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# DETERMINATION OF THE BIOLOGICAL OXYGEN DEMAND (BOD) AND CHEMICAL OXYGEN DEMAND (COD) OF LIQUID WASTE GENERATED FROM LANDMARK UNIVERSITY STUDENT'S CAFETERIA.

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## ABSTRACT

*Wastewater effluents are major contributors to a variety of water pollution problems. Most cities of developing countries generate on the average 30–70 mm3 of wastewater per person per year. Owing to lack of or improper wastewater treatment facilities, wastewater and its effluents are often discharged into surface water sources, which are receptacles for domestic and industrial wastes, resulting to pollution. The release of raw and improperly treated wastewater onto water courses has both short- and long-term effects on the environment and human health. For this project work it entails the determination of the biological and chemical oxygen demand, physiochemical parameters and also heavy metals from liquid waste generated from the landmark university cafeteria*

***Keywords:*** *Determination, Biological Oxygen demand (BOD), Chemical Oxygen demand (COD) Liquid waste, Landmark University, Student's Cafeteria.*

## INTRODUCTION

The uncoordinated disposal of liquid waste being generated has become a serious point of concern to the environmental health.

According to the Environmental protection agency (EPA) liquid waste is defined as any waste material that passes the definition of a "liquid." This means that the material must, "pass through a 0.45-micron filter at a pressure differential of 75 psi," according to the EPA's provided definition of a liquid,as the major producers of liquid waste in the environment are humans and animals Liquid waste disposal has become and extremely important part of waste disposal because it is very difficult to get rid of because liquid matter easily contaminates any object it comes in contact with e.g.: other liquids, underground water, plants etc.

As a result of this pollution living organisms around the area of pollution are liable to contamination, and this is hazardous to the environment

The liquid waste generated from the landmark university cafeteriahas been degenerate to the aquatic life of the university community because of the lack of the proper disposal method for this sanitary waste that is being generated from the different stands in the cafeteria down to the main cafeteria kitchen where all the food is being prepared and the generated waste causes aesthetical displeasure, foul smell etc...

It is also known that untreated liquid waste water can be very contagious to the aquatic life of the university community , Liquid waste water generated from the cafeteria that is being disposed of on the surface of the earth can find its way to the underground water by the principle of percolation , which is known as the migration of fluid through porous materials e.g. : soil which therefore leads to contamination of the underground water and also leading to the cause of water borne diseases

To determine the degenerating effect of this liquid waste water to the university community

**The biological oxygen demand** is the measure of the oxygen required by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. It is the most widely used parameter of organic pollution applied to both waste water as well as the surface water

Biochemical oxygen demand is the amount of oxygen required for microbial metabolism of organic compounds in water. This demand occurs over some variable period of time depending on temperature, nutrient concentrations, and the enzymes available to indigenous microbial populations. The amount of oxygen required to completely oxidize the organic compounds to carbon dioxide and water through generations of microbial growth, death, decay, and cannibalism is total biochemical oxygen demand (total BOD). Total BOD is of more significance to food webs than to water quality. Dissolved oxygen depletion is most likely to become evident during the initial aquatic microbial population explosion in response to a large amount of organic material. If the microbial population deoxygenates the water, however, that lack of oxygen imposes a limit on population growth of aerobic aquatic microbial organisms resulting in a longer-term food surplus and oxygen deficit

The biological oxygen demand procedure that would be carried out on the waste from landmark university cafeteria will determine how detrimental the liquid waste is to the aquatic health of the university community , which also causes oxygen depletion which is a phenomenon that occurs in aquatic environments as dissolved oxygen (**DO**; molecular oxygen dissolved in the water) becomes reduced in concentration to a point where itbecomes detrimental to aquatic organisms living in the system. Dissolved oxygen is typically expressed as a percentage of the oxygen that would dissolve in the water at the prevailing temperature and salinity (both of which affect the solubility of oxygen in water

**The chemical oxygen demand:** This is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution. It is commonly expressed in mass of oxygen consumed over volume of solution which in SI units is milligrams per liter (mg/L). A COD test can be used to easily quantify the amount of organics in water.The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface water (e.g. lakes and rivers) or wastewater. COD is useful in terms of water quality by providing a metric to determine the effect an effluent will have on the receiving body, much like biochemical oxygen demand (BOD).

