TITLE PAGE

COMPUTER APPLICATION IN EVALUATION OF
CHEMICAL COMPOSITION OF CEMENT
A CASE STUDY OF QUALITY
CONTROL DEPARTMENT CEMENT
COMPANY OF NORTHERN NIGERIA, SOKOTO

BY

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CERTIFICATION

This project entitled "COMPUTER APPLICATION IN EVALUATION OF CHEMICAL COMPOSITION OF CEMENT BY OKEKE NKIRUKA PATRICIA" meets the regulations governing the award of POST GRADUATE DILOPMA IN COMPUTER SCIENCE (PGD/CS) of FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, and is approved for it's contribution to knowledge and literacy presentation.

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DATE ______________________

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EXTERNAL EXAMINER

DATE: ______________________

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DEDICATION

I dedicate this work to God Almighty, the Alpha and Omega for keeping me alive up to this moment.

Also to the memory of my Late Parents, Mr. Beneth C. N. Okeke and Mrs. Selina ifeyinwa Okeke who laid the foundation of my present academic standard.

Adieu Papa and Mama, may your souls rest in the bosom of our Lord Jesus:

Amen

ABSTRACT

In recognition of the advantages or characteristics of computer technology, which includes, its accuracy, reliability, speed, storage facilities, ability to compare and perform arithmetic operations etc. It has been employed in various organizations, thus has affected all works of life. This recent development in computer technology especially to solve human problems, has generated a more significant impact on industries, Agriculture, and Commerce.

This study focused on identifying the method employed by the Quality Control Department of CCNN Sokoto in analysing and evaluating the chemical composition of cement. Data used for this study were collected by means of experiment.

The analysis of the current system shows that the Quality Control Department of CCNN Sokoto stil adopt the manual system of evaluation.

Thus this project was designed to establish the need for computer application in analysing and evaluating the chemical compositioon of cement.

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CHAPTER ONE

1.0 INTRODUCTION

Before the era of computer, computation and processing of data were done manually, thus, introduction of computer into the business world has concentrated on computerizing manual systems thus reducing the clerical burden.

Today, it has become a vogue to apply computer in almost any venture, be it in industry, agriculture, field of commerce or science and technology. With this varied application of computer, especially in advanced modern societies, it has become glaringly manifest that the computer machine has become a necessary apparatus for societal progress and development.

The continual existence of any industry depends on the quality of the product produced, this implies that for any industry to continue to exist, some qualities of the products will have to be maintained to certain standard for cheaper yield and market acceptance. This work is posed on the Quality Control Department of any industry.

Thus, Quality Control Department of CCNN Sokoto tests the quality of cement product produced by complete chemical analysis of the cement product and evaluation of the chemical composition of the product. This is done to make sure that the product is up to the required standard set by Nigerian Industrial Standard (NIS).

1.1 QUALITY CONTROL

Quality control could be referred to as methods used in an attempt to maintain the quality of manufactured products to an acceptable standard.

Variation is inherent in nature, and therefore in all manufacturing, manufacturers often set standard to which their product most confirm if they are to be considered satisfactorily. It could be in terms of actual use or selling price of the product.

The quality of cement depends on its chemical composition, therefore to maintain these composition, samples are tested in the Quality Control Department Laboratory for compliance with standard set by Nigeria Industrial Standard (NIS).

Some of the compounds analyzed by means of complete chemical analysis of cement are Silica Oxide (S_1O_2), Iron II Oxide (fe_2O_3), Magnesium Oxide (M_gO), Calcium Oxide (C_aO), Trioxe Sulphate IV Oxide (SO_3). Also, Insoluble Residue

(IR), loss of ignition (LOI), and moisture content of cement are determined.

There are four factors that could contribute to the variation in industrial processes, Viz, miscellaneous, process, material and operators.

i) Miscellaneous: This includes environmental factors such as heat, light, radiation and humility.

ii) Processes: Includes machine, vibration, hydraulic and electrical fluctuation. When all these variations are put together, there is a certain capacity or accuracy within which the process operates.

iii) Materials: Since variation occur in the finished product, it must also occur in the raw material. Such quality characteristics as tensile strength, thickness, porosity and moisture content would be expected to contribute to variation in the finished product.

iv) Operators: This is perhaps the greatest source of variation. This includes the method by which the operators perform operations. The operators perform operation. The operator's physical and emotional well-being could also contribute to variation. His lack of understanding may lead to frequent machine adjustment therefore compounding variations.

1.2 AIM AND OBJECTIVES OF THE STUDY

Today, computer is widely applied to solve different problems. This study is proposed to:

a) Study the method employed by the Quality Control Department of CCNN Sokoto in analyzing and evaluating the chemical composition of cement.

b) Improve the current system used by the department.

c) Improve on the accuracy and more effective and quicker computation.

d) Design and implement the soft ware required for effective use in the future.

1.3 SCOPE AND LIMITATION OF THE STUDY

This study is limited to Quality Control Department of CCNN Sokoto. The choice was guided by relevance of time and resources, and also the availability of research material.

1.4 METHODOLOGY OF THE RESEARCH

This study was designed to evaluate the analysis of chemical composition of cement using computer application. There are several methods which could be used to gather information (Data), amongst them includes observation, questionnaire, sampling, interview, record searching and special purpose record.

For the benefit of this particular research, the methods used are: Observation/Experiment and Oral Interview.

a) Oral Interview: This method was used to enable the researcher have direct discussion with the Head of the Department and Laboratory attendants.

b) Observation/Experiment: This method was employed not only to obtain first hand information (Data) from the department but the desire to observe closely how the experiment are being carried out and to obtain the accurate analysis of the cement.

1.5 **PROBLEMS AND PROSPECTS**

In carrying out this research, the following problems are anticipated:

(a) Limited resources such as financial difficulties encountered during the execution of this project.

