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Physico-Chemical Analysis of Rain Water from five different Sites in Enugu Metropolis (Emene, IMT Campus 3, Agbani Road, Abakpa and Coal Camp)

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ABSTRACT

The physic-Chemical properties of rain water from five selected areas in Enugu metropolis of Enugu State. Nigeria were carried out. Rain water samples were collected from five locations viz: Emene, IMT Campus III, Agbani road, Abakpa and coal camp in Enugu metropolis the sample rainwater were collected in the month of August which was fourteen physio chemical parameters such as P^H, acidity, temperature. Electrical conductivity, Total solids, Total suspended solids, Total dissolved solids, Nitrate, chloride, sulphate and heavy metals such as lead, cadmium, chromium and copper were tested. The results shown that the parameters from all the samples were within WHO standard for portable water except for lead. This confirms that there is no risk of environmental pollution.

Keywords: Physicochemical, rain water, parameters and Enugu

INTRODUCTION

Rainwater of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability. An average man of 53kg-63kg body weight requires about 3 litres of water in liquid and food daily to keep healthy [1]. This fact apparently accounts for why rain water is regarded as one of the most indispensible substances in life and like air it is **most** abundant [2], Rain water is an important source of fresh water especially for those who in rural areas, where water use is limited due to scarcity or where surface and underground water quality is poor. In many areas, rainwater is still considered as a safe and suitable source of portable water, and it commonly used as such [3].

Rainfall constitutes one of the largest sources of water in Nigeria. The rainfall is mainly during the rainy season which varies from north to south. Hence, it runs from June to October in the north and April to October in the south [4].

Developments in science and technology have brought improved living standard, but increased human population have also unwittingly introduced some pollution into our environment. Substances are regarded as pollutants if they are present in concentration toxic to man, animals and or plants [5]. These include emissions and effluents from factories, refineries, waste treatment plant, oil or gases of varying quality and quantity that are emitted into the atmosphere. Unsafe rainwater is a global public health threat, placing persons at risk for a host of diarrhea and other diseases as well as chemical intoxicant [6]. These chemicals are mostly odourless, colourless and tasteless and most, importantly are health hazards. Most of the fresh rainwater bodies all over the world are getting polluted, thus decreasing the portability of rainwater [7]. Pollutants released to the atmosphere as gases and aerosols from human activities are transported and deposited several kilometers away from their source as dry or wet deposition, with its consequences

over living organisms in the ecosystems [8]. The importance of rainwater to man cannot be over emphasized. Man can survive longer without food than without rainwater because he requires it for his cooking, washing, sanitation, drinking and for growing his crops and also run his factories. Therefore modern man like his primitive ancestors is heavily dependent on rainwater for his sustenance. The provision of good quality rainwater can help in eradicating rainwater-borne diseases and in improving the general sanitation of Nigeria's towns and villages [9]. Acid rain is formed through a complex process of chemical reaction involving air pollution [10]. The most important pollutants that contribute to the formation of acid rain are nitrogen oxide and sulphur-dioxide which react with moisture in the atmosphere to form nitric and sulphuric acid. The sulphur and nitrogen that contribute to acid rain primarily come from man made sources such as industries, utilities, automobiles and other forms of transportation and industrial processes. [11] There is need therefore, to investigate the effects of these pollutants on the rainfall occurring in the vicinity of those industries and neighbouring industrial. In this study, rainwater samples from five locations namely Emene, IMT campus III, Agbani road, Abakpa and Coal camp were collected in order to check for the physical and chemical properties.

Statement of Problems

Rainwater as a natural source of water has been known as major source of drinking water during rainy season, and most a times people living around ^these areas had been suffering from certain water borne diseases such as diarrhea, typhoid, cholera etc due to rainwater contamination. [12] As a result of this research work was therefore carried out to determine the physico-chemical properties of rainwater in these study areas within Enugu metropolis to find out if there are any diseases causing agent within the environment

Objective of the Study

1. To find out the pollution level in the rainwater collected around these areas of the state.
2. To find out if there is any significance difference between the World Health Organization (WHO) standard for drinking water and analysis carried out on rainwater.
3. To ascertain the level of heavy metal pollution in these areas.

