ASSESSMENT OF THE SUITABILITY OF TREATED BEVERAGE EFFLUENT FOR PUBLIC USE

BY

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BENIN- CITY

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PROJECT WORK SUBMITTED TO THE DEPARTMENT OF SCICENCE LABORATORY TECHNOLOGY, FACULTY OF LIFE SCIENCE, UNIVERSITY OF BENIN, BENIN- CITY, IN FULFULMENT OF THE REQUIREMENT OF THE AWARD OF BECHELOR OF SCIENCE DEGREE (B.SC) IN SCINCE LABORATORY TECHNOLOGY.

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CERTIFICATION

This is to certify that this project work was carried out by osasere gift OKUNGBOWA(MISS) with matriculation number of LSC1507927 of the department of science laboratory technology, faculty of life science, university of Benin, Benin- city

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DEDICATION

This work is dedicated to God almighty first, lecturers and management of Science Laboratory Technology, classmates and all lovers of science and knowledge in general.

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I am indeed grateful to God almighty for his guidance, and protection throughout the period of my study and preparation for this work.

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Finally I will love to appreciate my friends and classmate, for their cooperation and encouragement. The Lord bless and keep everyone of you in Jesus name. Amen.

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ABRSTRACT

Effluent treatment plants (ETPs) are common worldwide and a necessary step to improve the quality of wastewater before it is discharged to surface or groundwater and re-enters water supplies. Adequate water resource protection is critical as freshwater systems provide multiple environmental services such as supporting numerous species, supplying water for drinking and irrigation, and assimilating wastes through a biotic/biotic cycling. An effluent treatment plant is a system consisting of mechanical, chemical and biological devices and methods for the purpose of bringing the characteristics of waste water from a manufacturing process, to acceptable standard. Various stages of effluent treatment plants include the following which are influent pit, equalization tank, sequential batch reactor, buffer tank and clear water tank. Wastewater standards are specifications of the biological, chemical and physical quality of the wastewater that is produced by a treatment. These regularly comprise of allowable chemical oxygen demand (COD), Total suspended solids (TSS), Total nitrogen (TN), phosphorus (P), Conductivity, and PH. which indicates the municipal and industrial discharged standards, as well as the by-laws. The effluent treatment plant has a high potential of removing key pollutants and could be used for better treatment of wastewater managed properly.

CHAPTER ONE

1.0 INTRODUCTION

Populated areas ranging from small, rural communities to large, urban complexes all require adequate access to fresh water supply, but as populations increase and anthropogenic influences expand, meeting freshwater demands will require a balance between wastewater disposal and water resource protection (Tarr, *et al*, 1984; Burian, *et al*, 2000). Adequate water resource protection is critical as freshwater systems provide multiple environmental services such as supporting numerous species, supplying water for drinking and irrigation, and assimilating wastes through a biotic/biotic cycling (Naiman and Turner, 2000; Jackson *et al* ,2001). Linkages between terrestrial and aquatic systems (Meyer, *et al*., 1988; Likens and Bormann, 1995) lead to critical changes in freshwater systems that result from population growth and land use modifications.

Effluent treatment plants (ETPs) are common worldwide and a necessary step to improve the quality of wastewater before it is discharged to surface or groundwater and re-enters water supplies. Over the last 50 years, many countries have attempted to reduce the volume of untreated wastewater discharges to rivers and streams by carefully monitoring and constantly improving municipal an industrial effluent treatment plant (Tchobanoglous, *et al*., 2003). Effluent treatment plant is a desired alternative to unregulated discharges but effluent treatment plant do not discharge water of the same quality as that of the receiving water body and also impose physical changes to the receiving system. Effluent discharges have the potential to significantly alter many different aspects of aquatic systems including nutrient uptake efficiency (Hag-gard *et al*., 2001; Marti *et al*., 2004), organic carbon content (McConnell, 1980), bacterial levels (Petersen, *et al*., 2005), and hydrologic characteristics (Dennehy, *et al*., 1998). In most industrial processes, water is the most extensively used raw material in the production of high value products (Wijekoon, *et al*.,2011; Melamane, 2007). Water quality and its scarcity, has been identified as a future global threat to human health, marine organisms, livestock and the environment (Skouteris, *et al*.,2012; España-Gamboa *et al*.,2011; Agarwal *et al*.,2010; Méndez-Acosta *et al*.,2010; Acharya, *et al*.,2008; Alam, *et al*.,2007; Fritzmann, *et al.*,2007; Fewtrell & Bartram, 2001).South Africa‘s (SA's) water resources are limited due to climate changes, population growth and a developing economy. Hence, awareness campaigns for reasonable water consumption have increased (Haroon, *et al*.,2013; Hsineet *et al.*,2010; Melamane, 2007; Van Schoor, 2005; DWAF, 2004). An increase in industrial activities, along with the discharge of high strength wastewater from various industries such as beverage industries (distilleries, wineries, breweries, and soft drink manufactures), result in challenges with regard to methods that are used to remediate contaminants in the water in order to limit its environmental impact (Wijekoon, *et al.,*2011; Melamane, 2007). A hindrance for developing countries is how to improve their wastewater treatment capabilities, which at times are based on obsolete technology (Haroon, *et al*.,2013).Water and wastewater reutilization, costs of treatment and disposal guidelines remain the most critical factors for the development of sustainable water use for the food and beverage industries (Alam, *et al*.,2007; Fillaudeau, *et al*.,2006; Blöcher, *et al*.,2003). Regulatory bodies. Therefore, have imposed restrictions on the quality of the water to be discharged into natural resources, In SA wastewater should have a potential hydrogen (pH) value between 5.5 and 7.5; and a total chemical oxygen demand (COD) below 75 mg/L (SA, National Water Act, 1998-Act No. 36 of 1998). Hence, due to these regulatory guidelines, process water usage and wastewater management constitute a practical challenge for beverage industries in

SA .The beverage industry is a subdivision of the food industry (Guimarães, *et al*.,2012),and supplies a range of products from alcoholic (winery, vinasses, molasses and spirits) and brewery to non-alcoholic (fruit juices, vegetable juice, mineral water, sparkling water, flavored water and soft drinks) beverages (Gonzalez-Garcia, *et al*.,2013; Haroon, *et al*.,2013; Satyawali, 2013; Guimarães, *et al*.,2012). According to Haroon, *et al*. (2013) and Hsineet, *et al.*(2010), the beverage industry globally and in Africa requires large quantities (an average 7000 m3to 25000 m3per month) of freshwater, and do not reuse or recycle wastewater; hence they consume large volumes of freshwater. The beverage industry's wastewater originates from different individual processes such as bottle washing, product filling, heating or cooling and cleaning-in-place (CIP) systems, beverage manufacturing, sanitising floors including work cells, cleaning of zones and piping networks (Agana, *et al*.,2013; Haroon, *et al*.,2013; Alam, *et al*.,2007; Noronha, *et* al.,2002).There has been an increased demand for more efficient methods to treat beverage industry wastewaters due to progressively stringent international discharge standards (Amuda, *et al*.,2006; Akunna & Clark, 2000). According to Lin, *et al* .(2012); Judd., (2011);and Yang, *et al* (2006),the membrane bioreactor (MBR) technology is one of the technologies that are touted internationally both in research studies and for industrial applications for its smaller footprint and effectiveness in rapidly treating large quantities of water on a continuous basis

