DECLARATION

I Akpan Michael Augustus declare that this research project is solely the result of my work under the guidance of my supervisor Prof. J.O. Odigure of Chemical Engineering Department, Federal University of Technology Minna and I have neither copied someone's work nor has someone else done it for me.

All literature cited been duly acknowledge in the reference.

Student Signature 13/01/2010 **Date**

CERTIFICATION

This research project has been read, approved and certified by the undersigned. It was performed by Akpan Micheal Augustus, Mat No. 05/21687EH of Chemical Engineering Department, Federal University of Technology Minna Niger State. After having met the requirement for the award of bachelor of Engineering (B,Eng.) in chemical engineering

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PROF. J.O. ODIGURE **DATE**

PROJECT SUPERVISOR

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ENGR. J.O. OKAFOR **DATE**

HEAD OF DEPARTMENT

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EXTERNAL MODERATOR **DATE**

DEDICATION

With deep sense of respect and appreciation, I dedicate this research project to the Almighty God for having seen me through my B.ENGR and to my Father MR.OKPUNAM AUGUSTUS for being instrumental to the success of my study and my year of success.

May God Almighty make it possible for him to reap the fruit of his labour "Amen"

ACKNOWLEDGEMENT

My profound gratitude goes to my Father MR. OKPUNAM AUGUSTUS for his financial support and effectual ferment prayers for my success. Also my elder sisters MRS. ENO Happy, MRS. NSE Linus and my younger brother Nicholas Augustus for their support and prayers.

My unreserved appreciation goes to my project supervisor PROF J.O. Odigure and my HOD chemical Engineering Dept. Engr. J.O. Okafor for their inmense assistance during this research work.

My thanks also goes to the entire staff of the department of chemical engineering of Federal University of Technology minna and especially my project coordinator Engr, Galadima for his advice during this research work.

My warm and sincere appreciation goes to my special friends Idongesist Sunday, mallam Saidu, Morrison, Hamzat, Desmond, Agada, Aloe, Salisu Paiko (cross over) and my state brothers Ukeme Victor, Itoro and Ekpuk for making my stay worthwhile during the course of my study.

My special thanks goes to my pastor REV, E.A.O EZEMA and all members of Christ Accension Church Bosso, Minna District.

My most sincere gratitude goes to my brother in-law MR, Linus, MR,Happy and my neighbors Vera, Israel, Mr. and Mrs. Sunday, I say thank you so very kindly.

Lastly, my appreciation goes to the entire staff of Iganmu Brewery industry, utility manager, and worker in Iganmu brewery industry laboratory for their support to make this project successful.

Above all, I thank the Almighty God for the strength, wisdom, grace and life through the time of my stay in Minna

ABSTRACT

Wastewater (effluent) from brewery industries were treated, having analysis and varied the heavy metals, anions, colour with 2 g, 4 g, 6 g, 8 g and 10 g dosage of activated carbon. Calculation was carried out alongside with the tabulated of results before writing the observation, discussion, conclusion and the recommendation. Finally, it can be concluded that an increase in the activated carbon dosage cause a decrease in the amount of the total solid, BOD, heavy metals and colour removed. Hence, activated carbon dosage is a feasible method of treatment for IGANMU Brewery Industry wastewater since it is the carbon that does the purification and has the highest carbon content.

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CHAPTER ONE

1.0 INTRODUCTION

Industrial wastewater treatment covers the mechanisms and process used to treat waters that have contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use.

Most industries produce some wet waste although recent trends in the developed world have been to minimize such production or recycle such waste within the production process. However, many industries remain dependent on process that produces wastewater.

However, if un-reacted wastewater is allowed to accumulate the decomposition of the organic materials, it can lead to the production of large quantities of malodorous gases such as hydrogen sulphide.

In addition, un-reacted wastewater usually contains numerous pathogens or diseases causing organism that dwell in the human intestine trait or that may be present in certain industrial waste. Wastewater also contains nutrients, which can stimulate the growth of aquatic plant and it may contain toxic compound.

There are various methods of treating waste and these are classified into:

- Primary treatment
- Secondary treatment
- Tertiary treatment

In many industries, wastewater treatment is virtually non-existence, however, a few have installed the simplest pollution control equipment such as sedimentation, sand filtration and grease traps for effluents. Most of these treatment facilities, where they are grossly inadequate to cope with the volume and the type of waste generated. Others are poorly maintained or have broken down completely.

The pollution from industries mainly includes all form of chemical waste, which is lowed on effluent out of the industries into the rivers. The results in adverse effect on the ater quality of living aquatic resource being.

In short, what we have today, as treatment facilities are environmentally nacceptable. Hence most countries including Nigeria now have environmental laws and gulations in place to provide at least minimum standard of which industries are expected to lhere.(V.Afanasten)

1.1 AIM AND OBJECTIVES

The brewery industry has been a major contributor to the pollution of the nvironment.

- To carry out a comprehensive study and to determine the nature of wastewater generated in the brewery industries.
- To treat the wastewater using activated carbon effluent from brewery industries as a case study.
- to analyzed the following (pH, total solid, total alkalinity, chloride cl^-, sulphate $SO^2{}_4{}^+$, phosphate $PO^3{}_4{}^-$, nitrate $NO^-{}_3$, COD, BOD, copper Cu^{2+}, iron, Fe^{2+}, chromium Cr^{3+}, lead Pb^{2+}, Colour, turgidity and dissolved oxygen) present in the wastewater.

1.2 SCOPE

The scope of this project shall be:

Collection of wastewater from brewery industries.

- Treatment of the effluent with lime followed by required activated carbon using wood since it has the highest carbon content and it is the carbon that does the purification.

- Further analyzing of the effluent (treated wastewater to compare level of purification).

1.2 MOTIVATION

Wastewater disposal have caused a lot of havoc when they are discharged

Into the environment (river, ocean and lagoon) since persistent of such effluent could prove very virtual.

In order to reduce the havoc cause by the wastewater and to make it abundantly available for domestic and industrial uses, I hope to embark on the deals with treatment aid re-use of wastewater.

1.3 ECONOMIC IMPORTANT

- the treated water can be used for drinking, fountain, lavatories, showers, emergency, eye washing or other personnel uses by the plant's occupants.
- the treated water can be used for cooking, boiler making-up, washing, processing as well as for irrigation of landscape area.

1.4 LIMITATION OF PROJECT

When making an attempt to wastewater (effluent), most of the materials

needed are very expensive and even some of the equipment are not readily available as a result of these analysis carried out may be up to the standard.

CHAPTER TWO

2.0 LITERARY REVIEW

2.1 WATER QUALITY

Water quality is a social necessity rather than an optional understanding. Where industries such as steel, gasoline production may be considered necessary to the formation of a scale of society, water quality management is necessary if society is to operate at all. As structure of society becomes more complex, water quality requirement, waste product, management produce and environmental impact of the waste become greater in subtlety, complexity and magnitude.

Water quality and the sub areas of water and wastewater treatment reflect this increase complexity in a number of ways.

Modern society is central round the individuality, the flow of wastewater from these centers is generally large and the area into which the wastewater are discarded is generally small in a relative sense at the other end of the scale is the nomadic community, water usage and wastewater production with large area into which the wastewater can be discharge.

Water treatment for domestic and industrial use is directed related to the quality of the source in many cases, the source is also a receiver of industrial and domestic wastewater and therefore water treatment and wastewater treatment are closely tied together.

Engineering responsibility for water and wastewater treatment begins with the determination of the level of treatment necessary or desirable and extends to system design and operation.

