

Physico-Chemical Parameters of Water from Galena mining area at Nahuta Alkaleri Local Government Area, Bauchi State, Nigeria

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Abstract: Physiochemical parameters shows that Nahuta water and sediment samples shows an increase in pH values of acidity with change in time, with small fluctuations at varying samples. Conductivity test revealed that water samples shows increase in conductivity with increase in absorption time. Mean concentrations of Nitrates, chloride and Bromates in Nahuta was found to be 1.08 mg/l, 77.18mg/l and 0.044mg/l. Phosphate and Sulphates concentrations in water shows 1.77mg/l and 66mg/l respectively. Dissolve Oxygen (DO) and Biological Oxygen Demand (BOD) contributed about 7.1mg/l and 4mg/l, while COD and TOC remain as 57.6mg/l and 0.864mg/l. Bioaccumulation factor of Nahuta water samples was found to be 11.57mg/l. These signified that Nahuta Galena mine area water was nontoxic to both plants, animals and human consumption.

Keywords: Physiochemical, Conductivity, Water, toxic.

1. INTRODUCTION

Mining activities of mineral resources contribute immensely towards degradation of land surfaces that resulted to pollution of some heavy metals into soil by affected the water level composition. Desorption of surface-bound Pb^{2+} and other cations from mineral Galena surfaces under acidic solution conditions results in an increase in the concentration level of potentially bioavailable forms of heavy metal cations in surface waters and groundwater (Gordon *et al.*, 1999).

However, these anthropogenic activities, industrial and urban wastes are inevitably discharged into water bodies and consequently, heavy metals are frequently detected in water environment and have gradually become a major concern worldwide. Heavy metals can either be adsorbed onto sediment or accumulated by benthic organism to toxic levels, the bioavailability and subsequent toxicity of the metals being dependent upon the various forms and amount of the metal bound to the sediment matrices. The contamination of sediment with heavy metals, even in small concentration may lead to serious environmental problem as reported by (Bentum *et al.*, 2011).

2. MATERIAL AND METHODS

Sampling

The samples were collected from the identified points in the mining area at five different locations in Nahuta village in Alkaleri Local Government of Bauchi State. Samples of water from Galena (Kohl) mining area, are collected by using the methods described by (Samuel and Maina, 2010).

Water Sampling

Water samples was collected using water sampler by submerging the sampler bottle when close into the water location and opened up to collect water and then capped while submerged to avoid mixing with contaminants as adopted by (Apha,1992). Water Samples was also collected in plastic sample bottles, then each sample of water was mixed with 1.5ml of 70% HNO_3 in a litre that gave a $pH < 2$ for preservation due to analysis of elements present.

Table 1: Sample and Sample Locations

Samples	Location	Sample Type
Nahuta water	Nahuta mining site(Gwantanamo)	Mine lake water
	Nahuta Well(Deep Water)	Well water
	Nahuta mining site(Niger cape)	Mine water
	Nahuta (Panguru river mining site)	Mine lake water
	Nahuta (Panguru river water)	River water

pH Values of Water Sample 100cm³ of sample water was poured into a 250cm³ conical flask then 20cm³ of Buffer 7.0 solutions was added that mixed up the solutions. Then pH meter (3150 Jenway) was calibrated with the buffer solutions added and inserted into the solution immediately. The probe was then left standing in distilled water for 6 hours, the P^H values of the water samples collected from five samples locations were recorded at an hourly bases for 6 hours as reported by (Usman and Maitera, 2015).

Conductivity Test of Water Samples

50cm³ each of water samples was shaken in 50ml of distilled water in an extraction bottle with mechanical shaker for 1hr. The suspension was filtered twice to remove turbidity and two drops of 0.1% Na₂PO₃ was added to the filtrate. Probe of conductivity meter was inserted and value are recorded in NScm⁻¹ as adopted by (Apha, 1992).

Determination of Nitrates in Water

2g of KNO₃ was dried in an oven at 105⁰c for 24 h and 0.721g of powdered sample was dissolved in distilled water, then it was transferred into 1000 ml volumetric flask giving nitrate stock solution. 100ml of the stock solution was diluted to 1000ml giving intermediate nitrate solution. Nitrate calibration standards was prepared in the range 50-250 Mg NO₃⁻ /liter. The absorbance was recorded using UV Spectrophotometer and a calibration curve of absorbance versus concentration was plotted as adopted by (Apha, 1992).

