EFFECTS OF CAR-WASH EFFLUENTS ON THE QUALITY OF RECEIVING STREAMS AND THE SOIL

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MAY, 2004.

DEDICATION

This work is dedicated to my father, mother, brothers, sisters and my beloved wife.

DECLARATION

I hereby declare that this research project was conducted by me under the Supervision of Engr. Deacon .O Chukwu of the Department of Agricultural Engineering, Federal University of Technology, Minna. And I have neither copied someone's work nor has someone else done it for me. Writers whose works have been referred to in this Project have been acknowledged.

17-5-04

SAIDU ZEGI --

Signature

CERTIFICATION

This is to certify that this Project work is an original work undertaken by SAIDU ZEGI PGD/AGRIC ENG/01/02/167 and has been prepared in accordance with the regulations governing the preparation and presentation of Postgraduate research projects in Federal University of Technology, Minna.

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ABSTRACT

Car wash effluents were analyzed. The receiving stream water was also analyzed at some points (before the point of discharge and after the point of discharge). The surrounding soils were also analysed. The results indicated that the effluents have lowered the quality of the receiving stream water, making most of the parameters determined to be on the high side in comparison with World Health Organization (WHO) standard. The effluents were alkaline and this led to precipitation of heavy metals. The total dissolved solids were found to range from 82.1mg/l to 118.6 mg/l.

The levels of heavy metals were also high. For example, iron was above the recommended levels safe for drinking water. Chromium was found to be between 0.20mg/l and 0.27mg/l. The dissolved oxygen ranges from 1.41mg/l to 4.30mg/l, while biochemical oxygen demand (BOD) was between 2.18mg/1 for up stream (US) and 4.70 mg/l at the point of the discharge (POD).

Chemical oxygen demand (COD) on the other hand was between 4.01mg/l and 5.20mg/l for down stream (DS) and POD respectively. For soils, most of the parameters were within the WHO standard, except for iron. This might be attributed to the washing of corroded parts of cars. The P^{H} of the soil samples are weakly acidic. This might be due to the washing of car batteries that contains sulphuric acid as an electrolyte.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 CAR – WASH EFFLUENTS

Car-wash effluents refer to the waste water resulting from the process of washing motor cars, tankers, trucks, bicycles and motor cycles. Car-wash involves the use of detergents, petrol, kerosene and diesel for cleaning. The process of car wash utilizes large volume of water either to wash the cars or as medium for a greater attraction. In the process, large amount of waste water is released carrying with it left over hydrocarbons and detergents.

Water, which has been used and discharged from domestic dwellings, institutions and commercial establishments (domestic waste water and car wash) together with discharge from manufacturing industries (known as industrial waste water), contains a large number of potentially harmful compounds. As it is discharged directly into a water course, serious damage might result to the many forms of life which inhabit this water. In addition water courses utilized by man, either as a source of potable water or for washing or bathing, would present potential risks of the transmission of a large number of water-related diseases.

To ensure that such problems are avoided or minimized, attention should be paid to the management of our aquatic resources and also of the pollutants, which enter them. A sensible management strategy will involve analysis of the composition of waste water and their receiving water and the surrounding soil (Horan, 1990).

The threat to human lives and aquatic animals cannot be easily neglected. Ajayi (1996) gave a situation report as it affects the safety of our environment. He indicated that an estimated 1.2 billion of world's city dwellers breathed highly polluted air, ten percent of the world's rivers is heavily polluted and that chemical contamination of food had reached unacceptably dangerous levels.

Somanath and Muthikrishnam (1990) reported that phosphatase activity in muscle, liver and intestine of fishes in water polluted by tannery effluents decreased significantly with increasing concentration of effluents.

The late Earle B. Phelps, one of the early leaders in the field of streams sanitation wrote "Stream or rivers are subject to much natural pollution because they serve as a drainage channel for large areas of the countryside. In addition, rivers are capable of absorbing some man-made pollution" (Phelps, 1975, McGraw-Hill Series in water resources).

Yusuf (1994) Reported that an uptake of 0.002μg/l of metals is adequate for normal growth. Then concentration of metals above the limit will prove toxic.

Asaaga (1998) warned against gross pollution of streams and the soil. That their concentration could increase in future causing serious health problem.

1.2 THE SOIL

Soil is the medium where plants grow and their roots penetrate, or grow into a network and anchor themselves. This is highly essential to the provision of foods and fibres so as to sustain mankind, animals and plants. Soil is a reservoir of plant nutrients, which are taken up through the plant roots for the manufacturing of certain foods and to carry out other activities (Cheah, 1969).

The analytical studies of soil samples are very essential because of their importance to man, his environment and also toxicity to plants which directly feed on the soil. Routine analysis of soils and plants is very vital in assessing to what extent plant nutrients are available and whether toxic or non toxic. For instance the presence of Nickel, Chromium and Copper in the soil can make it toxic and is referred to as soil toxicity. These elements get into the soil through discharge into water bodies which might be used for irrigation. They are toxic when they exceed the normal level in the soil and could be taken up by the plant (Musa 1995).

Plant may acquire these elements from soil contaminated by trace metals and which in turn may result to some dangerous biochemical processes in man. This could be transmitted to man through the uptake of these plants, particularly vegetables.

The effect of soil P^H on the activities of the micro-organisms may be in extreme cases due to the H^+ concentration itself but these effects are mostly due to associated factors.

In general, bacteria and actinomycetes function better in moderately to slightly acid soils; their activity falls at P^H values below 5.5, fungi flourish at all normal soil P^H ranges encountered in soils. Nitrification and Nitrogen fixation take place most vigorously only at P^H value well above 5.5.

The causes of poor fertility of acid soils (low soil P^H) itself has little direct effect on plant growth, except below P^H of 4.0 when cation uptake by roots is inhibited by H^+ concentration. Poor crop growth on acid soils may be due to Calcium and Magnesium deficiency or Manganese toxicity. Because of its profound influence both on soil microbiological systems and on higher plants, soil

P^H is extremely important for soil fertility and productivity. Soil may be acid (P^H less than 7), Neutral (P^H 7) or alkaline (P^H higher than 7) (Anthony, Fred and Ochapa, 1999).

At P^H 3-4, solubility of some elements are considered very low e.g Fe (iron). However, with increasing P^H levels, solubility of some elements increases and reaches a maximum of approximately P^H 6.5 e.g phosphate. At above this P^H level some elements decrease again in solubility e.g Fe (iron). On extreme alkaline range (P^H 8.0), some nutrients e.g Ca (Calciun) and phosphate are in an insoluble form. By decreasing the P^H, these nutrients also become slightly soluble and maximum solubility is reached at P^H 6.5 (Marcel Deckker 1993).

1.3 NEED FOR SOIL ANALYSIS

Over the years, man has polluted soil in various ways. Soil has been polluted with industrial wastes, agricultural activities and even domestic sewage. Soils in urban areas are polluted by pit latrines and soak away pits, oil wastes from mechanic works, dyes from textile companies and car-wash from car washing.

This soil as found in nature is not pure but contains a number of chemical compounds, some of which give character to the soil. Soil must be free from toxic materials and concentration of chemicals that might constitute hazard to the soil and crops to be grown on it. Excess of a harmful chemical can lead to disease as a result of the uptake of the crops grown on such soil. These diseases are prevented simply by removing the chemical, which is harmful, or taking a measure that will minimize the occurrence.

In some cases, excess of this chemical waste is extremely difficult to remove and may lead to people to abandon the soil, as in the case of oil spillage.

It is thus evident that analysis of soil is necessary for social and economic development of any country.

1.4 WATER

Water is life. It is perhaps the most familiar of all substances.

It is essential to all forms of life and constitutes over 70% of the surface of the earth. It has acted as nature in forming rivers, carving out valleys and eroding mountains. Principally, there are two major sources of water.