(b) Time constraint imposed by the authority concerned with the project.

(c) Possibility of not securing correct data based on the experiment carried out.

(d) In adequate knowledge of computer and its application.

1.6 DEFINITION OF SOME PARAMETERS.

1. Lime Saturation Factors (L.S.F.): This is the measure of the amount of Calcium Oxide that can be combined with clay. This has to be observed in all cement industries because Calcium Oxide has to be carefully proportioned with respect to other constituents of cement raw mix: L.S.F is calculated after all the analysis of cement has been completed with the following formular.

$$L.S.F. = \frac{CaO - 0.7\,(SO_3)}{2.8\,(SiO_2) + 1.2\,(AL_2O_3) + 0.65\,(fe_2O_3)}$$

   L. S. F of 0.95 - 0.98 is appropriate for reasonable burning in the kiln.

2. Alumina Modulus (A.M): This helps in determining the degree to which the clinker can be burnt.

Clinker with high Alumina modulus produces cement with high early strength and also makes the reaction between silica and lime in the kiln very difficult.

The required value for Alumina modulus is between

1.4 - 1.9.

This is calculated using the formula below:

$$A.\ M. = \frac{AL_2O_3}{Fe_2O_3}$$

3. Silica Modulus (S.M.): Silica is a very important constituent of cement. It helps in preventing ring formulation during burning in the kiln. Low Silica modulus leads to ring formulation in the clinker and clinker with high silica modulus is very difficult to burn in the kiln and also result to poor coating properties; preferably 2.5 of Silica modulus is required for good quality cement. It is also calculated after all the analysis of cement has been completed using the following formular.

$$S.\ M. = \frac{SiO_2}{AL_2O_3 + fe_2O_3}$$

4. Burnability Factor (B.F): This serves as a guide to kiln operators to know the temperature at which the clinker can be burnt. The range of heating temperature should be between 1100 - 1450°C.

5. Clinker: The product of raw meal after burning in the kiln is called clinker.

6. Wet Process: This is one of the processes used in cement processes used in cement production. In this process, the raw mix is fed into the kiln as a slurry or paste.

7. Dry Process: Here the raw mix is fed into the kiln as a ground powder after crushing.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 BRIEF HISTORY OF THE COMPANY

Cement Company of Northern Nigeria (CCNN) Sokoto is one of the leading cement industries in Nigeria. The product of CCNN Sokoto is ordinary Portland Cement. The company is situated about 10km away from Sokoto town.

The foundation stone of CCNN Sokoto was laid in 1964 by the premier of former Northern Region, Late Alhaji Sir Ahmadu Bello, Sardauna of Sokoto. The cement plant was originally designed to produce 100,000 tons of cement per annum, using the wet process. The wet process was later changed to dry process during the early 70's. The plant was later expanded and the capacity increased to 600,000 tons of cement per annum. The expanded plant was commissioned in 1985 by then the Military Head of States, Major General M. Buhari.

CCNN Sokoto is a joint venture between some of the Northern States Government (Sokoto, Kebbi, Katsina, Kaduna and Kano), Federal Government and New Nigeria Development Company (NNDC).

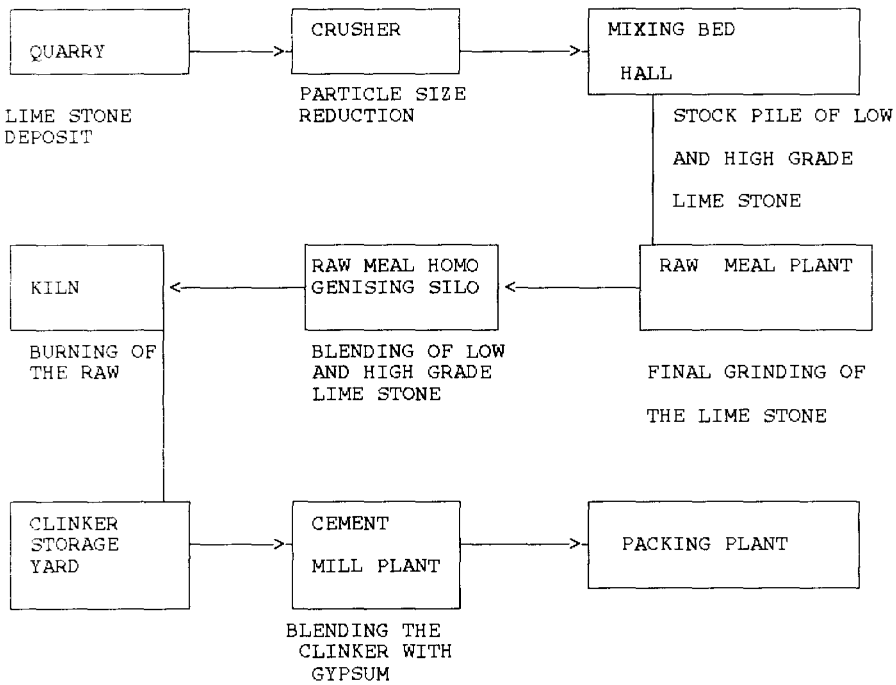
2.2 PROCESSES OF CEMENT PRODUCTION

2.2.1 PRODUCTION

Production is the processes of converting inputs from the raw materials into a specific finished product.

There are two distinct processes used in cement production. These are the wet and the dry processes.

Regardless of the process type, the raw materials are mixed so well so that after the production, the product will have a desired specified composition. CCNN Sokoto uses dry process of cement production because of the capacity increase in production.



PRODUCTION PROCESS FLOW SHEET DIAGRAM OF PORTLAND CEMENT

2.2.2 PROCUREMENT OF RAW MATERIAL

The two major raw material used in the manufacturing of Portland Cement are lime stone ($CaCo_3$) and gypsum ($CaSo_4 \cdot 2H_2O$). Both raw materials are locally available.