In most cases the level of treatment required is engineers that is, in the united state at least largely influence set by a regulatory agents, these agencies received advises and other needed information from other disciplines and governmental bodies. For example, fisheries, management, mines, water resources development, and agricultural specialist often are involved in regulatory agencies decision formulation and in some cases, their inclusion is legally required.

Engineers remain the predominate , group and agency statement and decision usually have an engineering flavour, however, while this fact is advantageous with respects to marking communication between the agency and the engineering community to find methods for incorporating non-quantitative information into regulatory and design decision.

2.2 SUBSTANCES PRESENT IN INDUSTRIAL EFFLUENT

2.2.1 DISSOLVED SOLID

Dissolved solids in natural consist of mainly carbonates, chlorides, sulphate, phosphate and some nitrate of calcium, magnesium, sodium and potassium. The minerals contents are raised by the addition of chemical wastes dissolved salt, acid, alkaline, gas, oil well brines and drainage water from irrigated lands. An industrial sources these pollutants includes metal platters, metal finisher, breweries, cooling towers, boilers bleed-off, and overflow of any tank containing minerals salt.

All substances in solution change the physical and chemical nature of the water. The also exert osmotic pressure that affect the aquatic life. But dissolved solid in industrial water can cause foaming in boilers and interface with the clearness, colure and taste of many finished products. High concentration of total dissolved solid also tends to accelerate corrosion. For this reason, many industries demonize their water before using its.

Since dissolve solids are generally ionic, their presence is determined by the conducting reading of the water. Conductivity will indicate the concentration of the dissolved solids, which can then be converted in to a part per-million or gm/c value.

2.2.2 SUSPENDED SOLID

Natural water contains suspended solids as well as dissolved solids nature al suspended solid may consist of erosion salt organic detritus and plantation. In dusty and communicates increased the natural amount of suspended solids by increased erosion, gravel washing links tailings steel will waste and metal plating and finishing wastes. Food and paper related industries also discharged water containing suspended solids.

There is a distinction between suspended and sellable solid. But strictly until they have settle to the bottom of the water course (or laboratory sample bottle.) all settleable solid are suspended solids. Only a fraction of suspended solids is settable. This fraction depends on the quiescence, temperature, density and other factors. The factors are controlled in order to transform suspended solids into settleable solids before industrial

wastes are discharge.

Suspended solid are measured by laboratory test performed on the percentage of settle able solids in a particular sample of water. Limits are also placed on the particle size and turbidity caused by the presence of the suspended solids.

2.2.3 ACIDS

Acidity can be described as the power of a sample of water to neutralize hydroxyl ions. Acidity is therefore determined by titration with the sodium hydroxide (0.02NAOH).

Depending on the indicator used "minimal acidity" or "total acidity" will be determined.

PH is the frequency thought of as the measure of all acidity, but ph and acidity are not necessarily the same thing. Ph measures the hydrogen ion concentration-log {H}

If a solution is buffered, it may contain much acid without having that reflected in the ph value. Therefore, acidity depends on the state of the water and substances theorem.

The hydrogen ion in acidic solution is highly reaction. The zinc outer coating of galvanized steel pipes is dissolved in affected by the presence of acid. Concrete decomposed in the presence of acid in a very low ph.

Because it is the hydrogen ions that are reactive, most industrial discharge of acids is limited by the total acidity of the discharged.

2.2.4 ALKALINITY

Alkalinity is caused by the presence of hydroxide (sodium hydroxide, potassium hydroxides) bicarbonates, carbonates and some birates. Total alkalinity is measured by titration with 0.02N sulfuric acid (using phenolphthalein as indicator)

When not buffered, the hydroxide ion will raised the ph substantially. Limits on alkalinity are set in term of ph rather than total alkalinity.

In itself, alkalinity water is not harmful in fact, a moderate amount inhibit corrosion of pipes. Excessive hardness (caused by the presences of dissolved slod carbonates and bicarbonates) may cause sealing which is detrimental to individual processes.

2.2.5 CYANIDES

Cyanides generally occur in metallic salts such as copper cyanides and sodium cyanides. These salts are readily dissolve in water electroplating baths make great use of cyanide salt. Other uses of cyanide include the extracting gold and silver from ore and generating HCN gas for fumigating.

When dissolved in water, the salt ionized to the metal and cyanide ion. The cyanide ion itself is not dangerous unless the ph is lowered to 6 or less. The ion then complex with hydrogen to form HCN, the toxic principle of the substance from 509 to 60mg of HCN injected by a human is considered lethal.

Limits on cyanides concentration, expressed in mgll are based on the possibility that the wastewater containing the cyanides may become acidic.

Cyanides in water decompose but only very slowly cyanides can also be oxidizes to relatively inert ion, the cyanides ion. Cyanides later undergo hydrolysis to ammonia carbonate (in aerobic) or ammonium and formic acid (in aerobic water)

The cyanides ion is generally found in effluents from gas work and coke ovens from the scrubbing of gases at steel plants from metal cleaning plants and from electroplating plants.

2.2.6 CHLORINE

Chlorine gas is the elemental form of the element chlorine. The greenish yellow gas dissolved in water to a maximum concentration of 700ppm, chlorine gas hydrolyses to HOCL dissociate to ocl- and h=

Combination of chlorine and organic, or chlorine cyanides may be determine since chlorine is very reactive. Free chlorine is generally added in tertiary treatment of sewage to destroy harmful bacteria.

Chlorine is also used in treatment of cyanide waste. Industries try to avoid over treatment of cyanide, which result in the discharge of the water containing free chlorine. Such free chlorine could destroy bacterial necessary to the proper functioning of the treatment plant.

2.2.7 COPPER

Since copper metal is insoluble, most copper enter the water system by water salts such as copper chloride, copper sulphate and copper nitrate. Such salt are used in electroplating industries engraving and photography. Waste from rinse tanks and filter cleanout also find their way into the sanitary system.

Copper ion, as a pollution does not accumulate in the human body. In measure amount, though copper can cause illness or even death. The most serious affect of copper in the sanitary sewage system and sub-sequent discharge into bodies of waters is its destruction of bacteria in treatment plants. Without optimum numbers of bacteria, a treatment facility cannot properly treat sewage for which it was designed. Used by industries, contamination water can harm production. Aluminum intensely are harmed by trace amount of copper. Also trace amount of copper in metal plating bath affect brightness and smoothness of metallic deposit.

Because copper does not decomposes when discharged and because of its detrimental effect on bacteria its is usually removed by precipitation of an insoluble copper compound before the industrial waste is discharge.

2.2.8 MERCURY

Mercury occur in element form and as mercury salts. Elemental mercury is insoluble in water. It is used in scientific and electrical instrumentals, density and the manufacturer of lamps. But the most frequent source of mercury is mercuric salts.

Mercury cyanide is also very soluble in water. It has been used as a diuretic, as a tropical antiseptic and disinfectants. It is likely to be part of the waste of chemical plants.

Mercury has been determining to be more toxic than copper, hexavalent chromium, zinc, nickel or lead to grant keep. Mercury poisoning in human has also been documented. Fish who survive in mercury containing water absorb mercury and concentrate it. Humans eating contaminated fish also concentrated the mercury, with resultant birth defects, insanity, severe intestine problems and possible death, because of severe and serious health hazard posed by mercury and the fact that it affect are accumulative and not reversible stringent limitations have been placed on concentration of mercury allowed in industrial discharge.