Determination of Chlorides in Water Sample

100ml of sample water was measured into volumetric flask. The pH of the water sample was adjusted to 8.0 using sodium hydroxide solution and 10ml of K₂Cr₂O₄ indicator added the mixture was titrated with 0.04ml AgNO₃ in micro burettes. A blank of 0.02ml of sample water was used for the titration as indicated by (Apha, 1992).

$$\text{Mg Cl}^{\text{tilter}} = \frac{\text{Titre value} \times \text{M} \times 1000}{\text{Volume of sample (ml)}}$$

Determination of Bromates in Water Sample Stock Solutions was Prepare by dissolving 1000 mg/L each of stock standard solutions of, Sodium bromate (NaBrO₃), Sodium chlorate (NaClO₃) and by weighing 0.1676 g, 0.1180 g, and 0.1275 g, respectively, of the corresponding sodium salts in separate 100 mL volumetric flasks of DI water. Standard Solutions prepared are then calibrated with curve of absorbance versus concentration was plotted that unveil the amount of bromate. (Brain and Jeff, 2004).

Methods for Sulphates in Water Samples

2.14g of KH₂PO₄ was measured and it was dissolved in 1 litre of distilled water which was about 500 ppm phosphorus stock solution of the extraction volume. 5ml of water sample was weighed into 25ml conical flask, and 25ml of extracting solution was added and then shaken on a mechanical shirker for 30 minutes, centrifuged and supernatant decanted. 0.543g of anhydrous K₂SO₄ was dissolved in 1 litre of distilled water in a volumetric flask giving 100ppm SO₄²⁻ stock solution. This was used to prepare working standard at 1,2,3,4,5 and 6µg. 5).

Absorbance was measured and calibration curve of absorbance versus concentration was plotted as adopted by (Apha, 1992).

Dissolved Oxygen (DO) Methods

Meter and probe was employed that did the testing in the field; dissolved oxygen levels in a sample bottle change quickly due to the decomposition of organic material by microorganisms or the production of oxygen by algae and other plants in

the sample. This can lower your DO reading. Variation of the Winkler method used, was possible that fixed the sample in the field and it was delivered to a laboratory for titration. This was preferable by sampling under adverse conditions that reduced the time spent collecting samples which avoided contamination. It was also a little easier to titrate samples in the laboratory, and more quality control was possible by the titrations as adopted by (Apha, 1992).

Method of BOD Determination

The Winkler method adopted involves filling a sample bottle completely with water without air that was be left to bias the test. The dissolved oxygen was then "fixed" using a series of reagents that form an acid compound that was titrated. Titration involves the addition of a reagent drop-by-drop that neutralizes the acid compound and that caused a change in the color of the solution. The point at which the color changes was the "endpoint" was equivalent to the amount of oxygen dissolved in the sample. The sample was fixed and titrated in the field at the sample site. It was possible, however, the prepared sample in the field was delivered to a laboratory for titration as indicated by (Apha, 1992).

Methods of Chemical Oxygen Demand (COD)

Sample solution was heated during oxidation with excess di chromate. The excess dichromate was determined by method of oxidation –reduction titration with ferrous ammonium sulphates using an Iron (ii) orthophenanthroline as an indicator the products are CO₂ and water while dichromate was reduced to Cr³⁺ which was known as back titration in analytical chemistry as described by (AEPA,1971)

Methods of Total Organic Carbon (TOC) in water

Water samples collected from the field at the sample site was fixed and titrated to determine the Total Organic carbon. It was possible, however, the collected sample in the field was delivered to a laboratory within 6 hours that avoided contamination for treatment titration as indicated by (Apha, 1992).

Bioaccumulation Factor (BAF)

Guidance was illustrated to calculate the BAF in terms of freely dissolved concentration in the water when data regarding total concentrations in the water, particulate organic carbon (POC), and dissolved organic carbon (DOC) measurements are available as reported by (USEPA, 1995).

$$BAF_w = \frac{C_t}{C_w}$$

Where BAF is the BAF calculated using empirical data;

C_t= Concentration of a contaminant in the tissues of an organism (mg/kg, preferably dry weight, but moisture content should also be reported);

C_s= Concentration of contaminant in the sediment (mg/kg, preferably dry weight); and

C_w= Concentration of the contaminant in the water (mg/L).

