*International Journal of Engineering Science Invention (IJESI)*
*ISSN (Online): 2319-6734, ISSN (Print): 2319-6726*
*www.ijesi.org ||Volume 10 Issue 6 Series II || June 2021 || PP 28-32*

# Physico-Chemical Evaluation of Waste Water From Romi Village, Kaduna, Nigeria

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***Abstract***

*It has clearly been noted that improper management and control of the vast quantities of waste generated as a consequence of several anthropogenic activities are the most critical environmental bottle neck of developing countries like Nigeria and many other African countries. This research work is therefore aimed at examining the status of some physicochemical parameters of waste water effluents obtained from Romi village Kaduna Nigeria. To achieve this aim, samples were collected from ten (10 ) different locations within the study area. All the parameters were analysed according to the standard methods of analyses. The results obtained indicated that the pH, electrical conductivity, turbidity, TSS, TDS and BOD values ranged from 8.7 – 9.9, 140 - 1990µs/cm, 0.74 – 19.99 NTU, 80 – 2170mg/l, 19.20 – 730mg/l and 0.90 – 81.30mg/l respectively. While the levels of Cadmium, Lead, Nickel and Zinc, were found to be in the range of 0. 001 – 0.012, 0.070 – 0.381, 0.004 – 0.019 and 0.001 – 0.092mg/l respectively. The overall results indicated high concentration of lead as well as high values of TSS, TDS, conductivity and BOD in the analysed waste water effluents. This has clearly shown that the waste water was already polluted and might further pollute the nearby water bodies within and outside the study area. The findings of this research has therefore indicated that there is urgent need to design and construct a small water treatment plant that can effectively mitigate the effect of such hazardous parameters on human health and the environment.*

***Key words:*** *Anthropogenic activities , physicochemical parameters, waste, Biochemical Oxygen Demand (BOD), Total Suspended Solids ( TSS ), Total Dissolved Solid ( TDS )*

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Date of Submission: 02-06-2021 Date of Acceptance: 16-06-2021

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## I. INTRODUCTION

One of the most critical problems of developing countries like Nigeria is improper management of vast amount of waste generated by various anthropogenic activities. More challenging is the unsafe disposal of these wastes into the ambient environment. Industrial effluent contamination of natural water bodies has emerged as major challenge in developing and densely populated countries like Nigeria (1).

Industries are the major sources of pollution in all environments. Based on the type of industry, various levels of pollutants can be discharged into the environment directly or indirectly through public sewer lines. Waste water from industries include employees' sanitary waste, process waste from manufacturing, wash waste and relatively uncontaminated water from heating and cooling operations (2). High levels of pollutants in river water system causes an increase in Biological Oxygen Demand ( BOD) , Chemical Oxygen Demand (COD) , Total Dissolved Solute ( TDS) , Total Suspended Solids (TSS), toxic metals such as Cd, Cr, Ni, Pb and faecal coliform and hence make such water unsuitable for drinking , irrigation and aquatic life. Industrial waste waters range from high BOD to biodegradable waste such as those from human sewage, pulp and paper industries, slaughter houses, tanneries and chemical industries. Others include those from plating shops and textiles, which may be toxic and require on sight physicochemical pre- treatment before discharge into municipal sewage system (3, 4). Men exert many effects which directly or indirectly affect his environment. The development of industries and extensive urbanisation means increased water consumption and pollution resulting from problems of waste disposal. Unfortunately, in most developing countries like Nigeria, effluents quality standards imposed by legislation are sometimes easily flouted (5). Industrial effluents are liquid wastes which are produced in the course of industrial activities. Quite over the years, the improper disposal of industrial wastes effluents has been a major problem and a source of concern to both government and industrialists. In most cases, the disposal or discharge of effluents, even when these are technologically and economically achievable for particular standards, do not always comply with pre-treatment requirements and with applicable toxic pollutant effluent limitations or prohibitions. The consequence of the anomalies is a high degree of environmental pollution, leading to series of health hazards ( 6 ).

The aim of this research is to carry out the physicochemical and metal concentrations evaluation of the sample of effluents obtained from Romi village Kaduna, Nigeria.

## II. MATERIALS AND METHODS

The samples of the analysed waste water were collected from ten different locations of the study area. 500ml of the waste water samples were collected in a glass bottles from each location for BOD while those for physicochemical analyses were collected in plastic bottles which were thoroughly cleaned and rinsed with deionised water. All the collected samples were treated and stored accordingly.

