THE EVALUATION OF WASTEWATER TREATMENT IN FEDERAL CAPITAL TERRITORY ABUJA.

(A CASE STUDY OF WUYE WASTEWATER TREATMENT PLANT)

BY

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PGD/AGRIC ENG/2000/2001/116

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AUGUST,2003

TITLE PAGE

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PRESENTED TO

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IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF POST - GRADUATE DIPLOMA IN SOIL AND WATER CONERVATION

AUGUST 2003.

APPROVAL PAGE

This is to certify that this is the original work embarked upon by EZENWANNE C. OKECHUKWU PGD/AGRIC. ENG./2000/2001/116 and has been prepared in accordance with the regulations governing the preparation of research project in the department of Agricultural Engineering, Federal University of Technology, Minna.

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DEDICATION

This project is dedicated to Almighty God whom his wonderful and excellent guidance and protection contributed immensely towards my academic success, both directly and indirectly.

Also, to my parents: Late Chief George A. Ezenwanne and my Mother Mrs. Mercy Ezenwanne for their support both financially and morally.

ACKNOWLEDGMENT

Firstly, I must have to express my greatest gratitude to almighty God for making it easy and possible for me to attain this height of academic life circle and also seeing me through the test of time.

My special thanks goes to my able supervisor Engr. A. C. Onuachu for his wonderful efforts which encompass his advice and patience exercised to see to development and accomplishment of this project. My thanks also to my Head of Department; Engr. Dr. D. Adgidzi and co-ordinator of this programme; Engr. Dr. A. Ajisegiri for their tireless and restless efforts towards the success of this project. I also wish to thank Engr. Bashir and Engr. N. A. Egharevba my able lecturers, whom their numerous advice, Lectures and handouts which they generously gave me have added immensely to the value of what is contained in this project.
I must at this stand point say; I am most grateful.

I must also have to express my sincere thanks to the Staff of Abuja Environmental Protection Board (AEPB); (Department of liquid waste) especially the incumbent Acting Head of Department; Mr. Michael Afih and his colleagues whose enormous contributions have been to no small meaures as regards materials that may be found in this project and also all the intellectual boosting they provided to me.

At this juncture, I wish to boldly and happily thank my late father, Chief G. A. Ezenwanne and my beloved mother Chief Mrs. M. O. Ezenwanne for boosting my morale psychologically and financially throughout my academic venture to see that I attain this height.

So also, I will never forget my beloved brothers and sister; Vincent, Eunice, Dorathy, Cordelia, Perptua, Tony and my in-laws; Joseph Obiadi, Christian Anyaegbu, Comfort Ezenwanne for their assistance when mostly needed.
Infact, they contributed immensely especially my immediate elder sister (perptua) and my eldest brother (Vincent). Honestly, they are my sister and brother indeed!

Finally, I am highly grateful to my relatives and friends such as: Mr. and Mrs. Philip Mefor, Engr. and Engr. Mrs. Oladoja Solomon Olagoke, Pastor Engr. Moses Adegun, Miss Nkiru Amaechina and host of others whom through their prayers and advice have seen to my success academically.

My sincere thanks to you all.

ABSTRACT

This work assesses critically, wastewater treatment in Federal Capital Territory (Abuja), using the Wuye (central Wastewater treatment plant as a case study. The quality/quantity of the influent water was examined and was related with the effluent discharge from the treatment plant. The physio-chemical and bacteriological parameters were analysed, and it was discovered that the plant was able to degrade the influent water. For example BODs was reduced from 320mg/l to 38mg/l, faecal coliform from 10^6CFU/ml to 120CFU/ml and P^H from 8.4 to 7.6, by the treatment plant, however, the quality of the discharge water still contain certain contaminants at higher concentration than WHO standards. The quality of wastewater treated is also grossly inadequate in view of the present population status of Abuja. Recommendations on how these can be solved were also discussed.

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CHAPTER ONE

1.0 INTRODUCTION

Wastewaters that are collected from the cities and towns must finally be discharged to receiving water or to the land. The complex question of which contaminates in wastewater must be removed to protect the environment and to what extent must be answered specifically for each case. This requires analysis of Local conditions and needs, together with the application of scientific knowledge, engineering judgment based on past experience, and consideration of federal and state requirements and regulations. Abuja is one of the fastest growing cities in Africa, wastewater must be collected and treated before being discharged to the environment.

1.1 GENERAL BACKGROUND

Abuja is the Federal Capital City of the Federal Republic of Nigeria, and was created in 1975 by General Murtala Mohammed. The municipal (City) areas today comprises of Garki and Wuse districts, they constitute 65% of the total population of the Federal Capital Territory (F.C.T.)). The Wuye central sewage treatment facility collects all the sewage from the Garki and Wuse districts. The wastewater is treated and discharge to the environment (the Kutunku River).