Limestone ($CaCo_3$) is mined from Kalambaina Quarry, located about 1 km from their factory site and is normally mined at the depth of 9.10m below the earth surface.

$CaCo_3$ content of limestone determines its grade. There are two grades:

i) The high grade limestone with about 75% $CaCo_3$.

ii) The low grade limestone with below 75% $CaCo_3$.

Gypsum ($CaSo_4 \cdot 2H_2o$) is supplied by contractors from the nearby villages, mainly from Goroyo, Gada and Wurno amongst others.

2.2.3 QUARRYING AND CRUSHING THE LIMESTONE

Quarrying is the last stage of geophysical prospecting. It is the process of extracting the raw material from its deposit. The process of removing deposit is referred to as quarrying while the location of such deposit is the quarry. It is at the quarry that low and high grade limestone are available.

Quarrying operations are done using bulldozer or chain dozer for stripping operations while (RH75) excavator is used for overburden.

Overburden is referred to as the top layer of the deposit which usually consist of brownish fine sand, redish mixture of laterite and bluish clay. Overburden is used to fill back the spaces where the limestone was removed. This restores the land scape after quarrying operations.

Crushing is the size reduction of the executed limestone. This is done in the crushed, which has the capacity of 55 tons per day output. The crushed material is transported by means of conveyor belt from the crusher to the stock pile. There are four stock piles I and II accommodate low grade $CaCO_3$ while III and IV accommodate high grade limestone. The crushed raw material is fed into the raw mill tube for grinding. Raw mill tube is a grinding plant that reduces the raw material to a final grain size that is required for the production of clinker. After grinding, the raw material which is now called the raw meal is conveyed to raw meal silo for storage.

2.2.4 BLENDING AND BURNING THE BLENDED MATERIAL

Blending is the process of homogeinizing the raw meal with corrective material (sand or clay) so that every cement grain consist of the same composition of the minerals. A complete homogeinization of the raw meal is achieved in the homogeinizing silo. the blended raw meal, now called the kiln feed is fed into the rotory kiln plant for burning.

kiln plant is a long cylindrical steel. In the kiln where the burning of the raw meal takes place, the raw material react to various temperatures in various stages. The product of the burnt material is called clinker. The rotary kiln consist of four zones, each lined with refractory materials depending on the temperature and the brick property.

The four principal zones are: pre-heating zone, calcining zone, cintering zone, and cooling or discharging zone.

i) Pre-heating zone This is the first zone, pre-heating takes place between the temperature of 100^0C to 800^0c. Dehydration of free H_20 from the material takes place between $100-500^0c$ while dehydration of chemically combined H_20 of clay material takes place between $500 - 800^0C$.

ii) Calcining Zone: Calcining takes places between $800-900^0c$

Calcining refers to decomposition of $CaCo_3$ to Ca0 and Co_2.

$CaC0_3$ $\underline{800-900^0c}$ Ca0 + $C0_2$.

iii) Cintering Zone: Cintering refers to reaction or fussion of Ca0, Al_20_3, fe_20_3 and $Si0_2$ to form the complexes or the main components that make up cement. This takes place between 900-1,285^0C.

The main components formed by the reaction of Cao, Al_20_3, fe_20_3 and $Si0_2$ are:

$2Cao + Sio_2$: C_2S (Dicalcium silicate)

$2CaoSi0 + Cao$: C_3S (Tricalcium Silicate)

$3Cao + Al_20_3$: C_3A (Tricalcium Aluminate

$4Cao\ Al_20_{3\ +}\ fe_20_3$: C_4Af (Tetra calcium) (Aluminate ferrite)

iv) Cooling or Discharging Zone: At this zone, clinker produced leaves the rotary kiln through the discharged opening and are stored at the clinker storage yard, which are used for cement production.

2.2.5 **BLENDING THE CLINKER WITH GYPSUM**

Clinker is fed together with gypsum at the ratio of 95% clinker to 5% gypsum into the rotary cement mill. Gypsum is added to control the setting time of cement produced and hence enhances its workability property, if gypsum is not added to the cement. Cement produced when at used will have a flash set. The finished product that is cement is pumped by means of peomatic conveyor system into the cement silo plant for storage.

2.2.6 **TYPES OF CEMENT**

Cement is a finely ground mixture of mainly anhydrous compounds. The addition of water to cement causes complex the mical reaction to occur. Cement has has been found useful in many construction works, for example in building bridges, roads, houses and many others.

Different types of cement product available are as follows:-

a) Portland Cement: This is the type of cement product produced by mixing calcerious (Cao) and argiltaneous (Silica, Aluminium and iron Oxide) materials and burning them at a clinkering temperature, and grinding the resulting clinker with gypsum. ($Caso_4 . 2H_20$) which controls the setting time.

b) High early Strength Cement: This cement contains higher amount of C_3S. It is used when high early compressive strength is required for an early removal of concrete.

C) White Portland Cement: This cement is almost the same as ordinary port land cement, it is characterized by low Iron and magnesium oxide content which are the compounds primarily responsible for the dark colouration of portland cement. Other chemical properties of white portland cement are the same as portland cement except for a slightly lower So_3 content and C_3Af.

iv) Portland Pozzolan Cement: Pozzolans are siliceous and Aluminious mineral substances which though having no cementitious quality, react with lime (Cao) in the presence of water at atmospheric temperature to form cementitious compounds. Portland pozzolan cement is a hydrautic binding material consisting of interground portland cement clinker and pozzolan. Portland pozzolan cement is used for various projects, mostly in concrete constructions which have to resist the attack of chemically aggressive water.

v) Fly Ash Cement: This cement is also designated as portland fly ash cement fly ash is produced in thermal power station, by combustion of pulverized coal and precipitation in dust collectors. In fly ash cement production, fly ash is ground together with clinker and gypsum in which up to 30% of clinker is replaced by fly

ash.

