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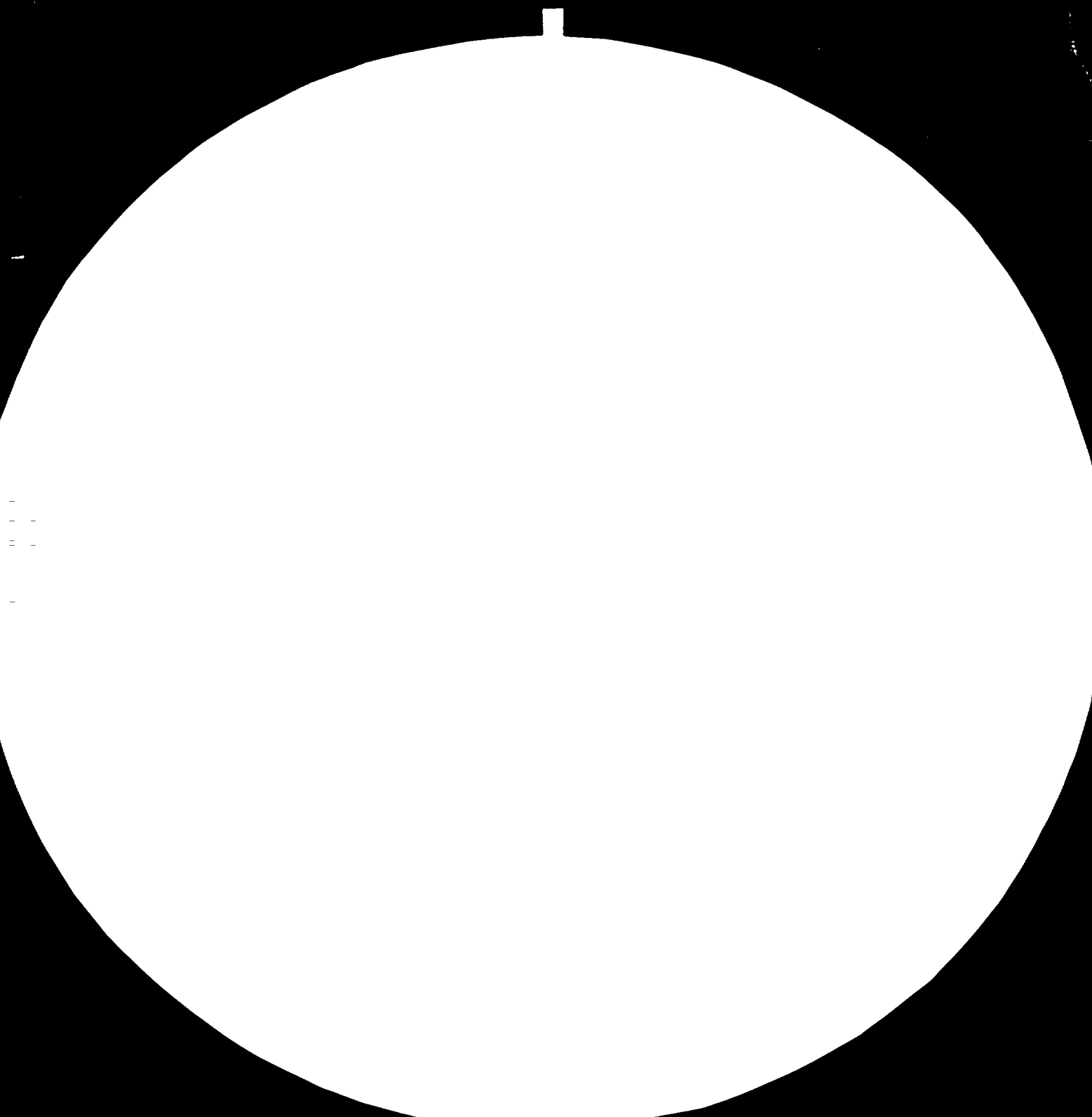