(a) Surface Water

(b) Underground Water

1.4.1 SURFACE WATER

This source of water is as a result of rainfall from the atmosphere, which flows on the ground as run-off through gutter, streams, rivers and oceans. The amount of water in this case is dependent upon climatic condition of the area concerned.

1.4.2 UNDERGROUND WATER

A Portion of rainwater infiltrates into the soil and accumulates under the ground surface as under ground water.

There are two sources of under ground water:

(a) Rainwater, which permeates into the ground through the pores or cracks in the rock formation and finally reaches the underground water table.

(b) The water from streams, lakes and reservoirs, which permeates through the soil to the under ground water table (Abdulmuminu, et al 1998).

1.5 NEED FOR WATER ANALYSIS

Over the years, man has polluted water in various ways. Surface water has been polluted with industrial wastes, wash-off from farmlands and even domestic sewage. Some wells have also been polluted particularly in urban areas by close proximity to pit latrines and soak away pits, oil wastes from mechanic workshops and dyes from textile industries, car wash from car washing e.t.c.

Water as found in nature is not pure but contains a number of chemical compounds, some of which give character to the water. Water for human consumption must be free from toxic materials and concentration of chemicals that may constitute hazard to health and aquatic animals.

For communities in urban areas, which take water from wells, pipes and treated water sources, water pollution through chemical present no major obstacles in that chemicals may be added to or removed at the treatment works. The communities that use half-treated or raw water like in most rural areas in developing countries face more serious problems. Chemical water pollution may lead to unpleasant taste or appearance and even death of aquatic life. This may cause people to abandon certain sources. It is thus evident that analysis of water is necessary for social and economic development (Aliyu, 2000).

1.6 STATEMENT OF THE PROBLEM

1.6 STATEMENT OF THE PROBLEM

A significant problem in developing countries is the effect of chemicals in the soil and water. The concentration of salts in ground water mainly chlorides and sulphates makes the water unfit for human consumption. This makes people to resort to the use of surface water, which is more likely to be biologically polluted. Sulphates from farmland (in form of fertilizers) are washed to rivers and streams and when they reach high level can impart taste and when combined with magnesium or sodium can have laxative effect.

Water polluted by industrial effluents can contain free mineral acid radicals from strong acids and their salts, with P^{H} values of below 3.7. The P^{H} of water and soil may reduce to below 3.7 or slightly higher due to washing of engines and car batteries that contain sulphuric acid (H_2SO_4) as electrolyte. Acidity in an unpolluted water is usually from dissolved carbon dioxide, which produces weak carbonic acid. The effect of this on aquatic life is death and on the soil is unfavourable condition for seed germination and soil fauna.

Thus, monitoring of pollution should not only include estimation of the concentration of the elements but also should cover all other possible sources of pollution (Fitzapatric 1983).

1.7 OBJECTIVES OF THE STUDY

The chemical analysis of carwash effluents, the receiving streams and the soil at the point of car washing using DR 2000 direct reading spectrophotometer will provide information on the toxicity levels of the soil and the water.

The objectives of this study therefore are:

(1) To find out the levels of the toxic elements/chemicals such as Iron, Chromium, Copper e.t.c in the soil and water samples collected from car wash.

(2) To determine the concentrations of the elements using DR 2000[direct reading]spectrophotometer so as to find out whether the receiving water and the soil are polluted as a result of car wash discharges into them.

1.8 JUSTIFICATION OF STUDY

Water courses are utilized by man as domestic water, industrial water, and such water containing carwash discharges could present potential risks to man, livestock and aquatic life. The soil could also be unfavourable for plant growth and to soil fauna.

To ensure that such problems are avoided or minimized, attention should be paid to the discharges, which enter them. A sensible management strategy will involve analysis of the composition of waste water and the receiving water (Horan, 1990).

1.9 SCOPE OF STUDY

The scope of this study is the analysis of carwash effluents, receiving stream and the soil at definite distances from the point of discharge (POD).

1.10 LAYOUT OF THE STUDY

This work begins with the introduction as Chapter one, followed by a Literature Review as Chapter two, Chapter three is the Methodology and Techniques of analysis. The Results and Discussion are in Chapter four, while Conclusion Recommendations are presented in Chapter five. There are also References and Appendices.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 THE SOIL

Some hold the extreme view that soil is a substrate for plant growth while others regard soil only as a natural phenomenon. However soil is the space continuum forming the upper part of the earth crust.

The above concept of soil includes the sands of the desert and the bare rock surface of the mountainous areas thereby excluding the presence of plants.

In general, soil refers to the loose part of the earth crust as differentiated from the solid rock. The latter definition has a more practical conception of soil and regard it as a medium in which crops grow, while a civil engineer, on the other hand looks upon soil as the material that supports buildings and construction of roads (Henry, 1958).

2.2 IMPORTANCE OF SOIL

Soil is the direct mineral substrate of terrestrial plants. All nutrients with the exception of carbon are drawn by plants mainly from the soil. Among the nutrients which the soil supplies, only hydrogen and oxygen from water, nitrogen and carbon cycle from the atmosphere.

Mineral elements essential for growth of plants reside in the soil and are for the most part immobile or nearly so. Absorbing organs (root) had to evolve that could penetrate through the whole mass of the soil.

Weaver and Darland (1972) have described and presented a discussion of the growth of roots in relation to soil environment and also described the living network of roots in prairie soils (flat wide area of land in North America and Canada, without many trees and originally covered with grass).

Apart from this importance, soil can be used for construction of houses, and planting of crops for our daily needs. Roads, Airports, Schools etc are all constructed on the soil.

2.3 SOURCES OF SOIL POLLUTION

Soil becomes polluted through discharges of effluent into the soil. Soil can be polluted through water containing large amount of lead (Pb) and heavy metals, especially chromium from industrial wastes dumped into streams and rivers when such water is used for irrigation. (Abdulkarim, 1980).

Other sources of soil pollution include:

1. **Land fill sites:-** Unlike domestic sewage or effluent, which has characteristics within a fairly narrow range, the water present in a land fill site results from direct precipitation and ground water movement. Consequently, the rate of leaching from a land fill site will be dependent upon the rate of infiltration. As a result, leachates generally have a high organic strength, low P^H and very high heavy metals concentration. These make the soil in such area polluted.
2. **Evaporation ponds:-** In arid regions where evaporation losses are much greater than the amount of rainfall, evaporation ponds have been used for disposal of effluents. Evaporation losses are directly proportional to the area,

so this method is applicable only if large areas of land are available (McGraw Hill – Series in water resources).

2.4 PROPERTIES OF WATER

Properties of water are sub-divided into two groups namely: Physical and Chemical properties.

2.4.1 PHYSICAL PROPERTIES OF WATER

2.4.1.1 **Colour:**- Pure water is supposed to be colourless. The presence of colour in water indicates the presence of dissolved colloidal materials and most consumers object to taste and colour in water.

2.4.1.2 **Taste and Odour**:- Dissolved impurities mostly organic in nature impart taste and odour to water. These are undesirable. These are difficult to measure as they depend on an individual's feelings. Other substances that add to taste in water include Algae, Magnesium and Iron salts etc.

2.4.1.3 **Turbidity**:- The presence of colloidal materials gives water a cloudy appearance. Silt and clay also makes water turbid. Turbidity makes water unattractive and may be harmful. Turbidity is measured by a turbidimeter in Nepherometric Turbidtiy Unit (NTU) or Formazin. Turbidity Unit (FTU) depending on the type of meter.

2.4.1.4 **Dissolved Solids**:- Water from the ground pick some soluble substances like calcium, sodium, magnesium, which occur in combined form as bicarbonates, sulphates and chlorides. Dissolved solids are objectionable even in low concentration. They occur in both organic and inorganic forms (Abdulmuminu, Mohammed and Emmanuel, 1998).