3. RESULTS AND DISCUSSION

Analysis of pH Values of Nahuta Water Bar charts representation on Figure 1 indicated that W4 showed increase in pH after five hours with a fluctuating increase from 6.65 to 7.08, W5 showed steady decrease in pH after one hour dissolution from 6.66 to 6.02 up to the fourth hour. On the other hand W1, W2, and W3 samples of from different sampling points at Nahuta gave a fluctuating changes pH values range from zero hour to five hours.

Conductivity Test of Water Samples

Bar charts representation on Figure 2 showed that conductivity values of W3 and W4 waters from Nahuta shows increase in conductivity ranging from low conduction at zero hour to an increase hourly bases up to five hour range of final conduction increment. On the other hand W5 is water sample from river bank of Punguru at Nahuta shows a steady increase from zero hour to 3 hours but small decrease in conduction occurs at the 4th hour that proceeded with normal increment at the 5th hour, while W1 and W2 water from Nahuta town well and Gwantanamo mine lake shows fluctuation conductivity values.



Figure 1: pH values of Nahuta water

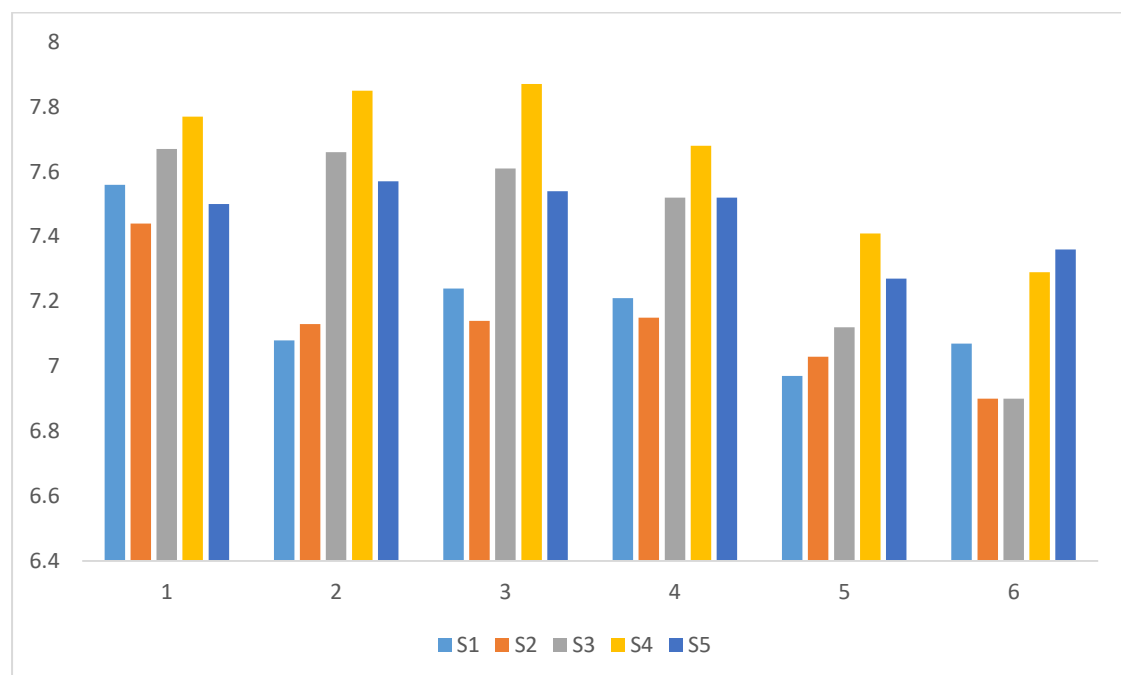


Figure 2: Conductivity Test of Nahuta Water (NScm⁻¹)

Nitrate Content of Nahunta Water

The analysis shows that nitrate content of Nahuta Water was displaced on Figure 3 with W1 and W5 having lowest nitrate content of 0.308mg/l and 0.479mg/l respectively, while W2 and W3 contain moderate amount of nitrate of 1.452 mg/l and 1.245 mg/l. W4 is the water from Punguru river bank mining site at Nahuta with a maximum nitrate content of 1.918mg/l. The result was indicated that both waters from Nahuta mining site was safe for animal and human consumption due to low nitrate content values.