CHAPTER THREE

3.0 SYSTEM ANALYSIS AND DESIGN

3.1 SYSTEM ANALYSIS:

In Computer science, system analysis could be referred to as methods of determining how best to use computers with other resources to perform tasks which meet the information needs of an organization. It is aimed at evaluating and examining the existing system to identify it's strength and weakness and to provide better procedures and method of solving the problems. Also system analysis is concerned with converting the objectives of management as far as information and data are concerned into methods that are amenable to processing by computer.

It was necessary to investigate the manual system currently used in the Quality Control Department of CCNN Sokoto in the evaluation of chemical composition of cement, to see how best computer application could be used for more efficiency. The study of this chapter will result in the design and implementation of the proposed system.

3.2 PROBLEM IDENTIFICATION AND DEFINITION.

Problem definition is the process of determining the nature and scope of the problem, it allows for re-evaluation of the existing problem in the old system, to find out if the problem is major or minor, incorrectly or completely defined, in order to provide the best way of solving the existing problem. Considering the manual system used by the Quality Control Department of CCNN Sokoto in the evaluation processes, the problems that could be identified are thus:

a) The manual system of evaluation is tedious, tiring and highly uninteresting.

b) Misplacement, mishandling and loss of previous calculation

c) There may be delay in production processes due to lack of information.

d) More often than not, human errors often result, with some manipulation using manual system.

e) The method is also found to be inefficient.

3.3 **FEASIBILITY STUDY**

This is the preliminary investigation conducted on the current system to determine whether the solution to the problem is feasible. This study is very necessary in developing a new system, this is to prevent wasting of capital and human effort in trying to carry out a project that is very large or too difficult to carry out.

The three testing project feasibility used in this study are as follows:-

a) Operational Feasibility: This study is concerned with the workability of the proposed system when developed and implemented. The operational feasibility of the proposed system was conducted, and it was discovered that the new system been proposed will be operationally feasible.

b) Technical Feasibility: This test seeks to clarify if the proposed system can be achieved with the current equipment, existing software technology and available personnel. At the moment, the Quality Control Department of CCNN Sokoto has no personal Computer. But there is hope that the proposed system can be handled with the current equipment and existing software.

c) Economic/Financial Feasibility: The cost of implementing the new system will be quite reasonable and affordable by the company.

3.4 OPERATION OF THE CURRENT SYSTEM

The system under review or investigation needs to be thoroughly understood in details so as to be able to analyse, design and assemble recommendation. The experimental procedures used in the current system which serves as the methodology of the research are:

3.4.1 PREPARATION OF THE SAMPLE SOLUTION

I gram of cement sample and 3 gram of solid Ammonium chloride (NH_4cl) were mixed in 150ml beaker, 10ml of concentrated Hydrogen Chloride (Hcl) was added, then mixed with glass rod and the beaker was covered. The mixture was heated on the sand bath for 20 - 30 minutes and the content stirred repeatedly using glass rod. 50ml of hot distilled H_20 was added and the mixture heated for another 5 minutes, filtered using a filter paper quality (589 black band) into 500ml graduated flask. The filtrate in the graduated flask was made to mark of 500ml with distilled H_20 and allowed to cool at room temperature, and was kept to be used for further analysis. The residue on the filter paper was washed, the residue contained the precipitated insoluble components of cement. It was kept for the analysis of silicon oxide (S_i0_2).

3.4.2 **DETERMINATION OF CALCIUM OXIDE (Cao)**

50ml of the filtrate obtained in 3.4.1 was taken with volummetric pipette into 300ml beaker, was diluted with distilled H_20 to 200ml mark. The beaker with the solution, stirrer and P^H paper was placed on magnetic plate. Potassium hydroxide (KOH) solution was added drop by drop from the dropping bottle until P^H paper showed P^H of about 4-5 with orange colour, 10ml of triethanolamine was added, followed by 20ml potassium hydroxide (KOH) solution, the solution changed to dark red. Finally the solution was filtrated using strong Ethyl Di amine tetra Acetic Acid (EDTA) solution until the end point reached. When the colour changed from dark red to blue violet. The volume of strong EDTA consumed was noted.

Evaluation

CaO = V_1 x FCaO

V_1 = Volume of strong EDTA consumed

FCaO = Standard factor for evaluation of CaO (2.0383)

3.4.3 DETERMINATION OF MAGNESIUM OXIDE (mgO)

50ml of the filtrate obtained in 3.4.1 was taken into 300ml beaker with volummetric pipette, was diluted with distilled H_2O to 200ml mark. The beaker with the solution, stirred and P^H paper was placed on the magnetic plate. Conc ammonium hydroxide (NH_4OH) was added drop by drop from the dropping bottle until P^H paper showed P^H of about 4-5. 10ml of Triethanol amine was added, 10ml of conc ammonium hydroxide (NH_4OH) was also added. A small spoonful of mixed indicator was added and the colour of the solution changed to light violet. The solution was filtrated against strong Ethyl diamine Tetra Acetic Acid (EDTA) solution until the end point reached, when the colour changed from violet to colourless. The volume of the strong EDTA consumed was noted.

Evaluation

MgO = Vi x FMgO

Vi = Volume of strong EDTA consumed

FMgO = Standard factor for evaluation of MgO.(1.4655)

3.4.4 **DETERMINATION OF IRON II OXIDE**

100ml of the filtrate from 3.4.1 was taken with pipette into 500ml graduated flask. 3 drops of bromophenol blue was added, the colour changed to yellow. Few drops of conc ammonium hydroxide (NH_4OH) was added from the dropping bottle, which changed the colour from yellow to blue. 20ml of hydrogen chloride (Hcl) was added which turned the colour back to yellow, 15ml of buffer solution, and 1ml of salicylic acid was added and the solution changed to violet colour. The flask with the solution was warmed on a hot plate. The solution was filtrated against weak solution of EDTA until the end point reached, when the solution changed back to clear yellow. The volume of weak EDTA consumed was noted.