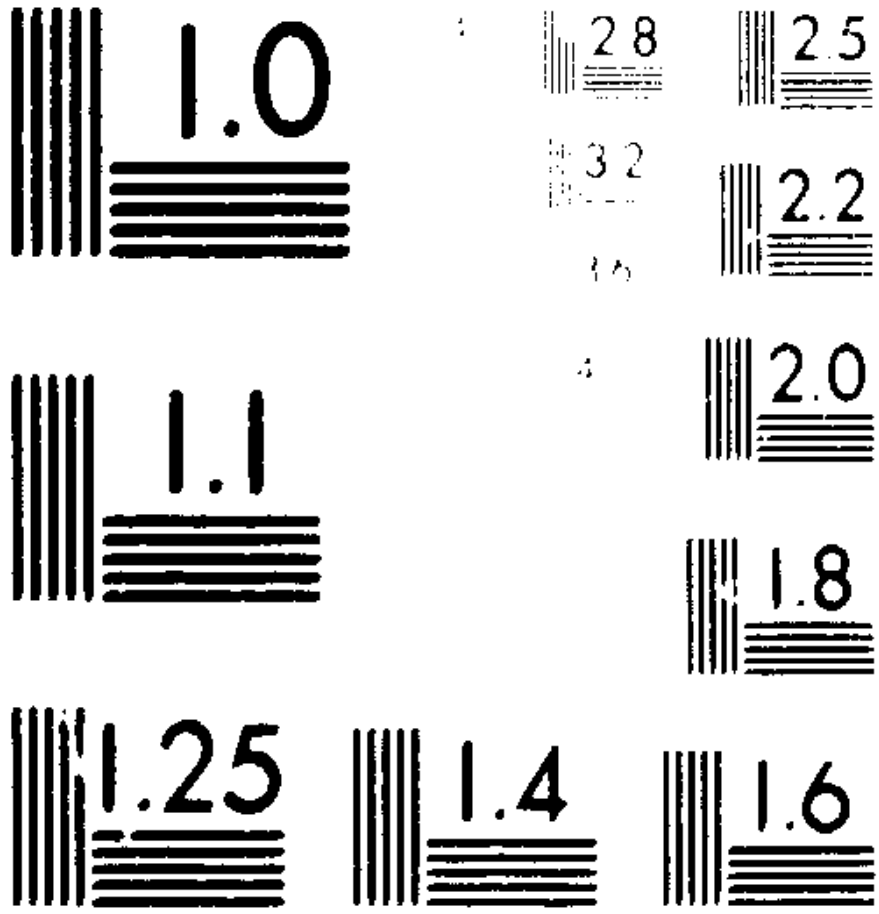
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DP/ID/SER.B/248
20 February 1980
English

RESTRICTED

IMPROVING AND EXPANDING THE OPERATIONS OF THE HIMAL CEMENT PLANT

SI/NEP/77/803

NEPAL

Terminal report

Prepared for the Government of Nepal
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Harald C. Boeck, independent cement consultant

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United Nations Industrial Development Organization
Vienna

80-31969

Explanatory notes

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

References to "tons" are to metric tons unless otherwise specified.

References to dollars ($) are to United States dollars, unless otherwise stated.

The monetary unit in Nepal is the Nepal rupee (NRs). During the period covered by the report, the value of the Nepal rupee in relation to the United States dollar was $US 1 = 12 NRs.

The abbreviation DIN refers to Deutsche Industrienorm.