Chloride Content of Nahunta Water

Chloride level in Nahunta water was represented on Figure 4 with W4 water from Punguru river bank mining site at Nahuta well having the highest values of 138.1mg/l, while Nahuta town well posed a least amount of chloride of 44.3mg/l. Moreover, W2, W3 and W4 are having chloride values of 51.3mg/l, 86.7mg/l and 65.5mg/l respectively. Both water

sample from Nahuta mining site are having an average chloride content of 64.2mg/l which is lower than environmental regulation thus Nahuta mine waters are nontoxic to animals and human consumption.

Bromate Content of Nahuta Water

Bromate Content of Nahuta Water was shown on Figure 5, whereby W4 Punguru river mining point water contain lowest amount of bromate of 0.00mg/l followed by W2 Nahuta town well with only 0.01mg/l, while W1 and W3 are Gwantanamo and Niger mining cape contain the same amount of bromate of 0.05mg/l each. W5 contain the highest amount bromate of 0.11mg/l which was the Punguru river flowing water. However the bromate average content of all the sample waters at Nahuta emanate with 0.044mg/l which gave rise to negligible amount of bromate in Nahuta water are harmless to biological life of organism and humans.

Phosphate Content of Nahuta Water

Punguru river bank mining point water W4 exhibit the highest content of phosphate of 3.89mg/l which was higher than the recommended value of 3.5mg/l, while W1 unveil the least composition of phosphate of 0.49mg/l. In the same way W2, W3 and W5 water sample contain 1.55mg/l, 1.66mg/l and 1.28mg/l amount of phosphate respectively. Average phosphate of Nahuta sample waters was calculated as 1.77mg/l. Thus, the value was safe for animal, plants and humans consumption as illustrated on figure 6.

Sulphate Content of Nahuta Water

The Sulphate content of Nahuta waters was represented on Figure 7 unveiling that W4 water from Punguru river bank mining carried the highest Sulphate of 114mg/l, of while W2 shows the lowest of 11mg/l. Others as W1, W3, and W5 contain 85mg/l, 64mg/l and 56mg/l respectively. Sulphates exhibit an average of 66mg/l which was safe and normal in accordance to WHO.

Dissolve Oxygen (DO) content of Nahuta water

Figure 8 represents the displayed values of Dissolve Oxygen (DO) of Nahuta water samples. W3 which is water sample obtain from Niger mining cape exhibits 12mg/l as the highest amount of DO, while W4 shows 6mg/l as the lowest amount of DO. Other as W1, W2 and W5 contained 8mg/l, 7mg/l and 3.5mg/l respectively. Average amount DO of Nahuta Water was calculated as 7.1mg/l which was moderate values.

Biological Oxygen Demand (BOD) content of Nahuta water

Biological Oxygen Demand (BOD) Content of Nahuta Water was shown on Figure 9 Whereby W2 and W4, Nahuta Town well water and Punguru river mining point contain least amount of BOD of 2mg/l each followed by W5 Punguru river water with no BOD content. W3 contain the highest amount of BOD of 12mg/l. Gwantanamo mining cape at Nahuta unveil only 4mg/l of BOD. Average amount of BOD of Nahuta water sample emanated as 4mg/l which indicated that BOD of Nahuta water sample are suitable for survival of biological life of organism and humans.

Chemical Oxygen Demand (COD) content of Nahuta water

Chemical Oxygen Demand (COD) level was represented on Figure 10 the bar charts shows that W3 revealed with 100mg/l as the highest COD, while W2 and W5 shows 24mg/l COD each. These are water from Nahuta town well and Punguru river water commonly used for breeding and domestic purposes. W1 and W4 are water samples from Gwantanamo mining site and Punguru river bank mining site unveil 60mg/l, 80mg/l respectively. Average amount COD of Nahuta sample waters resulted as 57.6mg/l which are suitable for survival of biological life including organism and humans.