2.2.9 CHROMIUM

Chromium enters the waste stream generally in the form of hexavalent salti such as sodium chromate, potassium chromate and sodium dichromate. The salts are used extensively in metal packing and plating operation, in anodizing of aluminum in leather tanning and in several other industries in sparser amount. Generally they are found in the effluent of the ceramic and glass industries. Because chromium compounds inhibitors, they are used to treat cooling tower water. Chromium acid in very dilute quantities is used to protect metal from corrosive. Discharge of such treated water is also a major source of chromium.

Haxavalent chromium is very reactive in solution, being a strong oxidizing agent. In dilute amounts, chromium itself does no appear to harm the human body. But extensive tests an long-term effects have not been carried out. Both trivalent and hexavalent chromium are toxic to various species of fish. Therefore, chromium-bearing waste are harmful to aquatic life. Chromium is also harmful to lower form of life, including bacteria. Most individual waste must first pass through a sewage treatment plant becomes no longer effective to prevent injury to treatment plant, chromium limit are set around 0.05mg/I.

2.2.10 DYES

Dyes are used predominantly in the industries. They are classified as direct acid, basic sulphure and vat and miscellaneous. The direct acid and basic dye waste are all highly colored and commonly have higher BOD than domestic. Sewage.

Direct dyes are readily soluble and can be used without mordant where they are used mordant and adjuvant may prove to be more toxic than the dye itself. Used mostly on cotton, rayon and vegetable fibred, direct dye are also compound and are frequently derivative of Benzedrine and Talihina. Because of their great solubility, direct dyes are difficult to remove from industries waste.

The amount, strength and character of the waste from industries will depends on the way in which the dye is applied and how often dyes are changed in the operation of each process. When dyes are changed, vats must be dumped and cleaned. At other time the waste consist of the uniform flow of rinses and wash water.

Because dyes affect the BOD are toxic to various species of aquatic life and generally affect the appearance of water streams, the discharge of dyes is verily limited.

2.2.11 PHENOL

Phenol wastes are produced in the plastic, coke and petroleum refining industries. They are highly soluble in water, alcohol, benzene and other organic solvents. Phenolic waste arises from the distillation of wood from gas work, coke ovens, oil refineries, chemical plants and sheep dips and from human and animals refuse.

Despite the fact that they are used as a bacteraricide in strong concentration, weak phenol solutions are decomposed by bacterial and biological action in streams. The ingestion by human of contradicted solution of phenol with a result in several in severe pain, renal irritation, shock, and possible death. A total dose of 1 .5 g may be fatal. It is not likely, however, that harmful concentration of phenol will consume in drinking water because such concentration of phenol are much higher than taste concentration allow.

Since phenol is contact with chlorine accentuates disagreeable taste in water, the requirement of the various state is very rigid as to the phenol content of the final waste discharge. The limit may be I 5ppm or less.

The effect of phenols and phenolic compound are varied. Generally, phenolic compound are toxic to fish, but they also impact a disagreeable taste to the flesh, far below toxic limits. Therefore even non-drinking must be essentially free of phenolic compounds.

2.3 INDUSTRIAL REQUIREMENT FOR BREWERIES

Breweries wastewater as a characteristics of it own, it exhibit peak but in the quantity delivered and the concentration of the waste carried. The unbalanced waste consists of mainly carbohydrate. Further characteristics are the changing PH and the influence of the cleaning process and disinfectants. In a well-run plant with careful process control, small material waste and ere- use of by-product the following are typically values.

- Specific water use: O.4-O.8m2/hi sell-able beers.
- Specific wastewater effluent: O.25/O.6m^3/ hi sell/able beers.
- Specific BODs fright: about 0.5kg. BOD5/hl sell-able beers or about 8 population equivalent to 60days /hl

The quantities of wastewater depend on the production process. Its contains various substances from the breweries process in the brew-house, where the ward is cooked, a starch and protein rich flocculent mass known as the "kettle break" (some 120g BODS 1kg) remains. Addition of yeast ferments the wart into beer in the tank in the fermentation cellars. A yeast residue (150g BODsIkg) and a beer-water mixture remain after pumping and emptying the tank. The same is true in the storage cellars were a yeast residue of some 130g BODs/kg enter the drains. Pumping, filtration, and bottling or casting all cause beer lost.

A brewery like all food processing industry must be kept very clean. Automatic processes clean all the tank and pipes with caustics soda and nitric acids and sometimes disinfect them.

Breweries release their wastewater only indirectly into the public drains. They have to keep it within the prescribe temperature and pH limits (temperature 350^0C, ph between 6.5 and 10) and should retreat it. The simplest way to do this s to use closed buffer tanks holding three-hour wastewater production if necessary, a neutralizing stage using sulphuric acid, carbonic acid from fermentation of flew gases is added. The wastewater can be graded and partially treated biologically in aerated mixing and compensating tanks provide excess sludge can be obtain from the communal treatment plant.

2.4 TREATMENT OF INDUSTRIAL WASTEWATER

The treatment of water in order to make it suitable for drinking, domestic or industrial use includes a complex of physical, chemical and biological methods, which change initial composition of water. Water treatment involves not only purification and removal of various unwanted and harmful impurities, but also improvement of the natural properties of water by adding certain deficient ingredients.

2.5 METHOD OF TREATMENT I.E INDUSTRIAL WASTEWATER

2.5.1 PRIMARY TREATMENT

The primary treatment process consists of three processes including, physical treatment, chemical treatment and biological treatment. The physical treatment includes the separation of solid and semi-solid materials from the efficient. The phase use equipment such as grit chamber and bar screen. After the physical processing is over, the efficient is treated chemically, which includes the processes like coagulation and flocculation. After the removal of solid materials and chemical treatment, the effluent is passed through a biological treatment process.

2.5.2 5SECONDARY TREATMENT

The secondary treatment includes the following processing in the entire treatment including activated sludge process, Aerobic/anaerobic digestion, sequence batch reactor, trickling filter, oxidation pond. These three are the major ones,

2.5.2.1 ACTIVATED SLUDGE PROCESS:

Activated sludge is a biochemical process for treatment sewage and industrial wastewater that was air (or oxygen) and microorganisms to biologically oxidize organic pollutions, producing a waste sludge (or floe) containing the oxidized material.

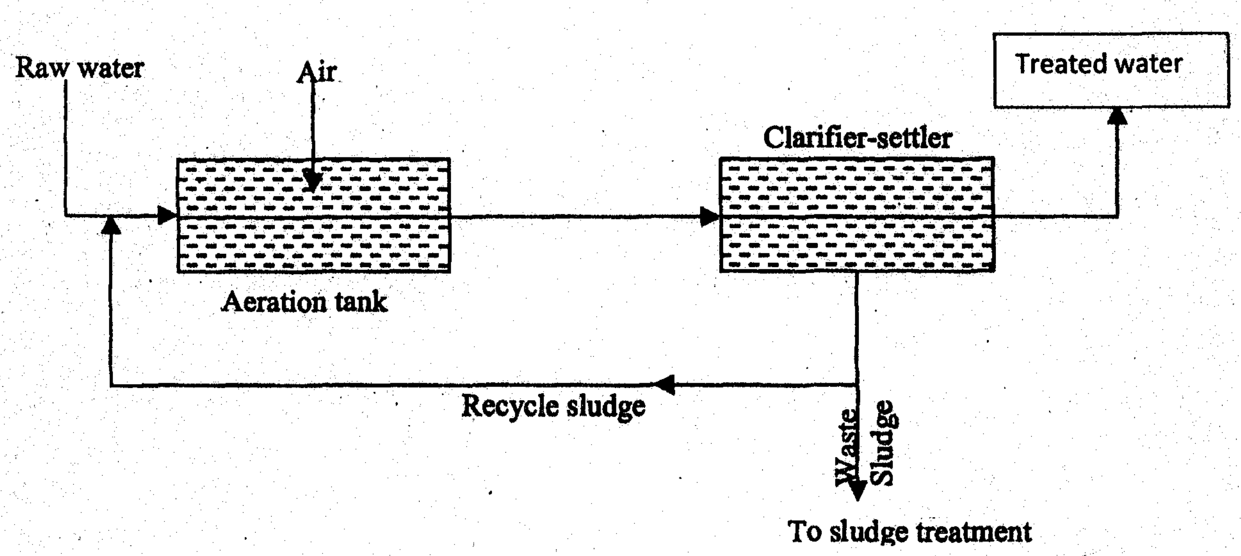

Fig 2.0 A generalized schematic diagram of an activated sludge process.