One characteristic of effluent that often impacts receiving waters is its nutrient content. Although one may assume that ETPs are regulated (i.e., requiring a discharge permit) and therefore not contributing significantly to pollutant loads, this is not necessarily true for nutrients (Hager and Schemel, 1992 ; Andersen, *et al*., 2004; Gibson and Meyer, 2007). Many aquatic systems have very low ambient nutrient concentrations and small shifts in the nutrient load can result in dramatic changes in community level (Miltner and Rankin, 1998; Dodds and Welch, 2000, ;Rabalais, 2002). Thus, many of the water quality concerns for aquatic systems in the are directly related to nutrient loading. Researchers investigating nutrient pollution from nonpoint sources have discovered that nutrient loads were often more strongly influenced by effluent than by nonpoint sources (Ahearn*, et al.,* 2005; Popova, *et al.,* 2006; Migliaccio, *et al.,* 2007). Effluent may become an even more dominant contributor to nutrient inputs into aquatic systems as best management practices (BMPs) are being developed and implemented to abate nonpoint source pollution (Lynch and Corbett, 1990; Park, *et al.,* 1994; Ice 200). Hence, our goal in this review is focused on ETP nutrient discharges and their implications for freshwater systems. The review includes a discussion of nutrient inputs and their influence on aquatic systems; ETP treatment processes and nutrient removal; and ETP effluent discharge impacts in waterways. We conclude with a summary of legislation that has been established to lessen the total environmental impact of ETPs and a discussion of future opportunities. In Nigeria the body responsible to control the inflow of effluent discharge is Nigeria Environmental standard and regulations enforcement agency [NESREA].NESRA is an environmental agency of the federal government that was established by law in act 25 of 2007 to ensure cleaner and healthier environment in Nigeria. NESRA was passed by the national assembly and signed by president UMARU MUSA YAR'ADU . it has a responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria resources in general and environmental technology.(Monsurat, *et al*., 2019)

1.1 Aim and Objective

1.1.1 Aim

The aim of the research study is to make sure that effluent is properly treated before discharging into the environment

1.2 Objectives

The objectives of the study are to:

1 To encourages the reuse of water for those countries with inadequate supply of water.

2 To ensures proper treatment of untreated effluent water before discharging into the environment

3 To encourage healthier environment for both plants and animals.

4 To protect the health of ecosystem.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 EFFLUENT TREATMENT PLANT

An effluent treatment plant is a system consisting of mechanical, chemical and biological devices and methods for the purpose of bringing the characteristics of waste water from a manufacturing process, to acceptable standard. Various stages of effluent treatment plants include the following. (Tshuma *et al*., 2016)

2.2 INFLUENT PIT

Waste water comes from bakery plant, beverage plant, sewage plant and canteen. They are altogether collected in the influent pit. The influent pit is further segmented as given below.

Note: high daily volumes of discharged effluent should be avoided (Heeb *et al*., 2008)

2.2.1 Grit channel

Removal of Solid Debris larger than 30mm in Diameter. This has a metal sieve that stops solid/large particles above 30mm diameter e.g. Nylon, bottles, caps, nose masks etc before entering the pump pit as a stage of pre-treatment process. (Mcnamara *et al.*, 2013)

2.2.3 Sand trap

Reduced Wastewater Flow Speed for Easy Collection of Settled Sand and Larger Solid Material. This is designed to trap sands that may have come with the water from the source/ and along the path. (Bhutiani and Ahamad, 2018)

2.2.4 Oil trap

Separation of Oil from Wastewater before Transfer to pump pit. This is designed to trap oil; consequently Oil remains here while water without oil is transferred to the next stage of the pre-treatment process. (Aleksic, *et al.,* 2014)

2.2.5 Pump pit

PH adjustment takes place here before transfer to EQ tank. It is expected here that the water is void of materials such as solid particles and oil. Furthermore, the pH level here is always maintained between 6-8. To achieve a "6-8" pH value both caustic soda (NaOH) and Sulfuric acid (H2SO4) are dosed as required constantly to maintain the pH level.

2.3 DOSING STATION

This is where the chemicals are kept. There are four (4) chemicals used in the system. Sulfuric acid (H2SO4): Given its acidic properties, it helps to reduce the pH value (e.g. from 9-10 to 6-8) of the waste water both in effluent pit and the equalization tank. Caustic soda (NaOH): Due to its alkaline properties, it helps to increase the pH value (e.g. from 1-4 to 6-8) of the waste water in both effluent pit and equalization tank. Sodium hypochlorite (NaOCl): This is dosed into the system between the buffer tank and the clear water tank to kill micro-organisms before water is transferred to the last stage in the system. Ferric Chloride FeCl3): This is dosed into the equalization tank to remove metallic elements and reduce stench.

2.4 EQUALISATION (EQ) TANK

Water from the pump-pit with a suitable pH value, void of large particles and oil is lifted (by pumps) into the EQ tank; but just at the entry point is a static filter which filters tiny particles such as threads, he filtered tiny particles are collected at the base of the tank by a waste bin while water without foreign bodies goes into the EQ tank. In the EQ tank, the PH value of 6-8 is constantly maintained; it's an automatic process which injects the required chemical to achieve the standard PH level. The EQ tank is aerated (stirred by means of blower sending in about 0.5 bar of air) 24 hours daily Biological activity starts from the here. (Motteran, *et al*., 2013)

2.5 SEQUENTIAL BATCH REACTOR 01 (SBR01)

At a set level in the EQ tank, water is transferred into the SBR01 tank. Here in the SBR01 tank, the system is aerated (stirred by means of blower) 16 hours daily. Bacteria are cultured here and are required to be alive at all times for the system to work properly because the feed on the waste water to break down the organic materials in the waste water. Extended biological activities to further degrade macro molecules to simple water and carbon dioxide Mixing is key design feature to allow the bacteria and food sources to meet. (Alagha, *et al*., 2020).it is a modification of much popular activated sludge process, it helps to introduces various process flexibilities and alternatives in process control and designs so as to achieve the latest effluent discharge standard.(Dulta and Sakar, 2015)

2.6 SEQUENTIAL BATCH REACTOR 2 (SBR2)

At a set level in SBR1 tank, water is transferred into SBR2 to create space in SBR1. Both SBR 1&2 tanks are designed to carry out same functions i.e. secondary treatment. High volumes of sludge help the microbial breakdown of macro molecules in the processed wastewater. (Alagha, *et al*., 2020)

2.7 BUFFER TANK

This serves as a storage tank where almost clear water is collected from SBR2. It is expected that the water here is void of activated sludge and should be clear .(Jedidi and Mabrounki, 2017). The aim of buffer is to realize a consistent volume and possibly consistent quality. It implemented to allow further purification process to run as effectively as possible.

2.8 SAND FILTER:

This is the last stage of filtration. It further filters any tiny substance that still exists at this point

And also clears the water from any color.(Yettefti, *et al*., 2013). The filter material are contained in a linear made of concrete, plastics, and other impermeable material. Depending on the design . the filter may be situated above ground, partially above ground, or below ground, and the filter surface may be single pass or covered.

2.9 CLEAR WATER TANK

Just before the entrance to clear water tank, sodium hypochlorite (NaOCl) is injected into the water as it flows from sand filter into clear water tank to eliminate any micro-organism. The clear water is the final stage of the treatment procedure and water is released out to the drainage and out to the environment. (Izady, *at el*., 2017) Temporal holding Tank for a limited Chlorination of Clarified Effluent before flowing into the Environment.

2.1.0 WASTEWATER QUALITY MANAGEMENT AND LEGISLATION

It is necessary to understand the importance of environmental impacts on the community, and then to contemplate the advantages and disadvantages related to several ranks of environmental control. Most effluent treatment plants will have on-site specific established requirements for the quality of wastewater that can be discharged into the natural environment and municipal sewers. The General Authorization offers additional guidance in respect of wastewater management, requirements and quality. The beverage industry should comply with several environmental protection acts and regulations (Simate, *at al.*,2011). Through environmental management systems (EMS) such as:1) Municipal discharged standards and by-laws; and 2) the International Organization for Standardization (ISO)14001. Therefore, the beverage industries have a duty to be able to proactively manage their impacts on the environment. The beverage industries needs to pay attention to efficient and effective management of both existing and forthcoming environmental impacts. Wastewater standards are specifications of the biological, chemical and physical quality of the wastewater that is produced by a treatment. These regularly comprise of allowable chemical oxygen demand (COD), suspended solids (SS), nitrogen (N), phosphorus (P) and other elements, which are expressed in concentrations as presented in, which indicates the municipal and industrial discharged standards, as well as the by-laws.

