7.49	190	120	412	100	342	146	4.30	N. D
AW6	7.62	150	130	1284	400	884	138	2.00	0.0004
AW7	7.87	110	132	458	110	348	70	1.30	N. D
AW8	8.20	150	128	298	75	223	62	1.50	0.0043
AW9	8.11	150	138	436	200	200	68	1.55	0.00175
AW10	8.12	100	120	398	100	298	52	1.10	0.0009
MEAN	7.56	11.5	123.2	484.2	135.1	345.5	99.6	1.90	0.0018
S.D	0.48	470	34.5	287.0	97.8	198.0	51.9	1.25	0.0015
MAX.	8.20	190	194	1284	400	884	199	4.5	0.0043
IN.	6.82	35	62	198	50	148	48	0.95	0.0004
W.H.O (mg/L)	65-8.5		500			1000	250	400	

Table 3: Summary of the result of the groundwater analysis at the eastern and western sides of Orita-Aperin abandoned refuse dump (in mg/L).

No	Parameters	Mean ± eastern	S.D	Mean ± Western	S. D	W.H.O STD. (mg/l)
1.	pH	784	0.24	7.56	0.48	6.5 – 8.5
2.	Total Alkalinity	104	57.4	111.5	47.0	
3.	Total Hardness	100.6	44.51	123.2	34.5	500
4.	Total Solids	562.4	246.30	484.2	287.0	
5.	Total Suspended Solids	134.9	63.88	135.1	97.8	
6.	Total Dissolved Solids	427.5	184.8	345.5	198.0	1000
7.	Chloride	74.5	38.86	99.6	51.1	250
8.	Sulphate	1,18	0.72	1.97	1.25	400
9.	Orthophosphate	0.0029	0.0036	0.0018	0.0015	

KEY: W. H. O = World Health Organization Standard.; NO G. V. S = No Guideline Value Set.

4. CONCLUSION

The result of chemical analyses of groundwater samples from eastern and western sides of Orita-Aperin abandoned refuse dump revealed the impact of the dump on the groundwater quality most especially the chemical pollutants; some of which are above the international standard recommended by the World Health Organization. From Table 3 above, it can been seen that the level of total hardness (123.2 mg/L ± 34.5), Sulphate (1.97 mg/ L ± 1.25), and Chloride (99.6 mg/L ± 51.9) were higher in the groundwater samples at the western side than level of total hardness (100.6 mg/L ± 44.51), Sulphate (1.18 mg/L± 0.72) and Chloride (74.5 mg/L ± 38.86) at the eastern side of the dump (see Table 3) although the level of these parameters at both sides fall below World Health Organization guideline values. This result was in agreement with the result of (Ikem et al., 2002).[8] Equally, the pH of the groundwater at the eastern part (7.84 ± 0.24) was higher than the pH of water samples at western part (7.56) although both values were within the range of 6.5 – 8.5 recommended as the pH of good drinking or potable water by World Health Organization.[9] It becames obvious that there was little or no contamination of groundwater in the area at the time of this research but routine analysis at interval from the area to assess any sudden increased in concentration of any parameter were hereby recommended. The researcher, therefore appealed to Oyo state government to remove the dumpsite as a final solution to groundwater contamination and future waste disposal sites should be located far away from residential area.

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