Total Organic Carbon (TOC) of Nahuta Water

The bar charts representation on Figure 11 revealed that W4 water sample from Punguru river bank mining point exhibit the highest TOC of 0.94mg/l. W1 and W3 water samples contained 0.94mg/l each of TOC, while W2 and W4 are waters from Nahuta town well and Punguru river waters exhibits the lowest TOC of 0.72mg/l and 0.77mg/l respectively. Average TOC of Nahuta sample waters was calculated as 0.86mg/l which a little higher than recommended values of WHO.

Bioaccumulation Factor

Bioaccumulation factor of Nahuta water samples was calculated from the concentration of the contaminant tissue of dry weight sampled divided by average total organic carbon of the water which found to be 11.57mg/l

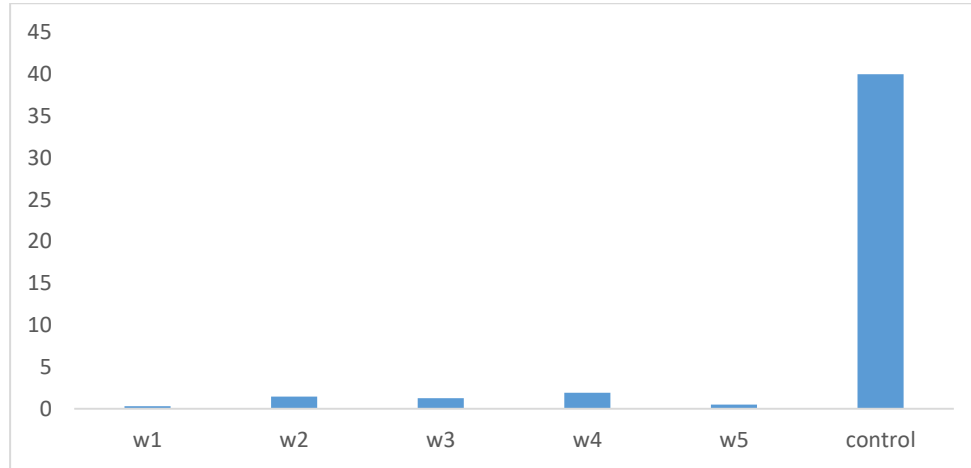


Figure 3: Nitrate content of Nahuta Water (mg/l)

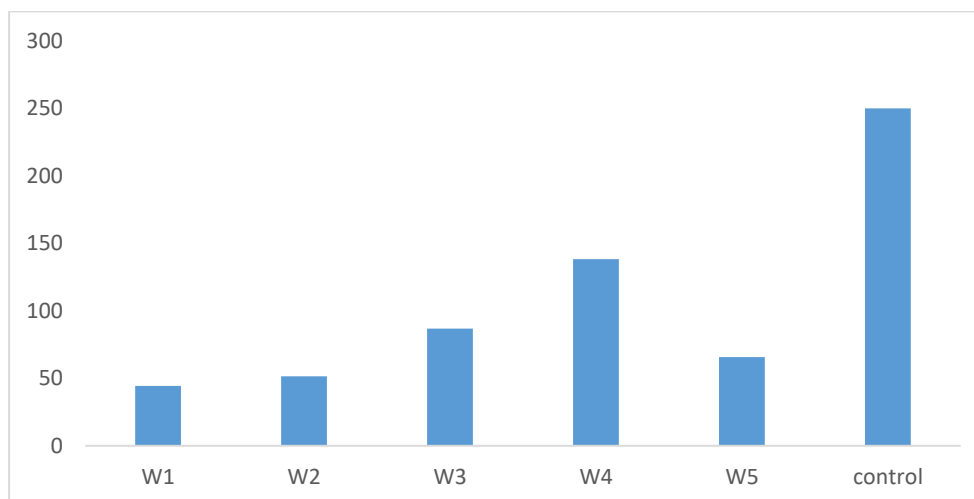


Figure 4: Chloride content of Nahuta Water (mg/l)