2.1.1 IMPORTANT OF EFFLUENT TREATMENT

"There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people - and the environment - suffer badly". (World Water Vision, 2000). Water is an essential natural resource for the development of life and for human activities. Currently, its scarcity is one problem that causes great concern in our society. The growing water shortage problem in arid and semi arid areas unavoidably leads to more efficient management schemes for water resources. Today nearly 1 billion people in the developing world don't have access to it (World Health Organization, 2013). Yet, we take it for granted, we waste it, and we even pay too much to drink it from little plastic bottles. Water is the foundation of life. And still today, all around the world, far too many people spend their entire day searching for it. In places like sub-Saharan Africa, time lost gathering water and suffering from water-borne diseases is limiting people's true potential (The Water Project, 2015). Good health begins with access to clean water. In developing countries, about 80% of illnesses are linked to poor water and sanitation conditions. One out of every five deaths under the age of five worldwide is due to a water-related disease such as diarrhea, cholera, typhoid fever and dysentery among others (World Health Organization, 2015 And Water Project, 2015). Without having access to clean water the developing countries cannot relieve hunger neither progress. It should be considered that without access to a reliable source of water, food is hard to grow and even more difficult to preserve and prepare. Globally we use 74% of our water sources for agriculture and irrigation, 18% for industrial uses and only 8% on domestic uses (International Water Management Institute, 2015). The 84% of people, who don't have access to improved water, also live in rural areas, where they live principally through subsistence agriculture. Sometimes, areas that experience a lack of water suffer because of poor water management, but more often it is a relatively simple economic issue that can be addressed. This is the difference between physical and economic scarcity. According to Population Action International, based upon the UN Medium Population Projections of 1998, more than 2.8 billion people in 48 countries will face water stress, both in terms of water scarcity and quality deterioration, by 2025. Of these countries, 40 are in West Asia, North Africa or sub-Saharan Africa. Over the next two decades, population increases and growing demands are projected to push all the West Asian countries into water scarcity conditions. By 2050, the number of countries facing water stress or scarcity could rise to 54, with a combined population of four billion people - about 40% of the projected global population of 9.4 billion(United Nations Environment Programmed, 2008) . Water pollution and reuse additionally to the global water scarcity, the release of pollutants with potential to harm both humans and the environment into water bodies is the biggest threat to the world's freshwater supplies. Pollution can be defined as "the introduction by man in the environment of substances or energy liable to cause hazards to human health, harm for living resources and ecological system, damages to structures or amenity, or interference with legitimate uses of the environment (Holdgate,1979).The rapid industrial and technological development, as well as the growing of human population, seriously affects the quality of the aquatic medium producing large amounts of wastewater. For this reason, the reclamation of these contaminated waters is currently seen as alternative water resource (Bixio, *et al*.,2006,Petala, *et al*.,2006,Bhatti, *et al*.,2011). The implementation of tertiary treatments is necessary to reach the appropriate quality of water from effluents of Wastewater Treatment Plants. Most methods of wastewater treatment limit themselves to reproducing the natural process of self-purification which for centuries has suffered water after discharge into water bodies. However, the huge volumes and pollutants to be treated should be accelerated by artificial means. Different degrees of treatment will be necessary depending on the final use of this reclaimed water. Effluent treatment is closely related to the standards and/or expectations set for the effluent quality. The main function of a effluent treatment is to minimize the environmental impact of discharging untreated water into natural water systems (Meneses*, et al*., 2010). The conventional effluent treatment consist of two levels of treatment: preliminary and primary (physical and chemical), and secondary (biological) treatment. These treatments may reduce: suspended solids, biodegradable organics, pathogenic bacteria and nutrients. Besides, as sustainability is promoted within the water cycle, the functions of effluent treatment also should be to recover: water resources (reclaimed water), energy (methane from anaerobic digestion) and materials (biosolids and nutrients).This treated wastewater is usually discharge into the sea or rivers but not used for reuse purposes. Also a Effluent treatment may get a resource from wastewater carrying out a tertiary treatment on the treated wastewater which can be reused .The main(Meneses, *et al*.,2010) n objective of wastewater reclamation and reuse projects is to produce water of sufficient quality for all non-potable uses (uses that do not require drinking water quality standards). Using reclaimed water for these applications would save significant volumes of freshwater that would otherwise be wasted. Reclaimed (Meneses, *et al*.,2010,Esteban, *et al*., 2010) effluent water can replace freshwater in traditional practices such as agricultural and landscape irrigation, industrial applications, environmental applications (surface water replenishment, and groundwater recharge), recreational activities, urban cleaning, firefighting, construction, etc.(Petala, *et al*., 2006,Yang and Abbaspour, 2007,Meneses, *et al*.,2010).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 CHEMICAL ANALYSIS FOR TREATED AND UNTREATED WATER

3.11 1) **Sample collection:**

Samples were collected at the various tanks which include:

1) Pump pit

2) Equalization tank

3) Sequential batch reactor 1

4) Sequential batch reactor 2

5) Buffer tank

6) Clear water

3.1.2 2) Sample labeling:

Each beakers used to collect sample were tagged with the name of each tank (in abbreviation) for easy identification for example: pump pit tag as PPT, equalization tank as EQT, sequential batch reactor 1 as SBR1, sequential batch reactor 2 as SBR2, buffer tank as BFT and clear water as CLW

3.1.3 3) Sample analysis:

There is different analysis carried out in each tank. It includes:

1) Chemical oxygen demand (COD)

2) Dissolved oxygen (DO)

3) Total suspended solid (TSS)

4) Total nitrogen

5) PH

6) Phosphate

7) Conductivity

8) Sedimentation test

9) Biochemical oxygen demand (BOD)

3.2 CHEMICAL OXYGEN DEMAND (COD)

The procedure for this analysis includes the following:

1) Suspend the bottom sediment in the reaction cell by swirling

2) Measure 2.0ml of the sample of EQ, SBRO1, SBRO2 and CL inside the cell through syringe

3) Measure 2.0ml of distilled water into the cell (blank cell)

4) Tightly attached the screw cap to the cell

5) Vigorously mix the content in the cell

6) Heat the cell at 148^{0}c in the preheated theromoreactor for 120 minutes (2hour)

7) Remove the hot cell from the preheated theromoreactor and allow it to cool in a test tube rack.

(do not cool with cold water)

8) Wait 10 minutes, swirl the cell and return the cell back to the rack for complete cooling to a room temperature at least 30 minutes

9) Measures in photometer and take read

3.3 DISSOLVED OXYGEN (D O)

The procedure includes the following:

1) Take the labeled sample inside the beaker.

