COSTS AND COSTING ANALYSIS

OF A CEMENT FACTORY -

A CASE STUDY

COSTS AND COSTING ANALYSIS OF A CEMENT FACTORY - A CASE STUDY

BY

KLAAS FREDERIKUS TILLEMA
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Leader: Prof. Dr. A.J.E. Sorgdrager

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To my Wife

INGE

PREFACE

Except the Lord build the house,
they labour in vain that build it.

Psalm 127 v. 1

No business undertaking can survive and grow unless the management is presented with a clear picture of the costs of producing its products. This applies to each and every enterprise and also, in particular, to the cement industry. The selling price of cement in South Africa is controlled by the Government and, unless cost figures are presented in a meaningful manner, no satisfactory profits can be generated to meet the continuous growth of the South African economy. This paper analyses the costing characteristics of a cement factory.

Prof. Dr. A.J.E. Sorgdrager, under whose leadership I completed this paper, inspired me continuously with his enthusiasm for the subject. My sincere thanks for his inspiration and encouragement in completing this work.

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Deo favente, Deo gratias

Lichtenburg
March, 1970

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I A short history and the importance of the Cement Industry in South Africa to-day

In the early days man's need for shelter urged him to think of methods of building crude houses. The first were probably tree branches covered with grass and, perhaps, with mud (called wattle and daub). Later, rough stones were bedded in mud.

The Assyrians and Babylonians had learned the art of burning clay which they used not only for building but also to produce permanent written records in the famous clay tablets of Babylon which exist to-day and show how durable this material was.

The ancient Egyptians had learned the art of using lime and gypsum for mortars and this was a great help in advancing their civilisation. From an analysis of the mortar used in the Pyramid of Cheops it is apparent that the Egyptians had practical knowledge of a cement similar in some ways to modern Portland Cement.

The Romans evolved a natural cement made from lime and a volcanic ash; they used this extensively for mortars and for the building agent in a concrete with stone and sand. They were responsible for naming the binding agent "Caementum" and the finished mass they called "Concretus". In buildings such as the Forum (27 B.C.), the Colosseum and the Basilica of Constantine are 2,000 year old examples of the use of Roman "Concretus" and Caementum" to be found. The harbour at Ostia, completed in 52 A.D. was constructed from a cement having the property of setting in sea water.

After Roman times there was no advance in the knowledge or use of cements for many centuries and indeed the knowledge of cement which would set under water seems to have been lost until interest was revived in the mid-eighteenth century when a search was made for a more permanent cement. Some materials similar to those used by the Romans and called Roman Cements were used but it was left to Joseph Aspdin, a bricklayer from Leeds, Yorkshire, England to make the fundamental discovery regarding hydraulic cement. His cement also hardened under water, hence the name "hydraulic" cement. He also gave us the name "Portland Cement" due to the similarity between his cement when hardened and a stone found on the Isle of Portland off the north coast of England.

Only 68 years after Aspdin's patent, Portland cement was produced commercially in South Africa. In 1891 Mr. Edward

Lippert obtained from the Government of President Kruger an undertaking that should he start a factory for the manufacture of cement, no similar factory would be permitted to operate within the Republic for a period of three years. Mr. Lippert opened his factory in 1892 at Daspoort near Pretoria, under the company name of "Eerste Cement-Fabrieken Beperkt". Production remained centred on Daspoort until 1913 when a factory was opened at Whites in the Orange Free State.

The cost of cement at this time was the equivalent of R1.96 for a 50 kilogramme pocket - approximately three times what it costs to-day. (See A1)

Since those early days, with a production of 3,175 metric tons per year at Daspoort, the industry has expanded in 77 years to where the total production of cement was over 4½ million metric tons for the year ending 30th June, 1969, in 15 factories situated throughout the Republic (See A2 and A3).

To-day cement is used extensively in -

- the storage and conservation of water
- all types of building construction
- the generation of electrical power
- farming, mining, transport, commerce and industry
- a multitude of forms which make modern life convenient

II Purpose of this study

To produce cement in large quantities it is necessary to install some of the biggest and most expensive units known in industry to-day e.g. the kiln of a cement factory, generally

known as "the heart of the cement making process", is one of the largest pieces of equipment used in modern industry. It follows that the cement industry invests huge sums of capital into plants and machinery and it can be classed as a capital intensive industry. However, the industry is under price control and after nearly eleven years the Price Controller authorised a price increase of the order of 3 cents per pocket (50 kilogramme) on the 21st May, 1969; but the effective increase after tax only amounts to 1.8 cents per pocket (Ref. South African Cement Producers Association - Johannesburg - Annual Report 1968/69 - p.1)

With the high capital investment on the one hand and the relatively low controlled selling price on the other hand, it is imperative that production costs and overheads are kept at an absolute minimum to ensure a satisfactory rate of return on capital employed.

Inefficient cost accounting systems not adapted to the production process will result in wrong cost prices. (Ref. A.J.E. Sorgdrager - Kosprysberekening en - tegniek - Nasou Bpk., Kaapstad, 1967 p.49)

"Die navorsing waaraan Suid-Afrika vandag die grootste behoefte het, lê op die gebied van doeltreffendheidsverhoging, nie alleen tegnies nie, maar ook ekonomies en vooral administratief".

This study tries to analyse the possible costing systems which could be used for the cement industry and it presents a costing system as in use in a certain cement factory.

III Study method

The method followed in this study is -

1. a system of references from literature publised in South Africa, Europe and the U.S.A.
2. Analysis of costing system in a certain cement factory
3. Annexures are attached at the back. Where no source is acknowledged the information was obtained as a result of own observations.

IV Classification of treatise

Chapter I - The principal stages of cement manufacturing are discussed here. In order to understand the costing system of a cement factory the reader should have a clear picture of the principal stages in the production process.

Chapter II - The process cost system and related systems and techniques are discussed in this Chapter and a theoretical costing system for a cement factory is proposed.

Chapter III - The characteristics of the costing system as in use at a certain cement factory A are discussed and presented.

Chapter IV - The theoretical system is compared with the system as in use at factory A and certain conclusions are drawn.

CHAPTER I - THE CEMENT PRODUCTION PROCESS

A. Introduction

The cement industry is not usually classed as a chemical or chemical engineering industry, but is generally hidden amongst those industries associated with building materials. Actually, portland cement manufacture is a complex chemical engineering process and in the standard specifications the manufacture is described as follows -

"The cement, whether ordinary or rapid-hardening, shall be manufactured by intimately mixing together calcareous and argillaceous and/or other silica, alumnia or iron oxide bearing materials, burning them at a clinkering temperature and grinding the resulting clinker so as to produce a cement capable of complying with the standard". (Ref. Portland Cement - F.S. Fulton & R. Sandler - Portland Cement Institute - Johannesburg - undated - p.20). (See Annexure A4)

B. The Raw Materials

The raw materials consist mainly of limestone and shale or clay but other material such as boiler ash and iron oxide may be used in place of the clay or shale. The main consideration is that the prepared and blended raw material should have such composition and such physical properties that a clinker of suitable composition may be obtained.

Limestone, which is the major raw material used in the manufacture of portland cement, is readily available in South

Africa. The limestone varies in quality from a very high grade material with a calcium carbonate content of 96 - 97%, to medium grade containing 85 - 86% $CaCO_3$. The magnesia content is usually in the range 1 - 3%.

Since the rock occurs as a deposit at or near the surface, open-cast quarrying methods are used, involving drilling, blasting and the use of large excavators for loading into dump trucks.

The material from the quarry may be several feet in size. The first reduction is carried out by means of primary crushers, driven by motors of 200 to 300 H.P., and capable of crushing 91 cm. boulders down to a size of 20 cm. to 25 cm. at a rate of 350 or more tons per hour.

The crushed rock is further reduced by means of secondary, and sometime tertiary crushers to a size of 1 cm. to 2 cm. This product is conveyed to storage and later fed to tube mills together with shale or clay for final preparation as slurry (for the wet process), or raw meal (for the dry process).

The secondary raw materials for the manufacture of Portland Cement are usually readily available, either from shale or clay quarries, or in the form of boiler ash from power stations.

C. Preparation of Raw Materials

The preparation and blending of the raw materials can be achieved either by the dry process or by the wet process.

In the dry process the raw materials are fed to the grinding mill in a dry state and when open circuit grinding is employed

a dry powder of the desired fineness is produced. In the case of close circuit grinding a powder coarser than desired is produced. This product is then fed to a separator for the separation of the powder of the desired fineness, the coarser particles being returned to the grinding mill.

In the wet process the raw materials are ground in the presence of water. Either the open or closed circuit system may be used. In the former the material is ground in the mill to the desired fineness. In the closed circuit system the material is ground coarser than desired, the product is separated by means of rake classifiers and the coarser fraction is returned to the mill for further grinding.

The slurry (in the wet process) is stored in tanks and large basins. To prevent settling or segregation of the components, continual agitation and mixing is required. In the dry process the raw meal is homogenised in special containers and stored in silos.

The raw material blend must be finely ground and uniformly mixed. If the different materials are not mixed intimately, the reactions will not take place uniformly throughout the mass.

The critical factors in the preparation of the raw mixture for the manufacture of portland cement are correct proportioning, fine grinding, and intimate mixing. All are controlled by vigilant chemical inspection and rigid adherence to the predetermined composition for the particular plant.

D. The Burning Process

The modern cement kiln is a revolving steel cylinder 92 m. to 185 m. long, and 3 m. to 6m. in diameter. It is lined with refractory bricks, the quality of which varies with the zone in which they are placed. The higher the temperature the higher the grade of brick.

In examining the design of kilns over the last 25 years increase in size has been a developing feature, and the greater capacities have resulted in reductions in fuel consumption.

The slurry or raw meal is fed into the back end of the kiln. The kiln rotates slowly, driven by huge electric motors and depending on design does approximately one revolution per minute.

As the raw materials enter the kiln from the back end, finely ground coal is blown in from the firing end to provide the heat which burns the raw material mix to clinker.

The coal used for firing is the duff or dross obtained from the collieries. Before being blown into the kiln it must first be dried and ground to a fineness comparable with that of cement.

As the kiln rotates the charge travels slowly downward toward the hot end of the cylinder. Maximum temperatures of the material in the "burning" zone are from 1400° to 1500°C.

The slurry, on entering the feed end of the kiln, passes through three stages. In the first stage the water is evaporated by the waste heat contained in the gases from the

burning zone. The second stage after drying takes place further along the kiln, and as the temperature rises the organic matter burns away and the carbonates lose their carbon dioxide. The third stage takes place in the hotter regions of the kiln, where about 25% of the mass is converted to liquid. Several new compounds crystallize out as the components of the original mixture disappear from the system. Only to the degree that they are formed is the mixture of ground raw material converted into cement clinker. Hence it is important that the reactions proceed to completion.

During the passage of the material through the hottest or burning zone some of the semi-liquid material adheres to or reacts with the refractory brick lining. This forms a coating and acts as a protection to the brick. Depending on the type of raw material and on the burning conditions in the kiln, the brick lining, provided it retains its coating, may last several months, and quite often for over a year of continuous operation.

The kiln is "the heartof the cement making process" and it is the biggest revolving unit in any industry in the world.

E. Cooling of Clinker

Shortly after the clinker has reached the position of maximum temperature, it drops from the kiln and may be cooled by any of a number of means. A common cooler is the

"planetory" type which is attached to the kiln itself. Another is the simple rotary-type cooler consisting of a rotating steel shell fitted with lifters, which lift and drop the clinker to effect the cooling.

To recover the heat contained in the clinker, air is drawn through the coolers, and the heated air enters the kiln as secondary air for combustion. Efficient enclosed air-circulating coolers have been developed. Advantages claimed for such treatment are fuel economy, better burning of the clinker, immediate availability of the clinker for grinding and improved grindability.

F. Grinding the Clinker

The cooled clinker is stored and is then passed to the mills for grinding to cement. A carefully adjusted quantity of gypsum is added to control the setting properties of the cement.

In open circuit grinding multi-compartment tube mills are used. The charge of grinding media in the various compartments is calculated and designed for optimum operation in the particular compartment.

In the closed circuit system, ball mills are used in conjunction with air separators. Preliminary crushing of the clinker is of assistance in improving the efficiency of the grinding mill and this procedure is used in many plants.

In South Africa normal portland cement is ground to a fineness of 2,800 to 3,300 sq. cm. per gm. and the fineness of

rapid hardening cement is between 3,800 and 4,500 sq. cm. per gm. It must be stressed that rapid hardening cement is not quick setting and differs from normal cement only in its rate of strength development at early stages.

G. Storage, packing and despatch

The ground cement is transferred either pneumatically or by belt conveyors to concrete silos where it is stored. The cement is extracted from these silos, and transported to the packing plant either by screw conveyors or by air slides where it is packed in 50 Kg. sacks for despatch. The packing machines automatically fill the sacks to the specified weight. Each sack has a valve at one corner which closes when it drops off the packer spout thereby sealing the sack. Adequate dust control is installed at all the packers and the extractors from the silos. The sacks with cement are usually transported on conveyor belts directly to railway trucks or lorries where they are stacked in a specified pattern.

Cement can also be transported in bulk by means of railway trucks which are specifically built for this purpose. The cement is extracted by means of compressed air directly out of the storage silos and is blown directly into the bulk tankcar by means of special pipes.

H. General

A clear understanding of the cement production process is necessary to enable the reader to follow the possible costing systems of a cement factory which are discussed in the following chapters.