The central sewage treatment facility in Wuye district of Abuja was designed and constructed by Julius Berger Nigeria Plc. in collaboration with OMS Waranlugen GMBH of Germany. It was commissioned in 1993. its purpose is to treat sewage generated in Wuse and Garki district areas of Abuja. It has the capacity to treat 500, 000 gallons of sewage per day. It boast of one of the best facilities in Africa. Its sits on an elevated land of about 200 by 500 sq meters.

1.2 DESIGN LAYOUT

Fig 1. shows the design layout of the facility. As can be seen, it is made up of various parts namely: pump station, the littering machine, the grit chamber, the classifier, activated ponds, sedimentation chambers, secondary sedimentation ponds, distribution chambers and the various sewage channels.

1.3 MODE OF OPERATION OF THE FACILITY

The facility was designed to use the natural process of aeration designed to treat sewage water. This involves the blowing and pumping of air (oxygen) at high pressures into the activated ponds and the grit chambers. It was a process called the activated shudge process, this a biological treatment process that uses the natural air to stimulate the activities of active degrading bacteria that act on the sewage to process it.

1.4 OBJECTIVES

The main objectives of this topic are as follows:

a. To study the problems encountered in the current wastewater treatment in Abuja and how it can be solved probably by modifying or re-introducing another method of wastewater treatment with the existing technology.

b. The type and degree of treatment, which would be required in order to render the discharge harmless.

c. Estimate the value and quality of water being treated.

1.5 JUSTIFICATIONS

Abuja population is growing in a geometric progression everyday, additional number of people implies generation of more wastewater (sewage), the facilities that are available currently must be evaluated to ensure they can cope with this increase, and discharge friendlier effluent to the environment. This work will strive to answer these questions. And provide possible solutions.

1.6 LIMITATIONS

In view of time and cost constraints, this work is limited to Wuye treatment works alone, with a view that the other mini-treatment works will have problems and solutions similar to the Wuye plant.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.0 LITERATURE REVIEW

Every community produces booth liquid and solid wastes. The liquid portion – wastewater - is essentially the water supply of the community after it has been fouled by a variety of uses. Metcalf and Eddy (1991) defined wastewater as a combination of the liquid or water–carried wastes removed from residences, institutions, commercials and industries establishment, together with such ground water, surface water, and stormwater as may be present.

If untreated wastewater is allowed to accumulate, the decomposition of the organic materials it contains can lead to the production of large quantities of malodorous gases. In condition, untreated wastewater usually contains numerous pathogenic or disease causing, microorganisms that dwell in the human intestine tract or that may be present in certain industrial waste.

2.1 WASTEWATER TREATMENT

Wastewater Collected From municipalities and communities must ultimately be and returned to receiving waters or to the land. The complex question of which contaminates in wastewater must be removed to protect the environment and to what extent must be answered specifically for each case. The answer to this question requires analysis of local conditions and needs, together with the application of scientific knowledge, engineering judgment based on past experience, and consideration of the existing legislative laws governing the environment in Nigeria.

2.2 WASTEWATER CHARACTERISTICS

An understanding of the nature of wastewater is essentials in the design and operation of collection, treatment, and disposal facilities and in the engineering management of environmental quality.

2.2.1 CONSTITUENTS FOUND IN WASTEWATER

Wastewater is characterized in terms of its physical, chemical
and biological composition.

The principal physical properties and the chemical and biological constituents of wastewater and the sources.

TABLE 1: physical, chemical and biological characteristic of wastewater and their sources.

CHARACTERISTICS	SOURCES
Physical properties: 1. colour	Domestic, industrial, waste, natural decay organism.
2. Odour	Decomposing wastewater, industrial wastes
3. Temperature	Domestic and industrial wastes
Chemical constituents organic-fats, oil, pesticides, etc	Domestic, industrial and commercial wastes
Inorganic:	Domestic, industrial and ground

Inorganic: 1. Alkalinity	Domestic, industrial and ground water infiltration
2. Chloride	Domestic waster and ground water infiltration
3. Heavy metals	Industrial wastes
4. Nitrogen, Phosphorous	Domestic and Agricultural waste
5. PH	Domestic, Industrial and Commercial waste
Gases: Hydrogen Sulphide methane, oxygen	Decomposition of domestic waste
Biological Constituents 1 Animal, Plants 2 Microbiological virus, bacteria, protozoa	Domestic waste, wastewater treatment plant

Source: Tchobanoglons (1986)

When secondary treatment standards for wastewater are concerned with the removal of biodegradable organics, susperded solids and pathogens. When wastewater is to be reused, standards normally include requirement for the removal of refractory organics, heavy metals, and in some cases dissolved inorganic solids.

2.3 WASTEWATER TREATMENT OBJECTIVES

Methods of wastewater treatment were first developed in response to the concern for public health and the adverse conditions caused by the discharge of wastewater to the environment.

In general, from about 1900 to early 1970's, treatment objectives concerned with (1) the removal of suspended and floatable material (2) the treatment of biodegradable organics, and (3) the elimination of pathogenic organisms. Sine 1980, because of increase scientific knowledge and expanded information base, wastewater treatment has begun to focus on the health concerns related to toxic potentially toxic chemicals released to the environment. The USA Federal Environmental Protection Agency (FEPA), set up a minimum secondary treatment for wastewater treatment that is to be discharged to the environment.