2) Dip the probe inside the beaker

3) Measure in dissolved oxygen meter and take reading

3.4 TOTAL SUSPENDED SOLID (TSS)

The procedure includes the following:

1) Grind the sample using blender for homogenization of the sample for at least 5minutes

2) Pipette 10ml of distilled water inside the spectrophotometer cuvette (blank cell)

3) Zero the spectrophotometer with blank cell

4) Pipette 10ml of the grind sample inside the cuvette

5) Measures in spectrophotometer and take reading

3.5 TOTAL NITROGEN

The procedure includes the following: it involves high and low range

3.5.1 High range procedure:

1) Add 1ml or the pretreated sample with 9ml of distilled water inside the empty cell by pipe ting using syringe and mix

2) Add reagent N-1K (one full spoon. Using blue micro spoon) and mix

3) Add reagent N-2K (6 drops) and mix with the cell tightly close

3.5.2 Low range procedure:

1) Add 10ml of the pretreated sample by pipe ting the sample inside the empty cell

2) Add reagent N-1K (one full spoon of blue micro spoon) and mix

3) Add reagent N-2K (6 drops) and mix with the cell tightly close

3.5.3 For both low and high range includes:

1) Heat the cell at 120^0c in the preheated theromoreactor for 1hour

2) Remove the hot cell from the preheated theromoreactor and allow it to cool in test tube rack (do not cool with cold water)

3) Shake the cell briefly after 10 minutes (precipitation frequently occurs in the solution)

4) Add 1ml of the sample into the reagent cell

5) Add 1ml of N-3K (using syringe)

6) Measures in photometer and take reading

3.6 PH

The procedure includes the following:

1) Take the labeled sample

2) Dip the pH probe inside the beaker containing the sample

3) Measures in pH meter and take readings

3.7 PHOSPHATE

The procedure includes the following:

1) Add 8ml of distilled water with 0.5ml of the pretreated sample inside the test tube

2) Add reagent $P0_4^{-1}$(0.5ml) by pipe ting using syringe and mix

3) Add reagent $P0_4^{-2}$(1dose), shake vigorously until the reagent is completely dissolve) Pipette 10ml of the sample inside a photometer curveted

4) Measures in the photometer and take reading

3.8 CONDUCTIVITY:

The procedure includes the following:

1) Take the labeled sample

2) Dip the probe inside the beaker containing the sample

3) Measures in the conductivity meter and take reading

3.9 SEDIMENTATION SAMPLE

The procedure includes the following:

1) Pour the sample inside a 1000 liter of a flask

2) Allow the sample to settle for 30 minutes and1hour

3) Take reading for each time

3.1.0 BIOLOGICAL ANALYSIS FOR ANLYSISING BOTH TREATED AND UNTREATED WATER IN THE LABORATORY

Before starting up any analysis the place used for analysis should be disinfect with 70% ethanol (70ml ethanol and30ml of distilled water) to avoid evaporation because it is volatile, gloves are worn to avoid contamination of the sample. Procedure carried out for biological analysis includes:

1) Sample collection

2) Sample labeling

3) Inoculation of the sample

4) Incubation of the sample

3.1.1 SAMPLE COLLECTION

Procedure includes:

1) Take sterilize whirl pack for the sample

2) Disinfect the outlet (sampling point) with 70ml ethanol solution

3)0pen the outlet and allow the clear water sample rush out for 5 minutes from the tap

4) Collect sample with whirl pack (sterilize)

3.1.2 SAMPLE LABELLING

Permanent marker is used to write the sample number, sample name and date sampled (in abbreviation) on the MC media pad (Mac Coney) and compact dry plate (CD)

3.1.3 INOCULATION OF THE SAMPLE

The procedure includes:

1) Put the sample inside the laminar flow to avoid contamination

2) Place your labeled mc media pad, compact dry plate and syringe inside the laminar flow

3) Take 1ml of the sample using the sterilize syringe for each sample into the mc media pad and compact dry plate.

3.1.4 INCUBATION OF THE SAMPLE

The procedure includes:

1) Place the compact dry plate of the various inoculation place inside the incubator for 2 days at 35^0c.

2) Place the inoculated compact dry plate downward.

3) Place the mc pad of total count inside the incubator for 2 days at 35^0c

4) Place the mc pad of the yeast and mould in a place at room temperature for 5 days

5) Take reading for the respective days.

CHAPTER FOUR

4.0 RESULT

TABLE1: Chemical Oxygen Demand: It is the measurement of the oxygen required to oxidize soluble and particulate organic matter in water and it does not distinguish between the organic compound that can be oxidize biologically. This analysis is carried on pump pit, equalization tank, sequential batch reactor 01, sequential batch reactor 02and clear water tank.

Treatment	**Mean ± S.E.M**
Pump Pit	5638 ± 375.1
Equalization Tank	4116 ± 662.6
Sequential Batch Reactor 01	1250 ± 339.1
Sequential Batch Reactor 02	114.9 ± 28.09
Buffer Tank	206.0 ± 22.93
Clear Water	33.14 ± 3.595

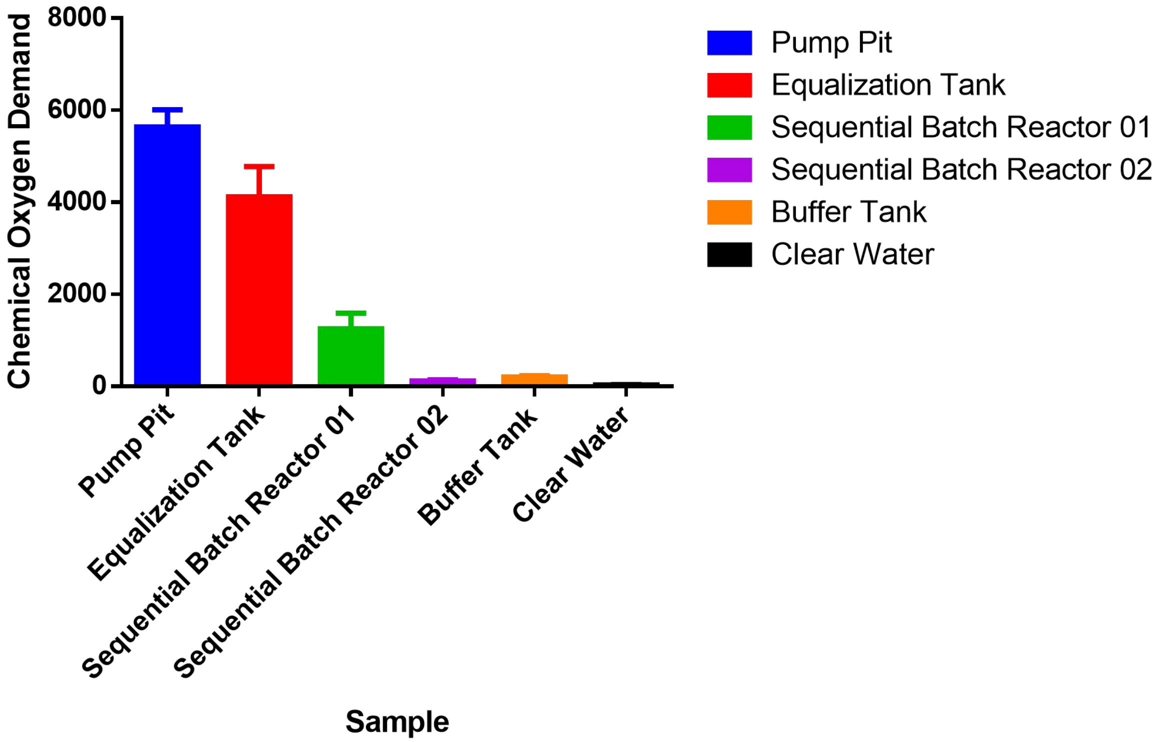

FIGURE 1: Chemical oxygen demand – pump pit, equalization tank, sequential batch reactor 01, sequential batch reactor 02, buffer tank, clear water.

