PHYSICOCHEMICAL PROPERTIES OF RAIN WATER COLLECTED AROUND AKPOHA QUARRYING AND MINING SITE, EBONYI STATE, NIGERIA

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ABSTRACT

Rainwater sample collected from the galvanized metal roof top around Akpoha mining and quarrying site in the month of July, 2016, were analyzed in order to ascertain its quality and properties. Standard methods were used in the analysis and the following results were obtained for various parameters: temperature (28.5^{0}C), pH (5.80^{0}C), conductivity (9.60µs/cm). TDS (5.90mg/L). TSS (10.0mg/L). TS (15.9mg/L) and Turbidity (7.73 NTU), Hexavalent. Chromium (BDL). Zinc (0.53mg/L), Lead (0.14mg/L), Potassium (0.70mg/L). Calcium (BDL) Magnesium (0.96mg/L). Total hardness (4.00mg$CaCO_3$/L), bicarbonate (7.00mg$CaCO_3$/L), Chloride (BDL), nitrate (1.30mg/L), ammonia (BDL), Sulphate (1.00mg/L), Dissolved Oxygen (6.70mg/L), BOD (6.05mg/L) and COD(10.0mg/L). The results were compared with the standard limits recommended by WHO and NIS for water analysis and it was observed that all the parameters tested except Pb was within the limits stipulated by the standard organization. This could be attributed to the mining and quarrying activities around the study location.

Keywords: Physiochemical, Akpoha, Rainwater, WHO, NIS

INTRODUCTION

Limestone is an important raw material that is widely used for cement production (Pamukcu and Simsir, 2006). Rapid economic development and the growth of urban areas in many countries have fueled an ever increasing need for limestone (Duan *et al.*, 2008).

Concentration of many compounds – present in the atmosphere has been significantly affected by human's activities such as industry, agriculture, mining, burning of vegetation and fossil fuel (Akoto *et al.*, 2011).

Quantification of these changes and their effects on terrestrial and aquatic ecosystems is important because of their potential adverse effect (Nriagn and Davidson, 1986).

Rain water composition plays an important role in scavenging soluble components from the atmosphere and helping understand the relative contributions of different sources of atmospheric pollutants (Gabriel et al., 2015). Various sources of the dissolved components in rainwater can generally be divided into three groups; (a) sea salt aerosols; (b) terrestrial aerosol (soil dust, biological emissions) and (c) Anthropogenic inputs (industry, agriculture and fertilizers, combustion of fossil fuels) (Negrel and Roy, 1998).

Rainwater functions as a major sink for both gaseous and particulate matter including trace metals in the atmosphere and therefore plays an important role in controlling the concentration of these species. The chemical composition of atmospheric depositions is the signature of numerous physical and chemical mechanisms of aerosol and precursor emissions transport, chemical – reactions and removal processes. Therefore the chemistry of wet depositions can provide insights into temporal – evolution of atmospheric pollution, and be used as a pertinent indicator to evaluate natural process versus anthropogenic influences. This is because rainwater composition plays an important role in scavenging soluble components from the atmosphere and helping understand the relative contributions of the different sources of pollutants (Tang *et al.,* 2005, Ozsoy *et al.,* 2008; Yang *et al.*, 2011).

Determination of rainwater composition reveals the relative importance of different sources/types of gases and particulate matter present in the atmosphere.

Determination of background concentration levels of those pollutants in precipitation become useful tools in diagnosis where possible environmental impact causes in a specific zone is required and establishing a comparison when reference laws or standards of non-criteria pollutants are not available. Commonly these values are established for remote areas with a minimal anthropogenic influence, by this way it is possible to accomplish a diagnosis of impact caused by non-criteria pollutants.