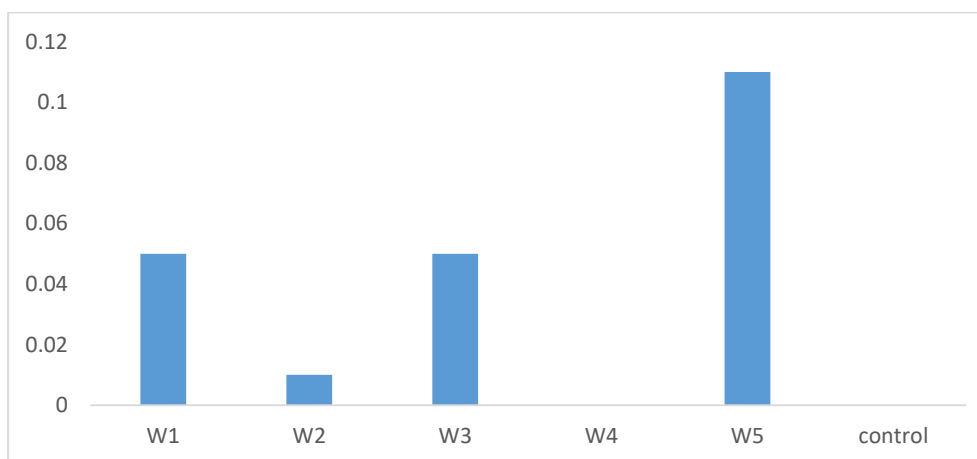


Figure 5: Bromate content of Nahuta Water (mg/l)

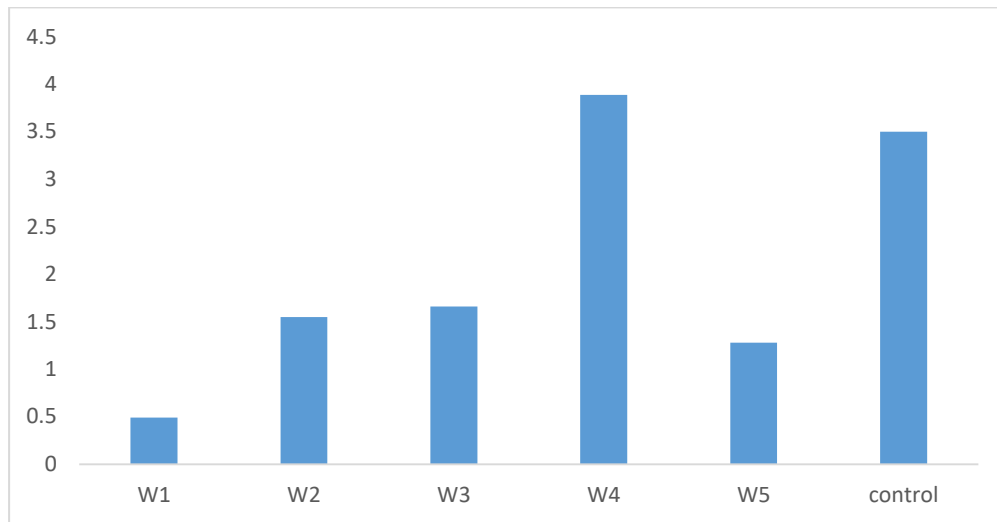


Figure 6: Phosphate content of Nahuta Water (mg/l)