All the instruments used for physical and chemical analyses were checked, calibrated and operated according to the manufacturer's specification.

The pH was determined using a pH meter (ENTERIS Model 623 IS). The meter was allowed to warm up for 15mins; the electrodes were washed and rinsed with deionised water. The reading was taken by immersing the electrode into the waste water sample in beaker of 100ml.

The electrical conductivity was estimated using a portable meter (JENWAY model DDS-307). The meter was calibrated before analysing the samples. The electrode was cleaned and dipped into the beaker containing the waste water sample. The corresponding conductivity value was noted for each sample and recorded accordingly.

The turbidity of each collected samples was determined using a portable turbidity meter (WGZ – 1B model). The meter was calibrated according to the manufacturer's specification. About 10ml of the waste water sample was taken into the turbidity sample bottle, capped and placed into its compartment. Then the corresponding turbidity value was read directly and recorded accordingly.

The total dissolved solute of each sample was determined by evaporation method (7). 100ml of the sample was collected and filtered into a cleaned beaker and transferred into a pre weighed evaporating dish which was heated at $105^0$c until all the water evaporated to dryness. The evaporating dish with the content was allowed to cool in a dessicator and weighed to a constant mass. The corresponding value of TDS was calculated:

$$\text{TDS (mg/l)} = \frac{A-B\ x\ 1{,}000000}{Sample\ volume(ml)}$$

Where A = weight of dish + residue (mg) and B = weight of the empty dish (mg)

The total suspended solids were estimated by filtration method ( 7). 100ml of the sample was measured into a clean beaker and filtered using a pre weighed Whatman filter paper no. 1. The filter paper with the residue was transferred into an oven and heated at $105^0$c for the period of 1hour. The filter paper with the residue was allowed to cool in a dessicator and weighed until a constant mass was obtained. The corresponding value of TSS was calculated:

$$\text{TSS (mg/l)} = \frac{A-B\ x\ 1{,}000000}{sample\ volume}$$

Where A = weight of filter paper + residue and B = weight of empty filter paper.

The BOD was determined using Dissolved Oxygen (DO) meter ( JPSJ-605 model ). 10ml of the waste water sample was taken into two separate BOD bottle of 300ml and diluted with the dilution water. The other two BOD bottles were filled with only the dilution water as blank. The bottles were closed immediately after removing the air bobbles. All the bottles were labelled accordingly. The DO of one blank and one sample were determined immediately. The other sample and the blank were incubated at $20^0$c for the period of 5 days. Then the DO of incubated sample and the blank were determined after 5 days. The corresponding value of the BOD was calculated as below:

Blank correction = B.R. for blank at $D_0$ – B.R. for blank at $D_5$

BOD mg/l = [(B.R. for sample at $D_0$ – $D_5$ ) – blank correction x dilution factor]

Dilution factor = $\frac{Bottle\ volume\ (300ml)}{Sample\ volume\ (10ml\ )}$

Where B.R. = bottle reading, $D_0$ = initial and $D_5$ = day 5 after incubation.

The heavy metals content was determined using Atomic Absorption Spectrophotometer (AA 500 PG model). 100ml of each sample was digested separately with 10ml of concentrated nitric acid. The residual mixture of about 20ml was allowed to cool and diluted to 50ml with deionised water. The instrument was calibrated with different standard solutions, the calibration curve was computed and recorded accordingly. All the parameters regarding the analysis were set according to the specifications. Blank was aspirated followed by the sample into the oxidizing air- acetylene flame. The corresponding concentration of each sample was noted and recorded appropriately.

## III. RESULTS AND DISCUSSIONS

The results obtained for the physicochemical and heavy metal analyses were presented in figures 1and 2 accordingly.