Table 2: Minimum Standards for Secondary wastewater Treatment

Characteristics of discharge	Units	Average 30-days concentration
1. BOD_5	Mg/1	30
2. Suspended solids (ss)	Mg/1	30
3. Hydrogen on concentration	P^H unit	60-90
4. COD_5	Mg/1	25

2.4 THE ACTIVATED SLUDGE PROCESS

Biological processes are used to convert the finely divided and dissolved organic matter in wastewater into flocculant settleable biological and organic solids that can be removed in sedimentation tanks. The most commonly used biological processes are (1) the activated sludge (2) aerated lagoon (3) trickling filter (4) rotating biological contactors and (5) stabilization ponds. The activated sludge process is often used for large installation.

This is the type of treatment plant at Wuye, the process involves the following processes: screening, grit, primary sedimentation tank, aeration tank, settling tank and the chemical contact chamber. This is shown in

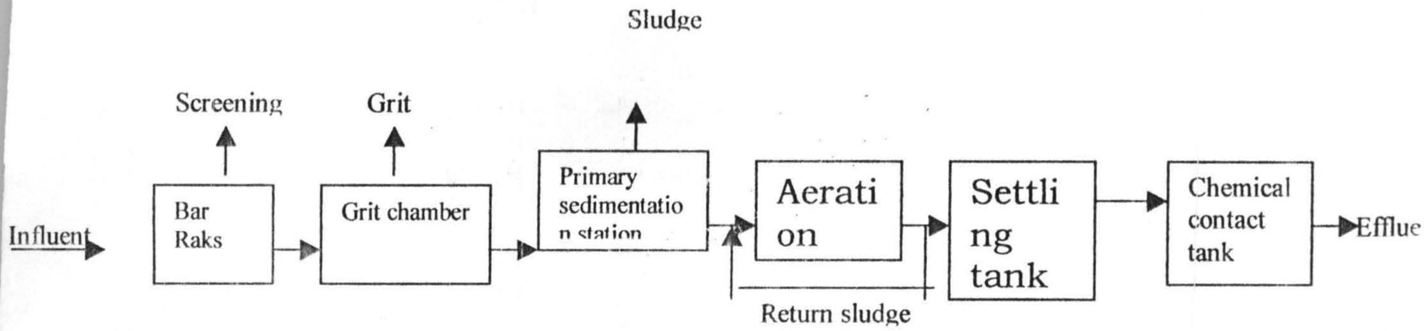

Fig 3: Simplified flow diagrams for activated sludge process

2.5 WASTEWATER REUSE

Continued population growth, contamination of both surface and ground waters, uneven distributions of water resources and periodic droughts have forced water agencies to search for innovative sources of water supply. Use of highly treated wastewater effluent, now discharged to the environment from municipal wastewater treatment plant, is receiving more attention as a reliable source of water.

2.6 STANDARD FOR EFFLUENT REUSE FOR IRRIGATION

The designed approach to irrigation with reclaimed municipal wastewater depends upon whether emphasis is placed on providing a water supply or wastewater treatment. A number of different irrigation water quality guidelines have been proposed. The guidelines in table 4 was adapted from Ayer and Westcof (1976).

Table 4: Guidelines for interpretation of water quality for irrigation

Degree of restriction

Parameter	Units	None	slight	Severe
Ec	*mmhos/cm*	*<70*	*70-300*	*>300*
Tos	mg/l	<450	450-2000	>2000
Na^+	mg/l	<3	3-9	>9

Cl-	Mg/l	<140	140-350	>350
Baron (Br)	*mg/l*	*<0.7*	*0.7-3.0*	*>3.0*
No_3^-	mg/l	<5	5-30	>30
Hardness	mg/l	<90	90-500	>500
PH	-		6.5-8.5	

2.7 WHO STANDARD FOR EFFLUENT REVERSE

The World Health Organization (WHO) has recommended that crops that will be eaten raw should be irrigated with treated wastewater only after it has undergone biological treatment and disinfections to adverse a coliform level of not more than 100/100ml in 80% of the samples.

2.8 WASTEWATER SOURCES AND FLOWRATES

Before the design of wastewater collection, treatment and disposals are being designed; the basic step to consider is to determine the rate at which the wastewater flows.

The aim of this chapter is to develop a basis for properly assessing wastewater flow rates from Asokoro District and Garki Area. The subjects considered include

1. Definition of the various components that make up the wastewater from the districts.
2. Wastewater sources and flowrates
3. Analysis of flowrate data
4. Methods of reducing wastewater flows
5. Methods of measuring wastewater flows.