2.4.1.5 **P^H Value**:- The degree of acidity or alkalinity is measured by the P^H. Actually, it is the active (H^+) ion or hydrogen concentration measured in solution. If the P^H is less than 7, it is acidic; if it is more than 7, it is alkaline. The P^H of 7 is regarded as neutral.

2.4.1.6 **Conductivity**:- is the measurement of the ability of a solution to carry electric current. As this ability is dependent upon the presence of ions in solution, a conductivity measurement is an excellent indicator of the total dissolved solids in water. The unit of conductivity is uS/cm (microsiemen per cm). For most waters a factor in the range 0.55-0.70 multiplied by the conductivity gives a close approximation to the dissolved solids in mg/1. The factor may be lower than 0.55 for water.

2.5 SOURCES OF WATER POLLUTION

Water courses receive pollution from many different sources, which vary both in strength and volume. Identification of the major sources of these pollutants is important. Typical sites include:

1. Discharge of either raw or treated sewage from towns and villages.
2. Discharges from industrial and manufacturing plants.
3. Run-off from agricultural lands.
4. Leachates from solid waste disposal sites.

In addition to these continuous discharges, there is also the danger of accidental discharges of highly toxic materials such as acid, cyanides or oil. The effects of these are often immediate, with the water course suffering severe long term damage. Freshly discharged domestic sewage is a grey, turbid liquid with a characteristic, but (surprisingly) not unpleasant smell. It may produce unpleasant smell if kept un-aerated due to formation of hydrogen sulphide, and amines (Horan, 1990).

2.6 ELEMENTS AND FACTORS OF INTEREST IN WATER AND THE SOIL

Elements and factors of interest are classified into three broad groups:

1. Physical Parameters
2. Chemical Parameters
3. Organic Parameters

2.6.1 PHYSICAL PARAMETERS

1. Temperature
2. Odour
3. Conductivity
4. Total dissolved solids
5. Suspended solids
6. p^H
7. Colour
8. Turbidity

2.6.2 CHEMICAL PARAMETERS

1. Total Alkalinity
2. Total hardness
3. Chloride (Cl$^-$)

4.	Sulphate	(SO_4^{2-})
5.	Magnesium	(M_g^{2+})
6.	Calcium	(Ca^{2+})
7.	Zinc	(Zn^{2+})
8.	Iron	(Fe^{2+})
9.	Chromium	(Cr^{6+})
10.	Copper	(Cu^{2+})
11.	Sodium	(Na^{+})
12.	Potassium	(K^{+})
13.	Nitrate	($N0_3^{+}$)
14.	Phosphate	($P0^{3}{}_{4}^{-}$)

2.6.3 ORGANIC PARAMETERS

1. Dissolved oxygen (DO)
2. Biochemical oxygen demand BOD)
3. Chemical oxygen demand (COD)

CHAPTER THREE

3.0 METHODOLOGY AND TECHNIQUES OF ANALYSIS

Car wash effluents and the soil were obtained from broadcasting road, Minna, in Niger State. The present study is to reveal to what extent the car wash effluents affect the quality of its receiving stream and soil.

The data collected were from the analysis carried out on the samples collected from these area using the stated materials and reagents.

3.1 SAMPLING FOR CAR WASH EFFLUENTS

Samples were taken at mid-depth. A tightly stoppered clean plastic container of about 4.5 litres capacity was plunged into the car wash effluent with the stopper on and the stoppered was removed at mid-depth while the container was filled to the point of overflowing. The stopper was immediately replaced and the sample refrigerated while the analysis was completed with minimum delay (Salami and Egwim, 1998).

The samples were designated as:

A_{US} - 100 meters before the point of effluents

B_{US} - 200 meters before the point of effluents

C_{US} - 300 meters before the point of effluents

D_{US} - 400 meters before the point of effluents

E_{US} - 500 meters before the point of effluents

POD - Point of discharge into the stream

A_{DS} - 100 meters after the point of effluents

B_{DS} - 200 meters after the point of effluents

C_{DS} - 300 meters after the point of effluents

D_{DS} - 400 meters after the point of effluents

E_{DS} - 500 meters after the point of discharge

Us= upstream

Ds= downstream

POD= Point of discharge

3.2 SAMPLING FOR SOIL

In the samples collection a hole of about 5cm deep was dug, and samples were collected differently from different layers. It was then mixed up and labelled as soil representing the soil in that area. The samples were collected into polythene bags.

Five soil samples were collected labeled CWS_1- CWS_5 from specific portions at a depth of about 5cm simply because elements and factors to be determined are most likely to exist at this depth. The random sampling method was used because of its convenience, less time consuming and economical.

The samples were designated as

CWS_1 – point of car wash

CWS_2 – 30 meters from CWS_1

CWS_3 – 30 meters from CWS_1

CWS_4 – 30 meters from CWS_1

CWS_5 – 30 meters from CWS_1

CWS = Car wash soil.

3.3 TRI-ACID METHOD OF SOIL DIGESTION

A 0.20g of the soil sample was accurately weighed into a platinum crucible. Few drops of distilled water were added in order to moisten the sample. Predigestion was carried out by adding 6ml British Drug House (BDH) concentrated nitric acid, and 1ml analar 48% perchloric acid. The mixture was heated gently on a hot plate until white fumes appeared. Thus, the more readily oxidized materials were removed. The contents were cooled in a desiccator and 1ml of perchloric acid, and 5ml of hydrochloric acid were added into the crucible. The crucible and its contents were heated again on a hot plate at a tempatature of 200°C to 250°C until evaporated to dryness. The crucible was removed and allowed to cool. To this, 10ml of 5M HNO_3 were transferred into already thoroughly washed and dried labelled plastic containers. Few drops of 1.5ml of HNO_3 were added to the sample solutions for preservation. (Yusuf, 1994 and Asaaga, 1998)

3.4 REAGENTS AND MATERIALS

The samples collected for this project work were:

1. Ten samples of car wash effluents
2. Five soil samples
3. Analar perchloric acid
4. Hydrochloric acid
5. Distilled water
6. BDH concentrated nitric acid
7. Platinum crucibles
8. Desiccators

9. Bibby hotplate bicasa product
10. Thermometer
11. Corning flame photometer 410 Bicasa product
12. Lovibond colour comparator Bicasa product
13. Biby merit W4000 distiller
14. Hach conductivity/TDS meter
15. DR/2000 direct reading spectrophotometer
16. Back-ups 600
17. HACH Digital Titrator
18. 60ml dissolved oxygen bottles
19. Masking tape
20. Wall clock
21. 25ml samples cells
22. Volumetric flasks
23. Conical flasks
24. Pipettes
25. Dissolved oxygen I reagent
26. Dissolved oxygen 2 reagent
27. Dissolved oxygen 3 reagent
28. Universal P^{H} strips
29. Iron reagent powder pillow
30. Sulphover 4 reagent powder pillow
31. Calcium and Magnesium indicator
32. Alkali solution

33. Ethylenediamine-Tetra-acetic acid (EDTA) solution

34. Ethylebis(oxyethylenenitrilo) Tetra-acetic acid (EGTA) solution

35. Chloride 2 indicator powder pillow

36. Silver nitrate (Ag NO_3) Titration cartridge

37. Sulphuric acid titration cartridge

38. Phenolphthalein indicator powder pillow

39. Bromo cresol green-methyl red indicator powder pillow

40. Flame photometer standard 1000ppm potassium.

41. Flame photometer standard 1000ppm sodium

42. Corning Air compressor 850

43. Phenol red indicator Delivery tubes

44. Clean towel

45. COD vial adapter.

46. Zincover 5 reagent powder pillow

47. Cyclohexanone

48. Razor blade

49. Chromium 1 reagent powder pillow

50. COD Reactor

51. Delivery Tubes

3.5 METHODS OF ANALYSIS

3.5.1 WATER ANALYSIS

3.5.1.1 DETERMINATION OF TEMPERATURE

1. Temperature/Conductivity/T.D.S meter was switched on by pressing the appropriate button.
2. The probe was immersed in the beaker containing the deionized water to rinse.
3. The probe was immersed in the meter containing the sample, and moved up and down and taped on the beaker to free any bubbles from the electrode area. The probe was immersed beyond the vent holes.
4. The reading was recorded in degrees Celsius (°C).