In general, an activated sludge process include:

- A generation tank where air (or oxygen) is injected and thoroughly mixed into the wastewater.
- A setting tank (usually referred to as a "clarified" or "settler") to allow the waste sludge to settle. Part of the waste sludge is recycled to the generation tank and the remaining waste sludge is removed for further treatment and ultimate disposed.

2.5.2.2 AEROBIC / ANAEROBIC DIGESTION:

Aerobic biological processes are used to decompose the biological content of the savage like food waste, soap, detergent and human waste.

Bacteria and protozoa are introduced to cover the biodegradable solution organic contaminant into flock.

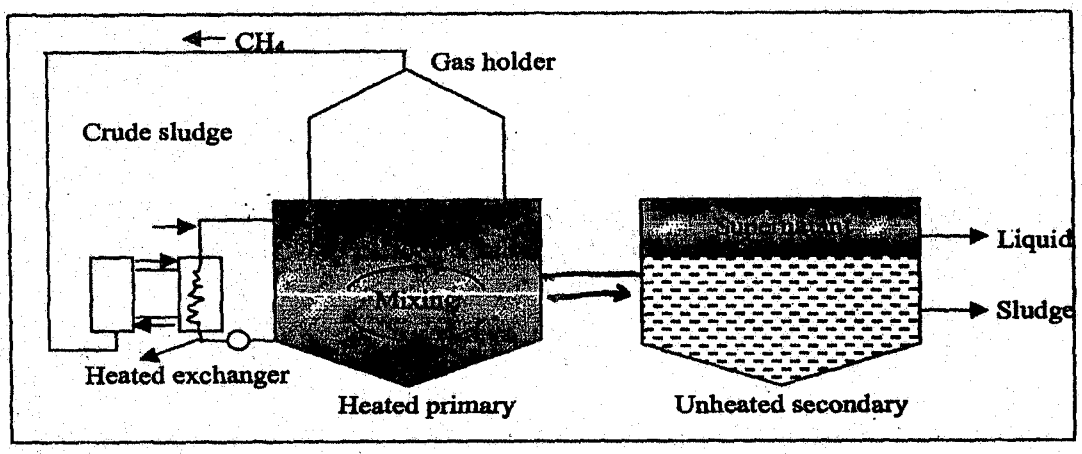

Fig 2.1 A schematic diagram of an Aerobic/Anaerobic digestion.

2.5.2.3 RICKLING FILTER PROCESS

A trickling filter is also often called a trickling filter, trickling biofilter, biological filter or biological trickling filter, it consists of a bed of rocks, gravel, slag, peak moss, or plastic media over which wastewater flows downward and contacts a layer (or film) of microbial slime covering the flowing through the bed or by natural connection of air. The process involves adsorption of organic compounds in the wastewater by the microbial slime layer, diffusion of air into the slime to provide the oxygen required for the biochemical oxidation of the organic compounds. The aid product includes carbondioxide gas, water and other products of oxidation. As the slime layer thickers, it becomes difficult for the air to penetrate the layer and an inner anaerobic layer is formed.

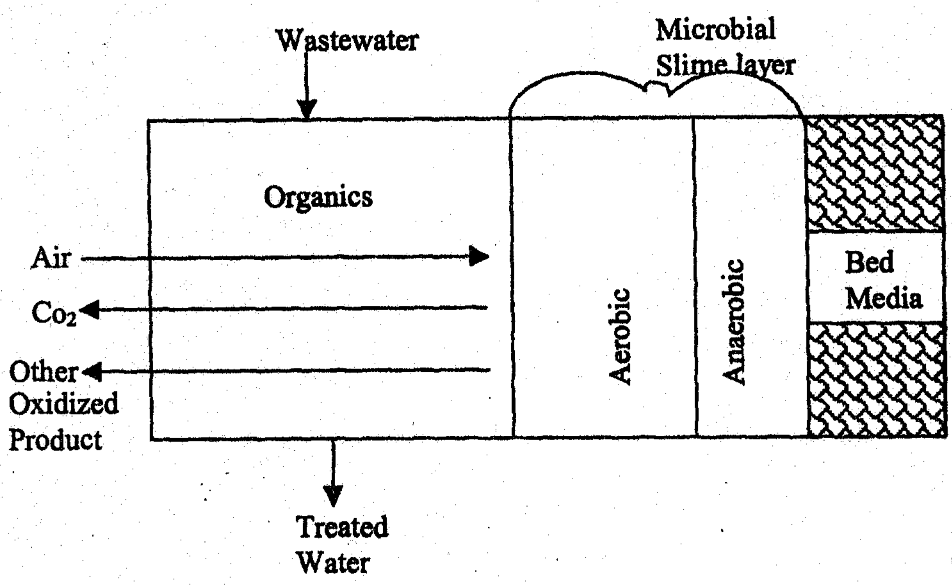

Fig 2.2 A schematic cross-section of the contact face of the bed median in a trickling filter.

The treatment of sewage or other wastewater with trickling filter is the most well characterized treatment technologies.

2.5.3 TERTIARY TREATMENT

Tertiary treatment of wastewater is essential to further enhance its quality. Some popular methods use in this stage are filtration, ionizing, removal of chemical like nitrogen and phosphorus etc. various treatment processes are use to remove nitrogen and phosphorus. The ammonia present in the wastewater is changed to nitrate and it is followed by densification. Phosphorus can be used by using specific bacteria called polyphosphate that collect large quantities of phosphorus within their cells. They are removed from water and are used as fertilizer.

2.6 WASTEWATER RECYCLE AND REUSE/EFFLUENT TREATMENT

2.6.1 WASTEWATER RECYCLE AND REUSE

The broadest technological range of us filter, help us to provide an excellent platform to address treatment, reclaim and reuse issues associated with the industries and the municipalities. We are able to provide combination processes to produce high quality water fit for human use as well as for industrial consumption. The combinations will be physical, chemical, biological, aerobic or anaerobic, absorption, ion exchange membrane filtration, etc.