2.8.1 SOURCES AND RATES OF INDUSTRIAL WASTEWATER FLOWS

Industrial wastewater flowrates vary with the type and size of the industry, the degree of water reuse, and the on site wastewater treatment methods used, if any. Peak flows may be reduced by the use of detention tanks and equalization basis. A typical design value for estimating the flows from industrial districts that have no wet-process industries is about $30 m^3/ha.d$ (- 3000 gal/acre.d). If the water requirements of the industries are known, wastewater flow projections can be based on water - flow projections. For industries without internal reuse programs, about 85 to 95 percent of the water used in the various operations and process will probably became wastewater. For large industries with internal-water-reuse programs, separate estimates must be made. Average domestic (sanitary) wastewater contributed from industrial activities may vary from 30 to 95 L/Capital.d (8 to 25 gal/capital .d).

2.10 Infiltration into Sewers

A portion of the precipitation in a given area runs quickly into the storm sewer or other drainage channels; another portion evaporates or is absolved by vegetation; and the remainder percolates into the ground, becoming groundwater. The proportion that percolates into the ground depends on the character of the surface and soil formation and on the rate and distribution of the precipitation according to season. Any reduction in permeability, such as that caused by buildings, pavements, or frost, decreases the opportunity for precipitation to become groundwater and increases the surface runoff correspondingly.

2.10.1 Inflow Into Sewers

For the purpose of analyzing sewer-flow measurement (gagings) and because of the measuring techniques available inflow is usually subdivided into two categories. The first category includes cellar and foundation drainage, cooling-water discharges, and drainage from springs and swampy areas. This type of inflow cause a steady flow that cannot be identified separately and so is included in the measured infiltration. The second category consists of inflow that is related directly to storm-water runoff and, as a result of rainfall, causes an almost immediate increase in flows in sewers possible sources are roof leaders, yard and raceway drains, manhole covers, cross connections from storm drains, manhole cover, cross connections from storm drains and catch basins, and combined sewers.

2.11 ANALYSIS OF WASTEWATER FLOWRATE DATA

Because the hydraulic design of sewer facilities is affected by variation in wastewater flows; design values for the expected peak flows must be developed. The best current design practices calls for peaking facts for domestic and industrial wastewater flow and for infiltration and flow separately.

2.11.1 Peaking Factors For Wastewater Flows

Ideally, peaking factors (the ratio of peak flow to average flow) would be derived or estimated for each major establishment or for each category of flow in the flow system. The individual average flows are multiplied by these factors to obtain the peak flows. The resulting peak flows from several areas would be combined to obtain the total expected peak flows. Unfortunately, this degree of refinement is seldom possible; therefore, peaking factors usually must be estimated by more generalized methods.

2.11.2 Peak Inflow Design Allowance

Separate design allowances for peak inflow rates should be made when designing relief for, or extensions of, existing sewers systems. The allowances should be based on analysis of sewer flow measurements (gaging) where possible, with appropriate reduction attributable to corrective measures proposed for the existing system.

2.11.3 Flow Measurement By Direct-Discharge Methods

The ability of measure wastewater flows is of fundamental importance in designing all wastewater - management facilities. The two principal methods for measuring flowing fluids are:
(1) Direct - discharge Method (2) Velocity - area methods.

2.11.4 Direct - Discharge Method

The rate of discharge relates to one or two easily measured variables. Frequently, if numerous flowrates are to be determined, rating curves are developed to simplify the work involved.

2.11.5 Velocity Area Method

Using the velocity - area methods, the flowrate is determined by multiplying the velocity of flow, m/s (ft/s), by the cross-sectional area, $m^2(ft^2)$, through which flow is occurring.

2.12 COLLECTION AND PUMPING OF WASTEWATER

The wastewater collection and conveyance from various sources where it is generated is the first step in the effective management of a community's wastewater. The pipes that collect and transport the wastewater away from its sources of generation are called sewers and the network of sewer pipes in a community is known as collection system.

Because such system must function properly and without creating nuisance, it is imperative that the fundamental principles involved in their design and implementation can be understood clearly. A sustainable and good collection system cannot be achieved if these factors mentioned below are not properly considered. They include gravity flow sewers, sewer pipe materials, sewer appurtenances, construction of sewers, maintenance of sewers.

Before the design of sewer and drains, there are the amount and detail of local information required. Special survey are generally made to produce needed maps and tables as follows:

1. Detailed plans and profiles of street to be sewered.
2. Plants and contours line of properties to be drained.
3. Sill or cellar elevations of buildings to be connected.
4. Location and elevation of the existing or projected building drains.
5. Location of existing or planned surface and subsurface utilities.
6. Kind and location of soils and will through which sewers and drains must be laid.

8. Location of drainage area divides
9. Projected changes in street grades.
10. Location and availability of sites for pumping stations, treatment works, and outfalls, and
11. Nature of receiving bodies or bodies of water and other disposal facilities.

2.13 PUMPING OF WASTEWATER

Pumping of wastewater has become important in some communities due to some features like topography. If ground slopes are less than those required to provide adequate velocity in a sewer, the sewer will become progressively deeper, and it my become necessary to pump the wastewater to a higher level to avoid excavation. Pumping will also be required if the treatment plant is to provide sufficient head for plant operation.