Chemical Oxygen Demand is an important water quality parameter because, similar to BOD, it provides an index to assess the effect discharged wastewater will have on the receiving environment. Higher COD levels mean a greater amount of oxidizable organic material in the sample, which will reduce dissolved oxygen (DO) levels. A reduction in DO can lead to anaerobic conditions, which is deleterious to higher aquatic life forms. The COD test is often used as an alternate to BOD due to shorter length of testing time, but for this research work we will be carrying out both the biological and chemical oxygen demand tests.

## MATERIALS AND METHOD:

**Materials used:** Liquid waste generated from the Landmark University Cafeteria was used. The waste was taken from four different locations.

**Tests carried out on the samples:**

BOD: Biological oxygen demand (BOD), also known as biochemical oxygen demand, is a bioassay procedure that measures the dissolved oxygen (DO) consumed by bacteria from the decomposition of organic matter. The BOD analysis is an attempt to simulate by a laboratory test the effect that organic material in a water body will have on the DO in that water body. Biochemical oxygen demand values are a measure of food for naturally occurring microorganisms or, in other words, a measure of the concentration of biodegradable organic material. When nutrients are introduced, naturally occurring microorganisms begin to multiply at an exponential rate, resulting in the reduction of DO in the water. The test does not determine the total amount of oxygen demand present, since many compounds are not oxidized by microorganisms under conditions of the test.

The BOD test was performed on all the four samples obtained from the university cafeteria

**Method applied:** instrumental method was used to carry out the test

**Experiment used:**

- Mw600 dissolved oxygen meter
- Incubator
- BOD bottles
- Measuring cylinder
- Beaker
- Wash bottle

## PROCEDURES

100ml of sample was measured and water was added to make 300ml in BOD bottle which mean we have dilution ratio of 1:3 factor. DO meter was inserted into the BOD bottle to take initial DO1 value. The sample will be kept in the

Incubator under the control temperature of $20^0$C for the period of 5days. Final reading will be taken at the end of 5days as DO2 value. The difference will be multiplied by the dilution factor and the reading is noted in mg/L.

**COD (chemical oxygen demand)**
Chemical oxygen demand (COD) is defined as the amount of a specified oxidant that reacts with the sample under controlled conditions. The quantity of oxidant consumed is expressed in terms of its oxygen equivalence.

**Method applied:** colorimetric method
**Equipment used**

- Palintest Photometer 7100
- COD Digester
- COD safety screen, pipette
- COD reagent solution.
- beaker and tubes rack

**Procedure**
Two ml of distilled water was added COD solution in the COD test tube to prepare blank. Then addition of two ml of sample was added to another COD solution and digest the sample prepared at the temperature of $150^0$C for two hours. Allow the sample to cool at room temperature and take the reading on the Photometer by first blank the equipment with the solution prepared with distilled water. The result is displayed as mg/L$O_2$ on the screen

**CONDUCTIVITY and TOTAL DISSOLVED SOLIDS (TDS)**
Conductivity determines the extent at which water sample is conducted to the electricity.
TDS is the amount of dissolved solids present in a given sample of water.

**METHOD APPLIED**:
Instrumental method was used to carry out the test.
**EQUIPMENT USED**: Multi-parameter

**PROCEDURE:** conductivity is first calibrated by insert EC probe into Distilled water. Then the probe is inserted into the sample and the reading for EC and TDS are displayed on the screen at the same time.

**pH VALUE**

The pH value is a measure of the acidity or alkalinity of water and is defined as the logarithm of the reciprocal of the hydrogen concentration in moles per liter; pH test determines the strength of acid or alkaline in water while the chemical tested for acidity determine the amounts of the acid or alkaline present. Water ionizes (split up into electrically charged ions) into hydrated hydrogen ions and hydroxyl ions.