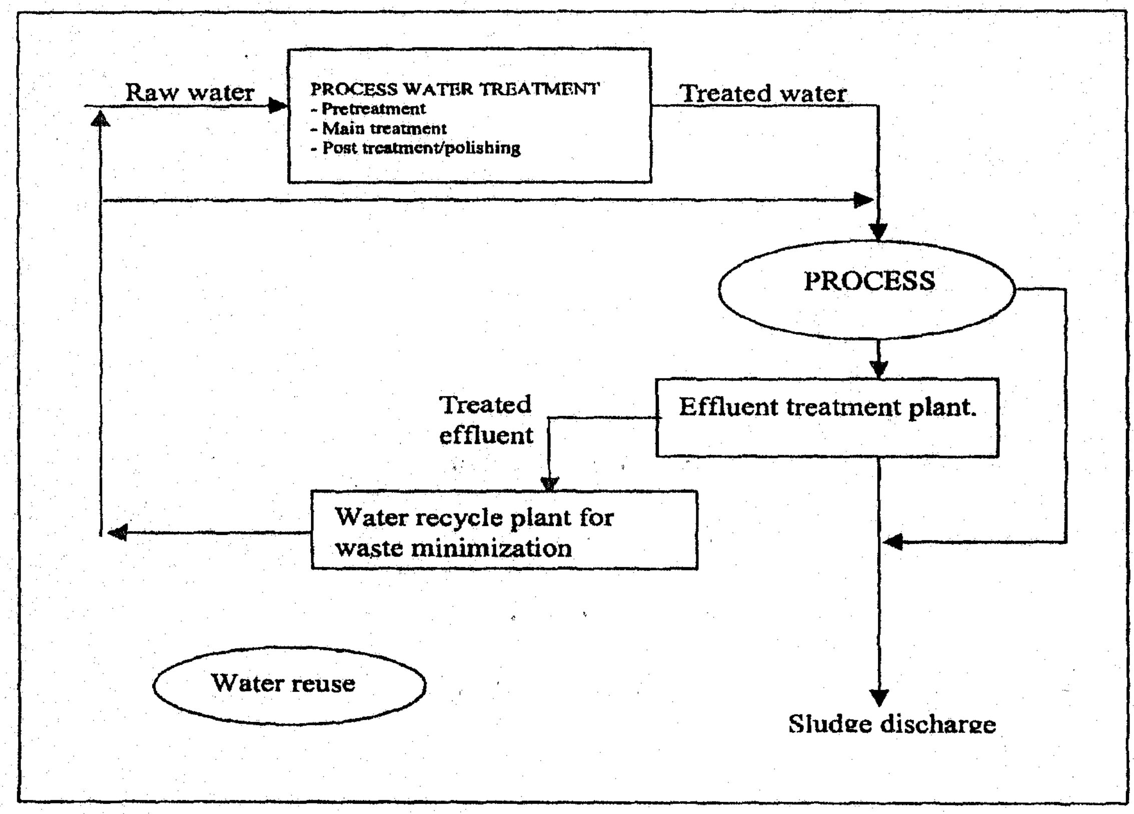

Fig 2.3 Flow chart of wastewater recycle and reuse plant.

2.6.2 EFFLUENT TREATMENT

Effluent is any substance that create pollution, such as municipal sewage is industrial liquid waste that flows out of a treatment plant, septic system, pipe, etc. effluent can be the out flow from a sewage treatment facility or the waste water discharge from industrial facilities, effluent are being produced in large amount from a number of industries, and it is posing a serious threat to our environment. Handling of such types of effluents is quite necessary to prevent our environment from being further threatened by such dangers

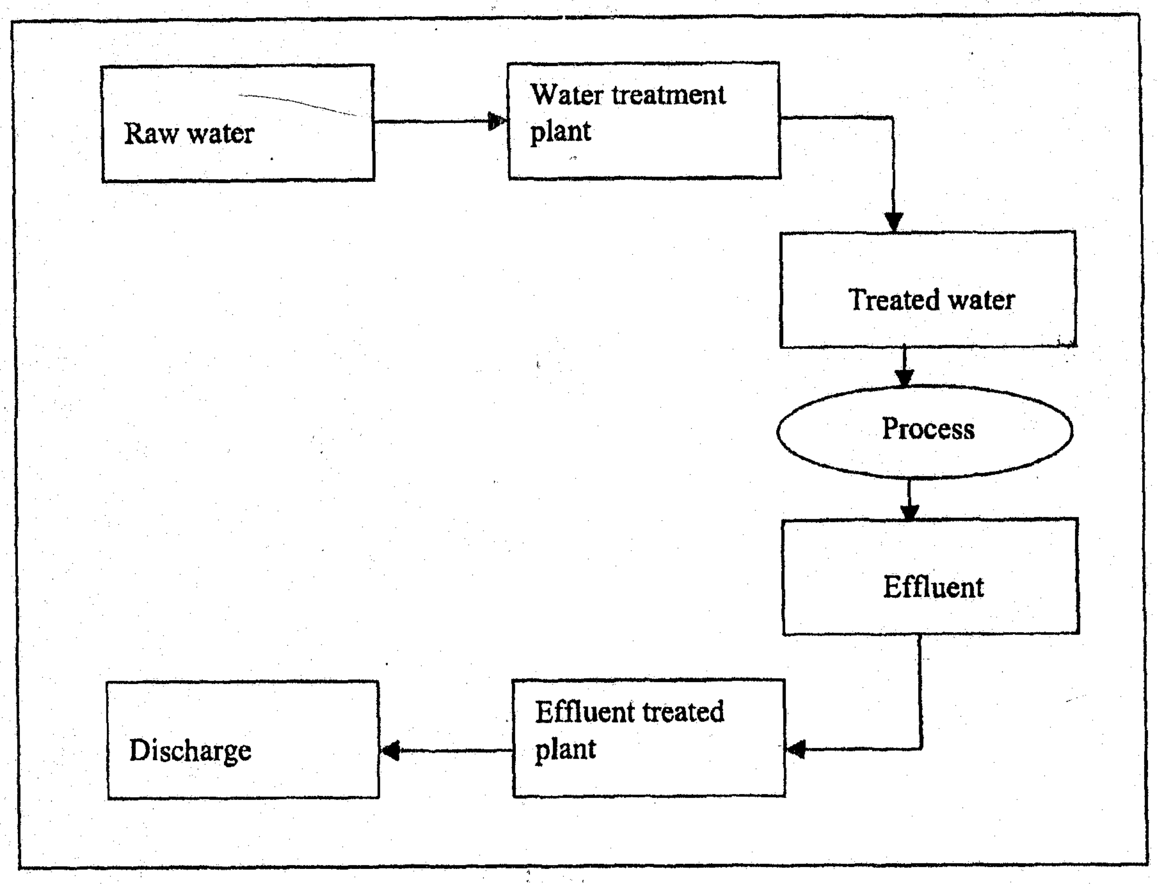

Fig 2.4 Flow Chart Process of Effluent Treatment Plant.

2.7 WASTEWATER CHARACTERISTICS

2.7.1 ORGANIC CONCENTRATION AND OXYGEN DEMAND

Most biological treatment process has the primary purpose of removing organic material from a wastewater.

Some organic materials are more difficult to degrade than lathers. Many industrial wastewaters contain high concentration of organic compounds that can be oxidized by bacterial to any grate extent. Examples of this type of material are lignums, cellulose and slightly soluble oils and greases. Thus, a biological treatment process can be expected to remove only the biodegradable fraction of the organic materials present, and at least two approaches to measuring organic concentration must be considered. The first type measures the total amount of organic compounds present. Chemical Oxygen demand (COD) determination, which measures the oxygen necessary for conversation of the organic material to carbon dioxides and water, and the total organic carbon (TOC) determination.

Measurement of oxygen uptake is an indirect method but has two significant advantages: oxygen uptake is a process operation parameter in aerobic biological processes and oxygen uptake is an important characteristic in determining effluent quality. For these reason, techniques based on oxygen demand have become the fundamental method of measuring organic concentration.