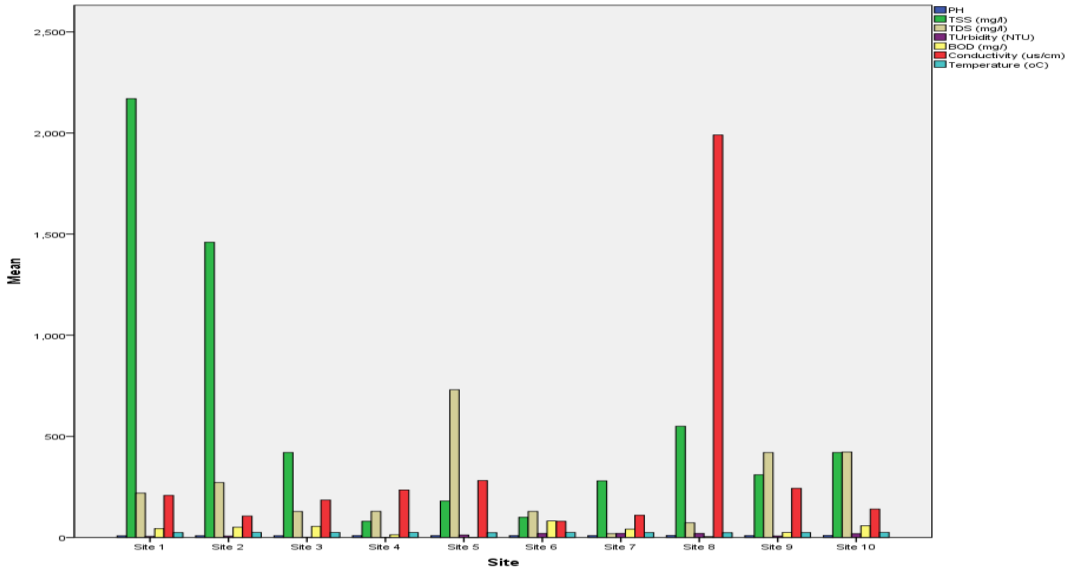


**Figure 1: plot of the various Physical parameters of the analysed waste of the different sampling sites .**

**ANOVA**

| Source of variation | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Sites | 933580.748 | 9 | 103731.194 | .637 | .761 |
| Error | 9776555.911 | 60 | 162942.599 | | |
| Total | 10710136.660 | 69 | | | |

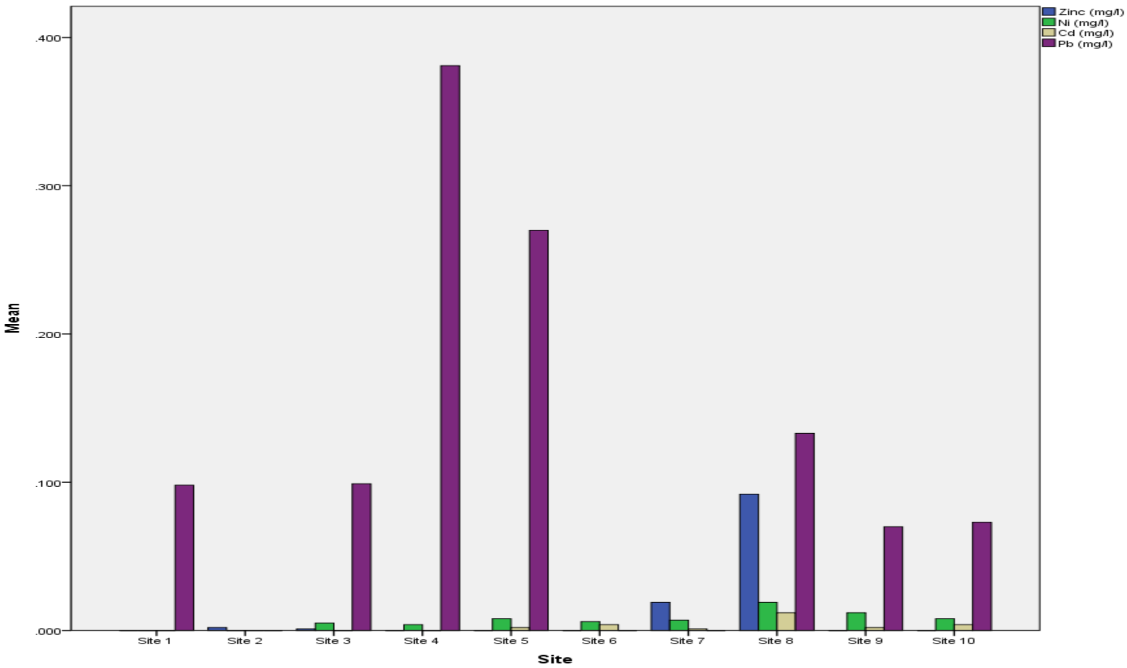


**Figure 2: Mean Concentrations ( mg/l) of the analysed heavy metals in the different sampling sites.**

pH is a measure of the degree of acidity or alkalinity of a given solution. The result of the study has shown that the pH (Figure:1) of the analysed waste water samples ranged from 8.7 – 9.9. This has indicated that all the samples were in alkaline condition. The value of pH is highly crucial as most of chemical reactions and biological activities especially in aquatic environment are being influenced by this vital parameter. The aquatic or marine organisms can only survive within a certain range of pH value. This is because excessive acidity or alkalinity usually hindered the survival of marine or aquatic organisms. Similarly, the solubility of heavy metals is greatly affected by pH of the medium which in turn enhances their toxicities. Generally, it can be categorically stated that pH plays a vital role in determining the quality of waste water and its treatment processes.