Evaluation

F_20_3 = Vi x Ffe_20_3

Vi = Volume of weak EDTA consumed

Ffe_2o_3 = standard factor for evaluation of fe_2o_3 (0.3355)

3.4.5 DETERMINATION OF ALUMINUM IV OXIDE (Al_2o_3)

After filtration for Fe_2o_3 determination from the same solution, filtration for Al_2o_3 was carried out. To the same solution ammonium acetate was added drop by drop until the colour changed from yellow to blue, few drops of acetic acid was added which changed the colour back to yellow - 3 drops of complexion indicator and 5-6 drops of PAN indicator was added, the solution changed to intensive pink. The flask with the solution was warmed on the hot plate and the solution was filtrated against weak EDTA solution. At the end point the colour of the solution changed to clear yellow. The volume of the weak EDTA was noted.

Evaluation

Al_2o_3 = Vi x FAl_3o_3

V1 = Consumption of weak EDTA

FAl_2o_3 = standard factor for evaluation of Al_20_3 (0.2142)

3.4.6 **DETERMINATION OF SILICON OXIDE ($S10_2$)**

The residue that contained precipitate insoluble components of cement from 3.4.1 was transferred into a clean platinum crucible together with the filter paper, weighed and was burnt on the Bunsen burner until the filter paper was completely burnt leaving only the $S10_2$ in the crucible. The crucible was removed, allowed to stay at the temperature of 1450^0c in side muffle furnace for 30 minutes it was finally cooled inside a desiccator for 5 minutes.

insoluble residue with the filter paper was then transferred into a clean platinum crucible and was weighed, burnt inside the Bunsen burner until the filter paper was completely burnt. The crucible with the content was put inside the muffle furnace for 30 minutes at 1450_0c, and was finally allowed to cool inside the desiccator for 5 minutes. The crucible with the content was re-weighed.

Evaluation

$$\% \text{ IR} = \frac{(Wt_1 - Wt_2)}{X} \times 100$$

Wt_1 = Weight of platinum crucible + the precipitate and the filter paper before burning.

Wt_2 - final weight of the crucible and the content after burning

X - weight of the sample taken.

3.4.9 DETERMINATION OF LOSS OF IGNITION (LOI)

Loss of ignition is defined as the amount of water lost on heating or burning the cement in the kiln. 1 gram of cement sample was taken into a clean platinum crucible and weighed. The crucible with the sample was placed inside the muffle furnace for 30 minutes at 1450_0C. It was removed, allowed to cool inside a desiccator and re-weighed.

Evaluation

$$LOI = \frac{(Wt_1 - Wt_2)}{X} \times 100$$

Wt_1 = Initial weight of the crucible and the cement sample

Wt_2 = Final weight of the crucible and the cement sample

X = Weight of the cement sample taken.

3.4.10 **DETERMINATION OF MOISTURE CONTENT (MC)**

100 gram of the cement sample was weighed into a container, kept inside ovum at 120^0C for 30 minutes. The container was removed, allowed to cool inside desiccator. The cement sample was re-weighed. the difference in the two weight gave the moisture content of the sample.

Evaluation

$$MC = Wt_1 - Wt_2$$

Wt_2 = Initial weight of the cement sample

Wt_2 - final weight of the cement sample.

3.4.11 **EVALUATION OF POTENTIAL COMPONENTS OF CEMENT**

The potential components of cement which are evaluated are Tricalcium silicate (C_3S), Dicalcium silicate

(C_2S) Tricalcium Aluminate (C_3A), and tetracalcium Aluminate ferrite (C_4AF). All these calculations are done after all the chemical components of cement have be evaluated.

i) $C_3S = 4.07(CaO)-7.605-(S_1 0_2)-6.72(Al_2 0_3)-2.85(SO_3)$

ii) $C_2S = 2.87(S_1 0_2) - 0.754(C_3S)$

iii) $C_3A = 2.65\ (Al_2 0_3)-1.69\ (fe_2 0_3)$

iv) $C_4AF = 3.04\ (Fe_2 0_3)$

3.5 ELEMENTS OF SYSTEM DESIGN

3.5.1 SYSTEM DESIGN

After analysis of the current system, the next step in the system processes, is the designing of the new system. This is achieved only after the system analysis by the analyst approved the proposal of a new system.

3.5.2 NEW SYSTEM DESIGN CRITERIA

a) Volume: The proposed system is designed to handle large amount of data for evaluation.

b) Simplicity: The system though designed to handle complete operations of computation or evaluation should be simple to use.

c) Flexibility: The system can operate in a dynamic rather than static environment

d) Security: The security of the system should be taken into consideration, such that the out put report are provided only for the authorized users to have access.

e) Efficiency: The system should be desired to be of high efficiency ensuring the best output of the desired evaluation.

f) User Or friendly : The system should be designed, in such a way that it simply gives the operators a choice of different transaction for implementation.

3.5.3 INPUT DESIGN

Input design is one of the items of elements of design. In designing a system, the type of input media, Data collection methods, volume of input documents and design of input layouts are to be put into consideration. The purpose of input design is to make sure that all input data are correctly identified and accurately recorded, and also that the processing of all data is accomplished without addition or omission.

3.5.4 **INPUT SPECIFICATION**

In designing a new system, the following input specification are required.

a) Volume of consumption of weak and strong Ethyl Diamine Tetra Acetic Acid (EDTA)

b) Standard factor for evaluation of Fe_2O_3, MgO, and SO_3

c) All the formular for the evaluation

d) Weight of the sample taken.

e) Weight of the platinum crucible

d) Weight of the sample + platinum crucible after burning.