2.7.2 SUSPENDED SOLIDS

Suspended solid are important characteristics in biologically wastewater treatment because they are often biodegradable and their oxidation may be the rate controlling variable in many situations. Ordinarily, the BOD of the suspended solids would be measured in the BOD test ward, and the rate of oxidation would be included in any race studies concluded.

2.7.3 TEMPERATURE AND PH

Effect of temperature and PH on bacteria and biochemical reactions were very vital. Problem related to the temperature and the PH characteristic of wastewater occurs in aerobic process that are extremely temperature and sensitive with respect to process stability. Many industrial wastewaters are either highly acidic (e.g. wine stiliage, which typically has the PH of 3.5 and acidity greater than 1000mg/i CACO3) or alkaline (e.g. laundry wastes, which typically have the PH greater than 9.0 and aikalinities of 250mg/i CACO3). Conventional biological treatment processes do not operate well outside the 6.5 to 8.5 PH regions, and acidic or alkaline characteristics must be modified in some manners. Possible method of PH modification includes neutralization, dilution with another effluent and control of biological reaction process.

Wastewater containing significant concentration of organic acids often have low PH values, for example, and effectively handed by matching the process removal rate to the mass input rate of the acid.

2.7.4 TOXICITY

Many Wastewater constituents are toxic to living organisms. Unfortunately, most elements are toxic nature to one organism or other in some concentration, and thus the question of to9xicity must be answered at least partially in terms of public values and attitudes. The simplest case in where a wastewater constituent is toxic to the bacterial in the treatment process. Typically, problem materials are copper, chromate, cyanide and phenol.

Public value and attitudes are important where the final discharge may be toxic to living organisms. Even well treated wastewater will alter the ecology of receiving water to some extent. In many cases, toxic materials in a discharge cause several damage to natural aquatic populations are the most common cause of public concern, in coastal areas, protection of shellfish, such as oysters, crab and shrimp has also been a major issue. Large fish kills often result in a strong public response, while discharge of toxicants, which inhibit reproduction or destroy food chain links receive less publicity. While both situation are serious, the recovery time of population from a fish kill is generally less than from damage to the reproductive cycle or the food chain.

2.7.5 BIOASSAYS

Estimated of the effects of a discharge on the natural population is usually made through use bioassays. These studies are most often concluded on fish, but the concept can be used with any organism. Test organisms are selected from Zero (control) to full strength (undiluted). The diluted water used would normally be the receiving water from the discharged, and the organism selected should be the most sensitive or important organism in the receiving water. Until recently, value were reported as means toxicity limits, the concentration at which half the test organism died within a specified time interval. As increasingly used criteria is to require that a specified percentage of the test organism survive for a given time.

Bioassays based on death of the test organism name obvious defeats. Chronic effect and damage of food chain component are not determined. Specification of the test organism may not always straight forward either for examples; sensivity of eggs, fry and adult to a given toxicant is often quite different.

2.8 WATER TREATMENT PROCESS IN BREWERY INDUSTRY

Water purifying chemical are agent, which give water a higher purity that keeps all that is needful in preserving the sensory of the beverages produced.

The whole process state from the borehole, which is the source of the water and the water (H_2O) is pump and allow to pass through the dear actor (ceramic filter) where solid impurities are filter or remove from the raw water (H_2O) tank where hydrated lime (chemical) is been dose into the raw water tank at intervals according to the required specification via pipe connected to the water stream. At the raw water tank there exist a pump that pump the water into Dial Media Filter (DMF) for coagulation process to take place and after the water is send through pipe where is chlorinated before getting to the treated water tank and from the treated water tank, the water is send to the activated carbon filter tank where the water is deodorizes and polish for consumption or used in the brewing house.

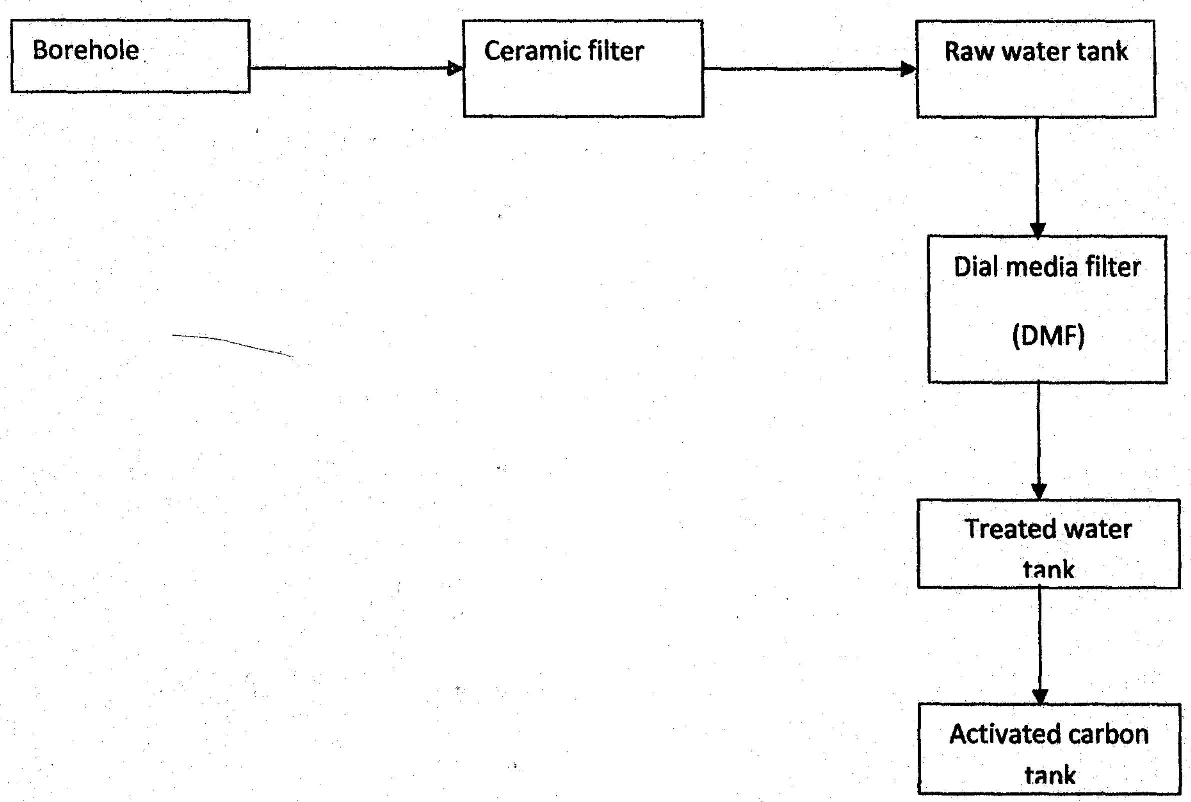

Fig 2.5 Flow chart of water treatment plant in brewery industry.

2.8.1 BOREHOLE

Any water has it problem depending on the chemical constituent. The plant sources most water use from its borehole although the municipal water is used from time to time depending on supply. The water from the borehole is considered raw since trace of dissolve solid / chemicals.

2.8.2 CERAMIC FILTER

The ceramic filters situated a distance from the borehole are two gigantic cylindrical vessel made up of steels and ceramics as filters inside of it. It performs the function of filtering the solid impurities in the water which includes insoluble salts in the water by means of trapping it on the ceramic filter. The sludge is always removed and the ceramic filter clean weekly with hot water solution at weekly intended.

2.8.3 RAW H_2O TANK

This is an under ground tank that permit the reaction of hydrate lime and the H_2O remove the soluble salt from the water before it is sent to the Dual Media Filter (DMF).