3.5.1.2 DETERMINATION OF CONDUCTIVITY

1. The Conductivity/T.D.S meter was switched on by pressing the appropriate button.
2. The probe was immersed in a beaker containing the deionized water to rinse the probe.
3. The probe was immersed in the beaker containing the sample. The probe was moved up and down and taped on the beaker to free any bubbles from the electrode area. The probe was immersed beyond the vent holes
5. The reading was recorded in microsiemens/cm (μs/cm) or millisiemens/cm (ms/cm)

3.5.1.3 DETERMINATION OF TOTAL DISSOLVED SOLIDS (TDS)

1. The Conductivity/TDS meter was switched on using the appropriate button.
2. The probe was immersed in a beaker containing the deionized water to rinse the probe
3. The probe was immersed in the beaker containing the sample. The probe was moved up and down and taped it on the beaker to free any bubbles from the electrode area. The probe was immersed beyond the vent holes.
4. The reading was recorded in milligram per litre (mg/l)or grams per litre (g/l).

3.5.1.4 DETERMINATION OF SUSPENDED SOLIDS

1. The stored program number was entered for suspended solids.
   630 READ/ENTER was pressed
   The display showed:
   DIAL nm to 810
2. The wavelength dial was rotated until the small display
   Shows: 810nm
3. READ/ENTER was pressed
   The display shows:
   Mg/l suspended solids.
4. The sample cell with 25ml of tap or deionized water (the blank) was filled.
5. The blank was placed into the cell holder. The light was closed.
6. ZERO was pressed.
   The display shows
   WAIT
   Then: 0.mg/lsuspended solids
7. The prepared sample cell was swirled to remove any gas bubbles and uniformly suspend any residue

8. The prepared sample was placed into the cell holder .The light shield was closed.
9. READ/ENTER was pressed

   The display showed:

   WAIT

   Then the result in mg/l suspended solids was displayed.

3.5.1.5 DETERMINATION OF P^H (POTENTIAL HYDROGEN)

The P^H was determined using universal P^H strips and lovibond colour comparator with phenol red as an indicator.

1. 2 Clean 10ml Cuvettes were used.
2. Distilled water was filled in one of the 10ml cuvette to the mark as blank.
3. The samples were filled in one of the 10ml cuvette and 1 to 2 drops of phenol red was added.
4. The phenol red disc was placed in the lovibond comparator. It was then rotated for colour matching. The reading was then recorded.

3.5.1.6 DETERMINATION OF COLOUR

1. The stored program number for true colour was entered.

   120 READ/ENTER was pressed

   The display showed:

   DIAL nm TO 455
2. The wavelength dial was rotated until the small display shows:

   455 nm

3. READ/ENTER was pressed

The display shows:

Platinum cobolt (P_t C_o)

4. A sample cell (the blank) was filled with 25ml of deionized water.

5. The blank was placed into the cell holder. The light shield was closed.

6. ZERO was pressed

The display showed:

WAIT

Then 0. UNITS Pt Co COLOR

7. The prepared sample was placed into the cell holder. The light shield was closed.

READ/ENTER was pressed

The display showed:

WAIT

And then the results in platinum – Cobalt units were displayed.

When the display stabilized, the result was recorded.

3.5.1.7 DETERMINATION OF TOTAL ALKALINITY

1. 100ml of the sample was selected and sulphuric acid (H_2SO_4) Titration Cartridge corresponding to the expected alkalinity concentration in mg/l was chosen.

2. Clean delivery tube was inserted into the titration cartridge. The cartridge was inserted into the titrator body.

3. Digital Titrator was held with the cartridge tip pointing up and the delivery knob was turned to eject air and few drops of titrant. The counter was reset to zero and the tip was wiped.
4. A graduated cylinder was used to measure the sample volume.
5. One Phenolphthalein indicator powder pillow was added and swirled to mix.
6. The contents were then titrated to a colourless end point with the sulphuric acid. While titrating, the flask was swirled to mix. The digits were then recorded.
7. One Bromo cresol Green Methyl Red indicator powder pillow was added to the contents and swirled to mix.
8. The titration was continued with sulphuric acid to a light greenish blue-grey, a light grey or a light pink color, as required.
9. Total digits required × Digit Multiplier = mg/l Total Alkalinity.

3.5.1.8 DETERMINATION OF TURBIDITY

1. The stored program number for turbidity was entered.

   750 READ/ENTER was pressed

   The display showed:

   DIAL nm TO 450
2. The wavelength dial was rotated until the small display shows:

   450 nm
3. READ/ENTER was pressed

   The display showed:

FTU Turbidity

4. 25ml of deionized water (the blank) was poured into a sample cell.

5. The blank was placed into the cell holder. The light shield was closed.

6. Zero was pressed

   The display showed: WAIT

   Then:

   0. Formazin Turbidity Unit (FTU)

7. 25ml of sample was poured into another cell. Immediately, the sample cell was placed into the cell holder. The light shield was closed.

8. READ/ENTER was pressed

   The display showed:

   WAIT

   Then the results in Formazin Turbidity Units (FTU) were displayed.

   When the display stabilizes, the results were recorded.

3.5.1.9 DETERMINATION OF TOTAL HARDNESS, MAGNESIUM AND CALCIUM

1. 100ml of water sample was poured in a 100-ml graduated mixing cylinder.
2. 1.0ml of Calcium and Magnesium indicator solution using a 1.0ml-measuring dropper was added. It was inverted several times to mix.

3. 1.0ml of Alkali solution for Calcium and Magnesium test using a 1.0ml-measuring dropper was added. It was inverted several times to mix.
4. 25ml of solution was poured into each of three sample cells.
5. One drop of 1M EDTA solutions was added to one cell (the blank). It was swirled to mix.
6. One drop of EGTA solution was added to another cell (the prepared sample) and swirled to mix.
7. A stored program number for Magnesium was entered.

   225 READ/ENTER was pressed. For units of mg/l mg as $CaCO_3$

   The display showed: DIAL nm TO 522
8. The wavelength dial was rotated until the small display shows: 522 nm
9. READ/ENTER was pressed

   The display showed:

   Mg/l $CaCO_3$ mg
10. The blank was placed into the cell holder. The light shield was closed.
11. Zero was pressed

    The display showed:

    WAIT

    Then 0.00 mg/l $CaCO_3$ mg
12. The prepared sample was placed into the cell holder.

    The light shield was closed.
13. READ/ENTER was pressed

    The display showed: WAIT

Then the result in mg/l mg as $CaCO_3$ was recorded

14. CONFIG/METH was pressed two times.

15. A stored program number for Calcium was entered.

    220 READ/ENTER for units of mg/l Ca as $CaCO_3$ was pressed.

    The display showed: DIAL nm TO 522

16. READ/ENTER was pressed.

    The display shows: mg/l $CaCO_3$ Ca

17. Zero was Pressed

    The display showed: WAIT

    Then: 0.00 mg/l $CaCO_3$ Ca

18. Place the third sample cell into the cell holder.

19. READ/ENTER was pressed

    The display showed:

    WAIT

    Then the result in mg/l Ca as $CaCO_3$ was displayed.

NOTE mg/l hardness equals mg/l Ca as $CaCO_3$ plus mg/l mg as $CaCO_3$

The Conversion factors for determination of total hardness are shown in Table 3.1.