To assess the impact from geochemical and anthropogenic sources (human activity, volcanic activity and crystal) on chemical composition of rainwater in a specific region, knowledge of the background levels of wet deposition is critical for new project areas (Gabriel *et al.,* 2015).Scavenging of the atmospheric pollutants by rain affects the chemical composition and the pH of rainwater. The degree of acidity in rainwater depends on the neutralization effects of certain components such as ammonia and calcium carbonate and/or hydroxide on the acidic ions present in the water (Kulshrestha *et al.*, 1995, a,b).

The present study reports the physicochemical composition of precipitation in Akpoha a limestone quarrying and mining are in Afikpo North L.G.A of Ebonyi State, Nigeria. The objective of this study is to determine the level of atmosphere pollution in Akpoha through the determination of the physical and chemical composition of rainwater. The data will significantly contribute to the very limited knowledge available on rainwater quality in West Africa.

MATERIALS AND METHOD

Sample of rainwater was collected around the mining and quarrying areas during the peak of raining season in 2016. In order to avoid collection of suspended solid particles, samples were collected at 1.5m above the ground using high density poly ethylene buckets.

Samples were placed on supports after the start of the rain to ensure that only wet depositions were collected. Samples were analyzed for temperature, pH, electrical conductivity and turbidity immediately after collection.

The total dissolved solid, total suspended solid, potassium, hardness, chlorides, alkalinity, bicarbonates, nitrate, ammonia, sulphate, DO, COD & BOD were determined using standard analytical procedures as reported by APHA (1995). Zinc, Lead and Hexavalent Chromium were determined using the AAS.

RESULT AND DISCUSSION

RESULT

The standard and observed values of physicochemical parameters of the experimental water sample are presented in the table-below

RESULT:

PARAMETERS	SAMPLES	NIS	W. H. O STANDARD
General appearance			20-32
Temperature (°C)	28.5	Ambient	20-32
pH @ 25. 0^0C	5.80	6.5-8.5	6.5-8.5
Conductivity (μS/cm	9.60	1000	0.1
Total Dissolved Solids (mg/L)	5.90	-	1000
Total Suspended	100	-	5

Solids (mg/L)			
Total Solid (TS)	15.9	-	
Turbidity (NTU)	7.730.53	5	5-25
Hexavalent Chromium (mg/L)	BDL	0.05	0.1
Zinc (mg/L)	0.53	3.00	3.00
Lead (mg/L)	0.41	0.01	0.01
Potassium (mg/L)	0.70		
Calcium (mg/L)	BDL	0.003	100-500
Magnesium (mg/L)	0.96	20	0.1
Total Hardness (mg/$CaCO_3$/L)	4.00	150	100-500
Ca Hardness (mg/$CaCO_3$/L)	BDL		
Mg Harness (mg/$CaCO_3$/L)	4.00		0.1
Total Alkalinity (mg/$CaCO_3$/L)	700		
Bicarbonate (mg/$CaCO_3$/L)	7.00		
Chloride (mg/L)	BDL	250	250
Nature (mg/L)	1.30	50	50
Ammonia (mg/L)	BDL		
Sulphate (mg/L)	1.00	100	200
Dissolved Oxygen (mg/L)	6.70		5-8
BOD (mg/L)	10.00		N. E
COD (mg/L)	8.00		N. E

pH of water is directly related to carbonate and bicarbonate ion present in it. This is closely associated with the CO_2 pressure and ionic strength of solution uttering the pH value changes the quality of water from this study, the pH of the harvested rain water was

found to be 5.80 which indicates some level of acidity. This could be attributed to the presence of bicarbonate, whose concentration in the harvested water sample was found to be 7.00mg/L. The pH value obtained for the harvested rain water samples fall below the range stipulated by both Nigeria Industrial Standard (NIS) and World health Organization (WHO).

The temperature of the water sample was found to be 28.50C, and this conforms to the WHO recommended standard of 20 – 32^0C.

The turbidity of the rain water was also found to be to be 7.73NTU which is relatively high compared to the limit of NTU set by WHO and NIS respectively. This may be attributed to the presence of organism pollutants. High turbidity levels in water are usually associated with disease micro-organisms.