TABLE: 2 Conductivity: It is the measure of water capability to pass electrical flow. This ability is directly related to the concentration of ion in the water. It is used for controlling. This analysis is carried on pump pit, and clear water tank

Treatment	**Mean ± S.E.M**
Pump Pit	334.0 ± 219.6
Clear Water	138.0± 25.96

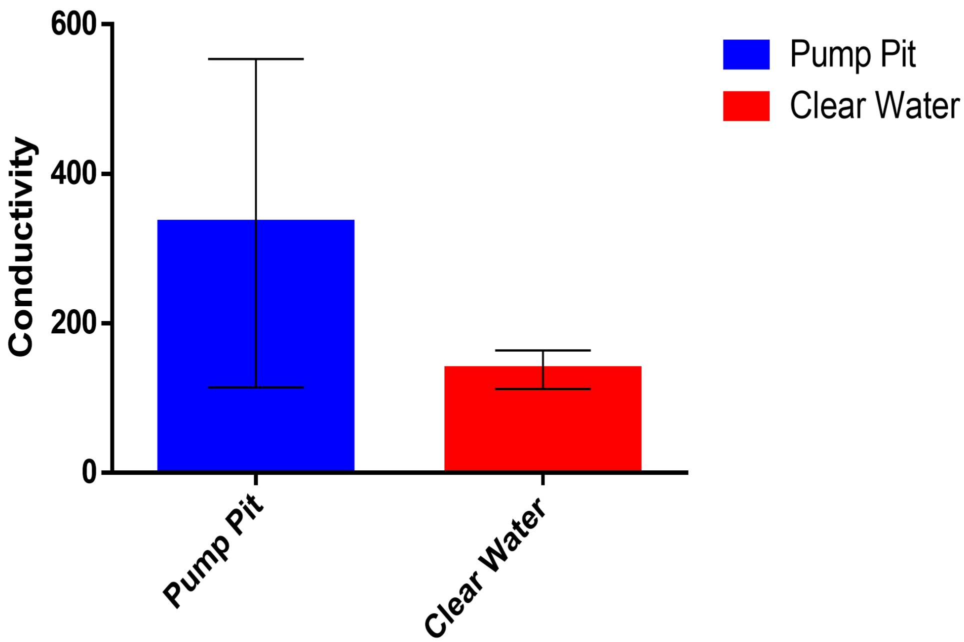

FIGURE 2: conductivity- pump pit and clear water

TABLE: 3 Dissolved Oxygen: it expresses the concentration of the dissolved oxygen on the waste water, it is the straight related with electric energy consumption and state of health of the micro organism. it values vary on the quantity and quality of the activated sludge [biomass] in the reactor. This analysis is carried on equalization tank, sequential batch reactor 01, sequential batch reactor 02 and clear water:

Treatment	Mean ± S.E.M
Equalization Tank	0.1400 ± 0.0245
Sequential Batch Reactor 01	0.1600 ± 0.0245
Sequential Batch Reactor 02	0.2600 ± 0.1860

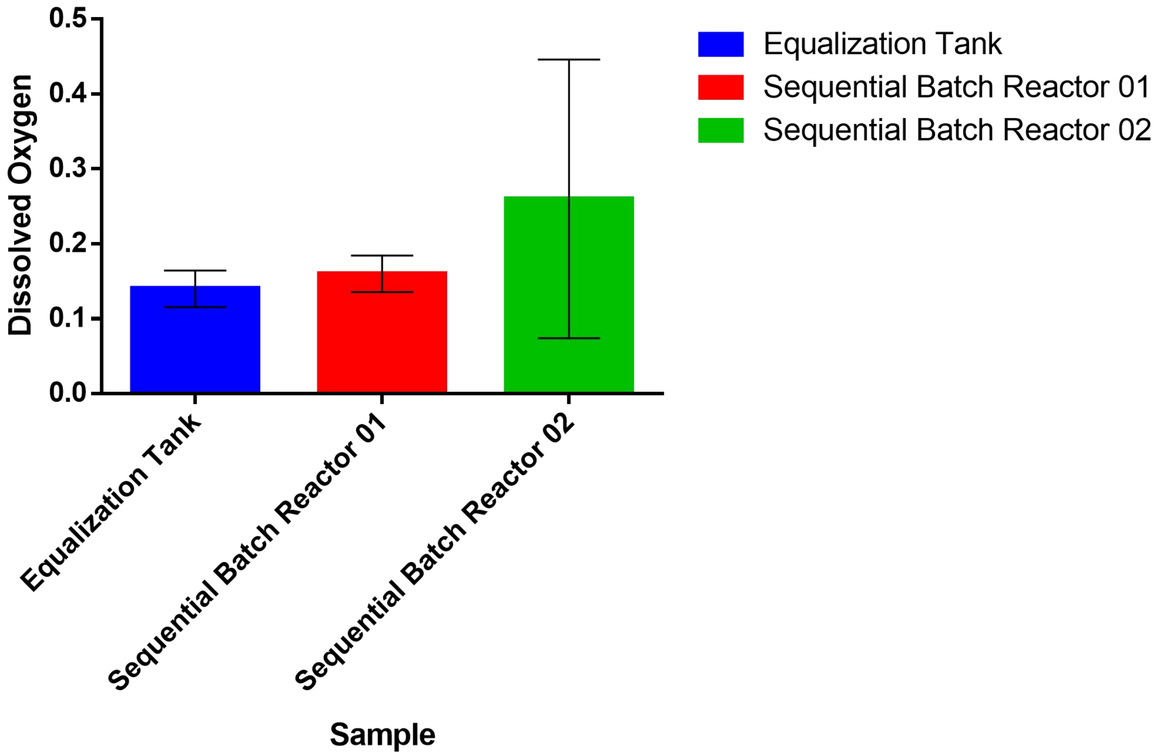

FIGURE 3: Dissolved oxygen- equalization tank, sequential batch reactor 01 and sequential batch reactor 02

TABLE4: PH: It refers to the measurement of hydrogen ion activity in the solution, determination of ph plays an important role in the waste water treatment process of particulate materials, accumulation of toxic chemicals and increasing alkalinity levels are common problem in waste water. This analysis carried in all tanks.

Treatment	**Mean ± S.E.M**
Pump Pit	7.148 ± 0.8318
Equalization Tank	6.642 ± 0.2106
Sequential Batch Reactor 01	6.714 ± 0.3858
Sequential Batch Reactor 02	7.874 ± 0.0928
Buffer Tank	7.642 ± 0.0872
Clear Water	7.496 ± 0.0877

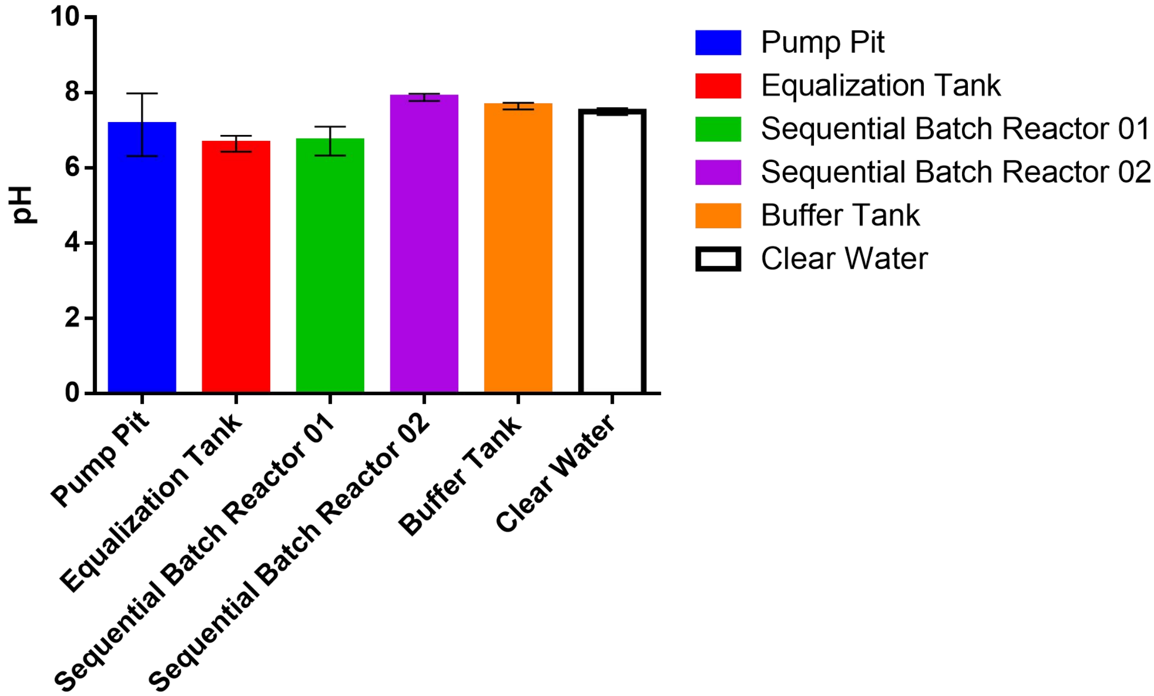

FIGURE 4: Ph- pump pit, equalization tank, sequential batch reactor01, sequential batch reactor 02, buffer tank and clear water tank.