The concepts of pump analysis are introduced and some of the terms describing pumps and pumping stations are defined. The concepts discussed include (i) Capacity (ii) Head (iii) Efficiency and power input. Pump and system head capacity curves are also introduced;

2.13.1 Capacity

The capacity (flowrate) of a pump is the volume of liquid pumped per unit of time, which usually is measured in liters per second or cubic meters per second (gallons per minute or million gallons per day).

2.13.2 Head

The term head is the elevation of a free surface of water above or below a reference datum. For instance, if a small, open ended tube were run vertically upward from a pipe under pressure; the head would be the distance from the center line of the pipe to the free water surface in the vertical table.

In pump system, the head refers to both pumps and pump systems having one or more pumps and the corresponding pipe system. The height to which a pump can raise a liquid is the pump head and is measured in meters (feet) of the flowing liquid.

Terms applied specifically to the analysis of pumps and pump system include (1) Static suction head (2) Static discharge head (3) Static head (4) Friction head (5) Velocity head (6) Minor head loss (7) Total dynamic head.

2.13.3 Minor Head Loss: This is the level of water that must be supplied to overcome the loss of head through fittings and valves is the minor head loss. Minor losses in the suction *(hms)* and discharge *(hmd)* piping system are usually estimated as fraction of the velocity head by using the following expression:

$$hm = K \; V^2/_{2g}$$

Where hm = Minor head loss, m (ft)

k = head loss coefficient

2.13.4 Total Dynamic Head: The total dynamic head *Ht* is the head against which the pump must work when water or wastewater is being pumped.

2.13.5 Pump Efficiency And Power Input: Pump performance is measured in terms of the capacity that a pump can discharge against a given head and at a given efficiency. The pump capacity is a function of the design.

2.13.6 Pump Selection

In selection equipment for a pumping station, many different and often conflicting aspects of the overall pumping system must be considered. Factors which must be evaluated include (i) Design flowrates and flow ranges (2) Location of the pumping station, (3) Force main design, and (4) System head-capacity characteristics. When these factors are evaluated properly, the number and sizes of the pumps, the types of drive, and the optimum size of force main can be selected.

2.14 CLASSIFICATION AND APPLICATION OF WASTEWATER TREATMENT METHODS

After the treatment objectives have been established for a specific project and the applicable state and federal regulations have been reviewed. The degree of treatment can be determined by comparing the influent - wastewater characteristics to the required effluent- wastewater characteristic. Then, a number of different treatment and disposal or reuse alternatives can be developed and evaluated, and the optimum combination can be selected.

2.14.1 Classification of Treatment Method

The contaminants in wastewater are removed by physical, chemical, and biological means. The individual methods usually are classified as physical unit operations, chemical unit processes, and biological unit processes. Although these operations and processes occur in a variety of combinations in treatment system, it has been found advantageous to study their scientific basis separately because the principles involved do not change.

2.14.2 Physical Unit Operations

Treatment methods in which the application of physical forces predominate are known as physical unit operations. Because most of these methods evolved directly from man's first observations of nature, they were the first to be used for wastewater treatment. Screening, mixing, flocculation, sedimentation, flotation and filtration are typical unit operations.

2.14.3 Chemical Unit Processes

Treatment methods in which the removal or conversion of contaminants is brought about by the addition of chemicals or by other chemical reactions are known as chemical unit processes. Precipitation, gas transfer, adsorption, and disinfection are the most common examples used in wastewater treatment.

2.14.4 Biological Unit Processes

Treatment methods in which the removal of contaminants is brought about by biological activity are known as biological unit processes. This is used primarily to remove the biodegradable organic substances in wastewater.

2.15 REUSED DISPOSAL OF WASTEWATER

It is generally impossible to reuse of wastewater completely or indefinitely. The reuse of treatment effluent by direct or indirect means is a method of disposal that complements the other disposal methods. The amount of effluent that can be reused of affected by the availability and cost of fresh water, transportation and treatment costs, water - quality standards, and the reclamation potential of the wastewater.

Water reuse may be classified according to use as (1) Municipal (2) Industrials (3) Agricultural (4) Recreational (5) Groundwater recharge

Municipal Reuse: Direct reuse of treated wastewater are drinking water, after dilution in natural waters to the maximum possible extent and after coagulation, filtration and heavy chlorination for disinfection, is a practicable on an emergency basis

Industrial Reuse: industry is probably the single greatest user of water in the world, and the largest of the industrial water demand is for process cooling water.

Agricultural Reuse: The largest current and projected use of water, offers significant opportunities for wastewater reuse.

Groundwater Recharge: this is one of the most common methods for combining water reuse and effluent disposal.

Recreational Reuse: Golf-course and park watering, establishment of ponds for boating and recreation, and maintenance of fish or wildlife ponds.