ABSTRACT

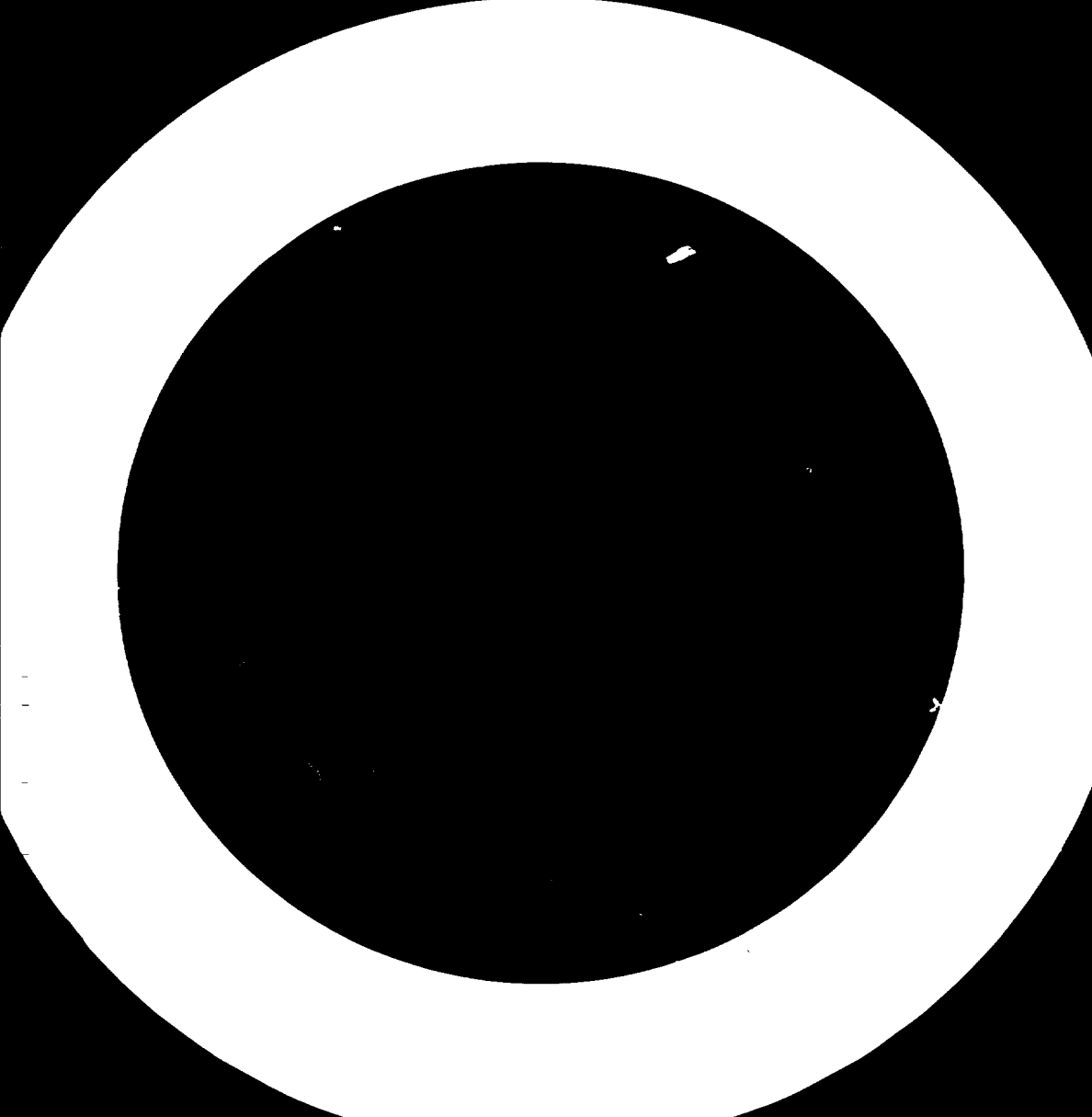
The project entitled "Improving and expanding the operations of the Himal Cement Plant" (SI/NEP/77/803) arose from a request made by the Government of Nepal in 1977 for United Nations Development Programme (UNDP) assistance. The request was approved in April 1979 for a duration of two months, subsequently extended to three months, with the United Nations Industrial Development Organization (UNIDO) serving as executing agency and the Ministry of Industry and Commerce as the government co-operating agency.

The main conclusions of the report include:

1. The two main reasons for the low productivity of the plant (about 60 per cent of capacity) are the poor nodulizing quality of the black meal and air leakages in the triple-gate discharge sluice of the kiln.

2. Further prospecting is required to insure a supply of clay which would improve the nodulizing property of the black meal.

3. While expanding the plant to nearly double present capacity could be justified on the basis of marketing considerations, no expansion can be planned until adequate supplies of raw materials have been proved.



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INTRODUCTION

Increasing demand for cement in Nepal necessitates improving and, if possible, expanding present production facilities. In 1977 the Government of Nepal asked UNDP to study the operations of the Himal Cement Company (Pvt) Ltd (HCC), Kathmandu, to recommend ways to improve current operations and to explore the possibility of expanding future operations. The Government request was finally approved in April 1979 for a duration of two months with UNIDO serving as executing agency and the Ministry of Industry and Commerce as the government co-operating agency. The mission, originally planned for two months but extended to three months, began in October 1979. The budget provided for a UNDP/UNIDO contribution of $22,500. The project received assistance solely from UNDP/UNIDO.

The HCC plant was set up at Chobhar, about 8 km south of Kathmandu, in 1975. The project is based on local limestone and clay deposits. Coke and gypsum are imported. The kiln is a vertical shaft type and the rated capacity is 160 tons of cement per 24 hours or 50,000 tons per year.