CHAPTER II - SYSTEMS

A. Introduction

The "process cost system" is in general use throughout the cement industry, due to the continuous cycle of operations. (Ref. John Hill - "Accounting for the Cement Industry - The Canadian Chartered Accountant - October, 1962 - p.354).

According to "The Cost Accountant", July, 1961, "process costing is one of the most common methods of costing, its main object is to provide an average cost of a product, this usually being calculated by accumulating for a period the relevant labour, material and factory overheads and dividing them by the units produced within that period".

Unlike "job order costing", where costs are recorded separately for each job or order going through the plant, the emphasis in process costing is on the accumulation of costs for all units worked on in a department during a given period of time. The units processed in a department typically are homogeneous in nature and average costs are computed to determine the basis for transferring costs from one department to the next processing centre.

Thus, the conditions for use of process costs are -

1. Continuous or mass production
2. Loss of identity of individual items or lots
3. Complete standardisation of product and processes

Process Cost Accounting is predicated in the theory that average costs are typical of operating conditions of production

and that average costs are of primary interest to management. The general principles of process cost accounting may be outlined as follows - (Ref. Blocker and Weltmer - "Cost Accounting" - 1954 - McGraw -Hill - p.227).

a. Costs, both direct and indirect are accumulated in cost accounts during the period and are reclassified by departments or processes at the end of the period.

b. Production in terms of quantities such as units, tons, kilos, metres and litres are recorded by processes daily or weekly and are summarised in departmental reports at the end of the period.

c. The total cost of each process is divided by the total production for the process to obtain an average cost per unit for the period.

d. When products remain in process at the end of a period, production and inventories are computed in terms of completed products, the stage of completion usually being estimated and the identity of each lot being ignored.

e. If units are lost or spoiled in a department, the loss is borne by the units completed and remaining within the department, thus increasing the average cost per unit. A.J.E. Sorgdrager - ("The particularisation of indirect cost in modern costing administration" - 1964 - Potchefstroom - p.30) states correctly that waste should not be incorporated in cost as such. It is irrational to expect the consumer to pay for the wastage factor. Wastage reduces the profit of the enterprise and it is the duty

of the management to prevent it in all spheres.

f. In cases where products are processed in more than one department, costs of one department are transferred to the next department, the total cost and unit cost of products being accumulated when completed.

We can make the following deductions from these principles (Ref. Neuner and Frumer - "Cost Accounting - Principles and Practice" - 1967 - Richard D. Irvin - p.289).

(1) Emphasis is placed on production for a given period i.e. a day, a week or a month.

(2) The continuous nature of the production usually implies that in many concerns there will be work-in-process inventories at the beginning and at the end of the given period. This gives rise to the problem of how to treat the work-in-process in computing unit costs.

(3) Emphasis is therefore placed on the period of time and on the number of units (or quantity) completed and in process.

(4) Since the products are manufactured on a continuous basis the factory production is generally for warehouse stocks, not for specific customers. This is also the reason for standardisation of products and accounts for the main difference in approach between a job order costs system

and a process cost system.

The following factors determine whether the continuous process cost accounting system will be a simple or a complicated procedure - (Ref. - Neuner - op. cit. - p.290)

(a) The number of products

(b) the length of the production cycle

(c) the number of operations or departments involved

(d) the number of departments in which materials must be added and whether these materials increase the number of units being produced or merely alter the units already in production

(e) the amount of shrinkage or waste and

(f) whether or not at the end of the month there is any work-in-process

B. Classification of Process Cost Manufacture

The production process can be two-fold, viz.

1. Firms manufacturing a single product continuously as in the cement industry or

2. firms producing a variety of products

The single product can be produced in one department or in successive departments. These costs may be further classified into those in which

1a. Materials to be processed are placed into production only in the initial department. All subsequent departments merely add labour and manufacturing overheads to the cost of manufacturing.

1b. Materials are added in initial and in some of the subsequent departments. This additional material may either increase the number of units being manufactured or merely increase the unit costs but not the number of units being produced.

1c. There is no work-in-process inventory in any of the departments at the end of the cost accounting period. The simpler the manufacturing processes and the more perishable the product the less likely it is that there will be any work-in-process inventory at the end of the period. If there is no work-in-process inventory at the end, the simpler becomes the computation of unit process costs.

1d. There is a work-in-process inventory in at least some of the departments at the end of the cost accounting period. The longer the manufacturing production cycle and the more involved the manufacturing operations, the more likely it is that there will be some unfinished work or materials in some of the departments. For example, bread bakeries, ice-cream manufacturers and food canners usually complete all work placed in process before computing unit costs. In cement factories, oil refineries, gas and electricity utility firms, steel mills and textile manufacturers, the operations invariably involve some unfinished work-in-process no matter when the costs are summarised.

These work-in-process inventories complicate the computation in the cost accounting work.

2. Firms manufacturing more than one product on a continuous basis.

There are several possible conditions which may exist here (Ref. Neuner - op. cit - p.365)

a. Separate products are produced in different departments which have no relation to each other. This is the same as a number of single-produced firms.

b. Separate products are produced, but the second product uses some of the first product in its manufacturing operations. In a fertilizer plant, acid phosphate is produced in one department. Some of this is sold and the rest is used in manufacturing fertilizer. It becomes necessary to determine the costs of the acid phosphate before any cost can be computed for the fertilizer.

c. A number of products are produced. In the course of manufacturing operations the work done in one department is transferred to several departments, after which further production results in several products.

G. Shillinglaw - (Cost Accounting - Analysis and Control - 1961 - Illinois - Richard D. Irvine - p.325) uses the following classification for multiple processes -

(1) Continuous sequential processing - successive cost centres apply the same process year after year on the same product with some small possible changes to allow for modernisation of the product or technical improvements. Typical examples in this group are the cement industry and oil refineries.

(2) Discontinuous processing - material also goes through different processes but the final product is not identical at the end of each period. Production facilities are used for a certain product or process for a certain period and are then changed for another product or process, after the first product has gone through the process stages. e.g. A canning factory can process tomatoes during the tomatoe season and peaches during the fruit season.

(3) Parallel processing -

Here different products go through different but parallel processes, with possible combination or assembling in one department or possibly parallel right through the process, e.g. one firm may manufacture refrigerators and washing machines.

(4) Selective processing -

Here we have preparation departments. Unit costs of preparation departments are carried forward to successive departments.

C. Sequential process cost account for Cement Plant

C.F. Schlatter and W.J. Schlatter - ("Cost Accounting" - John Wiley & Sons - New York - 1965 - p.112) give an example of a simplified form of an accounting method for a cement plant as an aid in understanding the principles and procedures of sequential process cost accounting. The detailed records are omitted and only the accounts in the general ledger are stressed.

It is essential that The Cement Company quarries the lime and clay which it consumes, but that it purchases gypsum from others. The management must then know the costs of producing the lime, of producing the clay, of grinding the raw materials, of burning the clinker and of grinding the clinker. It is necessary, therefore, to set upon the ledger following process cost accounts for the production departments -

- Raw Material A (lime)
- Raw Material B (clay)
- Raw Grinding
- Clinker Burning
- Clinker Grinding

None of these accounts receive entries in the accounting period except in very special cases. They receive entries, as a rule, only when adjustments and distributions are made and posted at the end of the month. This means that all costs must be charged to the primary accounts at the time the transactions take place and accumulated there until the end of the month. At the end of the month those accounts which

represent costs of production are distributed to the five accounts named and to the service department accounts. At the end of the month, after the adjusting and distributing entries have been made and posted, all the costs of manufacture will be in or will have passed through these five accounts.

In addition to these five accounts Schlatter and Schlatter (op. cit. p.114) advocate the use of the following additional accounts to record production costs -

- Coal Preparing account
- Power, Light and Water account
- Machine Shop account
- General Factory Overhead account
- Packing and Loading account
- Finished Cement account
- Cost of Sales account

(Table A5) illustrates the monthly cost sheet as used in this example.

As will be seen in Chapter III, all the cost accounts as used in this example can be combined into one account, named Production Cost Account. The only accounts necessary are the Stock Accounts (Raw Materials, Gypsum, Coal, Clinker and Cement) and the Production Cost - Wages - and Stores Accounts. The total of the Cost Sheets for the month can be posted in one lump sum to the Production Cost Accounts. Stock adjustments between months, as calculated on the cost sheets

can be posted straight from the cost sheets to the stock accounts. The wages account is kept for the balance of the wages accrued at the end of the month and the stores account for the balance of the stores items held in the plant stores (i.e. all items other than stocks used in the manufacturing process).

Neuner - (op. cit. p.796) also gives an example of a monthly cost summary (See Table A6) and a condensed Production Report (See Table A7) of a cement factory.

The difference between this example and the one as used by Schlatter and Schlatter - (op. cit. p.131) (See Table A5) is the method of transferring the costs of the raw material used to the successive processing departments. In (Table A5) the value is not transferred to the next department. In (Table A6) the costs of Limestone (Rock Costs) and Clay (Shale Costs) are transferred to the Raw Grinding Department, the total costs of this department are transferred to the clinker burning department and this department's total costs are transferred to the clinker grinding department reflecting total costs of cement produced. We believe that these values of the actual raw materials used should be transferred, as shown in (Table A6) - Neuner - (op. cit p.797).

D. Process Costs and allocation to various costing units

In "The Cost Accountant" - (July, 1961 - p.231), attention is directed to process costs in relation to division into cost centres. As a first step it will be necessary to decide the extent and number of the departments. A department, for normal purposes, may perform a number of operations. To make the costing efficient a further sub-division of each department into cost centres may be necessary. Whether or not a cost centre should be created is a matter to be determined by reference to the use to which the costs, separately accumulated, are to be put. Where the objective justifies a cost centre, then this should be created. Normally, process costing will call for division according to operations or processes.

Sorgdrager - (op. cit. p.159) states -

"This system of categorical classification of costs and the further divisions (into departments and cost centres) must be adapted to the nature and organic structure of the enterprise". The responsibility for costs must affect everyone in the enterprise. For instance, the foreman of production cost centre A is responsible for the costs of his cost centre - but only for those he directly controls, e.g. material consumed, labour etc. On the other hand, maintenance

costs for his centre should be the responsibility of the foreman of the maintenance cost centre and not that of the foreman of cost centre A. The centre of responsibility and the cost centre may be identical but this is not always the case. Codes are used increasingly by managements. Each code represents an account or unit and this saves time because only the codes are written down instead of the name of the account or unit.

"The Cost Accountant"- (op. cit. p.231) correctly asserts that wherever possible, charges which are readily traceable to departments or cost centres should be directly charged to such departments or cost centres. The cost of materials can usually be directly allocated by reference to departmental usage records or material requisitions. Labour cost expended can be obtained from wages sheets and departmental time sheets.

Meters may show the electricity, water or steam used by a department, whilst time sheets can show the time spent in each department by maintenance workers such as electricians and fitters. All the time the object is to trace responsibilities and then charge the costs as accurately as possible. Generally speaking, where costs in a department can be traced directly to products such a department is a producing department, in other words, a producing department actually carries out the conversion of the raw material.

A service department is a department whose costs cannot be traced directly to products. Thus the accounts, stores, purchasing, maintenance and personnel departments are all service departments.

Separate accounts for each service and producing department are kept and at the end of each accounting period the balances in the service department's accounts are transferred to the producing department. The service received by each department should be the basis for determining how the service costs are apportioned. The distinction between the two types of departments is of great importance; it is only when the transfer has been made that unit costs should be determined.

The conversion or production cost for each process should be separate from transfer costs applicable to previous operations. If the conversion costs are not clearly indicated there can be no guide to departmental efficiency for such costs are within the control of the department whereas the transfer costs are the responsibility of other departments.

E. Process costs, standard costs and budgets

1. Standard Costs -

C.W. Bennett - ("Standard Costs" - Prentice - Hall - 1962 - p.1) defines standard costs as "the anticipated cost of a specific product produced at a given level of

volume and under an assumed set of circumstances". The volume level and the set of circumstances must be carefully determined and the underlying details spelt out. Until these requirements have been met, no attempt to develop standard costs should be made, in fact, no steps can be taken in that direction because there will not be any standards.

A modern standard cost plan should be the result of combined management, engineering and accounting thinking. Management must determine the volume level to be adopted and the set of circumstances to be assumed. The engineer's job is to set the standards within the framework of management's prescription. The accountant's job is to show how these standards compare with the actual results and why there were differences.

2. Difference between standard and budget -

Budgets and standards are not the same thing. S.B. Henrici - ("Standard Costs for Manufacturing" - McGraw-Hill - 1960 - p.347) discusses the differences between standards and budgets and asserts that the first distinction is one of purpose. Budgets are statements of expected cost. At the beginning of the period for which they are used to forecast requirements of finance, manpower and other variables related to production and sales. During that period they are used

as a comparison to be sure that actual costs are not exceeding expectations. Standards, on the other hand, do not necessarily show what costs may be expected to be, but rather what they should be if certain, highly desirable performances are obtained.

The second distinction is one of emphasis. A budget emphasizes cost levels that should not be exceeded, but a standard emphasizes the levels to which costs should be reduced. If these levels are reached profits are increased. In a healthy business, costs never exceed budget; they do approach standard.

A third distinction is one of completeness. Budgets are customarily set for all departments in the company, from sales to manufacturing. Standards are frequently set only for the manufacturing division and can, indeed, be confined to controllable costs in a limited number of cost centres, although this is not a recommended practice. Furthermore, budgets customarily include both income and expense, whereas standards are more frequently set for expenses or costs only.