3.5.5 **OUTPUT DESIGN**

Output design is established as a final check on the accuracy of the processed data. In designing an output, certain things are to be put into consideration such as the time and how often the output report is needed, whether on daily, weekly, monthly or yearly basis, also the authorized people that need the output are to be considered such as the manager, Producers, or Customers. The overall view of the output design is that all the output report should be distributed on a timely basis and only to those that are authorized to receive them.

3.5.6 OUTPUT SPECIFICATION

The output report that is expected from the new system are:-

i) The total value of composition of Fe_2O_3, Al_2O_3, CaO, MgO, and SO_3

ii) Percentage composition of SiO_2, IR and LOI

iii) The value of the moisture content (MC).

3.5.7 DATA CONTROL

Data control referred to the exercise of counter measures to regulate a system so that it produce the desired output. It is one thing to process data, and another to know that all the necessary data for evaluation or processing has been received, processed and corrections made. In order to control flow of data in and out of the processing system, it is a normal practice to incorporate a data control in the data processing unit.

CHAPTER FOUR

4.0 SOFT WARE DEVELOPMENT AND IMPLEMENTATION

4.1 INTRODUCTION

System Development and implementation includes all activities to be carried out when converting an old system to a new one, since the time the decision to computerize was taken up to the time when the new system goes to live.

System Development involves designing of the new system based on the out come of the analysis and the recommendation made during the analysis. It also includes writing of the program and testing the program to ensure their correctness or functionalities. Here any existing data is taken from the old system and converted to new system. Proper system Development and implementation is essential to provide a reliable system in order to meet the organization requirement.

4.2 CHOICE AND FEATURES OF THE PROGRAMMING LANGUAGE USED

A quite number of programming language are available, this ranges from cobol, basic, Pascal, fortran and Data-base.

Most of these languages apart from Database are highly mathematical.

Basic language is widely used in programming scientific, mathematical and many Business problems. For the benefit of this project, QBasic was used for the program.

Q Basic language was choosen based on the fact that it encourages running the computer in an interactive mode. As soon as the user submits a program and some data to the computer the computer executes the program, produces the result back to the user immediately, thus, it is easy for the user to find out whether the program is working properly or there is a bug.

In most scientific field or commercial computing, Q Basic is used to perform complex calculation on small set of data or simple calculation which involves complicated manipulation of large set of data. Thus these are the main thing carried out in Evaluation of chemical composition of cement.

4.3 **CHANGE OVER**

The change over from the old system to the new system is known as conversion, it involves the conversion of the old file data into the form required by the new system.

There are four methods of handling a system conversion each method is considered based on the opportunities, it offers and problems that it may cause or have.

a) <u>Parallel System</u>: This is the most secured method of converting from old to new system. Under this approach, users continue to operate the old and the new systems. the output or results from both system are cross-checked. The results from the old system is continued to be cross-checked with the new system until the new system has proved satisfactorily. At this stage, the old system is discontinued and the new system takes its place. This method is the safest conversion approach since it quarantees, should problems such as errors or inability to handle certain types of evaluation arises in using the new system, the organization can fall back to the old system without loss of time, revenue or service.

This method of conversion is recommended for the proposed system. Thus the main disadvantages of the parallel system approach is that it cost double, since there are two sets of system to operate, also sometimes it is difficult for the staff to carry out two different operations using the time available for one.

b) Direct System: This method is the complete replacement of the old system by the new system in one move. The disadvantage of Direct system is that, should incase there is failure in the new system, the organization involved will take the pains of going back to the old system and all the money involved in designing the new system is lost, also in some instances, organizations even stop operation when serious problem arises from the new system until the difficulties are corrected.

c) Pilot System: When new system involves new technic or drastic changes in organization, pilot approach of conversion is often preffered. In this approach, a working version of the system is implemented in some part of the organization. When the system is deemed complete, it is installed through all the organization. This approach has the advantages of providing a sound proving ground before full implementation. However, if the implementation is not properly handled, users may develop the interest that the system may continue to have problem and that it cannot be relied on.

d) Phase-in-Method: This approach of conversion is used when it is not possible to install a new system through out an organization, all at once. Here a logical section or part of the organization is committed to the new system while the remaining parts or sections are processed by the old system.

Only when the selected part is operating satisfactorily that the remaining sections are transferred to the new system.

4.4 INSTALLATION

The following tools will be needed to check the quality of the new system.

i) Code Testing and Specification Test: This test examine what program should do how it should do it, in line with the result obtained.

ii) Verification Test: This test involves executing the soft ware in a simulated environment, using some assumption, testing a data for error finding.

iii) Validation Test: This test involves the process of using soft ware in a live environment for the purpose of spotting error.

iv) Certification Test: This test involves indorsement of soft ware for correctness.

4.5 TRAINING PERSONNEL

Even a well designed and technical system can fail because of the way they are operated and used. The quality of personnel/Staff involve with the system in various capacities helps or hinders and may prevent the successful implementation of the system.

In other words, the existing staff would be given an appropriate training once a system is implemented to enable them have basic knowledge on how to operate computer and its peripheral devices.

4.6 POST IMPLEMENTATION REVIEW

After the system is implemented and conversion is completed, a review of the system is usually conducted by users and the analysis. This is a formal process to determine how well the system is working, how it has been accepted and if any adjustment is needed.

The most fundamental concern during post implementation review is to determine whether the system has met its objectives, if the performance level of the user has improved and if the system is producing the result needed. Inability of the system to achieve any of these objectives may raise doubt on the workability of the system.