The plant has had a history of production interruptions. These have been caused principally by mechanical problems and by the quality of the clay in relation to the production process employed. Various components of the plant in the total production cycle are reported to be imbalanced. Maintenance manuals are incomplete or unavailable and workshop facilities are inadequate.

The plant was sited before a thorough geological survey of the area was made and, in spite of careful quarrying, some raw materials problems remain. The chemical properties of the clay are reported to be acceptable but its physical specifications are not suited to the production process employed. Clay from other deposits has been used with varying success. Most recently, samples from a new deposit have been used successfully but it is not certain whether the entire deposit will prove equally appropriate.

Another problem has been above normal air leakages (dust) throughout the production process, resulting in considerable loss of output.

The expert had the following specific duties:

(a) To inspect all installations in the plant;

(b) To report deficiencies in plant and operations;

(c) To recommend action to correct reported deficiencies;

(d) To study the possibility of expanding the production capacity of the plant; and

(e) If feasible, to recommend appropriate action to expand the production of capacity of the plant.

The following documents were prepared in the course of the project: a project proposal (1977) and a draft terminal report (1980). These reports are on file at UNIDO headquarters and at the UNDP office in Kathmandu.

I. FINDINGS

A. Raw materials

Limestone

The limestone quarry is situated 500 to 1,000 m from the plant; its estimated reserve is about 11 million tons. The quarry is complex, with heavy overburden in some places and with upper and lower limestone strata separated by a stratum of shale. The overburden, upper limestone, shale and lower limestone strata are approximately 10 m, 35 m, 20 m and 35 m thick respectively. The lower limestone is of the best quality.

Clay

Clay plays an important role in the vertical shaft kiln pyroprocess used in the plant because the nodules produced from the black meal of ground limestone, clay and coke breeze must be strong enough to resist certain physical and thermal loads.

The clay must suit the other components of the raw mix both chemically and physically. The physical properties of the clay from the quarry at HCC create problems. Because the ash content of the fuel is high and because the ash is part of the silicious component of the raw mix, it is difficult to add sufficient clay to assure nodules of the required strength.

In a report dated 16 September 1969 the Holderbank Technical Center, Switzerland, warned that the semidry process should be applied with great care because the raw materials tested were found to be moderate to poor for nodulizing.

HCC is searching for better clay and hopes that it can be found in the vicinity of the plant.

Gypsum and fuel

Coke breeze, to fuel the kiln, and gypsum are imported from India. The coke breeze presents a severe problem: ash content is increasing and now amounts to more than 30 per cent. This worsens the nodulizing problem since residual matter should not exceed 12 per cent. However, low-residue coal may be available in the near future.

B. Technology and production

Quarrying equipment

Because the kiln operates at only about 60 per cent of capacity, the demand for raw materials is low and the quarry can meet it without difficulty by daily production of about 160 tons.

Blasting

Blasting takes place once a day. Gelatin, a detonating cord, a plain detonator and a fuse cord are used. No electric blasting machine is used. Horizontal blast holes about 2.5 m deep with a diameter of 63.5 mm and declined 15°-30° are used. About ten holes are drilled each day. Drilling time is about 25 minutes per hole and production is 150 to 160 tons of limestone per day. About 90.9 g of gelatin are consumed per ton of limestone. Drillheads are changed every three months. A machine for regrinding the drillheads is not available.

Crushing department

Limestone crusher. The rated capacity of the single-shaft multi-impact hammer crusher is 50 to 80 tons per hour with an installed motor of 75 kW.

The 1,000 mm x 6,615 mm apron feeder of the crusher does not even appear to be strong enough to take the impact of 400 mm x 400 mm stones.

Clay crusher. The clay crusher is located next to raw materials and clinker storage. It is a two-roll crusher with a capacity of 30 to 80 m^3 per hour and is powered by a 30 kW motor.

Clinker crusher. Clinker production passes through a jaw crusher with a capacity of 10 to 15 tons per hour.

However, because access to the reciprocating plate conveyor which feeds the crusher is difficult, minor blockages cause frequent interruptions in production.

Gypsum crusher. Gypsum is crushed in a multi-impact hammer crusher which has a capacity of 15 to 35 tons per hour and is powered with a 30 kW motor.