2.8.4 DUAL MEDIA FILTER (DMF)

This is where the coagulation matters are collected in the process. This is a cylindrical tank with a volume of about thirteen thousand liter, which does not hold water but water flow through it in the process of treatment.

2.8.5 TREATED WATER TANK

This served as a reservoir where water is stored for chlorination before it being sent to the ACF tank before used. It is also an underground storage system.

2.8.6 ACTIVATED CARON TANK

Activated carbon tank serves as a carbon filter for removal of chlorine odor and colour from water. It is also used to remove residual organic matter from through its capillaries properties.

2.9 STANDARD AND REQUIREMENT TO WATER QUALITY

Water should meet different quality specification depending on the particular use as follows:

- Portable and domestic use water, water for baths, laundries and various
  - plants, of food and some other branches of industry.
- Cooling water (for cooling of processed equipment, stream, liquid and gaseous product blast furnaces and open-hearth furnaces, stream turbine conductor and stream engine, cupola furnaces forging process e.t.c.
- Feed water for steam boilers of thermal power station.
- Process water for some technology processed where it enter into the composition of products or comes into contact with them.
- Water for flooding of petrol station and water agricultural use.

Water quality standard should have both quantitative and qualitative aspects. The quantitative aspect includes the concept of what is a standard that is value of water quality parameter (e.g. dissolved oxygen, turbidity, colour, chemical oxygen demand and biological oxygen demand). Which must be met in a stream to maintain a specified environment.

The standard on potable water in this country specifies the following water characteristic.

Turbidity -- up to 1.5 mg/l

Coloration-- up to 20 deg

Ordure and flavor--------------------------------- up to 2 numbers at 20 °c

PH index-- 6.5-8.5

Total hardness------------------------------------ up to 7 mg-eg/l

Iron-- up to 1.3 mg/l

Lead-- up to 0.1 mg/l

Chloride-- up to 350 mg/l

Sulphate-- up to 500 mg/l

Water for certain processes food industry indicated should satisfy addition requirement apart from those indicated. For instance, water for breweries should be absolutely free from sulphate and certain not more than 0.1mg/1 of iron.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Material

Materials	Comments	Sources
Water sample (effluent)	Iganmu Brewery	
Buffer	Iganmu Brewery Lab	
Sort Tissue	Iganmu Brewery Lab	
Phenolphthalein	Iganmu Brewery Lab	
NaOH (Solution of NaOH)	Chemical Stores	
H_2SO_4	Chemical Stores	
$MnSO_4$	Chemical Stores	
Concentrated H_2SO_4	Chemical Stores	
Iodine	Chemical Stores	
Starch Solution	Iganmu Brewery Lab	
Thiosulphate	Chemical Stores	
Mercury (ii) Sulphate Solution	Chemical Stores	

Table 3.2 List of Equipments

Apparatus	Sources	Remarks
PH meter	Pyrex England	
Burette	Pyrex England	250ml
Pipette	Pyrex England	20-25ml
Conical Flask	Pyrex England	250ml, glass
Beaker	Pyrex England	25-2000ml, glass
Incubator	Summer and range KG, England	
Spatula		Metal
Measuring Cylinder	Pyrex England	100-1500ml, glass
Polyethylene bottle	Pyrex England	25-250ml
Spectrophotometer	Conoco, England	
Burner	Emmex, Nigeria	
Retort Stand		Metal
Filter paper	Fin texture	Laboratory material

3.3 TREATMENT PROCEDURE

A four-liter jerry can of wastewater was colleted from IGAMU Brewery

The sample was stored in a refrigerator prior to treatment to reduce temperature.

The water was screened to remove solid waste such as lint gilt and dirt.

One liter of the waste sample was measured into one liter conical flask 100 g of lime was added to the flask, lime was selected because of its ability to precipitate metal ions from wastewater.

The content of the flask was stored rapidly for some minute and gradual mixing for some 15 minutes.

The content of the flask after been allowed to settle was filtered using a filter paper and the filter collected and store prior treatment.

100ml of the pre-treated sample was then put into beaker.

Various quantities (2 g, 4 g, 6 g, 8 g, 10 g) of powered activated carbon were then added containing the wastewater sample.

The bakers containing the wastewater and the activated carbon were stirred for 20 minutes, after which at was allowed to stay for 24 hrs.

The content of each beaker was then filleted and the filtrate collected for analysis.

3.4 ANALYTICAL PROCEDURE

3.4.1 p^H

The ph meter was standardized using ph 4 and 7 bitter solution

The ph knob was switch off and the glass electrode removed from the buffer solution.

Rinsed with distilled water and the tip of the electrode cleaned with soft tissue paper.

The clean dried glass electrode inverted into the sample, the ph knob was switched on and the ph value was read directly from the scale.

3.4.2 ALKALINITY

100 ml of the water sample was pipette into a conical flask and 3 drops of the phenolphthalein indicator added.

If the same sample because pink, then it was titrated with 0.02 H_2SO_4 until the pink colure because colorless. The value was then recorded.

3.4.3 CONDUCTIVITY/TOTAL DISSOLVED SOLID

100ml of sample was pipette into a conical flask and the battery was check to know if is in good condition.

The cell constant was set to 0.83.

The glass electrode was dipped into sample and the highest deflection was read.

The reading was converted to mcm-1 by multiplying it by 0.666.

3.4.4 REFRACTIVE INDEX

The refract meter was on and he window of the refractormetre was open to light.

Two drops of sample was put into the refract meter to avoid dilution with solution.

The shark margin portion was half of the total circle in the upper knob eyepiece.

The reading was read from the lower knob eyepiece.

3.4.5 CHROMIUM IRON AND LEAD

The metal above determined using ALPHA atomic absorption spectrotometer.

3.4.6 CHLORINE

100ml of the wastewater sample was pipette into a conical flask.

$k_2Cr_2O_7$ stirred in and the solution was titrated with $AgNO_3$ until a reddish tint appearance.

The amount of $AgNO_3$ used was recorded.

3.4.7 PHOSPHATE

100ml of wastewater was measure into a beaker

A few drops of methyl red indicator was added into the sample.

A mixture of magnesium and concentrated ammonia solution was added slowly while string vigorously until the indicator turn yellow.

Crystalline precipitate of ammonia phosphomthydrate formed was dried and weighed

3.4.8 SULPHATE

100ml of sample was measure into a beaker

Concentrated HCL was then added and the mixture is boiled

Barium chloride solution was then added with a pipette while string and the solution was allowed to settle for 2minutes and the solution filtered and weighed

3.4.9 DISOLVED OXYGEN

1ml of manganese sulphate and 1ml of the potassium iodide was poured into 50ml sample of conical flask

The conical flask was shacked very well and 1ml of h2so4 was also added to dissolve the precipitate

1ml of starch indicator was added and the mixture was titrated using sodium thiosulphate solution until the colour turned colorless.

The reading of the burette was taken

$$\text{Cal d.o mg/l} = \frac{\text{mol of } Na_2S_2O_3 \times 100 \times 0.08}{\text{ml of sample}}$$

3.4.10 OXYGEN DEMAND

BOD is defined as the amount of oxygen required by bacterial for breaking down to simple substance and decomposable organic matter present in the water, wastewater or treated effluents. BOD can be taken as a measure of the concentration of organic matter present in that kind of water. The greater demand the decomposable matter present the greater the oxygen demand and the greater the BOD value.

The BOD bottle were rinsed with the sample and poured into the BOD bottles.