A fourth distinction is one of analysis and breakdown. If costs are within the budget it is well and good, but when actual costs differ in any marked degree from standard, the nature and cause of the variance is thoroughly investigated so that steps may be taken to reduce its amount. Knowing why actual cost differs from standard enables us to economize knowing why it differs from budget, if it is less, merely tells us of

good performances already obtained - if it is more, it tells us of a highly perilous situation.

We can summarise this by saying that a budget is a marker for keeping out of trouble whereas a standard is a compass that points the way to improvements.

3. Similarities between standard and budget -

Both budget and standards attempt to predetermine expenses. Both consider departmental expenses according to accounts. Both assume that costs are controllable along fixed lines of supervision and responsibility. Both require periodic comparative cost reports. Both require the measurement of costs as related to some other variable, such as prices, standard hours, etc.

4. Compiling the budgets -

C.W. Bennett - (op. cit. p.160) emphasizes that the standard costs are, in effect, subdivisions of the budgets. Budgets to be used only as a basis for setting up the standard costs may be quite different in form and construction from budgets prepared especially for management purposes. Yet the same fundamental data would probably be used in each instance.

There are three basic principles of budgeting. The budget must

a. be prepared in a manner that the operating management can understand and can use as an important tool in operating the business

b. be projected for a specific period ahead, and

c. be capable of comparison with actual results.

To effectively meet this two-way job of making the budgets serve two masters

(1) standard cost needs and

(2) management needs,

the budgets are frequently projected by months for a year ahead.

The following budgets, based on standard costs should be compiled for a modern cement plant -

(a) Sales forecast, usually compiled by the Sales Departments of South African Cement Manufacturers

(b) Production budget, based on the sales forecast, incorporating quantities and costs

(c) Maintenance budget, i.e. anticipated costs of maintaining the plant and equipment used for production

(d) Overhead budget

(e) Master budget, incorporating the production, maintenance and overheads budgets

F. Marginal Costing

1. Introduction -

J. Batty - ("Management Accountancy" - McDonald and Evans - London - 1966 - p.215) asserts that marginal costing (also known as Direct Costing, Variable Costing, Out of Pocket

Costing, Differential Costing, Incremental Costing) is a special technique which may be used in conjunction with costing methods - job or process - or with other techniques such as Standard Costing or Budgetary Control. The importance of the technique lies in the assistance it may give in solving managerial problems.

2. Definition and usefullness -

There is some difficulty in defining in precise terms what is meant by "Marginal Costing". From guidance given in accountancy journals and text books it would appear that the number of businesses which follow Marginal Costing principles to the exclusion of all others are in the minority. On the other hand, there is general acceptance that separation of fixed and variable costs can assist materially in controlling costs and arriving at sound decisions. It will be noticed from the discussion of the costing systems of Cement Factory A in Chapter III that the costs of this particular plant are in fact split between fixed and variable. Although a Process cost system is used, some of the principles of Marginal Costing are inherently built in and are used extensively.

Bearing the possible differences of opinion in mind, the best possible approach to defining Marginal Costing is to list the main features normally found in a complete system of Marginal Costing. If only some of the features or principles

are present, as in the case of Cement Factory A, then there is partial Marginal Costing.

The technique of marginal costing involves two principal steps:

a. Determination of marginal costs

b. Arrangement of these costs in the most suitable manner for showing the state of profitability and enabling management to reach conclusions which are conceived on a sound basis; i.e. "on the true costs of carrying out the particular action". (Ref. Batty - op. cit. p.215).

In addition, there are certain features which are an essential part of a complete system of Marginal Costing, as follows -

(1) The Marginal (variable costs) are regarded as the costs of the products, generally with the exclusion of variable selling and distribution costs.

(2) Stocks of work-in-progress and finished goods are valued on the basis of marginal costs.

(3) Prices are based on marginal costs plus the contribution, in other words, the difference between selling price and variable costs per unit is the contribution.

(4) A special form of Profit and Loss Account or statement is employed (Marginal Profit and Loss Account).

(5) Profit is calculated in a special way. Marginal costs are deducted from Sales Revenue to arrive at the contribution, which meet fixed costs, any surplus being profit.

(6) Break-even techniques and calculations which show the effect of increasing or reducing the volume of output or of changing the mixture or types of products are an integral part of the technique.

(7) The relative profitability of departments or products is usually based on a study of the contributions made available by each department or product.

Marginal costs are costs which vary in relation to activity. With an increase or decrease in production there are certain costs which increase or decrease and are called variable costs (Marginal Costs).

Fixed costs (or constant costs or period costs) are those costs which are fixed for a certain period and do not fluctuate when there is a change in activity during the period. However, it must be noted that there are certain limits in which the costs are fixed and when these limits are exceeded there is a change in fixed costs. (Ref. - H.J. v.d. Schroeff - Kosten en Kostprys - Kosmos, Amsterdam - 1965 - p. 316 - 330).

There are two possible meanings for marginal costs. First, they may be regarded as prime costs plus variable

overhead costs; i.e. all variable costs of whatever type they may be. The second definition gives a special meaning to these variable costs. However, in this connection it may be better to use the singular form - "marginal cost" (not costs). If a definite output is taken then the marginal costs are the amount (variable costs) by which total cost changes as a result of producing one unit more or one unit less. In this context "unit" may mean a single unit, 100, 1 gross, 1,000 or some other convenient multiple. Accountants also use the terms "differential" and "incremental" to describe the addition to total cost due to increasing or reducing output. (Ref. Batty - op. cit. p.216).

3. Advantages of marginal costing -

Arising principally from the fact that fixed costs are not apportioned to products a number of advantages are generated -

a. Marginal costs remain the same per unit of product irrespective of the volume of production

b. When predetermined overhead costs are used as is generally the case when job costing is employed, there is the complication of under or over recovery of overhead costs. Marginal costing avoids this.

c. Because of a. and b. above the problems of estimating and pricing are greatly simplified. However, as the selling prices of cement in South Africa are set and

controlled by the State, this advantage is not applicable to the Cement Industry.

d. Exclusion of fixed overhead costs from the cost of products means that work-in-progress and finished goods are valued much more realistically than when total costs are employed. The materials in the cement production process which can be regarded as work-in-progress are the raw meal (dry process) and slurry (wet process) and the clinker.

e. The effect on profit of producing a greater or smaller volume of output can be ascertained without great difficulty.

f. The division of costs into fixed and variable, facilitates cost control.

g. Reports to management are based on sales figures, not production figures. Unless products are sold a plant does not earn profit; therefore it is better to make comparisons of efficiency on the basis of sales and related costs not affected by stocks.

4. Possible disadvantages -

a. The effects of failing to achieve, or exceeding the normal activity or volume of production are only illustrated in an indirect manner.

b. Great emphasis is placed on the selling function, but the achievements of the manufacturing divisions are subordinated. Production as well as sales should be taken into consideration when viewing the state of efficiency.

c. The break-even techniques and charts used are subject to limitations which are often ignored when these techniques are being employed.

5. Use of marginal costing -

Some of the problems which may be simplified by the use of Marginal Costing techniques in the cement industry are as follows -

a. Profitability of Departments or Products (Marginal Profit and Loss Accounts)

b. Suspending activities, i.e. closing down a plant or part of a plant

c. Make or buy decisions

d. Expand or buy decisions

e. Purchasing of new assets or replacement of old assets

f. Comparing machines or hand labour

g. Profit planning

C. Suggested system on a theoretical basis

1. As outlined in Chapter II, the cement production process consists of definite stages and the materials are transferred from one stage to the next. Therefore it is clear that a process cost system is the only logical system which can be used in the cement industry and that the variable costs incurred in the previous stage should be added to the next, until all the variable costs are finally reflected in the last stage of the process, viz., the packing and loading compartment.

2. In all businesses certain costs are incurred whether there is any production or not over a certain period. These are classed as fixed costs but typical examples are fire insurance on the buildings, depreciation of buildings and machinery, real estate taxes and rent. The tendency in South Africa to-day is to class all labour costs as fixed costs as well, except overtime remuneration. The days of hiring and firing employees as production went up and down are something of the past and mainly as a result of protective legislation, employment can generally be regarded as reasonably permanent.

It is therefore suggested that the costs of cement production should be split between fixed and variable. Furthermore, all labour costs can be regarded as fixed, provided overtime remuneration is fairly constant from month to month. The fixed costs should be summarised for each stage but not be transferred to the next one. All the fixed

costs can be totalled into one lump sum for a fixed period, usually one month.

It is therefore clear that, although a process cost system should be in operation in a cement plant, only the variable cost of production can be transferred from the one stage to the next. It would be misleading for management to allocate some of the fixed costs to the product due to the variance of production from month to month. The variances of production quantities in a cement plant are mainly due to the uncertain length of the kiln run, as outlined in Chapter II. By adhering to this principle, closing stock values of Clinker and Cement are not influenced by fixed costs and these values would show the true costs of the product.

3. Actual results for the month should be compared with standards and budgets, and percentage variances should be presented. Any material deviation from budget should be investigated and explained whether results are over or below budget. Standards and budgets should be reflected on the actual cost sheets every month, and not on the variance report. The variance report should only reflect the <u>difference</u> in standards and budgets, and comments thereon. In this way, only the exceptions are highlighted and this would follow the principles of "Management by exception".

4. A further characteristic of a meaningful cost accounting system should be comparisons between actual year to date and budgeted year to date figures. This would show the trend during the year in relation to the budget. Any major deviation from budget can be spotted in time and corrective action can be taken.

5. Year to date results should also be compared with the previous year, to highlight any favourable or unfavourable conditions between these periods.

6. Sales results should be reflected on the cost reports to establish the profit of the plant. This would enable management to make use of break-even techniques and other advantages of marginal costing as outlined on page 33.

Let us now have a look at what is done in practice by analysing the costing system as in use at Factory A.

CHAPTER III - A PRACTICAL COSTS SYSTEM AT FACTORY A

A. Introduction

Factory A is the latest and most modern cement factory in South Africa, having been commissioned in 1966. It is a one kiln plant, using the dry process of cement manufacture. At present preparations are in progress for the erection of a second kiln and further kilns are planned.

The factory obtains the basic materials, limestone and clay, from its own quarries. These quarries also supply the limestone to another factory within the company, which is all transported by rail.

The finished cement is despatched by rail in paper sacks or in bulk and a limited quantity is picked up at the factory by customers.

The flow of materials and production is as shown in Annexure A4. Every organisation and plant has got one or more critical factors in striving towards its objectives. The factory key objectives are set as follows -

1. To assist in increasing Group profits by operating at maximum possible profitability. Generally this means - producing maximum possible clinker quantity commensurate with low operating costs.
2. To lead the design and execution of future extensions
3. To assist in sales promotion of the Company's product

The prime critical factor in reaching these objectives is the length of the kiln run. As explained in Chapter II the inner wall of a cement kiln is lined throughout with special fire bricks, but the life span of these bricks is limited. When the kiln has to be stopped for relining, production of clinker is completely discontinued and the time needed for relining can be anything from a few days up to a few weeks. The longer the kiln runs continuously, the more clinker and cement can be produced and despatched. Apart from the complete loss of production, the relining costs are very high.

Due to the vast amounts of capital required to build a cement factory (Cement Factory A - R13 million) it can only operated profitably if production is continuously kept at maximum capacity commensurate with being able to sell the production.

The secondary critical factor is the fixed costs of a cement plant. If any factory has one or five kilns it still needs the basic requirements in manpower and machines. Obviously, the higher the production the greater will be the contribution towards meeting these fixed costs.

Management must get a clear picture of the fixed and variable costs of producing the cement in order to keep these costs to the minimum.

B. Organisation

As can be seen from the Organisation Chart (See A8) the factory consists of three departments falling under the Works Manager. The three departmental heads, viz., Production Manager, Resident Engineer and Works Secretary are responsible for production, maintenance and administration respectively. Production is regarded as the line function and the other two as staff funtions.

The organisation is logical and no overlapping should take place. The number of departments has been brought down to the minimum and each one has got a clear function. Management is constantly striving towards improving productivity and efficiency by lowering the number of employees in each department through investigations, consultations and time studies.

The upper echelons of the organisation are split into responsibility centres, each having a number with an alphabetical prefix indicating the department. These numbers are mainly used on the following documents in the day to day operation of the plant -

1. Requisitions for materials from stores -

Raw materials used in the production process are taken automatically from the limestone - clay - boiler ash - magnetite fines - coal - and gypsum stockpiles. Similarly, the processed materials are taken automatically from the raw meal - clinker - and cement silos. No requisitions are made out for these materials, but usage is measured by means of meters and checked monthly through stocktaking.

2. Works orders, for allocating of labour costs to responsibility centres.

3. Requests to Chief Storekeeper to buy direct materials.

4. Management indicators, generated from the planning office, indicating various trends within the responsibility centre. Examples are machine performance, overtime worked, employees at work and value of stores drawn.

5. Clockcards used for all non-white labour hours.

6. Standard procedures, for various responsibility centres.

7. A multitude of documents for distribution to heads of responsibility centres.

C. Cost Centres, Job Numbers and Unit Numbers

Each responsibility centre is split into one or more cost centres and these consist of various job numbers and unit numbers.

1. Cost Centres and Job Numbers -

As stated on Page 24, the centre of responsibility and the cost centre may be identical but this is not always the case.