The results of Turbidity (Figure 1) for the waste water samples were found to be in the range of 0.74 – 19. 99 NTU. The turbidity is an index of undissolved particles in water. A highly turbid water can cause a lot of problems associated with water treatment processes such as flocculation and filtration which may significantly add to the cost of purification.

Electrical conductivity (EC) is a measure of the total inorganic salt content in water. The corresponding values of conductivity in this study were found to range from 80.0 – 1990.0$\mu s/cm$. Thus, with the exception of one of the sites all the values were found to be within the maximum permissible limit value of 1000 $\mu s/cm$(8).

The total suspended solid levels of the analysed waste water samples were found to be in the range of 80.0 – 2170.0mg/l. This has indicated that with the exception of only two sites all the corresponding values were above the maximum permissible limit of 100mg/l (10 ). High level of suspended solid in water is threat to both submerged plants and animals as it blocks the transmission of light and at the same time decreases the release of oxygen. The values of the suspended solid in waste water could provide vital information required in the design and construction of the relevant type of filters required in the treatment and purification of waste water for human consumption.

BOD is a measure of the amount of oxygen required by microorganisms to degrade the organic matter present in a given volume of water. The results obtained (fig. 1) had shown that the BOD values ranged from 0.90 – 81.30mg/l. The values obtained from three sampling sites were significantly above the maximum permissible limit of 50mg/l (9) which may be due to the presence of high amount of organic waste in the effluents. The BOD is an index of both organic matter and microorganism present in the waste water. High values of BOD are hazardous for the survival of the aquatic organisms (10) because the level of the dissolved oxygen is very low to support the survival of such organisms.

The result for the analysed heavy metals (fig. 2) has clearly indicated that the waste water contained significant levels of lead, zinc, nickel and cadmium in almost all the sampling sites. The result has generally shown that lead has the highest concentrations in all the sites and the levels were above the permissible limit of 0.01mg/l (8). The concentrations of Zn, Ni, and Cd were found to be below the permissible limit. While in few cases the concentrations were beyond the limit of detection.

The presence of heavy metals in waste water has been reported which was ascribed to the discharges from residential dwellings, ground water infiltration and industrial discharges ( 11). The accumulation of these metals has been found to depend on many factors such as the type of industries in the area, condition of life and level of awareness of the impact on the environment due to careless disposal of waste ( 12, 13). The high concentration of lead in waste water can cause variety of adverse health effects on exposure. It can result to delay in both physical and mental development in babies and children. It is also associated with slight deficits in attention span as well as in learning abilities (14) and in adults it causes kidney problems and high blood pressure.

## IV. Conclusion

The study conducted has clearly indicated that the analysed waste water contained significant amounts of parameters which effectively served as pollutants. The presence of contaminants in waste water could be attributed to the release of untreated industrial effluents and from other anthropogenic activities around the study area. The impact of pollutants is not only on the environment but also has a considerable negative effect on human health as well as the flora and fauna of the entire ecosystem. Similarly, the purity and quality of the portable water used for domestic and agricultural purposes in this area cannot be guaranteed as a result of frequent discharge of effluents by the nearby industries and other sources of contaminants.

It has therefore been recommended that indiscriminate disposal of waste from any source should be discouraged. Also it is imperative to ensure the treatment of all the industrial effluents before being disposed to the environment so as to safeguard further pollution of the surrounding water resources. Similarly, the design and construction of a portable water treatment plant is highly recommended to ensure the supply of portable water for human consumption and other domestic purposes.

## ACKNOWLEDGEMENT

We wish to sincerely appreciate the effort and support of Tertiary Education Trust Fund, the entire Management of Kaduna Polytechnic as well as the Chairman and members of RITTO Committee for sponsoring, monitoring and encouragement.

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Mohammed, SS, et. al, "Physico-Chemical Evaluation of Waste Water From Romi Village, Kaduna, Nigeria." *International Journal of Engineering Science Invention (IJESI)*, Vol. 10(06), 2021, PP 28-32. Journal DOI- 10.35629/6734