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 VISITATION TO THE WUYE TREATMENT PLANT

A visit was conducted to the Wuye central sewage treatment facility between the 5th to 9th of March, 2002. During this facility tour, I went round the whole treatment plant from one section to the other, and conducted oral interview to the site engineers. The oral question asked were principally

- What are the sources of wastewater in Abuja?
- How do they normally collect and pump the wastewater?
- What are the treatment operations and processes in use to meet specified treatment objectives related to the removal of wastewater contaminants?
- How do they dispose the treated wastewater to the receiving body?
- What are the problems encountered during the operation?
- How they intend to improve on the method in relation to present technological advancement.

3.2 COLLECTION OF INFLUENT AND EFFLUENT SEWAGE WATER SAMPLES.

Special sampling bottles were provided by quality control office of Niger State Water Board for the collection of samples. They were labelled:

(1) ISW1 – Influent sewage water 1

Incoming sewage water to the Wuye plant collected on the 1st occasion.

(2) ISW2 – influent sewage water 2

Incoming sewage water to the Wuye plant collected on the 2nd occasion.

(3) ESW1 – effluent sewage water 1

Outgoing treated water discharge to the river collected on the 1st occasion.

(4) ESW2 – effluent sewage water 2

Outgoing treated water discharge to the river collected on the 2nd occasion.

3.3 POPULATION DATA FOR ABUJA MUNICIPALITY

The population data for Abuja Municipality was collected from the National Population Commission Office in Municipal and Bwari area councils which covers the main city.

The population for the two area Councils are given in the table below

Table 5: Population of Abuja Municipality

Area Council	Population
1. Abuja Municipality	133,286
2. Bwari	74,059
Abuja Municipality Total	**207, 345**

Source: National Population Commission, Abuja Office.

This population figure was used as a basis to verify the capacity of Wuye treatment plant to see if it can satisfy the demand of the people.

The population was projected for 20 years which is the design life of the plant at a growth rate of 3% (National Population Commission) using the formular below:

$$Pn = Po\ (1+r)^n$$

Where, Pn = projected population

Po = present population

r = Growth Rate

n = Number of years projected

3.4 SEWAGE WATER SAMPLE ANALYSIS

Wastewater quality measurement programmes involve mainly

laboratory analysis. The selection of methods were based on:-

1. Total number of analysis
2. Frequency and scope of measurement
3. Sensitivity and detection limits
4. Constraints on accuracy and precision

A Hach-2000 multiparameter spectrophotometer was used for the determination of the concentration in wastewater of all the chemical parameters. An ion meter was used to measure the physical parameters and bacteriological set apparatus for the microbiology.

3.4.1 Physical Analysis

The iron meter was used to determine physical parameter such as temperature (^{0}C), P^{H}, and electrical conductivity (umhos/cm). It is simple, the ion meter is inserted into the sample, and the meter switch on to temperature or P^{H} or electrical conductivity and read automatically.

3.4.2 Chemical Analysis

Chemical parameter like Hardness, dissolved oxygen, chloride, sulphate, calcium, ion, magnesium, potassium, copper, boron, manganese, chlorine, total solids, total dissolve solids and suspended solids were measured using the Hach'2000 spectrophotometer.

They were measured with Light Emitting Diodes (LED) ranging between (400-1200nm and it is an adaptation of American Society of Tests and Measurement (ASTM) manual for water and environmental technology, and methods for the examination of water and wastewater WHO (1996, 18th Edition), the reaction between the parameter and the liquid reagents causes a colour tint in the sample.

3.4.3 Microbiological Analysis

The analysis includes BOD_5, faecal coliform, faecal streptococci, E Coli and total plate count. A complete microbiology set was used in determining both the presumptive test and the completed tests.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 MODE OF OPERATION OF WUYE TREATMENT PLANT

The facility was designed to use the natural process of aeration to treat sewage water. This involves the blowing and pumping of air (oxygen) at high pressure into the activated ponds I and II and the grit chamber. The treatment processes starts from the main pump station.

4.1.1 Main Pump Station

The pump station is about 150 meters outside the sewage treatment facility and 50 meter below it. As a result of this elevation difference, it is necessary to pump up sewage water into the facility. The pump station is made up of 4 submerged pumps with combine capacity of 2600 litres/second. The pumps are connected to the large central sewage pipe from the city.

4.1.2 The Filtering Machine

The pumps, pump sewage to the filtering machine, this large machine filters the sewage from solid debris like wood, stones, cloth, etc.

4.1.3 The Grit Chamber

Thus is a rectangular shaped chamber of 20m x 5m. air is blown into the sewage at high pressure for a period of 8 hours. This causes the separation of greese and water.