TABLE:5 Temperature: The degree of hottest and coldest in water and the analysis is carried out in all tank.

Treatment	**Mean ± S.E.M**
Pump Pit	25.90 ± 1.4160
Equalization Tank	29.70 ± 0.8142
Sequential Batch Reactor 01	31.56 ± 0.5913
Sequential Batch Reactor 02	31.32 ± 0.4779
Buffer Tank	28.00 ± 0.6148
Clear Water	26.50 ± 0.6332

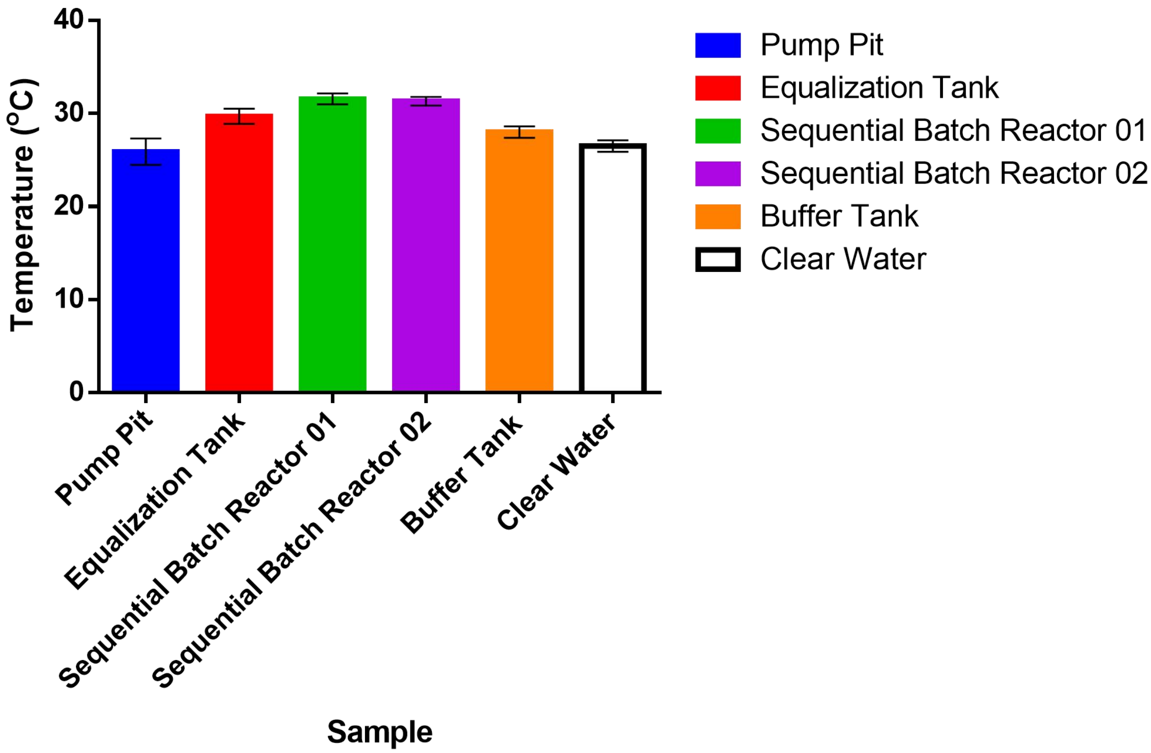

FIGURE 5: Temperature- pump pit, equalization tank, sequential batch reactor 01, sequential batch reactor 02, buffer tank and clear water tank

TABLE: 6 Total Nitrogen: It is the measurement of the sum of nitrate nitrogen [N03^-N], nitrate nitrogen [NO2^N], ammonia nitrogen [NH3^-N] and organic bonded nitrogen . total nitrogen comes from human waste, food and certain soap and detergent. Total nitrogen support the growth of algae and aquatic plant which provide food and habitat for fish, shell fish and small organism that lives in water. This analysis carried on equalization tank, sequential batch reactor 01, sequential batch reactor 02 and clear water tank

Treatment	Mean ± S.E.M	
Equalization Tank	26.60 ± 6.683	
Sequential Batch Reactor 01	8.800 ± 2.746	
Sequential Batch Reactor 02	3.060 ± 0.814	
Clear Water	4.1	0.347

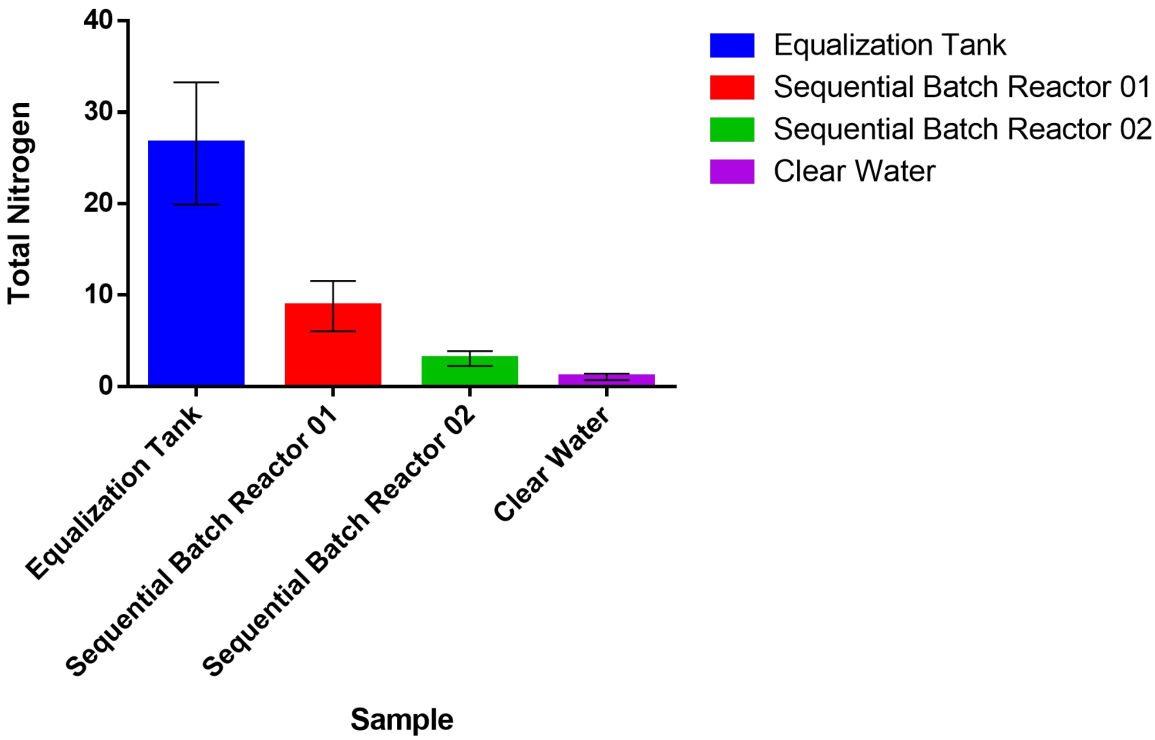

FIGURE 6: Total nitrogen – equalization tank, sequential batch reactor 01, sequential batch reactor 02 and clear water tank.