In Factory A most responsibility centres consist of more than one cost centre. The cost centre number might be the same as the job number, but not in all cases. In some cases a cost centre consists of more than one job

number. For all practical purposes the job number is used and not the cost centre number. This facilitates the monthly distribution of costs to cost reports.

The job number is used on the following documents -

a. Stores requisitions (See B 1 - page 41)

b. Works Orders

c. Invoices for materials purchased direct

d. Various control charts, generated from the planning office

e. Management Indicators

f. Clockcards

2. Unit Numbers -

The term "unit" in Factory A is used for all items which in total comprise the entire plant. Every building, machine and vehicle, in other words all fixed and moveable assets, are given a unit number. Machine history cards are kept to record the running and maintenance costs for every unit of plant. This process is known as "Unit Costing" -

This must not be confused with the general use of the term "unit costs" which are calculated as following -

$$\frac{\text{material + labour + manuf. overhead}}{\text{quantity produced}}$$

This formula refers to costs of units of production (Ref. R.I. Dickey - Accountant's Cost Handbook - The Ronald Press Company - New York - 1964 - p.12.17). Another general use of the word "unit" is found in the term "costing units" which mean "..... a major device for separating costs into those which apply to inventories from those which belong to cost of goods sold, for comparison purposes, and for other managerial uses". (Dickey - op. cit.p.2.13). Examples are tons and paper bags in the cement industry.

The unit numbers in Factory A reflect -

a. the cost centre

b. the type of machine and

c. the number of the main unit and the relation of this machine to the main unit

Examples: No. 301/022/001

301 is the cost centre (clinker burning)

022 means this is a kiln (as per list of definitions)

001 means this is kiln no. 1

No. 301/015/101

310 is again the cost centre

015 is an elevator

101 this number has now changed. Instead of 001 in the first example, the 1 has been transferred to the first digit and signifies that this is the first elevator to Kiln No. 1.

This convention is used to describe the difference between a main unit (001) or the accessory to that main unit (101).

When the number is appearing on any document, anybody

in the organisation can make out where it is located, what type of unit it is and what relation it has to the main unit provided the cost centre and machine definitions lists are at hand. These numbers are used at all factories within the group and greatly facilitate to centralised accounting procedures and Electronic Data Processing.

Unit numbers are mainly used on the following documents -

(1) Stores requisitions

(2) Works orders

(3) Breakdown reports

(4) Preventive maintenance schedules

(5) Maintenance check sheets

(6) Machine history cards

(7) Control charts

D. Monthly Cost Reports

1. Quarry - Monthly Operating Report -

An example of this report is shown in Annexure A9. Limestone and clay are quarried separately and tons quarried are recorded in tons. All the limestone is going through the primary crusher and the clay straight to the stockpile. The limestone is screened and a certain percentage processed through the cobra mill to produce agstone (agricultural limestone). The bulk of the material after screening is transferred to the limestone stockpile and the very fine material is transferred to the agstone stockpile. From the respective stockpiles,

the limestone is distributed to another factory by rail and to the raw mills of Factory A. The agstone from the two sources viz., cobra mill and screen, is despatched to customers.

This report reflects tonnages only.

2. Quarry - Quarry Costs Report (See A10) -

This report reflects the costs of each cost centre in the actual quarry up to the point where the material reaches the secondary crusher. Included here are the cost of prospecting and general costs for the quarry viz., road making, drainage, sanitation and other costs which cannot be allocated to any specific cost centre.

The excavators, bulldozers and other transport (trucks) are also partly used for transporting of factory materials (boiler ash, iron ore, clinker and clinker outloading) and the costs are split between quarry and factory on an actual tonnage basis. The quarry is credited with the factory costs as calculated (Transfers).

The costs are split between fixed and variable as indicated, and also between operating and maintenance (O & M), where applicable.

The total variable costs are split between limestone and clay, on the basis of tonnages mined.

The actual results for the month (tonnages and costs) are compared with the budget figures. A denotes "actual" and B denotes "budget". The variable costs are converted to cents

per ton and compared with the cents per ton as per budget.

3. Quarry Process Costs Report (See A11) -

The costs from the Quarry Costs report (See A9) are transferred to this report. The variable costs are split on a tonnage basis to clay, agstone and limestone and the costs of secondary crushing, screening and stockpiling are added under the respective headings. Loading costs and overheads are also separately recorded.

The respective stock accounts, viz., limestone, clay and agstone are debited with the variable costs of each product, as calculated on this report. The total loading costs which are incurred for sending limestone to Roodepoort and for sending the cement to customers are debited to Roodepoort factory and Head Office respectively.

The fixed costs are debited in total to quarry production cost account and transferred to Head Office at the end of the financial year.

4. Quarry Stock Accounts (See A12) -

The monthly entries in the stock accounts, viz., limestone, agstone and clay are summarised on this report. Both tonnages and values are recorded.

The closing stock values are calculated on the progressive monthly average costs of the opening stock and production costs.

5. Factory Production Report (See A13) -

Actual production results are recorded under the following cost centres, Raw Milling, Clinker Manufacture, Cement Milling and Packing Despatch. Only tonnages produced are shown on this report and these are compared with the monthly budget, actual year to date results are compared with budget year to date and also with actual last year to date results.

> Under the Cement Milling Cost Centre (A13/2) three types of cement are shown, viz., Ordinary, Kwikhard and P.B.F.C. (Portland Blast Furnace Cement). Factory A produces Ordinary Cement only. Kwikhard Cement, which is the popular name given to Rapid-Hardening Portland Cement, is produced by grinding the clinker to a fineness of 3,800 and 4,500 sq. cm. per gm. while normal portland cement is ground to 2,800 to 3,300 sq. cm. per gm. As mentioned in Chapter II, Kwikhard Cement differs from normal cement only in its rate of strength development at early stages. Portland Blast Furnace Cement is manufactured by the intergrinding of portland cement clinker with a proportion of selected granulated blast furnace slag. The principal difference between P.B.F.C. and normal cement lies in the slower rate of strength development of the former. P.B.F.C. is particularly suitable for mass concrete construction, as its rate of heat generation is somewhat lower than that of normal cement.

This report shows the electricity consumption per cost centre and the costs are split between fixed and variable elements.

The last section is used for recording the main machinery performance data, reflecting the percentage running times and

output in tons per hour. These are compared with the standards as calculated on the budget.

6. Factory Production Cost Report (See A14) -

Firstly, the variable costs are recorded per cost centre. The tons used and produced are also shown and costs are expressed in cents per ton and compared with budget, year to date budget and last year to date actual.

The reader will notice that at this stage costs are not yet transferred from the one cost centre to the next. This is done on the final process cost report (See A19).

Secondly the fixed costs are recorded and similarly compared with budget, year to date budget and last year to date actual. The service departments, i.e., material handling, locomotives and railway siding costs are classed as fixed costs and split between these headings. A summary of hours worked per cost centre is shown separately on this report.

7. Factory Maintenance Cost Report (See A15) -

The maintenance costs incurred are recorded in the same way as the production costs (See A14). These are the responsibility of the Resident Engineer.

8. Factory Overheads Report (See A16) -

All overhead costs are classed as fixed costs and recorded per department under respective job number descriptions. A certain percentage of these overheads are deducted and transferred

to the quarry, and are recorded on the Quarry Process Cost Report, under the Overheads cost centre (See A11).

9. Paper Sacks Cost Report (See A17) -

The quantities and costs of the different types of paper sacks used are recorded here, together with the closing stock quantities and values. The total costs are transferred to the Factory Production Costs Report (See A14). (Variable Costs - Packing and Bulk Loading cost centre).

10. Factory Raw Materials and Processed Stock Accounts Report (See A18)

The costs of raw and processed materials are calculated and recorded on this report. In addition opening stocks, quantities received and closing stocks are recorded in quantities and values. Values of raw materials used are transferred to the Factory Production Costs report (See A14). The costs of the processed materials, viz., Raw Meal, Clinker and Cement are calculated in conjunction with the process costs calculation on the Process Costs and total fixed costs report (See A19).

11. Factory Process Costs and Total Fixed Cost Report (See A19) -

The total fixed and variable costs for the factory are transferred to this report. The following reports serve as a basis for this report.

a. Factory Production Report (See A13), for recording tonnages produced for each cost centre and power consumed.

b. Factory Production Costs Report (See A14), for recording fixed and variable production costs.

c. Factory Maintenance Cost Report (See A15), for recording fixed and variable maintenance costs.

d. Factory Overheads Report (See A16), for recording the fixed overhead costs.

e. Factory Raw Materials and Processed Stock Accounts (See A16), for recording raw materials used and calculation of processed materials received for the month.

The fixed costs are recorded per cost centre and totalled in the final column.

The variable costs for raw material acquisition are totalled and transferred to the raw material preparation cost centre. The variable costs for these cost centres constitute the cost of producing the raw meal and the total costs are transferred to the Raw Materials Report (See A18), under Raw Meal received (value). The following step is to calculate the value of the Closing Stock of Raw Meal. This is calculated on the progressive average value of raw meal produced. The next step is to calculate the value of Raw Meal used for the month by adding the opening stock and received values and subtracting the closing stock from this total. The difference between opening stock and closing stock values constitute the stock adjustment, and this is either added or subtracted from the Raw Material preparation costs on A19.

The total variable costs of the Raw Material Preparation cost centre, in other words, the value of Raw Meal used, are now transferred to the Clinker Manufacture cost centre. The cost

of clinker used, cement milled and cement despatched is calculated on the same basis as explained for raw meal used.

The total variable costs are, therefore, reflected in the Packing and Bulk Loading cost centre, in total value and in cents per ton.

The variable costs are added to the quarry and factory fixed costs, clinker sold is deducted and the final figure represents the total cost of sales.

12. Quarry and Factory Variance Report (See A20) -

Actual costs for the month are compared with budget and a variance percentage is calculated as indicated on the reports.

Any significant variance is explained on the Variance report and comments are classified in "Planned" and "Unplanned" categories.

The departmental heads are responsible for the completion of the Variance Reports and final comments are made on the Works Manager's report. All cost reports, variance reports and the manager's report are sent to the Head Office of the company for information and further comment by top management.

Let us now compare Factory A's system with the proposals made in Chapter II.

CHAPTER IV - SUMMARY AND CONCLUSION

A. Introduction

When we compare the costing system as in use at Factory A with the ideal principles of a process cost system as put forward on pages 36, 37 and 38, we note the following differences -

1. On the quarry cost reports actual monthly results are compared with the monthly budget, but year to date results are not compared with year to date budgets. Similarly, actual year to date costs are not compared with the previous year to date results, as done on the factory reports.

It is suggested that these additional controls are being incorporated into the quarry cost reports.

2. Sales income is not reflected on the reports and is not known by the factory management. All sales and despatch instructions are channelled through the Head Office of the company.

It is suggested that factory management should be informed about the monthly sales income for the following reasons -

a. To establish profitability of the plant

b. To make use of break-even techniques and other advantages of marginal costing as mentioned on page 33.

Apart from these differences, it is noted that Factory A uses all the principles of process costing and a highly sophisticated system has been developed. By studying the cost reports, management gets a birds eye view of the efficiency of every department in relation to standards and budgets set.

B. Cost Comparisons

A further management tool employed by Factory A's company is the monthly quarry and factory cost comparisons between the different factories in the group. These comparisons are circulated through the group and form the basis for inter-factory information exchange. Outstanding results in certain departments in one factory, may be the incentive for cost reduction efforts in the same departments at another factory.

C. Conclusion

The sales of the Cement Industry in South Africa have expanded from just over 3 million tons in 1960 to more than 5 million tons in 1969. This increase has taken place principally since 1962 and meeting this phenomenal growth placed a considerable burden on the Industry's financial and technical resources.

During the three years 1966 - 1969 production capacity has been increased by 44% at a cost of approximately R23 million. In spite of this, recent demand has been such that

the Industry is at present operating near to capacity. Although plans for further expansion have been formulated, it requires up to two years to bring major plant extensions into production. One new plant will come into operation early in 1970, to be followed by others in 1971.

South African cement exports are sold in world markets which are very competitive. The Industry's volume of exports has increased substantially over the past ten years, although they are, as yet, small in relation to the domestic market.

For these reasons and also due to the fact that the Industry is under price control, it is absolutely imperative that factory costs are kept to the minimum. This will only be achieved if these costs are presented through the medium of a logical process cost system.

OPSOMMING IN AFRIKAANS

Hierdie skripsie analiseer die koste-problematiek van sementvervaardiging. Die sementnywerheid in Suid-Afrika is onder prysbeheer en die oprigting van sementfabrieke vereis hoë kapitaal. Die bepaling van akkurate vervaardigingskoste is absoluut noodsaaklik ten einde 'n bevredigende opbrengskoers op kapitaal te verkry.

Hoofstuk I

Die verskillende prosesse in sementvervaardiging word bespreek om 'n duidelike beeld te verkry waar die koste ontstaan.

'n Proses-verloopkaart is ingesluit om die beskrywing makliker te volg.

Hoofstuk II

Die beginsels van proseskoste word in hierdie hoofstuk bespreek. Aandag word ook gegee aan grenskoste in 'n proseskostestelsel, standaarde en begrotings. Sekere beginsels word gestel vir 'n proseskostestelsel in 'n sementfabriek.