Transport and storage of limestone and clay

The crushed limestone is stored in a buffer stockpile of about 4,600 m^3 or about 6,500 tons. From the buffer stockpile, where no prehomogenizing takes place, the limestone is transported by a 350 m long rubber belt to the roofed storage area and from there to the feed hopper for the raw mill by a travelling grab crane. The crane has a 6 t grab capacity and a 16 m span.

Raw mill department

Feeders. Rotary table feeders are used for limestone and clay; for coke breeze an electronic weigh feeder is used. The table feeder for clay causes serious problems because it is not appropriate for handling sticky clay.

Raw mill. The raw mill, a roller mill, is fed with particles of limestone, clay and coke breeze about 40 mm in size and with a maximum moisture content of 8.5 per cent. It has a rated capacity of 16 tons per hour of black meal, 8 to 10 per cent residue, DIN 0.09.

The raw mill is actually producing about 14 tons per hour of black meal, 5 to 6 per cent residue, DIN 0.09. This is surprisingly high because the mill is much worn and reconditioning is urgently needed. Replacement parts have been ordered and are expected to arrive in April or May 1980.

The hot air fan seems to be inadequate to deal with excessive moisture content in the raw mix or pressure drop across the system.

Cyclones and filter. Pressure drop across the filter alone has been measured to 188 mm alcohol = 150 mm water. Normal pressure drop would be 80-120 mm water.

However, the pressure drop across the raw mill is high.

Hot-gas generator. To produce 14 tons of black meal per hour with initial moisture content of 8.5 per cent and final moisture content of 1 per cent about 1,150 kg per hour of water must be evaporated requiring about 170 litres of diesel fuel per hour.

Homogenizing silos

The batch homogenizing system consists of two homogenizing silos, each of 100 tons capacity, located above a store silo of 600 tons capacity. Batch homogenizing is used where considerable fluctuation occurs in the composition of the raw mix.

The homogenizing system at HCC has created serious problems because of considerable fluctuation in the composition of the raw mix and a low degree of flexibility. Once an inappropriate raw mix has entered the system the process cannot be reversed and a day's kiln production can easily be spoiled.

The blowers for active and inactive air constitute another serious problem. The air intake filters of the blowers are very small and must be cleaned often.

When the filters are not cleaned, dust passes through the blowers and accumulates on the intake side of the fabrics or ceramics in the silo bottom. Hence there is no homogenizing effect because the air cannot pass through. This is the main cause of low productivity in the plant, not the operation of kiln.

Kiln department

The kiln is a vertical shaft kiln with diameters of 2.8 m and 2.6 m, 8 m high, and with a rated capacity of 160 tons per day. It suffers from low productivity because of limestone, clay and fuel with moderate to poor nodulizing properties. In addition, mechanical problems make it impossible to run the kiln more than, say, 20 to 22 hours per day. However, the kiln once produced 195 tons in one day and has on several occasions surpassed its rated capacity of 160 tons per day when suitable clay was available.

Cement mill department

Cement mill. The cement mill is a two-compartment closed-circuit mill with a diameter of 2.4 m and 7.56 m long with a rated capacity of 16 tons per hour, about 3,300 cm^2/g Blaine.

The mill actually works with only a 60 per cent ball charge because the shell of the first compartment is weak due to a repaired crack. The plate is only 16 mm thick. This is very thin for a mill with a diameter of 2.4 m.

Separator. The controllable distributor air separator is powered by 22 kW, 11 kW and 3 kW motors.

The cement produced at HCC is of high quality: three-day strength exceeds 220 kilopond per cm^2.

Storage of cement

There are two storage silos for cement, each with a diameter of 10 m and 15 m high, each having a capacity of 2,000 tons.

Packing plant

The packing plant is equipped with a valve bag packing machine with a rated capacity of 500 bags per hour. Working in two shifts the capacity is 6,000 bags per 16 hours.

Laboratory and workshop facilities

There is no laboratory at HCC. Clay samples are sent to India for analysis and about three months elapse before results become available.

Workshop facilities at HCC are inadequate. Spare parts ordered from Europe require 12 to 18 months for delivery by surface transportation or about 3 months for delivery by air freight.