TABLE:7 Total Phosphate: In waste water treatment phosphate is reduce so as not to have effect in the environment .it support the growth of algae and aquatic plant. The main source of phosphate is human excreta

Treatment	Mean ± S.E.M
Equalization Tank	4.340 ± 1.514
Sequential Batch Reactor 01	3.220 ± 0.780
Sequential Batch Reactor 02	1.060 ± 0.347

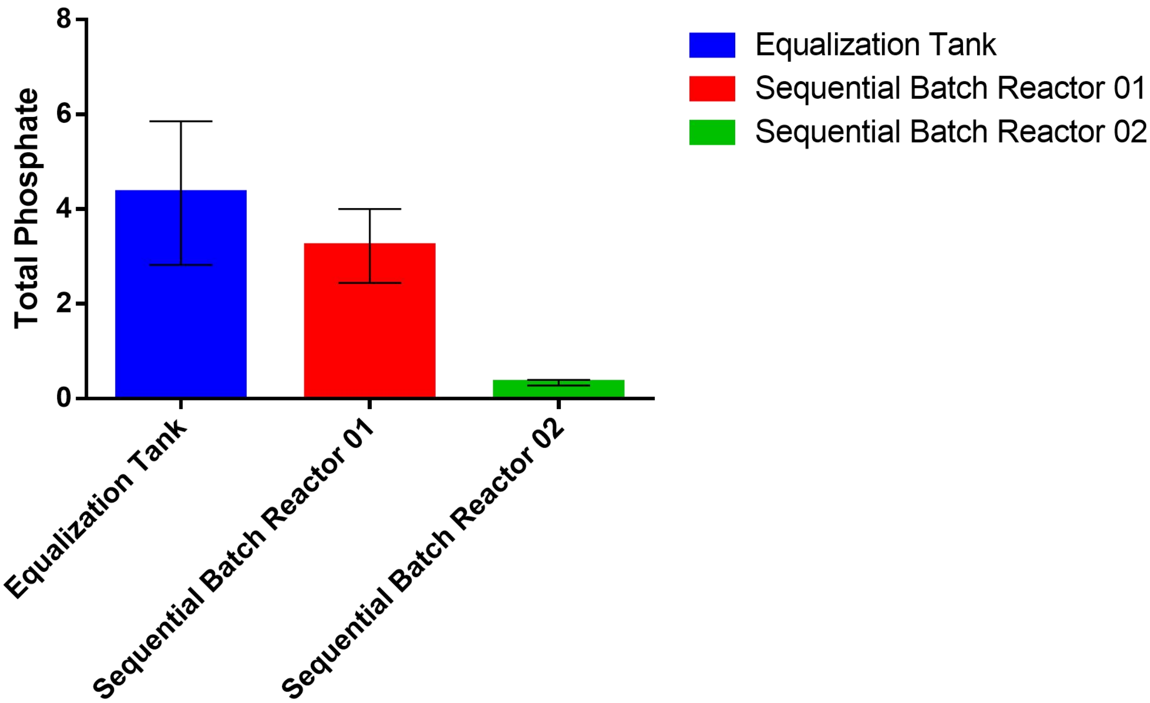

FIGURE 7: Total phosphate- equalization tank, sequential batch reactor 01 and sequential batch reactor 02.

TOTAL: 8 Total Suspended Solid: It measures the portion of the particulate matter that remains in suspension in water. The majority of suspended solid are made up of inorganic materials , bacterial and algae contribute to the total solid levels, there significant is regard as the less suspended solid that are resent the more clearer that the water will be. This analysis is carried on influent pit, buffer tank and clear water tank

Treatment	Mean ± S.E.M
Pump Pit	159.4 ± 21.82
Buffer Tank	13.00 ± 2.449
Clear Water	7.400 ± 1.503

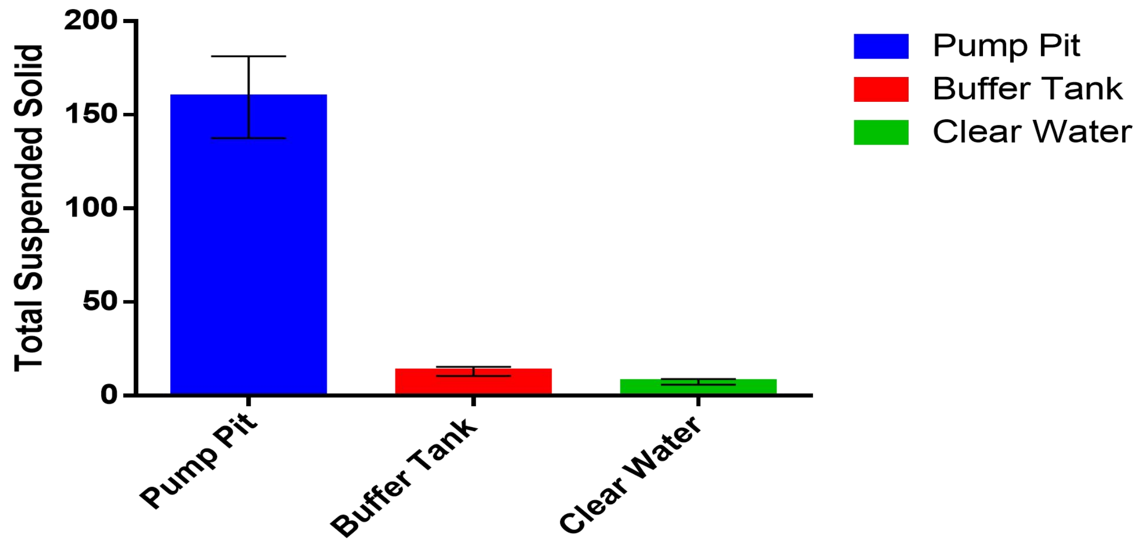

FIGURE 8: Total suspended solid- pump pit, buffer tank and clear water tank.

The data were expressed as means + standard error of mean. Significance of mean values of different parameters between the treatment groups and control group were analyzed using one-way analysis of variance (ANOVA) after ascertaining the homogeneity of variances between the groups. Turkeys multiple comparisons were done by calculating the significance at $P<0.05$. The analysis was carried out using Graph Pad Prism 6.0.

4.0 MICROBIOLOGICAL RESULT

SAMPLE NAME: ETP INLET

DATED SAMPLED: 04-02-2021

PARAMETERS	**RESULT**	**REMARKS**
Total aerobic count	Tntc	Unsatisfactory
Yeast and mould	Tntc	Unsatisfactory
Physical appearance	Cloudy	Unsatisfactory
Odour	Irritating	Unsatisfactory
Enterococci	Tntc	Unsatisfactory
E. Coli	$3.77*10^2$cfulml	Unsatisfactory
Total coliform	$2.9*10^2$cufulml	Unsatisfactory
Salmonella	Tntc	Unsatisfactory
Staphylococcus	Tntc	Unsatisfactory

TABLE 9: Effluent treatment plant inlet sample A

SAMPLE NAME: ETP INLET

DATED SAMPLED: 11-02-2021

PARAMETERS	RESULTS	REMARKS
Total aerobic count	$4.13*10^2$ cful/ml	unsatisfactory
Yeast and mould	$2.79*10^2$cful/ml	unsatisfactory
Physical appearance	Cloudy	unsatisfactory
Odour	Irritating	unsatisfactory
Enterocci	$2.73*10^2$cful/ml	unsatisfactory
E. coli	Tntc	unsatisfactory
Total coliform	$1.32*10^2$cful/ml	unsatisfactory
Salmonella	Tntc	unsatisfactory
Staphylococcus	$3.04*10^2$cful/ml	unsatisfactory