Table 3.1: Conversion factors for Total hardness determination.

TO CONVERT FROM	TO	MULTIPLY BY
mg/l Ca as as $CaCO_3$	mg/l Ca	0.400
mg/l Mg as as $CaCO_3$	mg/l $MgCO_3$	0.842
mg/l $MgCO_3$	mg/l Mg	0.29
mg/l Mg as $CaCO_3$	mg/l Mg	0.243

3.5.2 DETERMINATION OF SULPHATE

1. The stored program for sulphate (SO_4^{2-}) was entered.

   680 READ/ENTER was pressed

   The display showed:

   DIAL nm to 450

2. The wavelength dial was rotated until the small display showed 450nm.

3. READ/ENTER was pressed

   The display showed:

   Mg/l SO_4^{2-}

4. A clean sample cell was filled with 25ml of sample.

5. The contents of one sulfover 4 reagent powder pillow was added to the sample (the prepared sample). It was swirled to dissolve. A white turbidity developed signifying the presence of sulphate.

6. SHIFT TIMER was pressed

   A 5-minute reaction period began. The cell was allowed to stand undisturbed.

7. When the timer beeps, the display showed:

   Mg/l SO_4^{2-}

   A second sample cell was filled with 25ml of sample (the blank).

8. The blank was placed into the cell holder. The light shield was closed.

9. Zero was pressed

   The display showed:

WAIT

Then 0. Mg/l SO_4^{2-}

10. Within five minutes after the timer beeped the prepared sample was placed into the cell holder. The light shield was closed.

11. READ/ENTER was pressed.

    The display showed:

    WAIT

    Then the results in Mg/l SO_4^{2-} were displayed.

3.5.2.1 **DETERMINATION OF IRON CONTENT**

1. The stored program number for Iron (Fe), ferrover powder pillows was entered.
2. The wavelength dial was rotated until the displayed showed 510 nm.
3. READ/ENTER was pressed

   The display showed:

   Mg/l Fe Fv
4. A cell with 25ml of sample was filled
5. The contents of one ferrover Iron reagent powder pillow was added to the sample cell (the prepared sample) and swirled to mix. An orange color indicates the presence of Iron.
6. SHIFT TIMER was pressed

   A 3-minute reaction period began
7. When the timer beeps, the display showed:

   Mg/l Fe Fv

   Another sample cell (the blank) was filled with 25ml of sample.
8. The blank was placed into the cell holder. The light shield was closed.

9. Zero was pressed

The display showed: WAIT

Then: 0.00 Mg/l Fe Fv

9. Within thirty minutes after the timer beeped, the prepared sample was placed into the cell holder. The light shield was closed.

10. READ/ENTER was pressed

The display showed: WAIT

Then the result in Mg/l Iron was displayed.

NOTE: Samples containing visible rust was allowed to react at least five minutes.

3.5.2.2 DETERMINATION OF CHLORIDE

1. 100ml of the sample and Mercuric Nitrate ($Hg(NO_3)_2$) titration cartridge corresponding to the volume of sample were selected.
2. A clean delivery tube was inserted into the titration cartridge.
3. Digital titrator with the cartridge tip pointed up. Delivery knob was turned to eject air and a few drops of the titrant. The counter was reset to zero and the tip was wiped.
4. A clean graduated measuing cylinder was used to measure 100ml of the sample. The sample was transferred into 250ml of conical flask.
5. One Diphenyl Carbazone powder pillow was added and swirled to mix.
6. The delivery tube tip was placed into the solution and swirled while titrating with the Mecuric Nitrate from a pale yellow to light pink color. The number of digits was recorded.
7. Calculation:

   Digits X Digit Multiplier = Mg/l Chloride.

3.5.2.3 DETERMINATION OF ZINC

1. The stored program number for zinc was entered.

   780 READ/ENTER was pressed

   The display showed

   DIALnm TO 620

2. The wavelength dial rotated until the small display showed 620nm

3. READ/ENTER was pressed

4. 50ml graduated mixing cylinders were filled to the 50ml mark with the sample.

5. One Zincover 5-reagent power pillow was added and stopper. It was inserted several times to dissolve.

6. 25ml of the solution was measured into a sample cell (the blank).

7. 1.0ml of cyclohexanone was added to the remaining solution in the cylinder.

8. The cylinder was stoppered (the prepared sample) and shaken for 30 seconds.

9. SHIFT TIMER was pressed.

   A 3-minute reaction period began.

10. The solution was poured into a sample cell.

11. After the timer beeped, the blank was placed into the cell holder. The light shield was closed.

12. Zero was pressed.

    The display showed

    WAIT

    Then: 0.00 Mg/l Zinc

13. Within ten minutes after the timer beeped, the prepared sample was placed into the cell holder. The light shield was closed.

14. READ/ENTER was pressed

The display showed

WAIT

Then the result in Mg/l Zinc was displayed

NOTE: The addition of cyclohexanone causes selective releases of Zinc. The Zinc concentration is proportional to the resulting blue colour.

3.5.2.4 **DETERMINATION OF CHROMIUM**

1. The stored program number for total chromium (Cr) was entered.

100 READ/ENTER was pressed

The display showed

DIAL nm TO 540

2. The wavelength dial was rotated until the small display showed 540nm

3. READ/ENTER was pressed

The display showed/1Cr

4. A clean sample cell was filled with 25ml of the sample.

5. One chromium 1reagent powder pillow was added (prepared sample and swirled to mix)

6. The prepared sample was placed into boiling water bath.

7. SHIFT TIMER was pressed.

A 5- minute reaction period began

8. After the beeper sounded, the prepared sample was removed and cooled with running tap water at 25^0C.

9. One chromium 2-reagent powder pillow was added and swirled to mix

10. One content of one Acid Reagent powder pillow was added and swirled to mix

11. One content of one chromover 3 chromium Reagent powder pillow was added and swirled to mix

12. SHIFT TIMER was pressed.

    A 5-minute reaction period began

13. After the beeping of the timer, 25ml sample cell was filled with the sample (the blank). It was placed into the cell holder. The light shield was closed.

14. ZERO was pressed

    The display showed WAIT

    Then 0.00mg/lCr.

15. The prepared sample was placed into cell holder. The light shield was closed.

16. READ/ENTER was pressed

17. The display showed

    WAIT

    Then the result in mg/1 chromium was displayed.

.5.2.5 DETERMINATION OF SODIUM AND POTASSIUM

1000ppm stock solutions of sodium (Na) and potassium (K) were prepared as described in the corning 410 flame photometer instruction manual and various dilutions made for the preparation of the calibration curves.

To obtain maximum linearity, corning recommends that the highest standard concentration does not exceed 30ppm for sodium (Na) and 10ppm for potassium (K). Both standard solutions for Na and K were aspirated starting with the highest concentration standard. The value of each standard was noted and the results plotted on a graph against standard concentration on linear graph paper.

The sample and the blank were also aspirated using a flame photometer with the filters of sodium and potassium. The value of respective elements was evaluated by extrapolating from the standard graph (Appendices 3.1 and 3.2).

3.5.2.6 DETERMINATION OF DISSOLVED OXYGEN (DO) USING 60-ML BOD BOTTLE

1. A water sample was collected in a clean 60-ml glass-stoppered BOD bottle. This ensures that there is no air bubbles trapped in the bottle.
2. One content of one Dissolved Oxygen 1 Reagent powder pillow and one Dissolved Oxygen 2 Reagent powder pillow were added to the sample.
3. Stopper was inserted immediately so that no air is trapped in the bottle and inverted several times to mix. Flocculent precipitate forms. It was brownish-orange signifying the presence of dissolved oxygen
4. The sample was allowed to stand until the floc has settled, leaving the top half of the solution clear. Again, it was inverted several times to mix and allowed to stand until the upper half of the solution was clear.
5. The stopper was removed and one content of one dissolved Oxygen 3 powder pillow was added. The stopper was replaced with care not, to allow air bubbles into the bottle and it was inverted several times to mix.