Hoofstuk III

Die kostestelsel van sementfabriek A word bespreek, insluitende die kalkgroefstelsel. Die verantwoordelikheidsentra word uitgebeeld op 'n organisasiekaart.

Hoofstuk IV

Die kostestelsel van fabriek A word vergelyk met die beginsels soos gestel in Hoofstuk II en sekere aanbevelings word gemaak.

Die gevolgtrekking wat gemaak word is dat 'n logiese proseskostestelsel absoluut noodsaaklik is om 'n duidelike beeld van vervaardigingskoste te verkry.

ENGLISH SUMMARY

This paper analyses the costing system for cement production. The cement industry in South Africa is under price control and the building of cement factories requires huge capital investments. To ensure a satisfactory rate of return on capital invested it is absolutely imperative that production costs are kept to the minimum.

Chapter I

The cement production process is discussed in this chapter to enable the reader to understand where the costs are originated in a cement factory. A process flow sheet is attached.

Chapter II

The principles of process costing are discussed in this chapter. Attention is also given to marginal costs in a process cost system, standards and budgets. Certain principles of a process cost system for a cement factory are suggested.

Chapter III

The costing system of a certain Factory A is discussed, including the limestone quarry system. Responsibility centres are shown on an organisation chart.

Chapter IV

Factory A's costing system is compared with the principles as laid down in Chapter II and certain suggestions are made.

The conclusion reached is that a logical process cost system is absolutely imperative in order to obtain a clear picture of the cement production costs.

DEUTSCHE ZUSAMMENFASSUNG

Dieser Aufsatz analysiert das Kostsystem der Zementproduktion. Die Zement Industrie in Süd-Afrika steht unter Preiskontrolle und der Bau von Zementfabriken benötigt enorme Kapital Anlagen. Um einen genügend schnellen Kapitalumsatz zu sichern, ist es notwendig die Produktions Kosten niedrig zu halten.

Kapitel I

Der Zement Herstellungsprozess wird in diesem Kapitel beschrieben, um dem Leser verständ lich zu machen wo die Kosten ihren Ursprung haben. Ein Materialflusschema ist beigelegt.

Kapitel II

Das Prinzip der Prozesskosten Berechnung wird im diesem Kapitel erleutert. Beachtung wird auch den Grenzkosten in den Standard-und Haushaltskosten des Prozesskostensystems geschenkt. Bestimmte Prinzipien eines Prozesskostensystems einer Zement-fabriek werden vorgeschlagen.

Kapitel III

Das Kostensystem einer bestimmten Zementfabriek A wird erleutert. Dad System der Kalkgrube ist dabei eingeschlossen. Verantwortungs Bereiche sind auf einem Personalplan dagestellt.

Kapitel IV

Das Kostensystem der Fabriek A wird verglichen mit den Prinzipien die in Kapitel II zugrunde gelegt worden sind und bestimmte Vorschläge werden gemacht.

Zum Abschluss kann gesagt werden, dass ein logisches Prozesskostensystem unumgänglich ist, um ein klares Bild der Zement Produktionskosten zu bekommen.

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Cement Factory — Sales during April 1892

1	[illegible]	41 Bags Cement 30/6	62 10 6
[illegible]	v. d. Burg	2 " Roman L. 13/	1 6 –
5	[illegible] Blake	1 " Cement 33/	1 13 –
8	do	1 " do 33/	1 13 –
"	[illegible]	1 " do 27/6	1 7 6
9	do	2 " do 27/6	2 15 –
"	[illegible] Beckett & Co.	1 " do 27/6	1 7 6
"	Hallyburton & Co.	2 " do 30/	3 – –
"	do	2 " R. Lime 13/	1 6 –
11	R. Henwood Son & Co.	1 " Cement 27/6	1 7 6
12	v. d. Burg	2 " Cement 33/	3 6 –
"	do	2 " R. Lime 13/	1 6 –
20	[illegible]	1 " Gr. Lime 30/	1 10 –
27	[illegible] & [illegible]	3 " Cement 30/	4 10 –
"	do	3 " R. Lime 13/	1 19 –
			£ 90 17 –

E. & O. E.

Pretoria, 30th April 1892

pp. [illegible] Lippert

[illegible]

Recapitulation

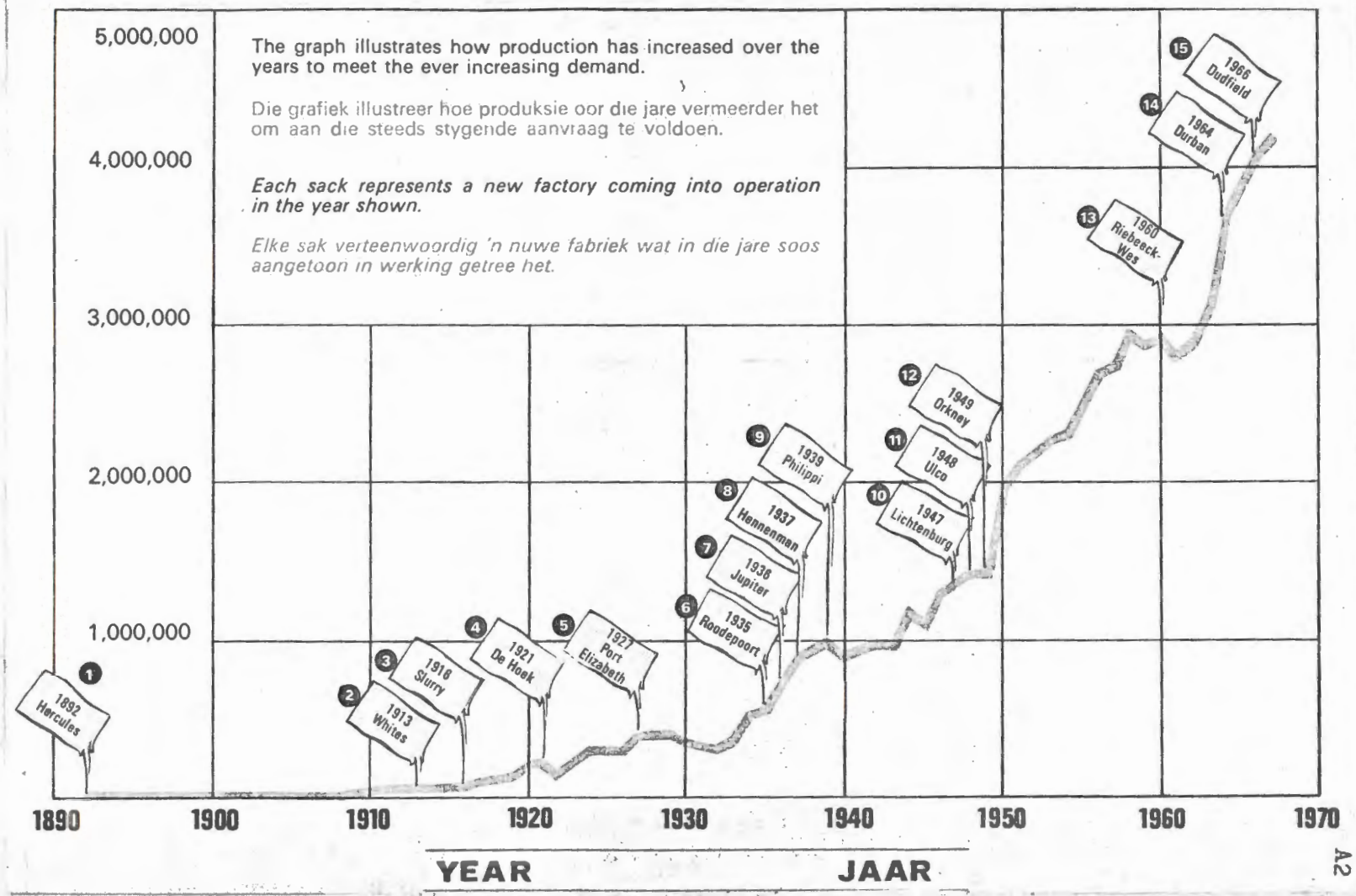
5	Bags Cement	27/6	6 17 6
5	do	30/	7 10 –
41	do	30/6	62 10 6
4	do	33/	6 12 –
9	Roman Lime	13/	5 17 –
1	Ground Limestone	30/	1 10 –
			£ 90 17 –

E. & O. E.

A page from the ledger of De Eerste Cement Fabrieken in 1892, just before its registration as a company.

SOURCE: A.P. Cartwright – A History of Pretoria Portland Cement Company Limited – Johannesburg – 1968 – p.1

ANNUAL PRODUCTION - TONS JAARLIKSE PRODUKSIE - TON



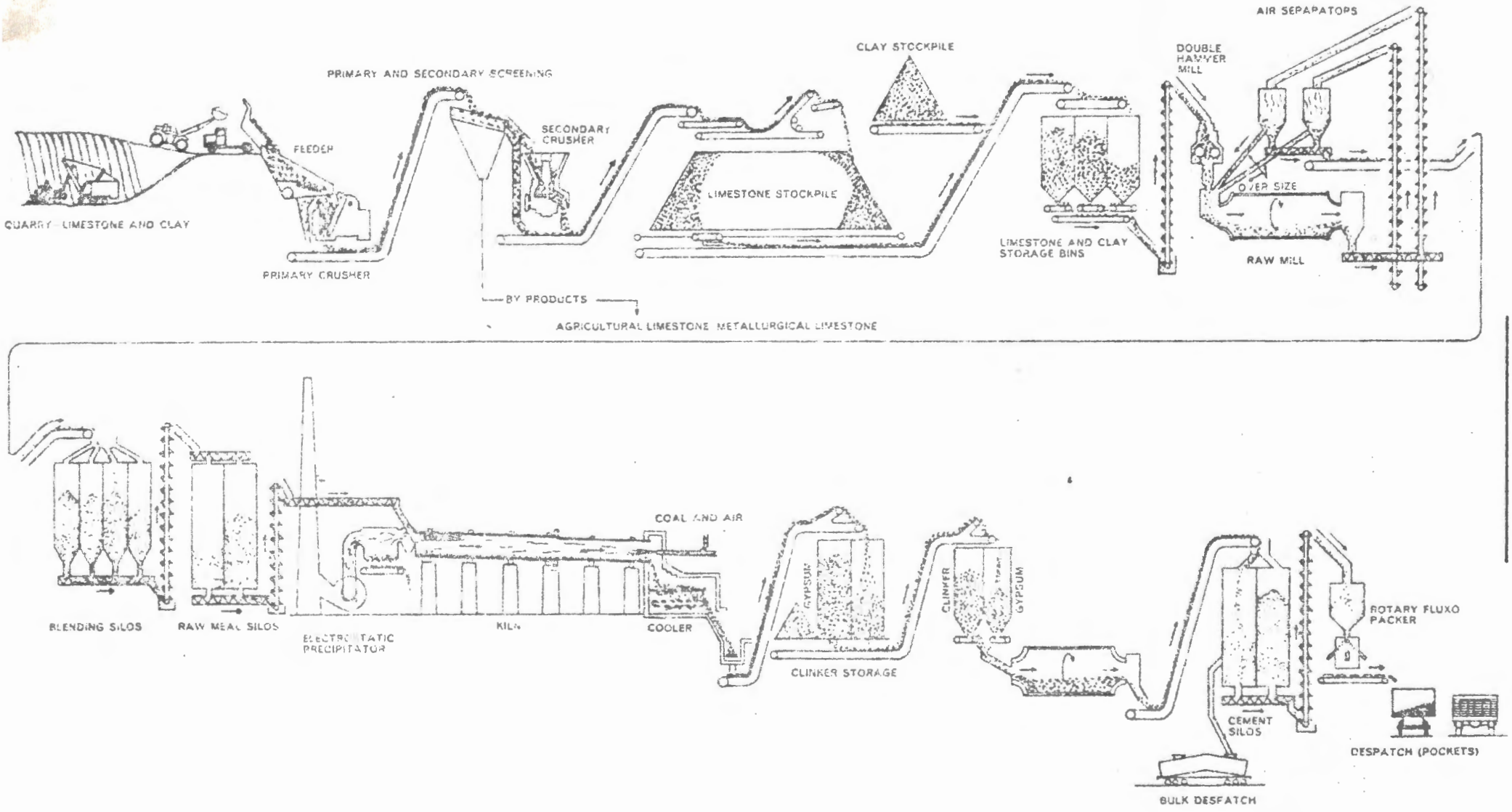
A2

SOURCE - Folder S.A.C.P.A.

CEMENT FACTORIES IN SOUTH AFRICA

1.	1892	P.P.C., Hercules
2.	1913	Whites, Whites
3.	1916	P.P.C., Slurry
4.	1921	Cape Portland, De Hoek
5.	1927	Eastern Province, Port Elizabeth
6.	1935	Anglo-Alpha, Roodepoort
7.	1936	P.P.C., Jupiter
8.	1937	Anglo-Alpha, Hennenman
9.	1939	National, Philippi
10.	1947	Whites, Lichtenburg
11.	1948	Anglo-Alpha, Ulco
12.	1949	P.P.C., Orkney
13.	1960	Cape Portland, Riebeeck-Wes
14.	1964	Durban Cement, Durban
15.	1966	Anglo-Alpha, Dudfield

SOURCE: Folder S.A.C.P.A.