4.7 HOW TO ENTER THE SYSTEM

To access the program designed in other to view the work, set up the system to DOS environment, change the system to QBasic environment by typing CD Q Basic. Press enter key, then this gives the program coding for the evaluation of the chemical composition of cement of the organization, then the program RUNS. Using file Nk result will appear on the screen when pressed F5, using file NK1 the result of computation will be produced on a hard copy.

4.8 EXIT FROM THE SYSTEM

The only way to exit from the system is by typing END and this takes the user back to DOS environment.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY.

This piece of work has been carried out with the aim to improve the manual system of evaluation used by the Quality control Department of CCNN Sokoto.

The Quality Control Department of CCNN Sokoto is a very

important section in the functioning of the organization. thus any factor that hinders the efficient and proper evaluation or computation of the chemical composition of cement produced, leads to poor product standard, poor competition and decrease in market.

Before the designing of the computerized system, a thorough study of the manual system used by the Department was carried out to really get first hand information of what is obtainable in the organization/Department under consideration. During the study, it was discovered that the manual system was characterized by limitations such as:-

a) In accuracy resulting from calculation

b) Incomplete record of the result

c) Delay in the production process due to lack of information.

The (program) computerized system was designed in order to reduce all the lapses that were characterized with the manual system. With the use of the new system, it will now take a short time to evaluate complex calculation, with a very high degree of accuracy. It has been tested and found to be useful to the organization.

5.2 CONCLUSION

Having gone through both the manual and computerized system of evaluation of chemical composition of cement; it cannot be over emphasized that there is an urgent need to computerize the method of evaluation in order to take the enormous advantages of computer such as it's high speed of execution of data, high degree of accuracy, and ability to handle large volume of data.

5.3 RECOMMENDATIONS

In view of findings in this project, the following recommendations which will help towards improving the organizations activities and services are made:

a) Once the system is implemented, some staff would be trained to be computer literate as to enable them have basic knowledge on how to operate the new system.

b) The organization, not just only training the staff, should also provide enough computers and other related equipments in the Quality Control Department for easy and complete evaluation of all the analysis, though computers are very expensive and the maintenance cost is relatively high, but the advantages over manual system cannot be over looked.

c) Lastly, in terms of accuracy, the new system provides for accurate evaluation and generates a comprehensive result, it is therefore recommended.

APPENDIX

```
'COMPUTER APPLICATION IN EVALUATION OF CHEMICAL
'COMPOSITION OF CEMENT
'
'*******************************************
'
'  NKIRUKA   P.  OKEKE
'
'*******************************************
'IRON 111 OXIDE (Fe2O3)
'V1=VOLUME OF WEAK EDTA USED
'M=STANDARD FACTOR FOR Fe2O3
V1 = 14.5: M = .3355
Fe = V1 * M
PRINT "IRON 111 OXIDE (Fe2O3)"
PRINT "VOLUME OF WEAK EDTA USED V1="; V1
PRINT "STANDARD FACTOR FOR MFe2O3 ="; M
PRINT "Fe2O3 = "; Fe
PRINT : PRINT
'********************************************
'ALUMINIUM  OXIDE (AL2O3)
'V1=VOLUME OF WEAK EDTA USED
'M=STANDARD FACTOR FOR AL2O3
VA = 24.5: MA = .2142
AL = VA * MA
PRINT "ALUMINIUM OXIDE (AL2O3 )"
PRINT "VOLUME OF WEAK EDTA USED V1="; VA
PRINT "STANDARD FACTOR FOR MAL2O3 ="; MA
PRINT "AL2O3 = "; AL
PRINT : PRINT
'***********************************************
'CALCIUM  OXIDE (CAO)
'V1=VOLUME OF STRONG EDTA USED
```

```
'M=STANDARD FACTOR FOR MCAO
VC = 30.4: MC = 2.0383
CA = VC * MC
PRINT "CALCIUM OXIDE (CAO)"
PRINT "VOLUME OF STRONG EDTA USED V1="; VC
PRINT "STANDARD FACTOR FOR MCAO ="; MC
PRINT "CAO = "; CA
PRINT : PRINT
'**********************************************
'MAGNESIUM  OXIDE (MgO)
'V1=VOLUME OF STRONG EDTA USED
'M=STANDARD FACTOR FOR MmgO
VM = 31.6: MM = 1.4655
MG = VM * MM
PRINT "MAGNESIUM OXIDE (MgO)"
PRINT "VOLUME OF STRONG EDTA USED V1="; VM
PRINT "STANDARD FACTOR FOR MmgO ="; MM
PRINT "MgO = "; MG
PRINT : PRINT
'**********************************************
PRINT "SILICON DIOXIDE (SiO2)"
T1 = 45.4638: T2 = 45.235: X1 = 1
SI = 100 * (T1 - T2) / X1
PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE BEFORE BURNING
WT1="; T1
PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE AFTER BURNING
WT2="; T2
PRINT "WEIGHT OF THE SAMPLE TAKEN X ="; X1
PRINT "SiO2 ="; SI
PRINT : PRINT
'************************************************
PRINT "SULPHUR IV OXIDE (SO3)"
S1 = 45.4638: S2 = 45.286: X3 = 1: MO = 3.43
SO = MO * (S1 - S2) / X3
```