II. CONCLUSIONS AND RECOMMENDATIONS

A. General

If raw materials are available, the production capacity of HCC should be expanded from about 50,000 to 120,000 tons per year of clinker. Without this degree of expansion the high investment costs could not be repaid within a reasonable length of time. However, to justify such expansion it would be necessary to demonstrate a 40-years' proved reserve of 6,500,000 tons of limestone (5 per cent moisture) and 2,000,000 tons of clay (30 per cent moisture). It would also be necessary to assure an annual supply of 6,000 tons of gypsum.

B. Raw materials

Limestone

If the plant is expanded, it will be necessary to study how to develop an appropriate quarry face and how to run the quarry efficiently, aiming at a daily production of about 600 tons. For a proven reserve of 6,500,000 tons of limestone with a moisture content of 5 per cent, which is needed for 40 years production of 120,000 tons per year of clinker, about 600 metres of limestone core with a recovery of at least 90 per cent will be needed. Core drillings should be initiated as soon as possible. Estimated time required for core drillings would be three to six months.

Clay

A new clay quarry has been opened at Panchkhat, about 50 km from the plant, and hopefully this clay in combination with a more appropriate fuel will meet the present and future requirements of the plant. Clay problems contribute to current daily losses amounting to NRs 90,000.

HCC should be able to analyse clay in a laboratory of its own and investment in appropriate laboratory equipment would soon pay for itself.

To prove a reserve of 2,000,000 tons of clay about 120 to 180 metres of auger drilling will be required.

Fuel

Because of the nodulizing problem coke breeze should be replaced by a fuel with high heating value and low ash content such as anthracite coal or petroleum coke.

Plant expansion would require an ensured fuel supply of 24,000 tons per year of coke breeze, or 17,000 tons per year of anthracite coal, or 15,000 tons per year of petroleum coke.

C. Technology and production

Quarrying equipment

If the plant is expanded, all quarrying equipment will have to be replaced by new and more appropriate equipment. Total cost of new quarrying equipment would amount to about NRs 12 million. Turnkey supply by a general contractor should be avoided, if possible, as it does not contribute to the development and satisfaction of local technical staff who have by now gained appreciable experience. If appropriate suppliers can be found, expansion could be planned in three or four successive stages, each stage comprising the introduction of both imported and locally produced components.

Blasting

The blasting system should be carefully studied, including possible use of large diameter blast holes, possible use of ammonium nitrate explosives, possible use of sequence blasting employing millisecond intervals.

Crushing department

Limestone crusher. The present apron feeder should be reinforced by supporting the upper part of the laminated steel belt with heavy rails. The speed of the belt should be reduced to about .025 m per second.

If the plant is expanded, the existing limestone crushing department should be replaced by a new one corresponding to the type and size of equipment available for transporting limestone.

The hopper for receiving limestone should have a capacity of about three times the capacity of a single truck load. The capacity of the existing hopper is about 25 to 30 tons, which is too small for an expanded plant.

Clay crusher. Since sticky clay clogs the existing clay crushing plant and reduces its efficiency, the clay should first be processed in a clay dryer. If the plant is expanded, this problem can be solved without a clay dryer by appropriate prehomogenizing.

Clinker crusher. If the plant is expanded, this system should be redesigned to eliminate reciprocating equipment.

Gypsum crusher. The present gypsum crusher would also be adequate for an expanded plant.

Transport and storage of limestone and clay

A travelling grab crane is undesirable because of high maintenance costs and unacceptable working conditions for the operator. If the plant is expanded, appropriate alternatives should be considered.

Raw materials homogenization should take place before raw milling. If the productivity of HCC operations is to be improved, this practice must be introduced.

Limestone and clay should be crushed simultaneously in separate crushers and the clay should be dressed on top of the crushed limestone to facilitate maintaining the $CaCO_3$ content 1 to 2 per cent below the value set for the finished raw mix.

Thereafter the raw mix should be stored in a prehomogenizing plant, preferably of circular design, consisting of a stacker and a reclaimer. The minimum reclaimable store capacity should be 7 days estimated consumption for an expanded plant or about 5,000 tons inclusive of 8.5 per cent moisture. Reclaimable store capacity is about 66 per cent of total store capacity as 34 per cent of the space is used to set up a new stockpile.

The estimated price and weight of a circular prehomogenizing plant with reclaimable store capacity of about 6,400 tons would be:

Price f.o.b. European port		$1,200,000
Mechanical equipment	100 t	
Electrical equipment	6 t	
Rails	11 t	
Roofed storage area	300 t	
Total weight	417 t	

A prehomogenizing plant is indispensable regardless of whether the pyroprocessing equipment consists of a shaft kiln or a rotary kiln.