PRODUCTION FLOW SHEET

COST SHEET

THE CEMENT COMPANY

FOR THE MONTH ENDING JAN. 31, 19_

	MATERIAL A	MATERIAL B	RAW GRINDING	CLINKER BURNING	CLINKER GRINDING	MILL OVERHEAD	COAL PREPARING	POWER LIGHT AND WATER	MACHINE SHOP	PACKING AND LOADING	TOTALS
Accrued Payroll	5,000	1,800	8,000	5,600	2,480	872	800	2,800	7,900	950	36,202
Operating Supplies	1,800	400	500	475	325		600	800	100	60	5,060
Repair Parts	1,500	60	780	1,300	790	100	500	700	40	50	5,820
Coal	1,500	900	450				15,000	12,000	150		30,000
Reserve for Depreciation											
of Mill Machinery			1,500	2,000	2,300		200				6,000
of Mill Buildings			200	400	200		33				833
of Quarry Equipment	110	40									150
of Machine Shop Equipment									166		166
of Power & Pumping Plant								1,000			1,000
Accrued Property Taxes	340	110	150	236	275		20	90	15		1,236
Reserve for Depletion											
of Quarry Land A	41										41
of Quarry Land B		11									11
Prepaid Insurance - Fire	50	20	70	10	100		10	90	40		390
Prepaid Insurance - Liability	100	36	80	56	24	8	8	28	80		420
Mill Overhead Cost			300	200	75		30	75	300		980
Machine Shop Cost	1,700	200	1,800	1,800	1,200		488	1,797			8,985
Power, Light and Water Cost	100		5,200	4,800	4,600		4,486		193		19,379
Coal Preparing Cost				22,176							22,176
TOTAL OPERATING COSTS	R12,241	R 3,577	R19,030	R39,053	R12,369	R 980	R22,175	R19,380	R 8,984	R 1,060	R138,849
Production	30,528 tons	18,094 tons	65,000 bbl.	65,000 bbl.	55,000 bbl.		10,000 tons				
Unit cost of operations	.40	.20	.29	.60	.22		.22				

SOURCE: Schlatter and Schlatter op. cit. p.131

CEMENT COMPANY COST SUMMARY

FOR THE MONTH ENDING MARCH 19 __

	ROCK COSTS	SHALE COSTS	RAW GRINDING	CLINKER BURNING	CLINKER GRINDING	POWER LIGHT AND WATER	MACHINE SHOP	PACKING AND LOADING	MILL OVERHEAD	COAL COSTS	TOTAL
Supplies	3,000	450	1,300	1,800	1,200	1,500	150	100	100	1,200	10,8
Payroll for Labour	5,000	2,000	8,700	5,200	2,400	3,000	7,850	900	800	800	36,6
Fuel	1,200	950	400			11,500	200			16,000	30,2
Depreciation:											
Machinery	100	50	1,500	2,500	2,400					180	6,7
Buildings			300	500	200					20	1,0
Taxes	300	100									4
Depletion	50	20									
Insurance	250	80	300	100	200	150	120		50	20	1,2
Total	9,900	3,650	12,500	10,000	6,400	16,150	8,320	1,000	950	18,220	87,1
Machine Shop	2,000	200	2,000	2,000	1,000	720				400	8,3
Power, Light and Water	100		6,000	4,100	4,600	16,870				2,070	16,8
Coal Costs				20,690						20,690	20,6
Total	12,000	3,850	20,500	36,890	12,000			1,000	950		87,1
Production	30,000 tons	19,250 tons	64,050 bbls.	64,050 bbls.	60,000 bbls.						
Unit Cost	0.40	0.20	0.32	0.5759	0.20						
Transfers:											
Rock 22,000 Tons			8,800								
Shale 13,200 Tons			2,640								
Raw Grinding 64,050 Bbls.				31,940							
Clinker Burning 60,000 Bbls.					64,477						
Gypsum Added					4,132						
Mill Overhead to Finished Cement Only					950				950		
Cumulative Cost Grinding			31,940								
Cumulative Cost Burning				68,830							
Cumulative Cost Cement				1.07462	81,560						
					1.3593			81,560			
Packing, Loading								1,000			
Final Cost Ready for Shipment								82,560			

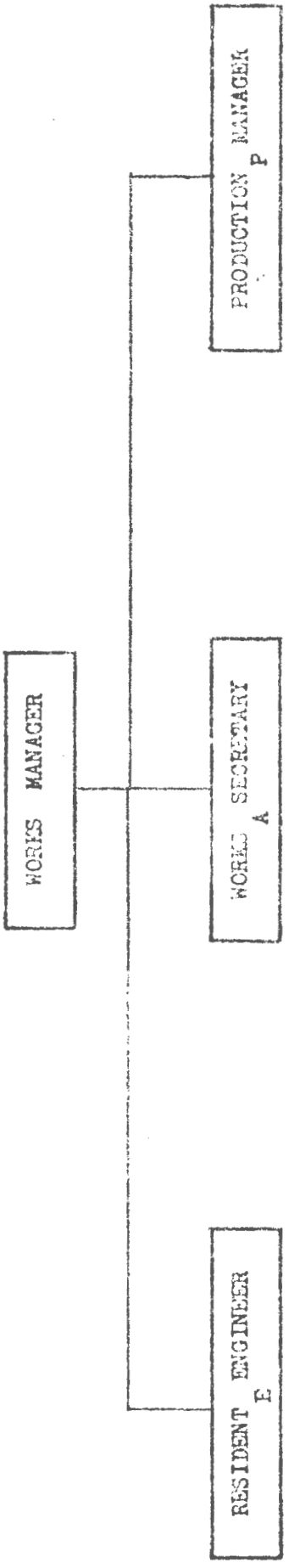
COST OF PRODUCTION REPORT

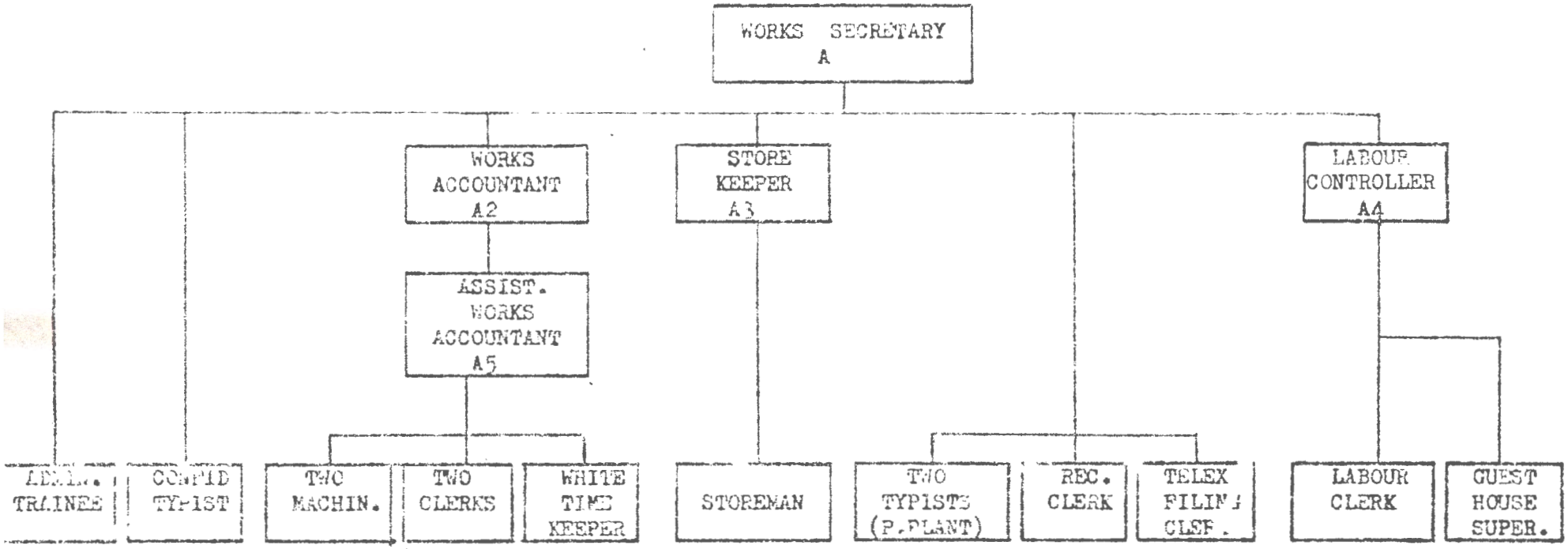
FOR MONTH ENDING MARCH 31, 19 __

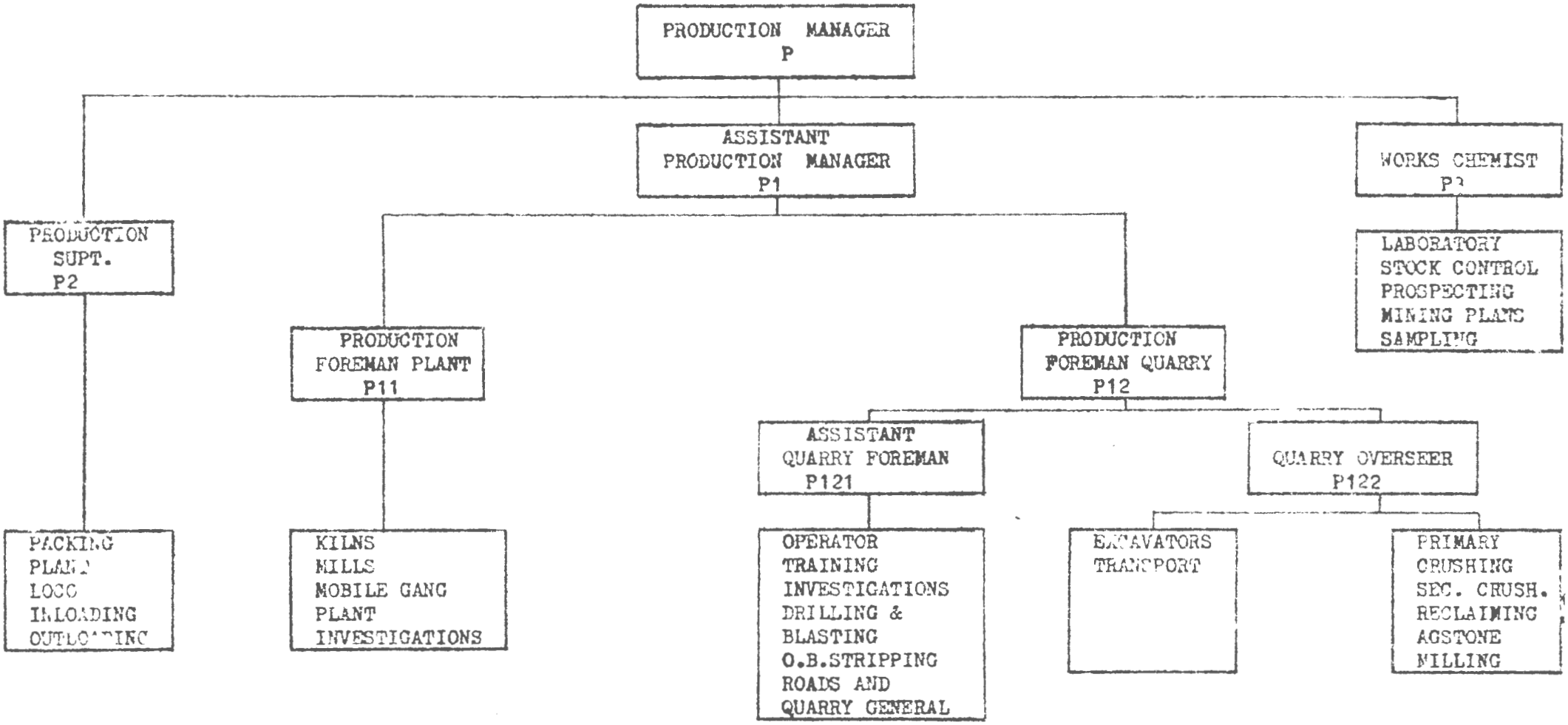
	TONS OR BARRELS	AMOUNT	AVERAGE PE TON OR BARREL
RAW MATERIAL NO. 1 - ROCK			
Production (Tons)	30,000		
Stripping		R 3,000.00	
Production		7,000.00	
Crushing, Receiving & Storing		2,000.00	
Total Cost of Raw Material No. 1		R12,000.00	
Add: Inventory at Beginning of Period		0	
Total		R12,000.00	R0.40
Less: Inventory at End of Period	8,000	3,200.00	
Less: Used in Stone Dust Opers.		0	
Used in Manufacture	22,000	R 8,800.00	R0.40
RAW MATERIAL NO. 2 - SHALE			
Production (Tons)	19,250	R 3,850.00	R0.20
Stripping		1,000.00	
Production		2,350.00	
Crushing, Receiving & Storing		500.00	
Total Cost of Raw Material No. 2		R 3,850.00	
Add: Inventory at Beginning of Period		0	
Total		R 3,850.00	
Less: Inventory at End of Period	6,050	1,210.00	
Used in Manufacture	13,200	R 2,640.00	R0.20
CLINKER			
Production (Barrels)	64,050	R68,830.00	R1.07462
Raw Material No. 1 - Rock		R 8,800.00	
Raw Material No. 2 - Shale		2,640.00	
Grinding, Mixing and Storing		20,500.00	
Burning, Cooling and Storing		36,890.00	
Total Cost of Clinker		R68,830.00	
Add: Inventory at Beginning of Period		0	
Total		R68,830.00	
Less: Inventory at End of Period	4,050	4,352.80	
Used in Manufacture	60,000	R64,477.20	R1.07462
CEMENT			
Production (Barrels)	60,000	R81,560.00	R1.3593
Cost of Clinker		R64,477.20	
Clinker Grinding		12,000.00	
Mill Overhead		4,132.80	
Reserves		950.00	
Total Cost of Cement		R81,560.00	1.3593
Add: Inventory at Beginning of Period		0	
	60,000	R81,560.00	R1.3593
Less: Inventory at End of Period	0	0	
Less: Cement Used	0	0	
Bin Cost of Cement Shipped	60,000	R81,560.00	R1.3593

SOURCE: Neuner op. cit. p.798

ORGANISATION CHART




WORKS SECRETARY
A
WORKS ACCOUNTANT
A2
STORE KEEPER
A3
LABOUR CONTROLLER
A4
ASSIST. WORKS ACCOUNTANT
A5
ADMIN. TRAINEE
COMPTD TYPIST
TWO MACHIN.
TWO CLERKS
WHITE TIME KEEPER
STOREMAN
TWO TYPISTS (P.PLANT)
REC. CLERK
TELEX FILING CLER.
LABOUR CLERK
GUEST HOUSE SUPER.