6. 20ml of the prepared solution was measured accurately and transferred into a titration flask.

7. A straight-stem delivery tube was attached to a 0.2000N sodium thiosulphate titration cartridge. The cartridge was twisted onto the titrator body.

8. The delivery tubes were flushed by turning the delivery knob to eject few drops of titrant. The counter was reset to zero and the tip wiped.

9. The prepared solution was titrated with 0.2000 Sodium thiosulphate until the sample changes from yellow to colourless.

10. The number of digits was read from the digital counter window.
    The reading was multiplied by 0.1 to determine the concentration of dissolved oxygen in mg/1.

3.5.2.7 DETERMINATION OF BIOCHEMICAL OXYGEN DEMAND (BOD)

Two 60-ml BOD bottles were filled with the sample to overflow.

The contents of one of the bottles were used for the determination of dissolved oxygen as described above, while the other bottle was incubated for five days at a temperature of 20± 1^0C. At the end of the fifth day, the dissolved oxygen in the sample was determined to obtain the dissolved oxygen at the end of the day five of incubation and the BOD was calculated by subtracting the final D.O from the initial D.O.

3.5.2.8 DETERMINATION OF CHEMICAL OXYGEN DEMAND (COD) USING REACTOR DIGESTION METHOD

1. The sample was shaken beginning with the second step.
2. COD Reactor was turned on. It was preheated to about 150^{0}C.
3. The cap of a COD Digestion Reagent vial was removed.
4. The vial was held at a 45-degree angle. 2.00ml of the sample was measured into the vial.
5. The vial cap was replaced tightly. The COD vial was rinsed with deionized water and wiped with clean towel.
6. The vial was held by the cap and over a sink. It was inverted several times to mix the contents. The vial was placed in the preheated rector.
7. The blank was prepared by repeating steps 3 to 6 substituting 2.00ml with deionized water for the sample.
8. The vial was heated for 1-2 hours.
9. The Reactor was turned off. The Reactor was allowed to stay for about 20minutes to cool to 120^{0}C or less.
10. The vial was inverted several times while still warm. The vials were placed into a rack. The vial was allowed to cool to room temperature.

Colorimetric determination techniques were used to determine the sample concentration and the process are as follows:

1. The program number for chemical oxygen demand (COD).

   430 READ/ENTER was pressed

   The display showed

   DIAL nm to 420
2. The wavelength dial was rotated until the small display showed 420nm

3. READ/ENTER was pressed

   The display showed mg/l COD

4. The COD vial Adapter was placed into the cell holder with the marker to the right.

5. The outside of the cell containing the blank was wiped with a clean towel

6. The blank was placed into the adapter.

7. ZERO was pressed.

   The display showed.

   WAIT

   Then: 0.mg/l COD

8. The outside of the sample vial was wiped with a clean towel.

9. The sample vial was placed into the adapter.

10. READ/ENTER was pressed

    The display showed

    WAIT

    Then the result in mg/l COD was displayed.

3.6 SOIL ANALYSIS

The elements taken into consideration were Lead, Nickel, Chromium, Iron and Copper. The elements were determined using DR 2000 spectrophotometer. The concentrations were determined at a given wavelength for digested soil samples. High quality distilled water was used as a blank for each of the parameters to be determined.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 PRESENTATION OF RESULTS

The samples were analysed using standard analytical technique developed by American Public Health Association (APHA) and World Health Organizations (WHO). (Appendices 4.1 and 4.2). The results of the analysis are presented in the Tables 4.1, 4.2,4.3 and 4.4.

TABLE 4.1: PHYSICAL PARAMETERS OF CAR WASH EFFLUENTS

AMETER	500m U_s	400m U_s	300m U_s	200m U_s	100m U_s	POD	100m D_s	200m D_s	300m D_s	400m D_s	500m D_s
idity (FTU)	290	290	290	294	320	461	452	451	451	450	450
erature(°C)	24.1	24.0	24.1	24.1	25.0	28.4	27.5	27.5	27.5	27.0	27.0
Odour	Odour free	Odour free	Odour free	Slight odour	Slight odour	offensive	Slight odour	Slight odour	Odour free	Odour free	Odour free
ur (PtCo)	271	270	271	271	278	550	542	501	501	501	497
ductivity ns/cm)	0.21	0.22	0.21	0.23	0.23	0.30	0.26	0.25	0.25	0.25	0.24
solved solids mg/l)	82.2	82.1	82.2	82.8	82.8	118.6	103	103	102	102	100
nded solids mg/l)	218	219	218	218	220	300	298	298	290	291	290
P^H	8.4	8.5	8.4	8.5	8.9	9.4	9.4	9.3	9.0	8.9	8.9

FTU= Formazin Turbidity Unit **PtCo= Platinum Cobolt**

(mg/l) = Milligram per litre.

P^H = Potential hydrogen

ms/cm = Millisiemens per centimeter

TABLE 4.2: CHEMICAL PARAMETERS OF CAR WASH EFFLUENTS

RAMETERS	500m U_S	400m U_S	300m U_S	200m U_S	100m U_S	POD	100m D_S	200m D_S	300m D_S	400m D_S	500m D_S
tal alkalinity (mg/l)	35.0	35.0	35.0	36.0	36.0	43.0	42.3	41.0	41.0	39.5	39.5
tal hardness (mg/l)	1.34	1.34	1.34	1.39	1.39	1.69	1.67	1.67	1.65	1.65	1.66
loride (mg/l)	0.36	0.36	0.36	0.37	0.37	0.43	0.43	0.41	0.41	0.43	0.41
lphate (mg/l)	66	65	67	67	69	75	75	72	72	71	72
agnesium (mg/l)	0.08	0.08	0.10	0.10	0.113	0.137	0.136	0.132	0.130	0.131	0.131
lcium (mg/l)	0.321	0.321	0.320	0.321	0.384	0.452	0.440	0.440	0.420	0.420	0.420
nc (mg/l)	0.22	0.22	0.22	0.25	0.28	0.36	0.36	0.34	0.33	0.32'	0.32
n (mg/l)	1.94	1.94	2.00	2.01	2.01	3.27	3.24	3.24	3.21	3.22	3.21
romium (mg/l)	0.20	0.20	0.20	0.23	0.23	0.27	0.27	0.24	0.24	0.25	0.24
pper (mg/l)	1.40	1.42	1.42	1.43	1.42	1.59	155	1.55	1.51	1.51	1.51
tassium (ppm)	22.2	22.2	25.1	25.4	25.4	34.2	34.2	33.2	30.1	30.1	30.1
dium (ppm)	12.1	12.1	12.6	12.7	12.9	13.5	13.5	12.4	12.3	12.3	12.3
trate (mg/l)	38.10	40.20	39.81	49.30	50.70	90.64	90.60	90.41	84.30	79.10	78.20
osphate	4.81	4.79	4.93	5.32	6.91	11.22	11.20	10.92	8.20	8.00	8.25

TABLE 4.3: ORGANIC PARAMETERS OF CAR-WASH EFFLUENTS

PARAMETERS	500m U_S	400m U_S	300m U_S	200m U_S	100m U_S	POD	100m D_S	200m D_S	300m D_S	400m D_S	500m D_S
Dissolved Oxygen (D O) (mg/l)	4.30	4.20	4.20	3.40	2.80	1.41	1.42	1.45	1.62	2.41	2.42
Biochemical oxygen Demand (BOD) (mg/l)	2.30	2.32	2.32	2.18	3.91	4.70	4.62	3.95	3.82	3.70	3.71
Chemical Oxygen Demand (COD) (mg/l)	0.97	0.98	0.98	1.02	4.39	5.20	5.12	4.41	4.22	4.11	4.01