**METHOD APPLIED**: Instrumental method will be used to carry out the test

**Equipment used**: pH meter

**Procedure:** the pH meter was first calibrated with buffer solution of 7, 4 and 10. The probe will be rinsed with distilled water to eliminate any present of acid or alkaline that can affect the value range. Then the probe will be inserted into the sample and the result is displayed on the screen.

CHROMIUM, COPPER, NICKEL, SULPHATE, ZINC AND PHOSPHATE are parameters carried out under chemical Analysis test.

**METHOD APPLIED**: Colorimetric method was applied to carry out these tests.

Equipment used is Palintest Photometer 7100, Palintest test tube, crushing stick

**consumable used**: distilled water, hand clove, nose cover.

**REAGENTS USED:** reagents for each element.

**PROCEDURE:** the same procedure was applied to all parameters but different reagents for each element.

Take **Copper for** example

**PROCEDURES**: The test tube was filled with distilled water to the 10ml mark to make blank for photometer calibration. Fill another test tube with sample to the 10ml mark. Add one copper tablet provided, crush the tablet with crushing stick mix to dissolve completely. Stand for one minute to allow full color development. Select copper on Photometer and insert blank prepared to calibrate the Photometer. Then insert the sample prepared and Take Photometer reading by press ok button on the Equipment and the result is displayed as mg/L on the screen.

Follow the same procedure for other parameter with their reagents.

**OIL AND GREASE**

**METHOD APPLIED**: Gravimetric method

**PROCEDURES:** 100ml of sample was measured and poured into the round bottom flask.150ml of n-hexane is also measured into this same flask and the flask is collected to Soxhlet apparatus with heating mantle. Under reflux, distill the solvent from the extraction flask at 85°c with heat supplied from an electric heating mantle. Cool in a Desiccator for about 30 minutes and then weigh.

W0 = weight of the empty round bottom flask use

W1 = weight of the sample after extraction

Oil and grease produced = $\frac{(W1-W0)mgX1000}{100ml\ of\ sample\ used}$

**RESULTS AND DISCUSSION**

The study indicates the results obtained from all the analysis presented below. As required, background information on determination of Bod and Cod of liquid waste some other parameters include : conductivity and total solid , physiochemical properties ,PH value , BOD and COD. Most of the readings gotten from this study are above the WHO standards and these readings would be discussed further.

**BOD (biological oxygen demand )**

Biochemical oxygen demand, or BOD, is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.

From this study we carried out BOD tests on three samples gotten from three different locations in the cafeteria : beans stand , the main cafeteria kitchen , the potato stand (I picked this locations because they produce the largest amount of liquid waste in the university cafeteria

For the process of the BOD test ,this involved me determining the intial DO and the final DO
The bod values :

| LOCATION | INITIAL DO | FINAL DO | BOD (after serial dilution calculation) | WHO STANDARDS |
|---|---|---|---|---|
| **Main cafeteria kitchen** | 6.2mg/l | 2.8mg/l | 680mg/l | 30mg/l |
| **Beans stand** | 4.2mg/l | 3.0mg/l | 280mg/l | 30mg/l |
| **Potato stand** | 4.6mg/l | 3.2mg/l | 260mg/l | 30mg/l |

In determining this values I used the following equipment's:mw600 dissolved oxygen meter, incubator, bod bottles, measuring cylinder, beaker, wash bottle after putting the samples into the incubator for five days, the sample appeared to be very concentrated so I diluted 2ml of this waste into the 380ml of distilled water before dipping the bod meter probe into the mixed solution and taking the readings and considering the serial dilution factor

$BOD_5$ = BOD mg/L = [(IDO -$DO_5$) – seed correction] x dilution factor

In general, maximum allowable concentration for direct environmental wastewater discharge fall around 10 mg/L BOD and maximum allowable concentrations for discharge to sewer systems around 300 mg/L BOD.