PRODUCTION MANAGER
P
ASSISTANT
PRODUCTION MANAGER
P1
WORKS CHEMIST
P3
PRODUCTION
SUPT.
P2
PRODUCTION
FOREMAN PLANT
P11
PRODUCTION
FOREMAN QUARRY
P12
LABORATORY
STOCK CONTROL
PROSPECTING
MINING PLANS
SAMPLING
ASSISTANT
QUARRY FOREMAN
P121
QUARRY OVERSEER
P122
PACKING
PLANT
LOCO
LOADING
OUTLOADING
KILNS
MILLS
MOBILE GANG
PLANT
INVESTIGATIONS
OPERATOR
TRAINING
INVESTIGATIONS
DRILLING &
BLASTING
O.B.STRIPPING
ROADS AND
QUARRY GENERAL
EXCAVATORS
TRANSPORT
PRIMARY
CRUSHING
SEC. CRUSH.
RECLAIMING
AGSTONE
MILLING

MONTHLY OPERATING REPORT

FUNCTION	MATERIAL	OPERATING HOURS	TONS PRODUCED	TONS
Quarrying	Limestone			
	Clay			
	TOTAL			
Primary Crushing				
Grading and Screening	Rejects			
	Inter Grade			
	Highgrade			
	TOTAL			
Secondary Crushing and Screening	Agstone			
	Highveld			
	Highgrade			
	TOTAL			
Stockpile	Clay			
	Highveld			
	Highgrade			
	Rejects			
Distribution of Highgrade	Roodepoort			
	Highveld			
	Other Despatches			
	Raw Mills			
	TOTAL			
Cobra Mill Rejects Re-Screen ex Secondary Screen	Agstone			
	Agstone			
	TOTAL			

Lichdruk—5278

PERIOD .....

TRANSFERRED	USED OR SOLD	OPENING STOCK	CLOSING STOCK	TEST	
				TYPE	RESULT

QUARRY COSTS

		(1) DRILLING & BLASTING			(2) EXCAVATORS			(3) BULLDOZERS		
		A	B	%	A	B	%	A	B	%
CLAY MINED										
L/STONE MINED										
TONS PRODUCED TOTAL										
Hours : White										
: Non-White										
FIXED COSTS		Rand			Rand			Rand		
Wages	O									
	M									
Other Charges	O									
	M									
Water										
Power										
TOTAL FIXED COSTS										

VARIABLE COSTS		R	C/T A	C/T B	%	R	C/T A	C/T B	%	R	C/T A	C/T B	%
Power													
Stores	O												
	M												
Explosives													
SUB TOTAL													
Transfers													
TOTAL VARIABLE COSTS													
Product Variable Cost - Clay													
Product Variable Cost - Limestone													

Lichdruk—5279

PERIOD .....

(4) TRANSPORT			(5) PRIMARY CRUSHING			(6) PROSPECTING			(7) GENERAL			(8) QUARRY C/F Q.3		
A	B	%	A	B	%	A	B	%	A	B	%	A	B	%
Rand			Rand			Rand			Rand			Rand		

R	C/T		%	R	C/T		%	R	C/T		%	R	C/T		%	R	C/T		%
	A	B			A	B			A	B			A	B			A	B	

QUARRY PROCESS COSTS

		QUARRY B/Fwd. from Report Q2			LIMESTONE Secondary Crushing Screening & Stockpiling			CLAY Crushing Stockpiling & Reclaiming			AGSTONE Screening	
		A	B	%V	A	B	%V	A	B	%V	A	B
Tons												
Hours : White												
: Nan-White												
FIXED COSTS			Rand			Rand			Rand			Rand
Wages	O M											
Other Charges	O M											
Stores	O M											
Water												
Power												
TOTAL FIXED COSTS												
		A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B
VARIABLE COSTS																
Power																
Stores	O M															
Explosives																
Transfers																
V/Costs SUB-TOTAL																
Transfers : Clay																
Agstone																
Agstone																
Highveld																
Limestone																
TOTAL VARIABLE COSTS																
Transfers																

LIMESTONE STOCK

STOCK CLAY

AGSTONE

Ex Milling

Ex Screening

PERIOD ....

	AGSTONE Milling & Stockpiling			HIGHVELD			LOADING COSTS			OVERHEADS			TOTAL		
%V	A	B	%V	A	B	%V	A	B	%V	A	B	%V	A	B	%
		Rand			Rand			Rand			Rand			Rand	

V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %	A	C/Ton A	C/Ton B	V %

STOCK

Tons	R	C/T

LOADING COST

	TONS	R
H/O		
Roodepoort		
TOTAL		

QUARRY STOCK ACCOUNTS

LIMESTONE

	Tons	R	C/Ton
ɔening Stock			
ɔduced			
ɛrage Variable Cost			
ɛd Dudfield			
ansferred — Roadspeed			
les Other			
ɔsing Stock			

COST OF LIMESTONE TRANSFERRED

ɛrage Variable Cost (above)		
Loading Costs		
Loco Haulage		

AGSTONE

Opening Stock

Produced

Average Variable Cost

Sold

Closing Stock

COST OF SALE — AGSTONE

Average Variable Cost (above)

Loading Costs

Loco Haulage

CLAY

Opening Stock

Produced

Average Cost

Sold to AAC

Closing Stock

chdruk—5281

PERIOD .....

Tons	R	C/Ton

Tons	R	C/Ton

HIGHVELD

	Tons	R	C/Ton
Opening Stock			
Produced			
Average Variable Cost			
Sold			
Closing Stock			

COST OF SALES — HIGHVELD

Average Variable Cost (above)			
Loading Costs			
Loco Haulage			

PRODUCTION REPORT
FACTORY

ks: ..... Month: .....

Month				RAW MILLING	Year to Date			Last Y to Da	
Actual		Budget			Actual			Actual	
%	Tons	%	%V		%	Tons	%V	%	%
				Raw materials used					
				Limestone ex					
				Titration					
				Limestone ex					
				Titration					
				Boiler ash					
				Iron oxide					
				Shale/overburden/clay					
				.....					
				.....					
				Total tons milled					
				Slurry/raw meal used					
				Requirements per ton clinker					
				% H_2O slurry/raw meal					
				R170 %					
				Loss on ignition %					

Month			CLINKER MANUFACTURE	Year to Date			Last Yea to Date	
Actual	Budget	%V		Actual	Budget	%V	Actual	%
			Coal used - Raw mills - tons					
			- Kilns - tons					
			Coal per ton Clinker					
			- Raw mills					
			- Kilns					
			Av Cal Val Kcal/Kg					
			Av Heat Cons Kcal/Kg clinker					
			Clinker produced - tons					
			Kiln 1					
			2					
			3					
			4					
			5					
			TOTAL					
			Dust loss as clinker %					
			Clinker transfers - tons					
			In ex					
			ex					
			Out to					
			.....					
			Clinker sold - tons					
			To					

GR

FACTORY

PRODUCTION REPORT
(CONTINUED)

ks: ..... Month: .....

Month					CEMENT MILLED	Year to Date					Last Year to Date		
Actual		Budget		%V		Actual		Budget		%V	Actual		%V
	Tons	%	Tons			%	Tons	%	Tons		%	Tons	
					Ordinary								
					Clinker								
					Gypsum								
					TOTAL								
					Blaine CM^2/gr								
					Kwikhard								
					Clinker								
					Gypsum								
					TOTAL								
					Blaine CM^2/gr								
					Milling factor								
					P.B.F.C.								
					Clinker								
					Gypsum								
					TOTAL								
					Blaine CM^2/gr								
					Milling factor								
					All Cements								
					Clinker								
					Gypsum								
					Slag								
					TOTAL								
					SLAG LOSS								
					PERCENTAGES MILLED								
					Ordinary								
					Kwikhard								
					P.B.F.C.								
					TOTAL								

./GR

FACTORY

PRODUCTION REPORT
(CONTINUED)

A13/3

ks: ..... Month: .....

EMENT PACKING & DESPATCH - Tons	Month								
	Actual			Budget					
Bagged	Rail	Road	Total	Rail	%V	Road	%V	Total	%V
O.P.C.									
K.W.H.									
P.B.F.C.									
TOTAL BAGGED									
Bulk									
O.P.C.									
K.W.H.									
P.B.F.C.									
TOTAL BULK									
Total Despatch									
O.P.C.									
K.W.H.									
P.B.F.C.									
TOTAL									
Percentages									
Bagged									
Bulk									
Railed									
Road									

	Year to Date									Last Year to Date					
	Actual			Budget						Actual					
Bagged	Rail	Road	Total	Rail	%V	Road	%V	Total	%V	Rail	%V	Road	%V	Total	%
O.P.C.															
K.W.H.															
P.B.F.C.															
TOTAL BAGGED															
Bulk															
O.P.C.															
K.W.H.															
P.B.F.C.															
TOTAL BULK															
Total Desp.															
O.P.C.															
K.W.H.															
P.B.F.C.															
TOTAL															
Percentages															
Bagged															
Bulk															
Railed															
Road															

GSTONE SALES - Tons	Month			Year to Date			Last Yea to Date	
	Actual	Budget	%V	Actual	Budget	%V	Actual	%

R/GR

PRODUCTION REPORT
(CONTINUED)

ks: ..... Month: .....

ELECTRICITY CONSUMPTION

	Consumption KWH	Production (Tons Clinker /Cement)	Cost		Specific Consumption KWH/Ton
			Fixed	Var.	
aw material acquisition					
aw material preparation					
linker manufacture					
Sub total					
ement factor %					
ement milling					
lag drying					
acking					
Sub total					
ervice departments		*			
dministration					
otal to working costs					

*

SPECIFIC CONSUMPTION (KWH/TON) BY PRODUCTS

Department	Average	Ordinary	Kwikhard	P.B.F.C.	
linker					
ement milling					
lag drying					
acking					
ervice Departments					
dministration					
TOTAL					

Maximum load ..... KW Average price ..... c/KWH
Average load ..... KW Variable cost ..... c/KWH
Utilisation ..... %

MAIN MACHINERY PERFORMANCE DATA
% Running Times and Output

	Total		1		2		3		4		5		6	
	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tor
lurry mills (tons/hrs.)														
Standard														
Actual														
ilns (tons/24 hrs.)														
Standard														
Actual														
ement mills (tons/hrs.)														
Standard : Ordinary														
Actual :														
: Ordinary														
: Kwikhard														
: P.B.F.C.														
otal actual milled														
recipitators : Actual														
ackers : Actual														

PRODUCTION MANAGERS COSTS

Works: ..... Month: .....

Month				VARIABLE COSTS	Year to Date			Last Year to Date	
Actual		Budget			Actual			Actual	
R	C/Ton	C/Ton	%V	Raw Material Acquisition Tons used	R	C/Ton	%V	C/Ton	%V
				Raw materials					
				Power					
				Stores					
R	C/Ton	C/Ton	%V	Raw Material Preparation Tons produced	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Grinding media					
				Power					
				Stores					
				Water					
R	C/Ton	C/Ton	%V	Clinker Manufacture Tons produced	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Kiln linings					
				Kiln chains					
				Grinding media					
				Power					
				Stores					
				Coal					
R	C/Ton	C/Ton	%V	Slag Drying Slag used	R	C/Ton	%V	C/Ton	%V
				Power					
				Coal					
R	C/Ton	C/Ton	%V	Cement Milling Cement milled	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Grinding media					
				Power					
				Stores					
				Gypsum					
				Slag					
R	C/Ton	C/Ton	%V	Packing & Bulk Loading Cement sold	R	C/Ton	%V	C/Ton	%V
				Power					
				Stores					
				Paper Sacks (C/Ton bagged)					
Actual(R)		Budget(R)		TOTAL VARIABLE COSTS	Actual(R)		Budget(R)		Actual(R)
				Raw materials(Incl. gypsum					
				Mill linings /slag & coal)					
				Kiln linings					
				Kiln chains					
				Grinding media					
				Power					
				Stores					
				Water					
				Paper sacks					

Works: ..... Month: .....

Month			FIXED COSTS	Year to Date		Last Year to Date	
Actual	Budget	%V	Raw Material Acquisition	Actual	%V	Actual	%
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Raw Material Preparation				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Clinker Manufacture				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Slag Drying				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Cement Milling				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Packing & Bulk Loading				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Service Departments				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Stores				
			TOTAL FIXED COSTS				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Stores				

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PRODUCTION MANAGERS COSTS
(CONTINUED)

ks: ..... Month: .....