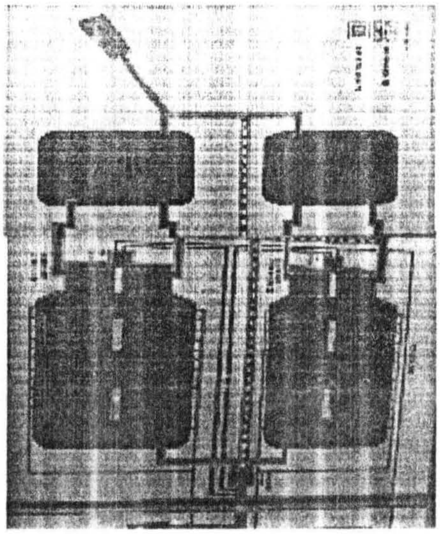

Fig 4: Schematic diagram of the mode of operation of Wuye sewage treatment plant.

4.1.4 The Classifier

This is a dual-purpose machine. It is located at the top of the grit chamber. It moves automatically form one end of the chamber to the other end. It removes greese at one end and removes sand at another end.

4.1.5 The Distribution Chamber

In this chamber is located three slice gates as openings to three different channels. The first leads to the activated pond I, the second to the discharge river and the third to the activated pond II.

4.1.5 Activated Ponds

The activated ponds I and II are very large ponds of dimensions 40 x30 meters. Sewage water flow into the ponds from the distribution chamber. The ponds are transveresed by network of 13 rubbers with 10 perpendicular pipes in each side. At high pressure air is blown into the ponds for 24 hours. This favours the growth of bacteria in the sewage. Between the breakdowns all the wastes in the sewage water and converts them into harmless substances, which poses no treat at all to the environment.

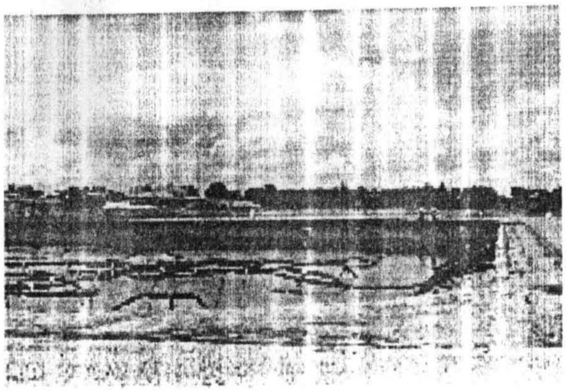

fig. 5 Activated Pond

4.1.8 The Sludge Pond

This is the pond where the sludge is accumulated; It is emptied of sludge into a trailer by means of a small crane.

4.1.9 Secondary Sedimentation Ponds

In this pond I & II the water is stored until the pond is full. The water here is safe for discharge. The water is released from these ponds and it flows through a series of channels into the river.

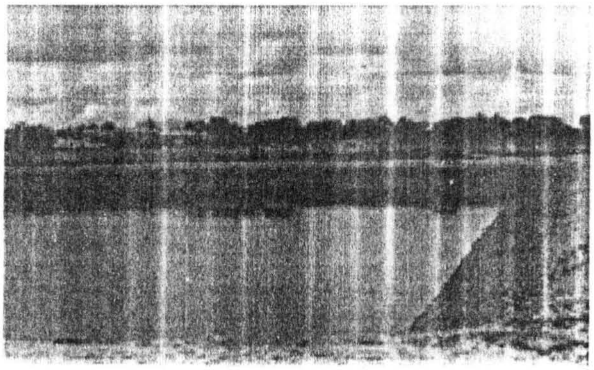

fig. 6 Sedimentation Pond

TABLE9: RESULT OF ANALYSIS OF INFLUENT SEWAGE WATER SAMPLE AT WUYE WASTEWATER TREATMENT PLANT, ABUJA.

SAMPLE FORWARDED TO THE LAB. ON: 20th August, 2003.

;ICO-CHEMICAL ANALYSIS	ISW2	ESW2	FAO	WHO
nperature (^0C)	30.8	27.9		
	8.4	7.6	7-7.5	6.85-8.5
:ctrical conductivity (umhos/cm)	167	72	15	30
tal Hardness-EDTA(mg$CaCO_3$)/L	432	217	28	100
ssolved Oxygen(mg/L)	1.5	5.7	4	1.3
iloride Cl^- (mg/L)	235	84.6		
ilphate SO4-(mg/L)	189	28	200	200
ılcium Ca(mg/L)	52	12		70
ɔn Fe^{2+}(mg/L)	1.7	0.23	0.3	0.3
/lagnesium Mg^{2+}(mg/L)	25	2.12		30
'otassium K+(mg/L)	41	7.3		
Copper Cu+(mg/l)	1.8	1.76		
3oron Br+(mg/L)	2.51	1.3		1.2
langanese Mn+(mg/l)	1.9	0.02		
Chlorine (mg/l)	1.7	7.9		
3OD$_5$,20^{0}C(mg/L)	320	38	25	
COD(mg/L)	326	38	50	
Total Solids TS(mg/L)	457	37	100	
Total Dissolved Solids TDS(mg/L)	290	148		
Suspended Solids SS(mg/L)	532	78		
Boron Br+(mg/L)	3.2	1.23		1.2
:TERIOLOGICAL EXAMINATION				
'aecal Coliform(CFU/ml)	10^6	120	100	0
'aecal Streptococci(CFU/ml)	10^3	102	100	0
:. Coli. (CFU/ml)	10^5	134	100	0
Total Plate Count(CFU/ml)	10^8	321	1000	100

;AMPLE ANALYSED ON:21st,22ndand 23rd August, 2003.