From the result gotten comparing them with the world health organization standard we can see that our results are very high and are harmful to the environment talk more of an environment where consumables are prepared and according to EPA (environmental protection agency) for food making houses the biological oxygen demand reading must not exceed 30mg/l

If BOD is high in raw wastewater, proper treatment methods such as aerobic and anaerobic biological treatment, filtration, coagulation and flocculation should be utilized to remove organic material. The greater the BOD, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD are the same as those for low dissolved oxygen: aquatic organisms become stressed, suffocate, and die.

| BOD Level in mg/liter | Water Quality |
|---|---|
| 1 - 2 | **Very Good:** There will not be much organic matter present in the water supply. |
| 3 - 5 | **Fair:** Moderately Clean |
| 6 - 9 | **Poor:** Somewhat Polluted - Usually indicates that organic matter present and microorganisms are decomposing that waste. |
| 100 or more | **Very Poor:** Very Polluted - Contains organic matter. |

From this table classification we can say that all our BOD values fall under the very poor category which is known to be hazardous to the environment.

## COD (chemical oxygen demand)

COD is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant. COD is widely used as a measure of the susceptibility to oxidation of the organic and inorganic materials present in water bodies and in the municipal and industrial wastes.

From this study we carried out BOD tests on three samples gotten from three different locations in the cafeteria: beans stand, the main cafeteria kitchen , the potato stand (I picked this locations because they produce the largest amount of liquid waste in the university cafeteria

For this COD test I diluted 10ml of the waste into 90ml of distilled water then I measured 2ml of the diluted solution and I poured it into a COD 2000, the COD 2000 is used because of the concentration of the waste.

A picture of the cod 2000 solution

Below are the values gotten from the COD test

| LOCATION | COD values | WHO STANDARDS |
|---|---|---|
| **Main cafeteria kitchen** | 760mg/l | 250mg/l |
| **Beans stand** | 180mg/l | 250mg/l |
| **Potato stand** | 60mg/l | 250mg/l |

From the readings that we've gotten from the chemical oxygen demand test

We discovered that only the waste sample gotten from the Main cafeteria kitchen is way above the WHO ratings for COD in waste water ,The higher the COD value, the more serious the pollution of organic matter by water. The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface water (e.g., lakes and rivers) or wastewater (Davidson, 2001; Sara and Goncaloglu, 2008).

## HEAVY METALS

### Chromium

Chromium is widely used in metallurgy, electroplating, and in the manufacturing of paints, pigments, preservatives, pulp and papers among others. The introduction of Chromium into the environment is often through sewage and fertilizers. Hexavalent Chromium compounds including chromates of Ca, Zn, Sr, and Pb are highly soluble in water, toxic and carcinogenic, Furthermore, compounds of Chromium have been associated with slow healing ulcers. It has also been reported that Chromate compounds can destroy DNA in cells. The WHO recommended safe limits for Cr (hexavalent) in wastewater is 0.05mg/lrespectively

But from out test carried out on the samples these are the results gotten

| **sample** | **concentration** |
|---|---|
| **1** | 0.29mg/l |
| **2** | 0.53mg/l |
| **3** | 0.49mg/l |

From the reading gotten we can see that the chromium values are way above the WHO standard for the allowable chromium in waste water which is 0.05mg/l

Chromium VI is the most dangerous form of chromium and may cause health problems including: allergic reactions, skin rash, nose irritations and nosebleed, ulsers, weakened immune system, genetic material alteration, kidney and liver damage, and may even go as far as death of the individual.