Significance of The Study

1. The data obtained from these research will help to monitor the anthropogenic activities going on around these areas such as insistent burning of tyres and fossil fuel.
2. The data to obtain from this work will help to guard the people so that they can conveniently collect the rainwater for drinking; without the fear of contamination.

Limitation of The Study

This research work is limited to the determination of the physicochemical properties of rain water samples collected from IMT, Ernene, Agbani road, Albakpa and Coal camp.

Sample Collection

Rainwater samples were collected in five (5) different places Emene, Agbani road. Abakpa, IMT Campus III arid coal camp in Enugu metropolis. During the time of collection, care was taken to ensure that samples were collected accordingly and that no accidental contaminations occur during sampling. Rainwater samples were collected using a clean light-blue plastic containers by placing the container on top of a tank in an open environment to ensure that the water have no contact with any object entering into the container. [13] At the collection point, the containers were rinsed with the first run water twice before filling with the samples and the containers was then corked tightly after collection. The containers were labeled at the point of collection and transported to the laboratory were it was kept in the refrigerator until the time of analysis

SAMPLE ANALYSIS OF DIFFERENT PARAMETERS

Procedure of Analysis General Appearance

The water samples were placed in a clean beaker and the appearance was observed.

Physical parameters of Rainwater

Determination of P^H

The p^H was determined using Technel p^H meter. A portion 50ml of the sample was measured into a 100ml beaker and the p^H electrode was inserted into the beaker. The readings were recorded.

Determination of Acidity

The P^H of the water was measured with a calibrated P^H meter. A 50ml burette was properly cleaned and rinsed severally with 0.05m NaOH. Fill the burette with NaOH solution, make sure there is no air bubbles in the tip. 100ml of the sample was measured into a conical flask. 3 drops of phenolphthalein indicator was added and titrated with NaOH solution in. the burette until a pink colour endpoint was observed. Acidity = (ml of NaOH) X (Morality of NaOH) x 50.00/vol of sample.

Determination of Total solid (TS)

Clean dry beakers were placed in the oven at 105°c for 1 hour. [14] They were placed in a desicator to cool. The beakers were weighed after drying on analytical weighing balance, l00rnl of each sample was measured into the pre-weighed beakers and evaporated to dryness on a hot plate with magnetic stirrer. The beakers were allowed to cool very well in the desicators and then reweighed.

Total solids (mg/1) = Ws x l00/vol of water used

Where Ws ~ Weight of filter paper

Volume of water used = 100ml

Determination of Total Suspended solid **(TSS)**

Whatman no 1 filter papers were pre-weighed and the weights noted. L00rnl of each sample was measured out and filtered. Through the filter with a clean funnel. [15] The filter paper was removed and placed in the oven at 105°c to dry. They were placed in the desicator to dry and reweighed.

Total suspended solids (mg/1) = (A-B) x l00/vol. of water used.

Where A = weight of filter paper + residue

B = weight filter alone

Volume used = 100ml

Standard = 1000crn^3

Determination of Total Dissolved Solid (TDS)

Total dissolved solid = total solid-total suspended solid.

Determination of Temperature

The temperature of the sample was measured with a temperature meter.

Determination of Electrical Conductivity

The electrical conductivity was determined and measured with a standard Henna conductivity meter, a portion 50ml of the sample was measured; into 100ml beaker and the conductivity recorded by inserting the electrode.

Chemical parameters of rainwater

Chloride determination

Method: Chloride analysis was done according to APHA standard method [APHA: 1998).