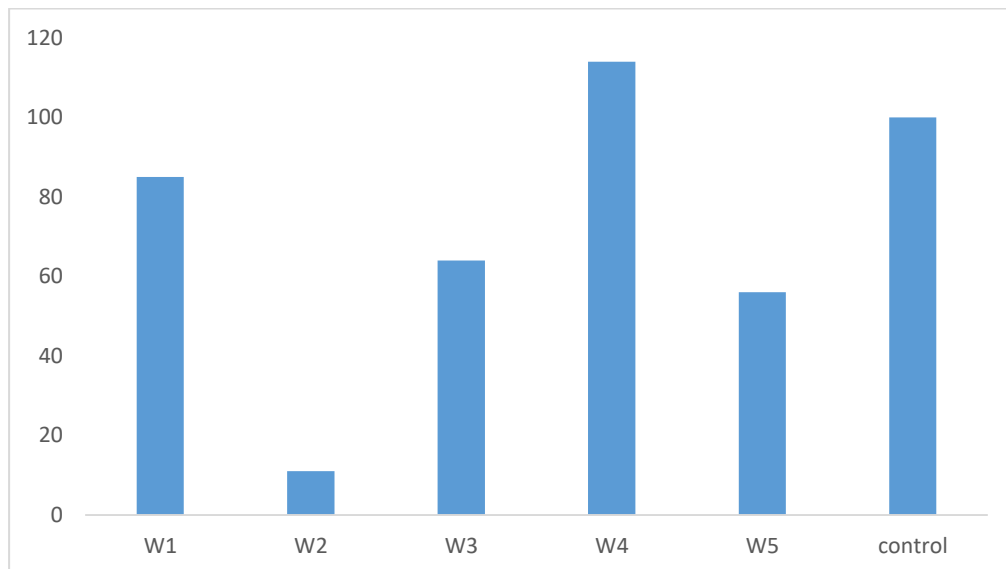


Figure 7: Sulphates content of Nahuta Water (mg/l)

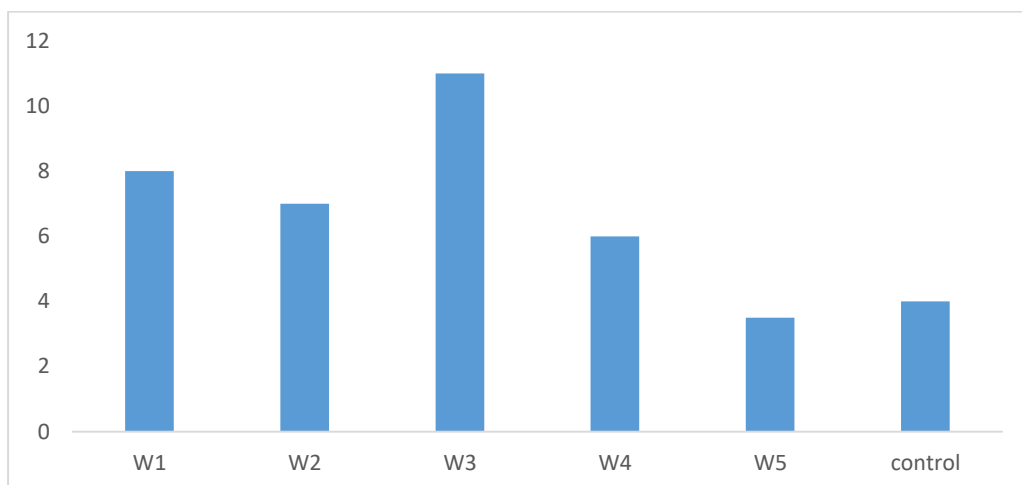


Figure 8: Dissolve Oxygen content of Nahuta Water (mg/l)

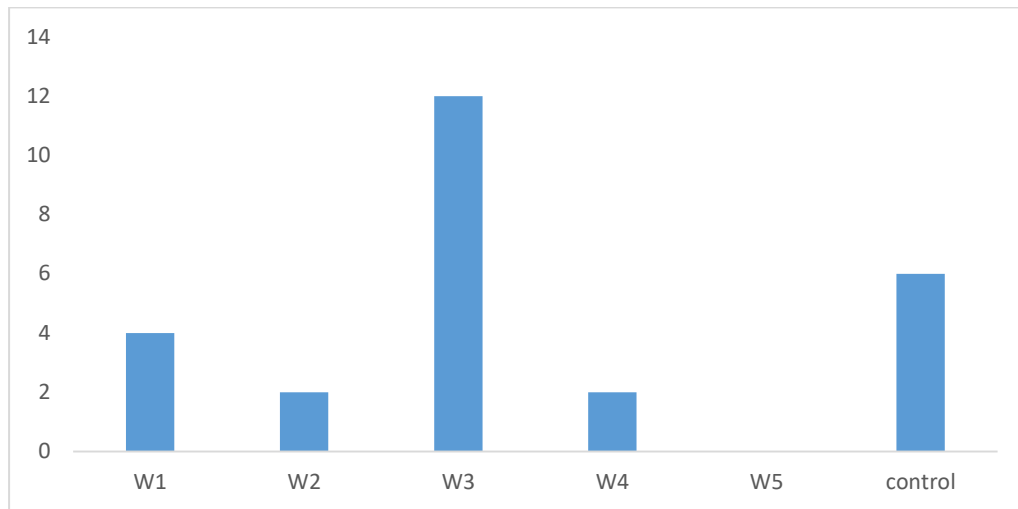


Figure 9: BOD content of Nahuta Water (mg/l)