## NICKEL.

Nickel is a silver - colored metal used in making stainless steel, electronics, and coins among other uses. Globally, the release of Ni to the environment is estimated to vary from 150, 000 to 180, 000 metric tons per year. Exposure of Ni to humans is through food, air and water. Previous study has shown that ingestion of dust contaminated with Nickel was the main exposure pathway of the heavy metal by local residents when compared to inhalation and dermal pathways. Upon exposure to Nickel, an individual may show increased levels of Ni in his or her tissues and urine. The disadvantageous effects of nickel on human health may include dermatitis, allergy, organ diseases, and cancer of the respiratory system. The recommended safe limits by WHO for Ni in wastewater 0.02mg/l

From the reading gotten we can see that the chromium values are way above the WHO standard for the allowable Nickel in waste water which is 0.02mg/l

But from out test carried out on the samples these are the results gotten

| SAMPLE | concentration |
| --- | --- |
| 1 | 2.75mg/l |
| 2 | 5.00mg/l |
| 3 | 4.80mg/l |

Form this readings we can see that the allowable amount for Nickel according to WHO has been exceeded. Ni can cause a variety of health effects, such as contact dermatitis, cardiovascular disease, asthma, lung fibrosis, and respiratory tract cancer. Inhalation exposure in occupational contexts is a main route for nickel-induced toxicity in the respiratory tract, in the lung, and immune system. Inhalation exposure may also affect non-occupationally exposed individuals, mainly those who handle stainless steel and nickel-plated articles, with a high prevalence of allergic contact dermatitis . However, the exposure of human beings mainly concerns oral ingestion through water and food as nickel may be a contaminant in drinking water and/or food.

## ARSENIC

Arsenic is the twentieth most abundant element on earth and its inorganic forms such as arsenite and arsenate compounds are lethal to the environment and living creatures. Humans may encounter arsenic by natural means, industrial source, or from unintended sources. Drinking water may get contaminated by use of arsenical pesticides, natural mineral deposits or inappropriate disposal of arsenical chemicals. Deliberate consumption of arsenic in case of suicidal attempts or accidental consumption by children may also result in cases of acute poisoning

The allowable amount of arsenic in waste water according to WHO is 0.015mg/l

Below are the readings gotten from the test for arsenic in our samples

| Sample | Concentration |
| --- | --- |
| 1 | **1.16mg/l** |
| 2 | **1.45mg/l** |
| 3 | **0.46mg/l** |

Its evident that the readings weve gotten from the test are way above the WHO standards adverse health effects that may be associated with long-term ingestion of inorganic arsenic include developmental effects, diabetes, pulmonary disease, and cardiovascular disease. Arsenic-induced myocardial infarction, in particular, can be a significant cause of excess mortality. In China (Province of Taiwan), arsenic exposure has been linked to “Blackfoot disease”, which is a severe disease of blood vessels leading to gangrene. This disease has not been observed in other parts of the world however, and it is possible that malnutrition contributes to its development.

## LEAD

Lead is a naturally occurring bluish-gray metal present in small amounts in the earth’s crust. Although lead occurs naturally in the environment, anthropogenic activities such as fossil fuels burning, mining, and manufacturing contribute to the release of high concentrations. Lead has many different industrial, agricultural and domestic applications.

According to WHO the allowable amount of lead in waste water is 0.25mg/l

Below are the readings we’ve gotten from our test for lead in our samples

| sample | concentration |
| --- | --- |
| **1** | 1.3mg/l |
| **2** | 0.9mg/l |
| **3** | 2.7mg/l |

Exposure to high levels of lead may cause **anemia, weakness, and kidney and brain damage**. Very high lead exposure can cause death. Lead can cross the placental barrier, which means pregnant women who are exposed to lead also expose their unborn child. Lead can damage a developing baby's nervous system.

**COPPER**

Copper is a natural element of the normal composition, but the copper concentration is too high will be harmful to humans, animals and plants.
Below are the readings gotten from testing for the presence of copper the waste samples

| | |
|---|---|
| **Sample 1** | **1.75mg/l** |
| **Sample 2** | 3.2mg/l |
| **Sample 3** | 3mg/l |

**CADIUM**

Cadmium is the seventh most toxic heavy metal as per ATSDR ranking. It is a by-product of zinc production which humans or animals may get exposed to at work or in the environment.Cadmium distributed in the environment will remain in soils and sediments for several decades. Plants gradually take up these metals which get accumulated in them and concentrate along the food chain, reaching ultimately the human body.