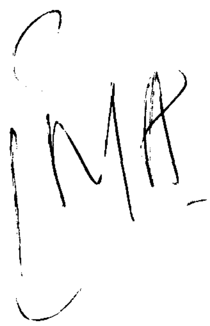
```
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE BEFORE BURNING
WT1="; S1
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE AFTER BURNING
WT2="; S2
    PRINT "WEIGHT OF THE SAMPLE TAKEN X ="; X3
    PRINT "STANDARD FACTOR FOR  MSO3 "; MO
    PRINT "SO3 ="; SO
    PRINT : PRINT
    '************************************************
    PRINT "INSOLUBLE RESIDUE (IR)"
    R1 = 45.024: R2 = 45.0094: XR = 1
    IR = 100 * (R1 - R2) / XR
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE BEFORE BURNING
WT1="; R1
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE AFTER BURNING
WT2="; R2
    PRINT "WEIGHT OF THE SAMPLE TAKEN X ="; XR
    PRINT "IR ="; IR
    PRINT : PRINT
    '*************************************************
    PRINT "LOSS OF IGNITION (LOI)"
    L1 = 45.014: L2 = 45.0005: XL = 1
    LO = 100 * (L1 - L2) / XL
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE BEFORE BURNING
WT1="; L1
    PRINT "WEIGHT OF PLAT.  CRUCIBLE+ SAMPLE AFTER BURNING
WT2="; L2
    PRINT "WEIGHT OF THE SAMPLE TAKEN X ="; XL
    PRINT "LO ="; LO
    PRINT : PRINT
    '**************************************************
    PRINT "MOISTURE CONTENT  (MC)"
    WS = 100: CB = 309: CW = 308.02
    T0 = WS + CB: T1 = WS + CW
    MC = T0 - T1
```

```
     PRINT "WEIGHT OF SAMPLE ="; WS
     PRINT "CONTAINER BEFORE WARMING ="; CB
     PRINT "CONTAINER AFTER WARMING = "; CW
     PRINT "WEIGHT OF  SAMPLE + CONTAINER BEFORE WARMING
T0="; T0
     PRINT "WEIGHT OF  SAMPLE + CONTAINER AFTER WARMING
T1="; T1
     PRINT "MC ="; MC
     PRINT : PRINT
     '*****************************************************
      PRINT "LIME SATURATION FACTOR (LSF)"
      LS = CA - .7 * SO
      LB = 2.8 * SI + 1.2 * AL + .65 * FE
      LSF = LS / LB
      PRINT " LSF ="; LSF
      PRINT : PRINT
      '*****************************************************
      PRINT "SILICA MODULUS (SM)"
      SM = SI / (AL + FE)
      PRINT "SM ="; SM
      PRINT : PRINT
      '******************************************************
      PRINT "ALUMINA MODULUS (AM)"
      AM = AL / FE
      PRINT "AM ="; AM
      PRINT : PRINT
      '******************************************************
      PRINT "TETRA CALCIUM ALUMINATE FERRITE"
      C4 = 3.04 * FE
      PRINT "C4AF ="; C4
      PRINT : PRINT
      '******************************************************
      PRINT " TRICALCIUM ALUMINATE"
      C3A = 2.65 * AL - 1.69 * FE
```

```
      PRINT "C3A ="; C3A
      PRINT : PRINT

'*******************************************************
      PRINT "TRICALCIUM SILICATE"
      CP = 4.07 * CA - 7.605 * SI
      CK = -(6.72 * AL + 1.43 * FE + 2.85 * SO)
      C3S = CP + CK
      PRINT "C3S ="; C3S
      PRINT : PRINT

'*******************************************************
      PRINT "DICALCIUM SILICATE"
      C2S = 2.87 * SI - .754 * C3S
      PRINT "C2S ="; C2S
```



OUTPUT RESULT

IRON 111 OXIDE (Fe2O3)
VOLUME OF WEAK EDTA USED V1= 14.5
STANDARD FACTOR FOR MFe2O3 = .3355
Fe2O3 = 4.86475

ALUMINIUM OXIDE (AL2O3)
VOLUME OF WEAK EDTA USED V1= 24.5
STANDARD FACTOR FOR MAL2O3 = .2142
AL2O3 = 5.2479

CALCIUM OXIDE (CAO)
VOLUME OF STRONG EDTA USED V1= 30.4
STANDARD FACTOR FOR MCAO = 2.0383
CAO = 61.96432

MAGNESIUM OXIDE (MgO)
VOLUME OF STRONG EDTA USED V1= 31.6
STANDARD FACTOR FOR MmgO = 1.4655
MgO = 46.3098

SILICON DIOXIDE (SiO2)
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE BEFORE BURNING WT1= 45.4638
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE AFTER BURNING WT2= 45.235
WEIGHT OF THE SAMPLE TAKEN X = 1
SiO2 = 22.87979

SULPHUR IV OXIDE (SO3)
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE BEFORE BURNING WT1= 45.4638
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE AFTER BURNING WT2= 45.286
WEIGHT OF THE SAMPLE TAKEN X = 1
STANDARD FACTOR FOR MSO3 3.43
SO3 = .6098514

INSOLUBLE RESIDUE (IR)
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE BEFORE BURNING WT1= 45.024
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE AFTER BURNING WT2= 45.0094
WEIGHT OF THE SAMPLE TAKEN X = 1
IR = 1.459885

LOSS OF IGNITION (LOI)
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE BEFORE BURNING WT1= 45.014
WEIGHT OF PLAT. CRUCIBLE+ SAMPLE AFTER BURNING WT2= 45.0005
WEIGHT OF THE SAMPLE TAKEN X = 1
LO = 1.350021

MOISTURE CONTENT (MC)
WEIGHT OF SAMPLE = 100
CONTAINER BEFORE WARMING = 309
CONTAINER AFTER WARMING = 308.02
WEIGHT OF SAMPLE + CONTAINER BEFORE WARMING T0= 409
WEIGHT OF SAMPLE + CONTAINER AFTER WARMING T1= 408.02
MC = .980011

LIME SATURATION FACTOR (LSF)
LSF = .8369822

SILICA MODULUS (SM)
SM = 2.262492

ALUMINA MODULUS (AM)
AM = 1.078761

TETRA CALCIUM ALUMINATE FERRITE
C4AF = 14.78884

TRICALCIUM ALUMINATE
C3A = 5.685508

TRICALCIUM SILICATE
C3S = 34.23343

DICALCIUM SILICATE
C2S = 39.85299