US =Up Stream

DS = Down Stream

POD = Point of Discharge

PPM = Part per million

TABLE 4.4: PARAMETERS OF CAR-WASH SOIL

PARAMETERS	C WS$_1$	C WS$_2$	C WS$_1$	C WS$_4$	C WS$_5$	Wavelength
Lead (mg/1)	0.20	0.50	0.65	0.40	0.61	217.0nm
NICKEL (mg/1)	0.30	0.20	0.25	0.10	0.40	232.0nm
Chromium (mg/1)	0.50	2.50	0.55	2.50	2.50	257.9mm
Iron (mg/1)	8.0	0.06	7.20	6.32	5.10	248.3mm
Copper (mg/1)	0.30	0.05	0.35	0.40	5.10	248.3mm
P^H	5.7	6.2	5.9	5.3	6.7	

cws$_1$ = Point of Car Wash

cws$_2$ = 30 meters from cws$_1$

cws$_3$ = 30 meters from cws$_1$

cws$_4$ = 30 meters from cws$_1$

cws$_5$ = 30 meters from cws$_1$

4.2 Discussion of Results

4.2.1 The Water

The Tables 4.1, 4.2 and 4.3 show the results obtained in respect of physical, chemical and organic parameters of the control US and effluents POD and DS. The high colouration value of effluent impart on the receiving stream water lowers the quality of the water making it unfit for washing and bathing. The offensive odour further lowers the quality. Decomposing organic matter might be responsible for quality of the water making it unfit for washing and bathing. The offensive odour further lowers the quality. Decomposing organic matter might be responsible for this. The total dissolved solids of the effluent (POD and DS) were higher than the control US. This could be attributed to the electrical conductivity.

The level of zinc in the effluents POD and DS is within the WHO standard (1983 and 2004) that permits 5.0 mg/l for drinking water. Toxicity of this parameter could occur over periods of time because the receiving stream is used for irrigation of sugarcane in the dry season. Iron content for the effluents is between 3.21mg/l and 3.27mg/l for the POD and DS. This is above the WHO guidelines of 1983 that allow 1.0mg/l for drinking water. This was attributed to the washing of corroded car parts. Excessive high amount of iron is known to interfere with the oxygen- carrying capacity of the body.

The chromium content of the effluent at POD and DS lies between 0.24mg/l and 0.27mg/l which is higher than the control US values that range between 0.20 and 0.23mg/l. This might be due to car colours that contain chromium compound as colouring agent. Chromium toxicity is considered to be capable of causing mutagenicity (Bell and Paterson, 1986). The value of sodium for the effluents was within the WHO standard for drinking water. Excessive high level of sodium in humans can result in muscular twitching and rigidity (Bell and Paterson, 1986). The samples recorded high values of potassium. High level of potassium imparts metallic taste to water.

The values of dissolved oxygen (DO) for the effluents at POD and DS range from 1.41mg/l and 2.42mg/l. These are lower than the minimum of 5ppm value required to sustain normal life in aquatic environment and the water is said to be polluted (Rao, 1993). Water samples with biochemical oxygen demand (BOD) higher than 5ppm are said to be fairly polluted (Welcher, 1975). Drinking water is expected to have a BOD less than 1ppm and water is considered fairly pure with BOD of 3ppm. The values obtained are above 1ppm and some are above 3ppm. The streams are considered fairly polluted.

Chemical oxygen demand (COD) on the other hand was between 4.01mg/l and 5.20mg/l for the effluents at DS and POD respectively compared to the control, which falls between 0.97mg/l and 4.39mg/l. it can be seen that change in COD is a measure of the amount of carbon sources that was utilized as a food source by the mico-organisms. In addition, it can give an indication of the fraction of the waste which will remain.

4.2.2 The Soil

The car wash soil on the other hand, has high concentration of iron especially in CWS_1. This is because the corroded parts of cars are washed and deposited on the soil. Concentrations of lead (P_b) range from 0.2 mg/l to 0.65 mg/1.

Furthermore, the table also shows the concentrations of chromium ranging from 0.5mg/1 to 2.50mg/1.

Copper (C_u) as shown in the table, ranges from 0.05mg/1 to 0.40mg/1. Nickel on the other hand ranges from 0.10mg/1 to 0.4mg/1.

Since it has been fond out that an uptake of 0.002μg/l of metals is adequate for normal growth, then concentration of metals above the tolerable limit will prove toxic, and may cause disarrangement of ions in the body and the damage to the systems (Yusuf, 1994).

Concentrations of the metals in the soil are all within the hearable unit imposed by various health agencies, and organizations except iron. But industries and individuals should be warned against gross pollution of streams and soil as their concentrations could increase in future causing serious health problem

(Asaaga, 1987).

From the studies carried out, it was found that the results obtained were quite in agreement with several other experimental findings, regarding the estimateion of the amounts of metals in the soil, water, crops and vegetables which grow on the soil e.g the experimental work of Yusuf, (1994), and Asaaga (1988). Although the methods of digestion were different, the results were comparable and similar.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

After the analysis, the results presented clearly indicate that most of the elements and the chemicals in the various soil and water samples were above the acceptable limits imposed by various health agencies and organizations. Hence, considering the analysis carried out on Physical parameters (Temperature, Odour, Conductivity, Total dissolved solids, Suspended solids, P^H Colour and Turbidity), Chemical parameters (Total hardness Total alkalinity, Chloride, Sulphate, Magnesium, Calcium, Zinc, Iron, Chromium, Copper, Sodium and Potassium), Organic parameters (Dissolved oxygen, Chemical oxygen demand and biochemical oxygen demand) of car wash effluents and Lead, Nickel, Chromium, Iron and Copper for soil samples, one safely draw the conclusion that, the car wash effluents have lowered the quality of receiving stream and the soil.