Cadmium is a highly toxic nonessential heavy metal that is well recognized for its adverse influence on the enzymatic systems of cells, oxidative stress and for inducing nutritional deficiency in plants

| **SAMPLE** | **CONC** |
|---|---|
| **1** | 0.4mg/l |
| **2** | 0.9mg/l |
| **3** | 0.6mg/l |

The allowable limit of cadmium in waste water is 0.1mg/l in relation to the readings in the table above the values gotten are way more than the allowable amount by WHO which leaves the waste as a threat to the environment .

**ZINC**

Zinc is the 23rd most abundant element in the Earth's crust and its concentrations are rising unnaturally, due to addition of zinc through human activities. Most zinc is added during industrial activities, such as mining, coal and waste combustion and steel processing. When it is present in less quantity in human's body, it affects considerably human's health. Although humans can handle large extent of zinc, too much of it can still cause eminent health problems below is the table that contains the readings gotten from the test for zinc in the waste samples

| Sample | Conc. |
|---|---|
| 1 | 12mg/l |
| 2 | 22.5mg/l |
| 3 | 23mg/l |

The WHO standard for zinc in waste water is 15mg/l from this information we can derive that sample 2 & 3 are way above the WHO standard therefore they appear to be a threat to the environment .

**PHYSIO CHEMICAL PARAMETERS**

Sources of wastewater in the selected area, macro industries household activities (domestic wastewater). Wastewater is collected through sewage systems (underground sewage pipes) to one or more centralized Sewage Treatment Plants (STPs), where, ideally, the sewage water is treated. However, in facilities with old sewage systems treatment stations sometimes simply do not exist or, if they exist, they might not be properly equipped for an efficient treatment. Even when all establishments are connected to the sewage system, the designed capacities are often exceeded, resulting in a less efficient sewage system and occasional leaks that would definitely contaminate the environmentThe physio chemical parameters that we searched for are: **SULPHATE, PHOSPHATE, NICKEL, PH, TOC, SULPHATE.**

**SULPHATE**.

Sulphate is an essential nutrient for tissue growth in plants and animals. The reductionoxidation ability of sulphates via chemical and microbiological pathways, makes them an important link in the global Sulphur cycle ,Below is a table that contains the values gotten for the test for sulphate in our waste water samples .

| Sample | Concentration |
|---|---|
| 1 | 57mg/l |
| 2 | 81mg/l |
| 3 | 82mg/l |

From the above table all values gotten from the samples are below the permissible WHO standards which is 100 mg/l for waste water

**PHOSPHATE**

Phosphate reflects BOD (Biological Oxygen Demand), therefore the number microbes as Escherichia coli (bacterium) also increase tremendously the number Escherichia coli per unit volume of water is main parameter of water pollution. Phosphate affects degradation led to oxygen depletion which affects (and even kills) fish and other aquatic decomposing plants are known to produce toxins as strychnine which kills animals including cattle.

Below is the table for the concentrations obtained from testing for the presence of phosphate in the waste samples

| sample | Concentration |
|---|---|
| 1 | 0.99mg/l |
| 2 | 1.7mg/l |
| 3 | 1.85mg/l |

The permissible amount of phosphate according to WHO is 1-2mg/l this means that the concentration of phosphate in the waste is allowable.

**NICKEL**

Nickel is a toxic substance and is detrimental to aquatic and human health as well as the operation of biological processes in wastewater treatment.