A sample station should be set up to check the raw mix before prehomogenizing.

Between the prehomogenizing plant and the raw mill department provision should be made for adding corrective amounts of limestone and fuel.

Even in the case of plant expansion HCC will not require additional storage for raw materials and fuel.

Raw mill department

Feeders. In the present plant little can be done to improve feeding until a clay dryer is installed.

If the plant is expanded, electronic weigh feeders should be used for all raw materials. The clay problem could be solved without a clay dryer by pre-homogenizing.

Raw mill. The present motor should be replaced with a 110 kW motor.

To expand the plant a new mill with a rated capacity of about 30 to 35 tons per hour, 5 to 6 per cent residue, DIN 0.09, feed moisture content maximum 8.5 per cent, is recommended. Such a mill would be able to supply black meal both to the existing kiln and to a new kiln with combined capacities of 400 tons per day of clinker.

Cyclones and filter. One way to improve the existing raw mill department is to keep pressure drop as low as possible. The pressure drop across cyclones and filter is acceptable but cleaning and replacing filter bags may improve productivity by 10 to 15 per cent.

Hot-gas generator. Since diesel fuel is more than four times as expensive as coke breeze, coke breeze should be used to fuel drying operations in an expanded plant (annex I). This would produce a saving of about NRs 450 for each hour that the raw mill is fed with raw materials containing 8.5 per cent moisture. This consumption is equal to 741.06 J/kg of clinker.

Homogenizing silos

The blower problem can only be solved by installing a large filter for the blowers. If the plant is expanded, a continuous homogenizing silo should be installed. In combination with prehomogenizing continuous homogenizing will facilitate production considerably regardless of whether a shaft or rotary kiln pyroprocessing system is employed. In addition continuous homogenizing is a simpler process than batch homogenizing and requires less energy.

Kiln department

These mechanical problems require attention: (a) The hydraulic triple-gate discharge sluice does not function properly; (b) The blower for combustion air appears to be too small; (c) There is not enough space for maintenance at the drive of the reciprocating plate conveyor which transports clinker from the kiln to the jaw crusher; (d) The filter capacity of the dedusting system is

too small; (e) The two-step nodulizer should be changed to a three-step nodulizer.

Necessary parts have been ordered and should arrive in April or May 1980.

Although it has been demonstrated that the existing shaft kiln can perform satisfactorily when suitable clay and properly homogenized raw mix are available, its productivity has been low because suitable clay and properly homogenized raw mix have generally been lacking.

If HCC is expanded, it will be necessary to consider whether a shaft kiln or a rotary kiln would be more appropriate for the expanded plant.

An additional shaft kiln would require less direct investment, less construction work, and would make better use of available local know-how. However, realization of this alternative presupposes a proved reserve of about 2,000,000 tons of suitable clay and improvement of the raw materials handling system. If suitable clay is available, expansion in the form of an additional shaft kiln with a capacity of 200 tons per day is recommended. If suitable clay is not available, then a rotary kiln would be more appropriate. However, four-stage preheater rotary kilns with low energy requirements and capacities below 500 tons per day are rarely available in the market.

If it is necessary to use a rotary kiln, the existing shaft kiln should be shut down and a 400 tons per day, four-stage precalciner rotary kiln with 100 per cent bypass should be used. Fuel consumption would be about 900 cal/kg of clinker inclusive of drying the raw materials to 7 per cent moisture content. Such a rotary kiln would mean a very high investment but it would not be desirable to use two different processes at the same plant. The costs of installing a rotary kiln at HCC would probably be 50 to 60 per cent higher than the cost of installing an additional shaft kiln.

In either case environmental conditions will have to be taken into consideration by fitting the kiln or kilns with an electrostatic precipitator.

The advantages and disadvantages of shaft and rotary kilns are summarized below:

Shaft kilns

Advantages. (a) Investment costs are low; (b) There are few moving parts, i.e. maintenance costs are low; (c) Kiln and cooler are integrated;

(d) High ash-content fuel can be used; (e) Refractory brick consumption is extremely low; (f) Fuel consumption is about 900 to 1,000 kcal/kg of clinker; (g) Dust emission is low, about 1 to 2 per cent of clinker production, even when operating without an electrostatic precipitator; (h) Clinker quality is good; (i) If the black meal process is used, a separate coal mill department is unnecessary.