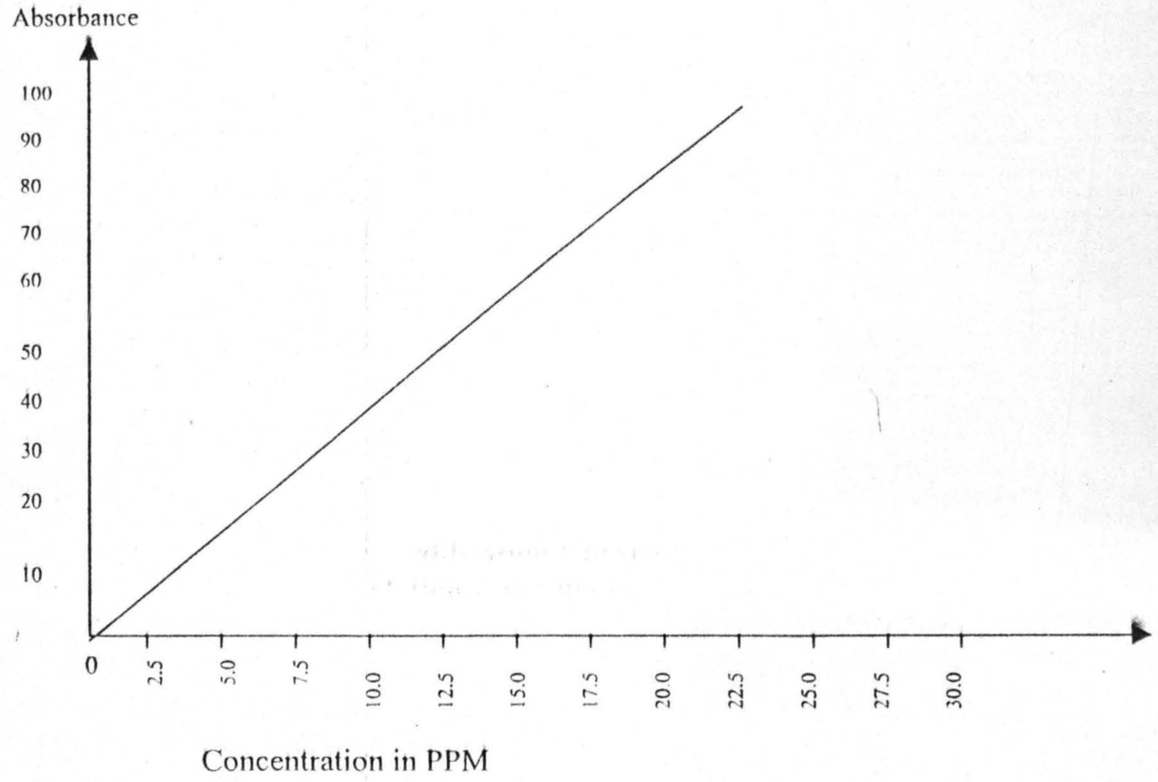
5.2 RECOMMENDATIONS

I wish to recommend that the analysis of elements and chemicals of car wash effluents and the soil should be carried out periodically as a result of persistence usage of the contaminated water by the farmers, so as to check gradual accumulation of these elements and chemical in the water, the soil, and the plant that grows there. Meanwhile, since the scope of this analysis was limited to the possibility of toxicity available in the soil and the contaminated water, I therefore recommend that sampling should be done during rainy and dry seasons and the

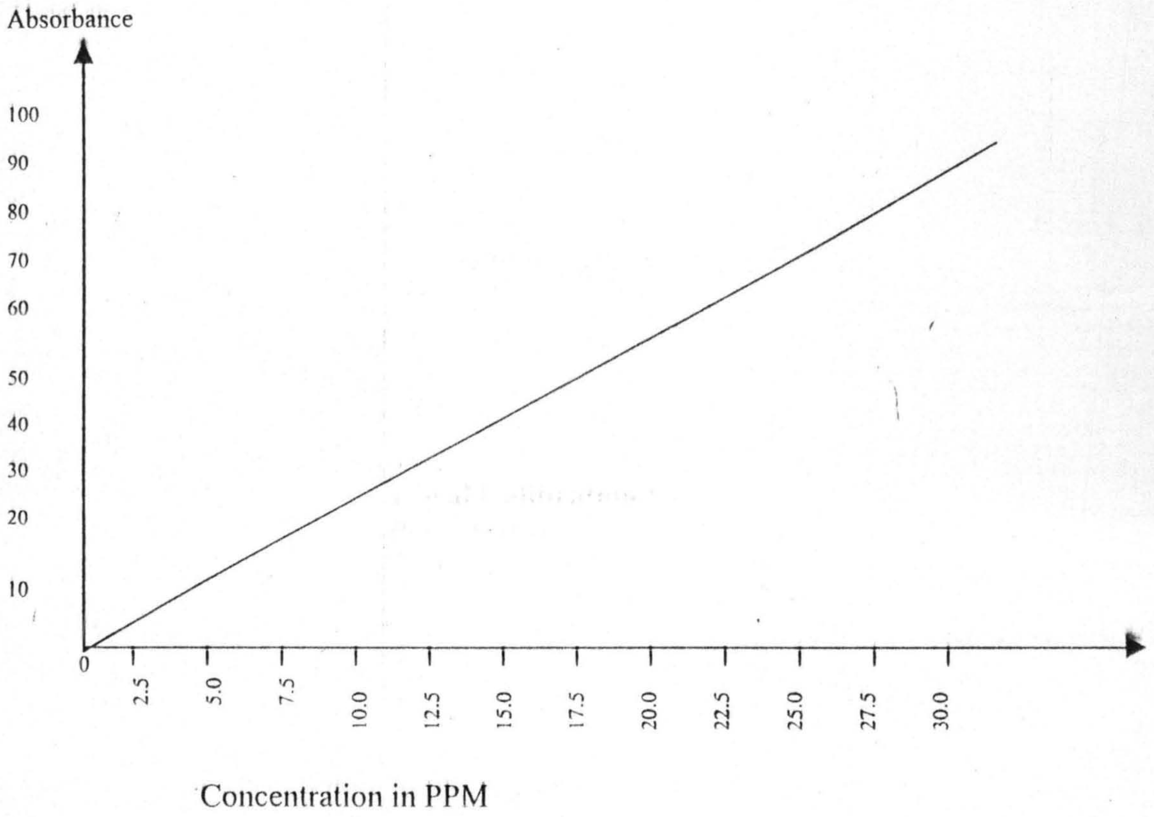
Finally since the contaminates in addition to the metal pollution contain high levels of micro-organisms. I recommend that chemical and biological analysis of contaminates be carried out.

To the government, I wish to recommend that a layout should be established for only car – wash, and the effluents chanelled to sewage treatment plant to avoid its usage for irrigation purposes.

Appendix 3.1 Typical Calibration Curve for POTASSIUM (K) from which extrapolation was made.



Appendix 3.2 **Typical Calibration Curve for Sodium (Na) from which extrapolation was made.**



Appendix 4.1 World Health Organization Standards for (1983)

S/No	Substances or Characteristics	Unit	Symbol	Guideline Value
1.	Chromium	mg/l	Cr	0.05
2	Lead	mg/l	Pb	0.05
3.	Nickel	mg/l	Ni	0.001
4.	Nitrates	mg/l	$N0_3$	10asN
5.	Calcium	mg/l	Ca	N/A
6.	Chloride	mg/l	CL	250
7.	Copper	mg/l	CU	0.05
8.	Iron	mg/l	Fe	0.30
9.	Magnesium	mg/l	Mg	30
10.	Nitrite	mg/l	No_2	1
11.	Potassium	mg/l	K	N/A
12.	Sodium	mg/l	Na	200
13.	Sulphate	mg/l	$S0_4$	400
14.	Total dissolved solids	mg/l		1000
15.	Conductivity	mg/l		N/A
16.	Total hardness as caco$_3$	mg/l		500
17.	Colour	P_tC_o		15
18.	Odour			Inoffensive
19.	Taste			Inoffensive
20.	Suspendul solids	mg/l		N/A
21.	Turbidity	FTU		5
22.	P^H			8.5
23.	Zinc	mg/l		N/A

N/A= Not Available.
FTU= Formazin Turbidity Unit
P_tC_o = Platinum Cobolt

Appendix 4.2 Part of the world Health Organization Standard, for (2004)

S/No	Substances or Characteristics	Unit	Symbol	Guideline Value
1.	Chromium	mg/l	Cr	0.1
2	Lead	mg/l	Pb	0
3.	Nickel	mg/l	Ni	N/A
4.	Nitrates	mg/l	$N0_3$	10
5.	Calcium	mg/l	Ca	N/A
6.	Chloride	mg/l	CL	250
7.	Copper	mg/l	CU	1.0
8.	Iron	mg/l	Fe	0.3
9.	Magnesium	mg/l	Mg	30
10.	Nitrite	mg/l	No_2	1
11.	Potassium	mg/l	K	N/A
12.	Sodium	mg/l	Na	200
13.	Sulphate	mg/l	$S0_4$	250
14.	Total dissolved solids	mg/l		500
15.	Conductivity	us/cm		N/A
16.	Total hardness as $caco_3$	mg/l		500
17.	Colour	P_tC_o		15
18.	Odour			Inoffensive
19.	Taste			Inoffensive
20.	Suspendul solids	mg/l		N/A
21.	Turbidity	FTU		5
22.	P^H			6.5-8.5
23.	Zinc	mg/l	Zn	5
24.	Biochemical Oxygen demand	mg/l	BOD	0
25.	Dissolved oxygen	mg/l	DO	5
26.	Chemical oxygen	mg/l	COD	N/A

N/A= Not Available.
FTU= Formazin Turbidity Unit
P_tC_o = Platinum Cobolt

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