Below are the concentrations gotten from the test for the concentration of Nickel in the waste water samples

| Samples | Concentration |
|---|---|
| 1 | 2.75mg/l |
| 2 | 5mg/l |
| 3 | 4.8mg/l |

The WHO standard for nickel in waste water is 0.5mg/l , therefore the nickel concentration values gotten here are way above the permissible limits thus it poses as a threat to the environment and the people in it

**PH**

The pH of the environment has a profound effect on the rate of microbial growth. pH affects the function of metabolic enzymes. Acidic conditions (low pH) or basic conditions (high pH) alter the structure of the enzyme and stop growth. Most microorganisms do well within a pH range of 6.5 to 8.5. However, some enzyme systems can tolerate extreme pH and will thrive in acidic or basic environments. Fungi, for example, do well in an acidic environment. Most bacteria and protozoa, however, grow best in neutral (pH 7) environments. Abnormal or irregular pH in biological treatment processes can result in a significant decrease in the rate of removal of organic compounds from the environment, which will affect the biochemical oxygen demand (BOD) measurements.

The ph. values gotten from the waste water samples are 5.39 , 5.47 ,5.63

**TDS** (total dissolved solids)

Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water.

Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions but does not tell us the nature or ion relationships. In addition, the test does not provide us insight into the specific water quality issues

| **samples** | **Concentration** |
|---|---|
| **1** | 294.5mg/l |
| **2** | 238.5mg/l |
| **3** | 77.55mg/l |

**TOC (total organic carbon)**

Total Organic Carbon (TOC) is a measure of the total amount of carbon in organic compounds in **pure water** and aqueous systems. TOC is a valued, analytical technique that is applied by organizations and labs to determine how suitable a solution is for their processes.

| samples | Concentration |
|---|---|
| 1 | **230mg/l** |
| 2 | **55mg/l** |
| 3 | **20mg/l** |

According to WHO the standard permissible value for TOC is 100mg/l that is only the first sample is above the standard which means it poses a threat to the environment and the people in it.

## OIL AND GREASE

The term FOG (fat, oil and grease) encompasses a number of different materials (liquid and solid) and describes a heterogeneous group of chemicals including tri-, di- and mono-glycerides, sterols, non-volatile hydrocarbons, waxes and other complex lipids.

Table of values for oil and grease from the samples

| Samples | concentration |
|---|---|
| 1 | **3686mg/l** |
| 2 | **3526mg/l** |
| 3 | **3248mg/l** |

## CONCLUSION AND RECOMMENDATION

Wastewater effluents are major contributors to a variety of water pollution problems. Most cities of developing countries generate on the average 30–70 mm3 of wastewater per person per year. Owing to lack of or improper wastewater treatment facilities, wastewater and its effluents are often discharged into surface water sources, which are receptacles for domestic and industrial wastes, resulting to pollution. The poor quality of wastewater effluents is responsible for the degradation of the receiving surface water body. Wastewater effluent should be treated efficiently to avert adverse health risk of the user of surface water resources and the aquatic ecosystem. The release of raw and improperly treated wastewater onto water courses has both short- and long-term effects on the environment and human health.

Poorly treated wastewater can have a profound influence on the receiving watershed. The toxic impacts may be acute or cumulative. Acute impacts from wastewater effluents are generally due to high levels of ammonia and chlorine, high loads of oxygen-demanding materials, or toxic concentrations of heavy metals and organic contaminants. Cumulative impacts are due to the gradual buildup of pollutants in receiving surface water, which only become apparent when a certain threshold is exceeded

For food making houses, like the university cafeteria and the two other places that samples were picked from it was discovered that the liquid waste is disposed in a very wrong way as shown in the images above its clearly represented there that the mode of disposal of the waste which is directly on the ground directly beside where food is being made from the survey taken waste water would remain stagnant for three days before flowing in to a septic tank this is because there is no proper channeling of the waste , and this subjects the food being made to contamination which could lead to health complications.

From the values gotten from the test carried out which are : Bod ,Cod ,physiochemical parameters and heavy metals it is very evident that the liquid waste been emitted from the cafetria and other food stands, due to the mode of disposal has a high possibility of causing contamination and can also cause health complications

Therefore I strongly advise that a proper waste disposal method is adopted to futher reduce the risk of contamination and health complications.

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