TABLE 10: Effluent treatment plant inlet sample B

SAMPLE NAME: ETP INLET

DATED SAMPLED: 18-02-2021

PARAMETERS	RESULTS	REMARKS
Total aerobic count	Tntc	unsatisfactory
Yeast and mould	Tntc	unsatisfactory
Physical appearance	Cloudy	unsatisfactory
Odour	Irritating	unsatisfactory
Enterocci	$0.18*10^2$cful/ml	unsatisfactory
E. coli	Tntc	unsatisfactory
Total coliform	Tntc	unsatisfactory
Salmonella	$2.43*10^2$cful/ml	unsatisfactory
Staphylococcus	$2.80*10^2$cful/ml	unsatisfactory

TABLE 11: Effluent treatment plant inlet sample C

SAMPLE NAME: ETP CLEAR WATER

DATED SAMPLED: 04-02-2021

PARAMETERS	RESULTS	REMARKS
Total aerobic count	2.0cful/ml	satisfactory
Yeast and mould	Nil	satisfactory
Physical appearance	clear	satisfactory
Odour	Nil	satisfactory
Enterocci	Nil	satisfactory
E. coli	12.0cful/ml	satisfactory
Total coliform	3.0cful/ml	satisfactory
Salmonella	Nil	satisfactory
Staphylococcus	Nil	satisfactory

TABLE 12: Effluent treatment plant clear water sample A

SAMPLE NAME: ETP CLEAR WATER

DATED SAMPLED: 12-02-2021

PARAMETERS	RESULTS	REMARKS
Total aerobic count	nil	satisfactory
Yeast and mould	nil	satisfactory
Physical appearance	clear	satisfactory
Odour	nil	satisfactory
Enterocci	nil	satisfactory
E. coli	nil	satisfactory
Total coliform	nil	satisfactory
Salmonella	nil	satisfactory
Staphylococcus	Nil	satisfactory

TABLE 13: Effluent treatment plant clear water sample B

SAMPLE NAME: ETP CLEAR WATER

DATED SAMPLED: 18-02-2021

PARAMETERS	REULTS	REMARKS
Total aerobic count	3.0cful/ml	satisfactory
Yeast and mould	Nil	satisfactory
Physical appearance	clear	satisfactory
Odour	Nil	satisfactory
Enterocci	4.0cful/ml	satisfactory
E. coli	Nil	satisfactory
Total coliform	Nil	satisfactory
Salmonella	2.0cful/ml	satisfactory
Staphylococcus	Nil	satisfactory

TABLE 14: Effluent treatment plant clear water sample C

NOTE

TNTC MEANS TOO NUMERSIOUS TOO COUNT

CFUL/ML MEANS COLONY FORMING UNIT PER MILLE

CHAPTER 5

5.0 DISCUSION

Wastewater characteristics

The mean value of each water quality parameter considered for both influent and effluent wastewater samples have been computed and tabulated as well as the standard deviation and standard errors of 95% confidence interval.

Temperature

The temperature of the influent wastewater to the treatment plant ranged from 26^{0}C to 32^{0}C and with a mean of 42^{0}C. The effluent temperature ranged from 24^{0}C to 29^{0}C. The drop in the effluent temperature could be due to heat losses by convection to the atmosphere and conduction to the walls of the receiving treatment tanks. A drop in temperature is paramount to aiding bacterial

pH

All the influent wastewater samples analyzed were partly alkaline and acidic. The mean pH value was 12 and was in the range of 6 to 10. The mean pH values of the effluent wastewater ranged from 7.21 to 7.86 and were all within. The decrease in the pH value of the effluent wastewater indicates that some form of treatment had been achieved. The decrease in the effluent pH value could be attributed to the dosing of sulphuric acid to the influent wastewater at the pre-treatment section of the treatment process, in order for biological processes to be effected.

The result for ph is carried out in all tank to measure the quality of hydrogen ion activity to check the alkanity and acidity of the waste water before and after treatment, It is at the highest in pump pit and get to normal ph of water at clear water tank which is after treatment

Conductivity

Generally conductivity of water is determined to ascertain the ability of the waters to conduct electrical current. The mean influent conductivity value ranged between 90 µS/cm and 1210 µS/cm. The high influent conductivity values may be attributed to the high concentration of dissolved ions present in the wastewater during the bottles washing stage of the bottle preparation process. Mean effluent conductivity was 245 µS/cm in a range from 110 µS/cm to 270 µS/cm. The result for conductivity is carried out on pump pit, buffer tank and clear water tank to measure the concentration of ions before treating the water and after treating the water.

Dissolved Oxygen (DO)

Dissolved oxygen is required for the respiration of aerobic microorganism as well as all other aerobic life forms. Mean influent DO ranged from 0 mg/l to 0.1 mg/l . The result for dissolved oxygen carried out on equalization tank, sequential batch reactor01 and sequential batch reactor 02, it is at the highest in sequential batch reactor 02,it help the activated sludge to increase the health of microorganism.

Total suspended solids (TSS)

The mean influent TSS value ranged from 108 mg/l to 220 mg/l and was 218 mg/l. The mean effluent TSS value ranged from 3 mg/l to 15 mg/l and was 10.5 mg/l. The mean TSS value could be attributed to incomplete sludge settlement during the sedimentation. The result for total suspended sold carried out on pump pit, buffer tank and clear water tank to know the solid particle before and after treated water is at lowest at clear water showing that there is low solid practices in the treated water after passing through treatment.

Chemical Oxygen demand (COD)

The mean influent COD value ranged between 6000 mg/l to 59.3 mg/l and was 6029.65 mg/l. The mean effluent COD was between 22.1 mg/l and 41.2 mg/l with a mean of 42.7 mg/l. The result for chemical oxygen demand carried out on pump pit, equalization tank, sequential batch reactor 01, sequential batch reactor 02, buffer tank and clear water tank shows that the chemical oxygen demand is at the highest in pump pit before treated and it is the lowest in clear water tank that is after treated. So the chemical oxygen demand is reduced when treating the water.

Total nitrogen

The mean influent of TN value ranged between 2 mg/l to 37 mg/l and was 38 mg/l. The mean effluent of TN was between 2.2 mg/l and 0.1 mg/l and was 2.25 mg/l. The result for total nitrogen is carried out on equalization tank, sequential batch reactor 01, sequential batch reactor 02 and clear water, it is the lowest in clear water to signify that the nitrogen compound is at lowest in treated water which will not have any effect to the environment.

Total phosphate

The mean influent of TP value ranged between 0.7 mg/l to 5.3 mg/l and was 3.35 mg/l. The result for total phosphate is carried out in equalization tank, sequential batch reactor 01 and sequential batch reactor 02. It is at the highest in sequential batch reactor 02 cause phosphate increase the growth of microorganism to breakdown wastewater.

Microbiological analysis

The result for microbiological analysis shows there is more microorganisms present in effluent inlet that is before treated in terms of fungi, yeast, bacterial and total aerobics count. Odor and physical appearance are not friendly to the environment and to the health of human and animal. But after treated the microorganism is reduced to the level which is friendly to the environment likewise the odor and physical appearance of the water.

6.0 CONCLUSION

The overall result shows that ph and temperature are carried on all tank while the other analysis are carried out in not all the tank depending on it is needed. Treatment of wastewater is divided into two which are untreated water (pump pit, equalization tank, sequential batch reactor 01 and sequential batch reactor 02) and treated water (buffer tank and clear water tank). The result showed that there is significant different between the treated water and untreated water to shows that the treated water is safe for both environment, human and animal. The effluent treatment plant has a high potential of removing key pollutants and could be used for better treatment of wastewater managed properly.

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