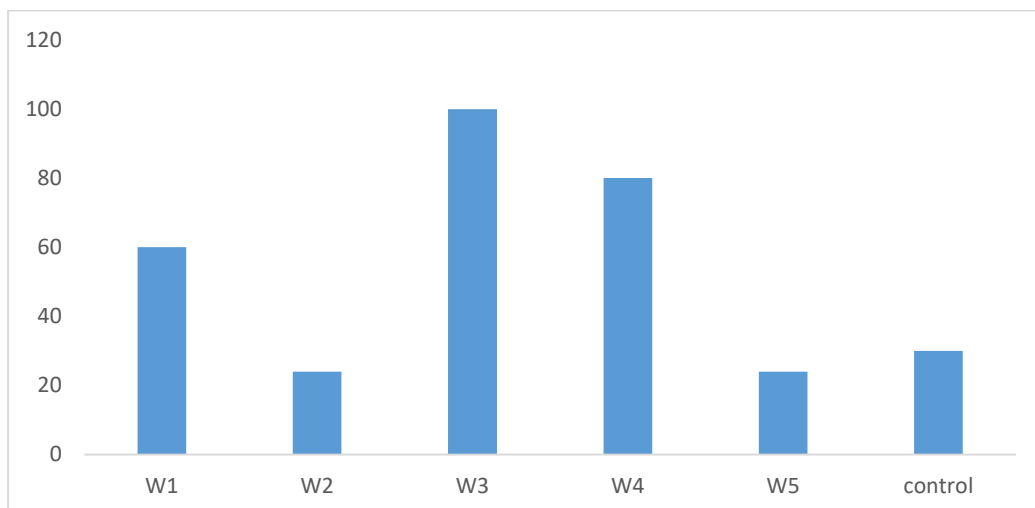


Figure 10: COD content of Nahuta Water(mg/l)

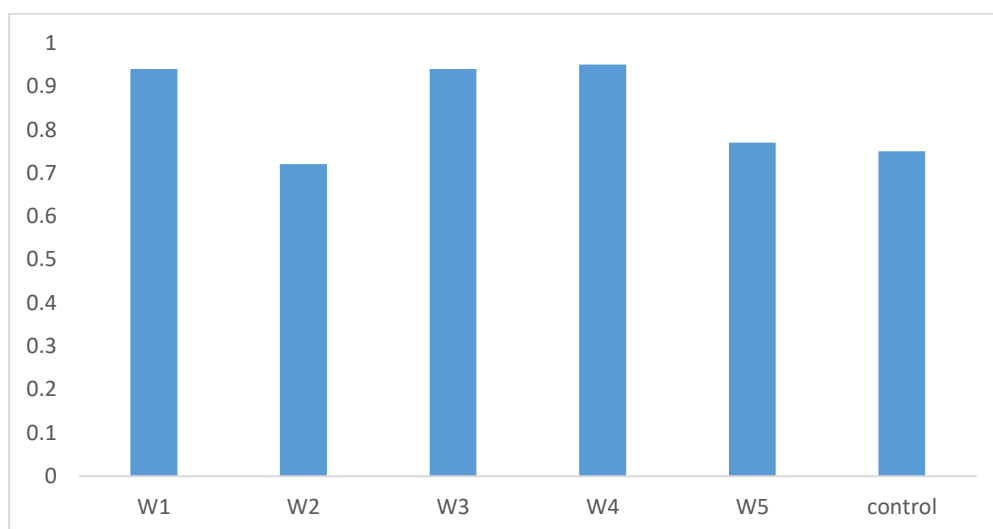


Figure 11: Total Organic Carbon content of Nahuta Water (mg/l)

4. CONCLUSION

Analysis of Nahuta Galena mining site waters indicated that Amount of Nitrate, Bromate, Chlorate, Sulphate and phosphate were moderate for animal and human consumption. However, W1, W3 and W5 water samples from Gwantanamo, Niger and Punguru river bank Galena Mine Lake at Nahuta contain excess amount of bromate that could be toxic for consumption. Parameters of DO, BOD, COD, TOC of Nahuta Galena water were confirmed to normal for survival aquatic animals and human activities.

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