Procedure: A 100ml of the clear sample was pipetted into an Erlenmeyer flask and the p^H adjusted to 7-10 with either H_2SO_4 or NaOH solution. Then 100ml of K_2CrO_4 indicator solution was added with standard solution of $AgNO_3$ in a permanent reddish brown colouration. The $AgNO_3$ titrant was standardized and a reagent blank established. A blank of 0.2-0.3ml is usual for the method.

Calculation

Chloride conc. = Titre value (x) x 10 = 10xmg/l.

Sulphate determination

Method: Sulphate analyzed according to APPIA standard method (APHA: 1998).

Procedure: A 250cm^3 of the water sample was evaporated to dryness on a dish. The residue was moisten with a few drops of, cone. HCL and 30cm^3 distilled water added. This was boiled and then filtered.

The dish was rinsed and the filter paper washed with several portions of distilled

water and both filtrate and washings added together. This was heated to boiling and then 10cm^3 of 10% $BaCl_2$ solution was added drop by drop with constant stirring. The mixture was digested for about 30 minutes, filtered and the filter paper washed with warm distilled water. It was then ignited, cooled and weighed in an already weighed crucible.

Calculation

Mg/drn^{3}SG4^{2-} = $MgBaSO_4$ x 411,5cm^3 of water sample.

Nitrate Determination

Method: Nitrate is determined using PD303UV spectrophotometer (APHA: 1998).

Principle: Nitrates react with phenoldisulphonic acid and produced a nitrate derivative which in alkaline solution devel ops yellow colour due to rearrangement of its structure. The intensity of colour produced is directly proportional to the concentration of nitrates; present in the sample.A known volume (50ml) of the sample was pipette into a porcelain dish and evaporated to dryness on a hot water bath. 2ml of phenol disulphonic acid was added to dissolve the residue' by constant stirring with a glass rod. Concentrated solution hydroxide and distilled water was added with stirring to make it alkaline. This was filtered into a Nessler's tube and made up to 50ml with distilled water. The absorbance was read at 410nm using a spectrophotometer after the development of colour.

Method for the heavy metal analysis of Rainwater samples

Heavy metal analysis was conducted using Varian AA240 Atomic Absorption spectrophotometer according to the method of APHA 1995 (American Public Health Association)

Working principle: Atomic absorption spectrometers working principle is based on the sample being aspirated into the flame and atomized when the AAS's light beam is directed through the flame into the monochromator and onto the detector that measures the amount of light absorbed by the atomized, element in the flame. Since metals have their own characteristic absorption wavelength, a source lamp composed of the element is used known as hallow cathode lamp. Making the method relatively free from spectral or radiational interferences. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample measured.

Procedure: The sample were thoroughly mixed by shaking and 100ml of it was transferred into a glass beaker of 250rnl volume to which 5ml of cone. Nitric acid is added and heated to boil till the volume is reduced to about 15-20ml by adding cone. Nitric acid in increment of 5ml till the entire residue is completely dissolved. The mixture is cooled, transferred and made up of 100ml using metal free distilled water. The sample is aspirated into the oxidizing air-acetylene flame. When the aqueous sample Is aspirated, the sensitivity for 1% absorption is observed.

Preparation of reference solutions

A series of standard metal solutions in the optimum concentration range are prepared, the reference solutions were prepared daily by diluting the single stock element solutions with water containing 1.5ml cone. Nitric acid/litre. A calibration blank was prepared using all the reagents except for the metal stock solutions.

Determination of the metal content

The instructions given by the manufacture, of the spectrometer was followed In order to reduce interference and background noise. Three parallel extractions were carried out. The concentration of each element were determined by means of the calibration graph.

RESULTS

The results of the physicochemicai parameters of the different samples (Rainwater) collected from Emene, IMT Campus III, Agbani road, Abakpa and coal

camp are presented in Tables 1 and 2 below.

Table 1: Physical and Chemical Analysis of rainwater in Ernene, IMT campus III, Agbani road, Abakpa and Goal camp.