Conductivity estimates the total amount of dissolved ions or total dissolved salts into the water. The conductivity value for the sample was found to be 9.60μs/cm and is below the standard of 1000μs/cm set by NIS. Although there is no set standard by WHO for electrical conductivity also the value gotten was found to be below the one recorded.

The concentration of nitrate and sulphate ions in the sample was found to be 1.30mg/L and 1.00mg/L respectively. The values were within the maximum permissible limits set by WHO and NIS. The concentration of chloride ion and ammonia were found to be below detectable limit.

Dissolved oxygen in natural waste water depends on the physical, chemical and biological activities in a given water body. The present study shows that the dissolved oxygen was found to be 6.70mg/L. This value was found to be within a maximum permissible limit set by WHO. Although there is no set standard for dissolved oxygen by NIS, Chemical oxygen demand is a

measure of oxygen equivalent to the organic matter content susceptible to oxidation and this is an index of organic pollution in water environment while biochemical oxygen demand is the quality of dissolved oxygen needed by aerobic biological organism in a given water sample at a certain temperature over a specific period of time. The present study shows that the value for BOD and COD are 6.5mg/L and 10.0mg/L respectively. There are no set standard by NIS and WHO for BOD and COD of water sample.

The values for the total dissolved solid and total suspended solid were found to be 5.90mg/L and 10.0mg/L respectively. TDS measures the amount of dissolved salt in water just like electrical conductivity and are both measures of salinity. The two properties were found to be below the standard limits set by NIS and WHO.

The concentration of potassium and magnesium were found to be 0.70mg/L and 0.96mg/L, the value for calcium concentration were found to be below detectable limits which could be attributed to the heavy rainfall within the period of study even through the sampling location is situated around a limestone mining and quarrying site. The value for magnesium concentration was within the standard stipulated by NIS. However there are no set standard for potassium and calcium concentration.

The concentration of the heavy metals were found to be 0.53mg/L for zinc, 0.41mg/L for lead and 0.008mg/L for cadmium while the concentration of hexavalent chromium was found to be below the detectable limits. With the exception of zinc, the concentration of lead and cadmium were found to be above the maximum permissible limits set by WHO and NIS. The presence of zinc could be attributed to the chemical constituent of the roofing sheet from where the rain water was harvested. As expected the location of the quarrying and mining might have contributed to the high level of lead in the collected rain sample. Lead can cause several unwanted effect such as: disruption of the biosynthesis of

haemoglobin and anemia, a rise in blood pressure, kidney damage, miscarriages and subtle abortion. Disruption of nervous systems, brain damage, and declined fertility of men through sperm damage diminished learning of children, behavioral disruption of children, such as aggressing impulsive behavior and hyper activity. Lead can enter a fetus through the placenta of the mother; because of this it can cause serious damage to the nervous system and the brain of unborn children. Adedeji, *et al* (2014)

The total hardness of the water was found to be 4.00mg/L. Although the calcium harness was found to be below detectable limit and that of magnesium was found to be below detectable limit. Consequently, the total hardness was still within the standard range stipulated by WHO and NIS.

CONCLUSION AND RECOMMENDATIONS

A preliminary assessment of harvested rain water is essential before use as they could contain substances that may be harmful. The presence of some heavy metals in the sample under study could be attributed to the mining and quarrying activities around the sample location and since the concentration of most of the world acclaimed notorious heavy metal pollutants (lead) are significantly higher than the standard stipulated by WHO and NIS, this study has established a measure environmental concern that if not addressed in time could trigger some health malady on the populace living within and around the study location.

Furthermore, there is possibility of sever contamination of other environmental matrices like soil and stream water from rain water runoff in view of the significant heavy metal load in the harvested rain water. Effort should be made by appropriate government agencies to regulate the activities of mining and quarrying industries in the study location so as to safe guard the health of the inhabitant of the study area. The public are enjoined to participate fully in the enforcement of the strict environmental and safe

environmental management practices so as to safe guard the environment.

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