;ENERAL COMMENTS

The samples were analysed using the standard procedure.

SW1=Influent sample 1, ISW2 = Influent sample 2, ESWI - Effluent sample, 1 ESW2 = Effluent ;ample 2.

1 DISCUSSIONS

The results of the analysis and findings are discussed in this section.

.4.1 Problems of Wuye Treatment Plant.

The problems that are affecting the operation and performance of the treatment plant are enumerated below:-

1. Lack of a reliable and dependable power source, NEPA is erratic, and costs of running generators are high.
2. Inappropriate usage of manholes, leading to leakage and infiltration of storm water.
3. Non-availability of facilities for plant operation and maintenance – all the major components have to be imported, with scarce foreign exchange.
4. Workers exposure to hazard environment without insurance cover.
5. The blowers currently in use are difficult to maintain.
6. Lack of enough skilled and properly trained manpower.

.4.2 Treatment Efficiency Standards Of The Wuye Plant

From the result of the influent and effluent water analysis, it is clear that the plant is doing a very hard task in reducing the harmful organics and inorganic, including the bacteriological parameters. Though these effluent discharge into the river, meets the requirement for discharge into rivers or natural water, more advance treatment will have to be used to be able to reuse the effluent for irrigation or fishing.

CHAPTER FIVE

.0 CONCLUSION AND RECOMMENDATION

.1 CONCLUSION

I discovered that the main source of wastewater from phase 1Area of Abuja FCT is from domestic wastewater i.e. wastewater discharge from residences and from commercial, institutional and other facilities for example Gado Nasko and Yakubu Gowon Barracks.

It was discovered that water is transported by gravity to the treatment works and from the treatment works to the receiving body. In general, the easily treatment objectives were concerned with.

- The removal of suspended and flow table materials.
- The treatment of biodegradable organics, and
- The elimination of pathogenic organisms.

In few years ago, however, in Abuja, a major effort have been undertaken by both state and federal Agencies to achieve more effective and widespread treatment of wastewater. This effort has resulted in part from.

- Increase understanding of the environment effects caused by the discharge of untreated or particularly treated wastewater.
- The need to conserve natural resources and is many locations to reuse wastewater.
- Ever-expanding fields of knowledge of the basic principles and capabilities of the various methods used for wastewater treatment and so on.

The Abuja Municipality population is growing rapidly, while the sewage plant is one and sufficient now. It will be impossible to use the same plant in the next few years to satisfy the growing population.

New plants will have to be built or the capacity of the present on increased.

The wastewater that is generated from the treatment plant is enormous, and this will continue to increase with the increase in population. The standard will have to increase, in order to reuse these abundant resources for irrigation and fishing or industrial cooling.

ECOMMENDATION

Based on the above conclusions the following recommendations are made for the effective treatment of sewage/wastewater in Abuja.

New sewage treatment plants should be built and the existing ones upgraded and maintained.

The new treatment plants should be designed with Local engineers and Local components to reduce maintenance cost and scarce foreign exchange.

Advanced treatment plants (example Reverse osmosis, nano filtration, ion exchange plant etc) that will treat the sewage better should also be built to enable the reuse of the treated effluent for irrigation, fishing or industrial cooling.

The staff of the plant should be sent on training abroad, to better understand the system and bring operational efficiency to the plant.

REFERENCES

GORDON .M. FAIR/JOHN .C. GEYER/DANIEL .A. OKUN: (1958)
WATER SUPPLY AND WASTEWATER REMOVAL,
VOL. 1 - 2 2D ED,
JOHN WILEY & SONS,
NEW YORK.

GORDON .M. PAIR/JOHN .C. GEYER/DANIEL .A. OKUN: (1958)
WATER PURIFICATION AND WASTEWATER TREATMENT AND DISPOSAL,
VOL. 2, 2D ED,
JOHN WILEY & SONS,
NEW YORK.

WHITE: (1986) WASTEWATER ENGINEERING: AISE,
EDWARD ARNOLD (PUBLISHERS) LTD
LONDON.

. S. (1971) IRRIGATED & AGRICULTURE DEVELOPMENTS.
BAG HDDD IRAP.INDIA

L & EDDY:(1979) WASTEWATER ENGINEERING:
TREATMENT,
DISPOSAL, REUSE, 2D ED,
MC FRAW-HILL,
NEW YORK.

METACALF & EDDY: (1981) WASTEWATER ENGINEERING: COLLECTION AND PUMPING OF WASTEWATER
MC GRAW HILL, INC.
NEW YORK.

AY. K. LINSLEY: (1992) WATER RESOURCES ENGINEERING, 4TH EDITION.
MC GRAW HILL; INC,
NEW YORK.