Parameter	Abakpa	Agbani	Coal	Emene	IMT	WHO standard
pH	6.74	6.07	5.65	6.97	5.82	5.8-8.5
Acidity	0.632	0.403	0.880	0.525	0.356	100
Temperature (^oC)	23	22	23	24	21	23
Electrical conductivity	30 US/cm	30 US/cm	36 US/cm	36 US/cm	20 US/cm	900
Total solids (mg/l)	305	305	205	489	250	500
Total suspended solids (mg/l)	330	236	352	280	330	500
Total dissolved solids (mg/l)	ND	69	ND	209	ND	500
Nitrates (mg/l)	2.8947	2.8947	2.8947	3.684	2.8070	10
Chloride (mg/l)	126	150	129	146	120	250
Sulphate (mg/l)	86.415	131.681	139.91	119.747	102.875	500

ND = Not detected

Table 2: Result for Heavy Metal Analysis from Sample

Metals	Emene	Coal camp	Abakpa	IMT	Agba	WHO standard
Cadmium	ND	ND	ND	ND	ND	0.005
Lead	0.026	0.157	0.025	0.095	0.076	0.05
Chromium	ND	ND	ND	ND	ND	0.05
Copper	ND	ND	ND	ND	ND	0.05

ND = Not detected

DISCUSSION

The results showed that the P^H values of the samples ranged from 5.65-6.97 which falls within the WHO limit. Unpolluted rain water has a p^H of about 5.6 while alkaline dust can raise the p^H to about 7.0 and P^H value of 4 or below results in acid rain water [16].

Acidity increases the capacity of the water to attack geological materials. Slight acidity of rainwater suggest that the water were susceptible to some degree of trace 489 and 236-352 respectively and therefore, No health threat is posed by them.

The total dissolved solids value were not detected in some areas while the areas where it was detected fall within the WHO limit.

The nitrate values ranged between 2.8070-3.684. The result showed that all-samples had low nitrate value when compared with WHO limit. Nitrate detected in the rain water might be attributed to the burning of fossil fuels and flaming of petroleum, gas into the atmosphere. The chloride value of the samples fall within the WHO standard for drinking water with the values from I 120-150. The sulphate value of the samples fall within the WHO limit with the values ranging from 86.415-139.191.

Heavy Metals Analysis: Cadmium, Chromium and Copper were not detected in the samples. Lead value of the samples ranged from 0.025-0.157 which is higher than the WHO standard for drinking water. The presence of Lead in the

environment may be attributed both to natural and anthropogenic activities such' as burning of fossil fuels and from exhaust fumes of motor cars, because lead is a major component of antiknock ingredients in petrol.

CONCLUSION

The properties of the rain water investigated met the WHO drinking water standard. Though the rain water is safe for drinking and for the other domestic activities but the presence of dust and other particles is inevitable. The quality of rain water is directly related to the cleanliness of catchments and storage tanks. Rooftop catchment surfaces collect dust, organic matter, leaves/ birds and animal droppings which can contaminate the water and cause sediment buildup in tanks. Care should also be taken to avoid materials that may cause adverse taste, colour and odour in rainwater collected. Regular cleaning of catchment surfaces should be undertaken to minimize the accumulation of debris and avoid contamination of the rainwater. The results obtained from the analysis of the samples revealed that the quality of rain water in Emene, IMT-campus III, Agbani road, Abakpa and Coal camp had been assessed by comparing each concentration with the standard limit of the parameter in drinking water as prescribed by WHO are within permissible limits with the exception of lead.

RECOMMENDATION

It is therefore recommended that routine analysis of this type should also be embarked upon on a regular 'basis to ascertain the level of climate and other pollution factors impact on the rain water in these areas. Government should also embark on mitigation polices addressing the indiscriminate burning of fossil fuel releasing toxic gases, into the environment which contributes to rainwater pollution.

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