The exact amount needed was then poured into the BOD bottles

The BOD bottle was kept in the dark cupboard and maintain at 20c for five days

The value obtained and the fifth day were dissolved oxygen final and it was titrated.

$$\text{BODmg/l} = \frac{(\text{Doo-Dod}) \text{ volume of Bod bottle}}{\text{Ml sample}}$$

Doo = dissolved oxygen found in the sample on the initial say.

Dod = dissolved oxygen found in the solution of the sample after titration on the final day.

3.4.11 TURBIDITY

The Reference Slandered was placed on the optical cell and the light shield was placed in the position over the reference slandered.

The front panel range switch was placed in the lowest NTU ranger.

The reference adjustment knob was adjusted in the lest forward corner of the instrument as possible to cause the displayed to read the same value as the reference standard value.

Place the sample in the optical on the front panel light should in position.

Set the range switch located on the front panel light shield in position.

Read the value on the digital display.

3.4.12 COLOUR

The colour determination was made using a panel of 10 people using visual observation

3.4.13 NITRATES

Stock Solution was prepared by weighing 62 g Of NO_3, which was contained in the 101g of KNO_3, was dissolved in liter of water to give 1000ppm. Serial dilution was carried out to give the required concentrations, which were 0.2, 0.4, 0.6, 0.8 and 1.0 ppm respectively.Each of them was evaporated to dryness in conical flask.2ml of phenol diaphonic was added to each of the flask aid were allowed to dissolve completely.

8ml of water was added, 5ml of NAOH was added and absorbance against concentration was drawn.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 RESULT

Wastewater sample were collected from IGANMU BREWERY INDUSTRY. This served as the representative wastewater sample.

The wastewater treatment and analysis was carried out in IGANMU BREWERY INDUSTRY laboratory in accordance with procedure in the previous chapter.

The Lagos state environment agency (LASEPA) standards are still regarded as the international standard for portable water. The table below shows comparism between Lagos state environment agency and wastewater samples after activated carbon treatment.

Table: Comparism between Lagos state environmental agency standard and Wastewater samples after activated carbon treatment.

ND= Not Detected

NA= Not Applicable

PARAMETER(mg/l)	LASEPA	2g	4g	6g	8g	10g
PH	6-8	8.5	8.3	8.0	7.5	7.0
Total solids	2000	1490	1670	1775	1870	1950
Total alkalinity	ND	ND	ND	ND	ND	ND
Chloride Cl-1	250	467	360	280	270	270
Sulphate SO4	ND	0.0-25	0.01	ND	ND	ND
Phosphate PO4	ND	2.0	0.3	0.1	ND	ND
Nitrate NO3	<0.01	1.65	1.4	0.8	0.62	0.6
Biochemical Oxygen Demand	58	59	54	53	49	44
Copper Cu2	<1.00	0.04	0.035	0.02	0.01	ND
Iron Fe2+	9.8	5.8	5.2	4.3	2.5	1.4
Chromium Cr3+	<1.00	0.03	0.03	0.27	0.025	ND
Lead Pb2+	<1.00	0.9	0.14	0.12	0.11	0.11
Colour	Clear	Clear	Clear	Clear	Clear	Clear
Turbidity	NA	NA	NA	NA	NA	NA

Refractive index	1.3333	1.3314	1.3319	1.3309	1.3312	1.2211

4.2 DISCUSSION OF RESULT

The results obtain from treatment procedure in the previous chapter are discussed.

The result shown in the table 2 are those obtained from the water analysis after activated carbon treatment. The pretreated wastewater was treated with varying quantities of activated carbon (2g,4g.6g,8g.10g) and the concentration of total solids. BOD, various heavy metals as well as colour among. Others parameter remaining after the contact with the indicated carbon dosage are reduced subsequently. Only those heavy metals whose presence was indicated in the preliminary wastewater an analysis were analysis for.

Although, when the wastewater was analysed there was a lot of onion and metal present but after treatment with activated carbon, the concentration of metals and anions reduced drastically (Pb^{2+} ,Cr^{3+}, Cu^{2+}, Cl^{-}, $S0_4^{3+}$, and PO_4^{3} respectively) until they were no longer detected.

However, more of BOD, DO, total solids and even heavy metals were removed with increase in the activated carbon dosage, colour removed were also obtained as more activated carbon was added and they become clearer. This is due to the (increase) in the surface area available for absorbtion when activated carbon concentration are increased. For example, the BOD, value for 2 g of activated carbon was 59 mg/l and when contact with 10 g of activated carbon it was 44 mg/l.

Meanwhile, it can be seen from the table 2.0 that the value of P^{H} decreases with increasing in the activated carbon dosage, which means more of anions were removed.

Comparing the values obtained together after treatment to those lands down by the LASEPA, it was observed that most of the values obtained were within LASEPA values are 9.8, 250 ml, < 1.00, while those obtained when treated with 10 dosage of activated carbon dosage were 0.3, 270 and 1.4 mg/

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

At the end of the analysis carried out on the effluent sample, it can be seen that the sample 4.1 and 5.1 are not only the most effective of all but also conform with standard obtained from the Lagos state environmental agency (LASEPA) standard.

However, analysis of the effluent treated with powdered activated carbon of varying dosage yields reduced concentration of total solids, BOD, heavy metal, labour, anion.

Hence, an increased in the activated carbon dosage cause a serious in the amount of total solids, BOD, heavy metal and colour removed.

Lastly, activated carbon absorption is a feasible method of treatment for IGANMU BREWERIES INDUSTRY wastewater since it is the carbon that does the purification.

5.2 RECOMMENDATION

The volume of the wastewater provided should be reduced, their will help to concentrate the effluent in a smaller volume of water and in turn reduced the water purification cost. Water re-use techniques and counter flow processing achieve the cost.

For further researched work it is advisable to use reflux condenser so that the chemical oxygen demand can be carry out.

Formulation, which will meet the required standard, must be use to reduced concentration of total solids, BOD heavy metal colour and anion.

The solution shows the activation carbon (chemical) treatment of wastewater is feasible. It is therefore recommendation that the assessment of full potentials of activated carbon absorption should be taken for there because through this, a more effective and most economical solution can be found for the treatment of wastewater (effluent)

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FORMULAE AND PREPARARTION OF REAGENTS.

(1) Preparation of 0.02m H_2S0_4

Purity of the acid = 98%

Density = 1.82g/ml

Molecular weight = 9.8g

If 100g of H_2S0_4 contain 98g of pure H_2S0_4

$$\text{Then} \frac{100}{1.82} = 54.945 \text{ ml}$$

If 54.945ml = 98

$$100\text{ml} = \frac{98}{54.945} \times 1000/1 = 1783.6\text{g}$$

$$\text{No of moles} = \frac{1783.6}{98} = 18.2\text{moles}$$

OR

$$\text{Morality of stock} = \frac{\text{Actual weight}}{\text{Molar weight}} = \frac{1783.6}{98} = 18.2\text{g}$$

$M_1V_1 = M_2V_2$

0.02×250

TREATMENT AND RE-USE OF WASTEWATER IN BREWERY INDUSTRY

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DECEMBER, 2009

100

$$\text{Molarity of stock} = \frac{\text{actual weight}}{\text{molar weight}} = \frac{430.7}{36.46} = 11.81\text{m}$$

$M_1V_1=M_2V_2$

$$V_1 = M_2V_2/m1 \frac{3 \times 100}{11.81} = 25.4\text{m}/100\text{m}/\text{distilled } H_20$$

Calculation,

DOO mg/l = ml of na2s203 × 100 × 0.08/ml of sample.

BOD mg/l = (Doo – Dod) × volume of BOD bottle/ml of sample used.