Month			FIXED COSTS	Year to Date		Last Year to Date	
ctual	Budget	%V		Actual	%V	Actual	%V
			Hours				
			Raw material acquisition				
			- White				
			- Non-White				
			Raw material preparation				
			- White				
			- Non-White				
			Clinker manufacture				
			- White				
			- Non-White				
			Cement milling				
			- White				
			- Non-White				
			Packing & bulk loading				
			- White				
			- Non-White				
			Service departments				
			- White				
			- Non-White				
			Total				
			- White				
			- Non-White				
			GRAND TOTAL HOURS				

R	R	%V	ANALYSIS OF SERVICE DEPARTMENTS	R	%V	R	%V
			Overhead Cranes				
			Wages - White				
			- Non-White				
			Power				
			Stores				
			Material Handling				
			Wages - White				
			- Non-White				
			Other charges				
			Power				
			Stores				
			Locos & Sidings				
			Wages - White				
			- Non-White				
			Other charges				
			Stores				
			Loco Haulage Inwards				
			Other charges				
			TOTAL SERVICE DEPARTMENTS				

RESIDENT ENGINEERS COSTS

ks: ..... Month: .....

Month				VARIABLE COSTS	Year to Date			Last Year to Date	
Actual		Budget			Actual			Actual	
R	C/Ton	C/Ton	%V	Raw Material Acquisition Tons used	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Stores					
R	C/Ton	C/Ton	%V	Raw Material Preparation Tons produced	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Stores					
R	C/Ton	C/Ton	%V	Clinker Manufacture Tons produced	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Stores					
R	C/Ton	C/Ton	%V	Slag Drying Slag used	R	C/Ton	%V	C/Ton	%V
				Stores					
R	C/Ton	C/Ton	%V	Cement Milling Tons produced	R	C/Ton	%V	C/Ton	%V
				Mill linings					
				Stores					
R	C/Ton	C/Ton	%V	Packing & Bulk Loading Tons sold	R	C/Ton	%V	C/Ton	%V
				Stores					
ctual(R)		Budget(R)		TOTAL VARIABLE COSTS	Actual(R)		Budget(R)	Actual(R)	
				Mill linings					
				Stores					

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RESIDENT ENGINEERS COSTS
(CONTINUED)

Works: ..... Month: .....

Month			FIXED COSTS	Year to Date		Last Year to Date
Actual	Budget	%V		Actual	%V	Actual
			Raw Material Acquisition			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			Raw Material Preparation			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			Clinker Manufacture			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			Cement Milling			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			Packing & Bulk Loading			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			Service Departments			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			
			TOTAL FIXED COSTS			
			Wages - White			
			- Non-White			
			Other charges			
			Lubrication			
			Stores			

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rks: ..... Month: .....

Month				Year to Date		Last Year to Date	
Actual	Budget	%V		Actual	%V	Actual	%V
			Hours				
			Raw material acquisition				
			- White				
			- Non White				
			Raw material preparation				
			- White				
			- Non-White				
			Clinker manufacture				
			- White				
			- Non-White				
			Cement milling				
			- White				
			- Non-White				
			Packing & bulk loading				
			- White				
			- Non-White				
			Service departments				
			- White				
			- Non-White				
			Total				
			- White				
			- Non-White				
			GRAND TOTAL HOURS				

R	R	%V	ANALYSIS OF SERVICE DEPARTMENTS	R	%V	R	%V
			Overhead Cranes				
			Wages - White				
			- Non-White				
			Other charges				
			Stores				
			Material Handling				
			Wages - White				
			- Non-White				
			Other charges				
			Stores				
			Locos				
			Wages - White				
			- Non-White				
			Other charges				
			Stores				
			Sidings				
			Wages - White				
			- Non-White				
			Other charges				
			Stores				

FACTORY OVERHEADS REPORT

RESPONSIBILITY CENTRE	DEPARTMENT	LABOUR (HOURS)			WAGES	
		WHITE	NON-WHITE	TOTAL	WHITE	NON-WHITE
Works Secretary	Administration					
	Stores					
	Compound					
	Labour Control					
	Recreation Club					
	Mess and Single Quarters					
	Guest House					
	Redundant and Obsolete Stores					
	Surplusses and Deficits					
	European Dwellings					
	Property					
	Sanitation					
Planning Officer	Planning					
Production Manager	Laboratory					
	SUB-TOTAL					
	25% Transfer to Quarry					
	Sundry Factory					
	TOTAL OPERATING					
Resident Engineer	Administration					
	Stores					
	Compound					
	European Dwellings					
	Property					
	Laboratory					
	Sundry Factory					
	Workshops					
	SUB-TOTAL					
	25 Transfer to Quarry					
	TOTAL MAINTENANCE					
	GRAND TOTAL					

PERIOD ....

TOTAL	COSTS (R)					BUDGET R	VARIANCE		75%
	OTHER CHARGES	WATER	POWER	SUNDRY MATERIALS	TOTAL		R	%	

PERIOD: _ _ _ _ _ _ _ _ _ _ _

TYPE OF PAPER SACKS DESCRIPTION	PLY	SIZE C/M	WEIGHT EACH (LBS)	STANDARD COST PER PAPER SACK – CENTS			DESPATCHED		EMPTIES TO CUSTOMERS		BROKEN AT WORKS			TOTAL COST OF SACKS USED		STOCK	
				RLGE.	PRICE	TOTAL	POCKETS	R	PKTS.	R	PKTS.	R	DESPATCH	PKTS.	R	PKTS.	R
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ORDINARY:																	
Open																	
Valved																	
Valved																	
Valved																	
Valved																	
KWIKHARD:																	
Valved																	
Valved																	
Valved																	
Valved																	
P.B.F.C.																	
Open																	
Valved																	
Valved																	
Valved																	
Valved																	
Railage Date		R		/ton		TOTALS											

Tariff _ _ _ _ _ _ _ _ _ _ Railage _ _ _ _ _ _ _ _ _ _

Miles _ _ _ _ _ _ _ _ _ _ S.A.R. Siding Charges _ _ _ _ _ _ _ _ _ _

Sending Station _ _ _ _ _

Receiving Station _ _ _ _

Sales of Waste Paper Cr. _____

Variance _____

Actual Cost _____

PAPER SACKS USED ACCOUNT

Works: ..... Month: .....

	Quantity (Tons)						Value (R)									
	Received			Stocks		Consumed	Price (Dry)		Haulage on Cartage		Total Delivered Cost 6+7		Opening Stock	Closing Stock	Cost of Consumption 8+9-10	
	H_2O	Wet	Dry	Opening	Closing		R	C/Ton	R	C/Ton	R	C/Ton	R	R	R	C/Ton
RAW MATERIALS		1	2	3	4	5	6		7		8		9	10	11	
Limestone ex Dudfield																
Limestone ex																
Shale/overburden																
Boiler ash																
Magnetite fines																
Pyrites ash																
TOTAL DEPARTMENT 1																
Coal - Rail																
Coal - Road																
TOTAL DEPARTMENT 3																
Gypsum ex Riverton																
Gypsum ex																
Slag ex Houtkop																
Slag ex Cordelfos																
Slag ex Amcor																
Coal for slag drying																
TOTAL DEPARTMENT 4																
TOTAL RAW MATERIALS																
PROCESSED MATERIALS																
Slurry																
Clinker own																
Clinker ex Dudfield																
Clinker ex																
Cement Ordinary																
Cement Kwikhard																
Cement P.B.F.C.																
Cement ex																
TOTAL PROCESSED MATERIALS																

orks: ..... TOTAL PROCESS COSTS AND TOTAL FIXED COST REPORT Month: .....

Month					RAW MATERIALS	Year to Date			Last Ye to Dat	
Actual			Budget			Actual			Actual	
Usage Ratio	Cost R	Cents /Ton	Usage Ratio	Cents /Ton		Usage Ratio	Cost R	Cents /Ton	Usage Ratio	Ce /T
					Limestone ex					
					Limestone ex					
					Shale/Overburden/Clay					
					Boiler ash					
					Iron oxide					
					Coke ash					
					Raw material mix					
					Slurry/Raw meal used					
					Stock adjustment					
					Requirements per ton clinker					

Month				CLINKER	Year to Date			Last Ye to Dat
Actual		Budget			Actual			Actual
				Tons Produced				
Cost(R)	C/Ton	C/Ton	%V	Cents/Ton Clinker	Cost(R)	C/Ton		C/Ton
				Raw mix materials				
				Coal				
				Power				
				Water				
				Grinding media				
				Kiln linings & chains				
				Mill linings				
				Operating materials				
				Maintenance materials				
				Add imported clinker				
				Clinker used				
				Clinker transfers				
				Clinker sales				
				Stock adjustment				

RR/GR

rks: ..... Month: .....

CEMENT MILLING

Month				ORDINARY PORTLAND	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%V
ost(R)	C/Ton	C/Ton		Tons Produced (Cents/Ton O.P.C.)	Cost(R)	C/Ton		C/Ton	
				Clinker					
				Gypsum					
				Grinding media					
				Mill linings					
				Operating materials					
				Maintenance materials					
				Power					
				Sold					
				Stock adjustment					

Month				KWIKHARD	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%V
ost(R)	C/Ton	C/Ton		Tons Produced (Cents/Ton Kwikhard)	Cost(R)	C/Ton		C/Ton	
				Clinker					
				Gypsum					
				Grinding media					
				Mill linings					
				Operating materials					
				Maintenance materials					
				Power					
				Sold					
				Stock adjustment					

Month				P.B.F.C.	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%V
st(R)	C/Ton	C/Ton		Tons Produced (Cents/Ton P.B.F.C.)	Cost(R)	C/Ton		C/Ton	
				Clinker					
				Gypsum					
				Slag					
				Slag loss					
				Coal for slag drying					
				Grinding media					
				Mill linings					
				Operating materials					
				Maintenance materials					
				Power					
				Sold					
				Stock adjustment					

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rks: ..... Month: .....

PACKING & BULK LOADING

Month				ORDINARY PORTLAND	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%
ost(R)	C/Ton	C/Ton		Tons Sold (Cents/Ton O.P.C.)	Cost(R)	C/Ton		C/Ton	
				Cement					
				Operating materials					
				Maintenance materials					
				Power					
				Cost of sales bulk					
				Paper pockets					
				Variable cost of sales					

Month				KWIKHARD	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%
st(R)	C/Ton	C/Ton		Tons Sold (Cents/Ton K.W.H.)	Cost(R)	C/Ton		C/Ton	
				Cement					
				Operating materials					
				Maintenance materials					
				Power					
				Cost of sales bulk					
				Paper pockets					
				Variable cost of sales					

Month				P.B.F.C.	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%
st(R)	C/Ton	C/Ton		Tons Sold (Cents/Ton P.B.F.C.)	Cost(R)	C/Ton		C/Ton	
				Cement					
				Operating materials					
				Maintenance materials					
				Power					
				Cost of sales bulk					
				Paper pockets					
				Variable cost of sales					

ALL CEMENTS

Month				SUMMARY	Year to Date			Last Year to Date	
Actual		Budget	%V		Actual		%V	Actual	%V
t(R)	C/Ton	C/Ton		Tons Sold All Cements (Cents/Ton All Cements)	Cost(R)	C/Ton		C/Ton	
				Variable cost of sales:					
				O.P.C.					
				K.W.H.					
				P.B.F.C.					

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FIXED COSTS

ks: ..... Month: .....

FIXED COSTS

Month Actual	Month Budget	Month %V		Year to Date Actual	Year to Date Budget	Year to Date %V	Last Year to Date Actual	Last Year to Date %V
			Wages - Operating					
			- Maintenance					
			- Administration					
			TOTAL WAGES					
			Power					
			Water					
			Lubricants					
			Stores - Operating					
			- Maintenance					
			- Administration					
			Other charges					
			- Operating					
			- Maintenance					
			Total factory fixed costs					
			Add quarry fixed costs					
			TOTAL FIXED COSTS					

TOTAL COST OF SALES

			Variable costs - Naked					
			Paper pockets					
			Total variable costs					
			Fixed costs					
			Total cost of cement sales					
			Add V/C of clinker sold					
			Add V/C of clinker transferred					
			TOTAL PRODUCTION COST					

LABOUR COMPLEMENT

			Whites - Operating					
			- Maintenance					
			- Administration					
			- Quarry					
			TOTAL WHITES					
			Non-Whites - Operating					
			- Maintenance					
			- Administration					
			- Quarry					
			TOTAL NON-WHITES					
			TOTAL EMPLOYEES					

MAN HOURS PER TON CEMENT

			Man/hours - Operating					
			- Maintenance					
			- Administration					
			TOTAL FACTORY MAN/HOURS					
			Per ton cement					
			Man hours - Quarry					
			Per ton cement					
			Percentage O/T hrs to total hrs					

MONTHLY COST COMMENTS FOR : ..... 19... .

JOB NO.	COST CENTRE	PRODUCTION VARIANCE TONS +	PRODUCTION VARIANCE TONS -	COST VARIANCE R/c +	COST VARIANCE R/c -	REASONS FOR DEVIATION FROM BUDGET PLANNED	REASONS FOR DEVIATION FROM BUDGET UNPLANNED.

QUARRY & FACTORY VARIANCE REPORT

ACC