Disadvantages. (a) Raw materials must be suitable for proper nodulizing; (b) Only low ash-content fuels, such as anthracite coal, petroleum coke and coke, can be used; (c) Liquid or gaseous fuels cannot be used; (d) Kiln output is limited to about 250 tons per day.

Rotary kilns

Advantages. (a) Precalciner kilns can use all kind of fuels, even fuels with a low heating value; (b) Preheater kilns can use all kind of fuels with a calorific value above 6,000 kcal/kg; (c) Kilns with capacities ranging from 200 to 10,000 tons per day are available although kilns with capacities below 500 tons per day are rare; (d) Because rotary kilns are direct fired, extremely high temperatures can be achieved in the burning zone, i.e., very high clinker quality can be produced. Clinker of this quality, however, is not needed in most countries; (e) Fuel consumption is low for four-stage preheater and precalciner kilns; (f) Exit gases can be used to dry raw materials and coal; (g) Start-up time is relatively short, especially for precalciner kilns; (h) Refractory brick consumption is relatively low for rotary kilns with capacities up to 500 tons per day; (i) Because there are many manufacturers, the choice of suppliers is great.

Disadvantages. (a) Rotary kilns with capacities below 500 tons per day are relatively expensive; (b) Construction work is relatively expensive; (c) If an electrostatic precipitator is not used, dust emission is excessive, amounting to about 7 to 10 per cent of clinker production.

The estimated cost of both alternatives is summarized below:

	Additional shaft kiln ($)	Rotary kiln ($)
Installed equipment	7,000,000	11,000,000
Construction work	2,800,000	4,400,000
Interest during construction	2,000,00.	3,000,000
Contingencies	2,200,000	2,600,000
Total	14,000,000	21,000,000

In both cases twenty to twenty-four months would be required to carry out the necessary construction work and install the new equipment.

It should be noted that the cost of installing a new shaft kiln could be repaid within one and a half years if the selling price of cement ($126 per ton) remains unchanged.

Clinker transport and storage

Storage hall. The existing storage hall for clinker, gypsum and fuel will suffice for an expanded plant.

Storage crane. The 6 t travelling grab crane is difficult to maintain and alternative means of transport such as a drag chain or a rubber conveyor-belt should be studied.

Cement mill department

Hoppers and feeders. Electronic weigh feeders or at any rate vibrating feeders for clinker and gypsum should be considered both for the existing mill and for a possible new mill instead of the existing table feeders.

Cement mill. If the plant is expanded, an open-circuit mill with a capacity of 10 to 15 tons per hour should be considered. An open-circuit mill of latest design would be able to produce cement of the required fineness with the same energy consumption as a closed-circuit mill but investment and maintenance costs would be reduced considerably.

Storage of cement

If production is expanded from 50,000 to 120,000 tons per year, cement storage capacity should be increased to accomodate at least 14 days production or about 5,250 tons. This would require the construction of one or, even better, two more silos.

Packing plant

If the plant is expanded, an additional packing machine will be required.

Laboratory

A laboratory should be set up at HCC which could perform these tasks:

(a) Ascertaining the physical characteristics of clay;

(b) Determining the mineral composition of clay and limestone;

(c) X-ray analysis and differential thermal analysis - thermal gravimetric analysis;

(d) Rapid analysis of proportioning and quality control.

In addition equipment will be needed to air-condition the physical testing rooms, humidity cabinets, and autoclave testing apparatus.

Training. Laboratory personnel would benefit from study visits to cement plants with shaft kilns and from training in a research laboratory which investigates the suitability of raw materials for shaft kilns.

Machine workshop

The workshop should be able to make and service processing equipment with a steel plate thickness of at least 20 mm. The existing machine workshop should be expanded to include the following essential equipment:

1 rolling machine for steel plate up to 20 mm
1 guillotine press, 200 t
1 hydraulic press, 100 t
1 oxygen cutting machine
1 cutting machine for steel plate up to 6 mm
1 turning lathe for large diameters and short lengths
1 overhead crane, 5 t
1 compressor, about 170 to 250 litres per second
1 welding machine, DC, 500 A
3 welding machines, DC, 350 A, rotary or rectifier type
1 CO_2 welding machine, semi-automatic
Compressed-air tools including an Atlas Copco surface grinder, type LSS 84, which is indispensable for high quality welding

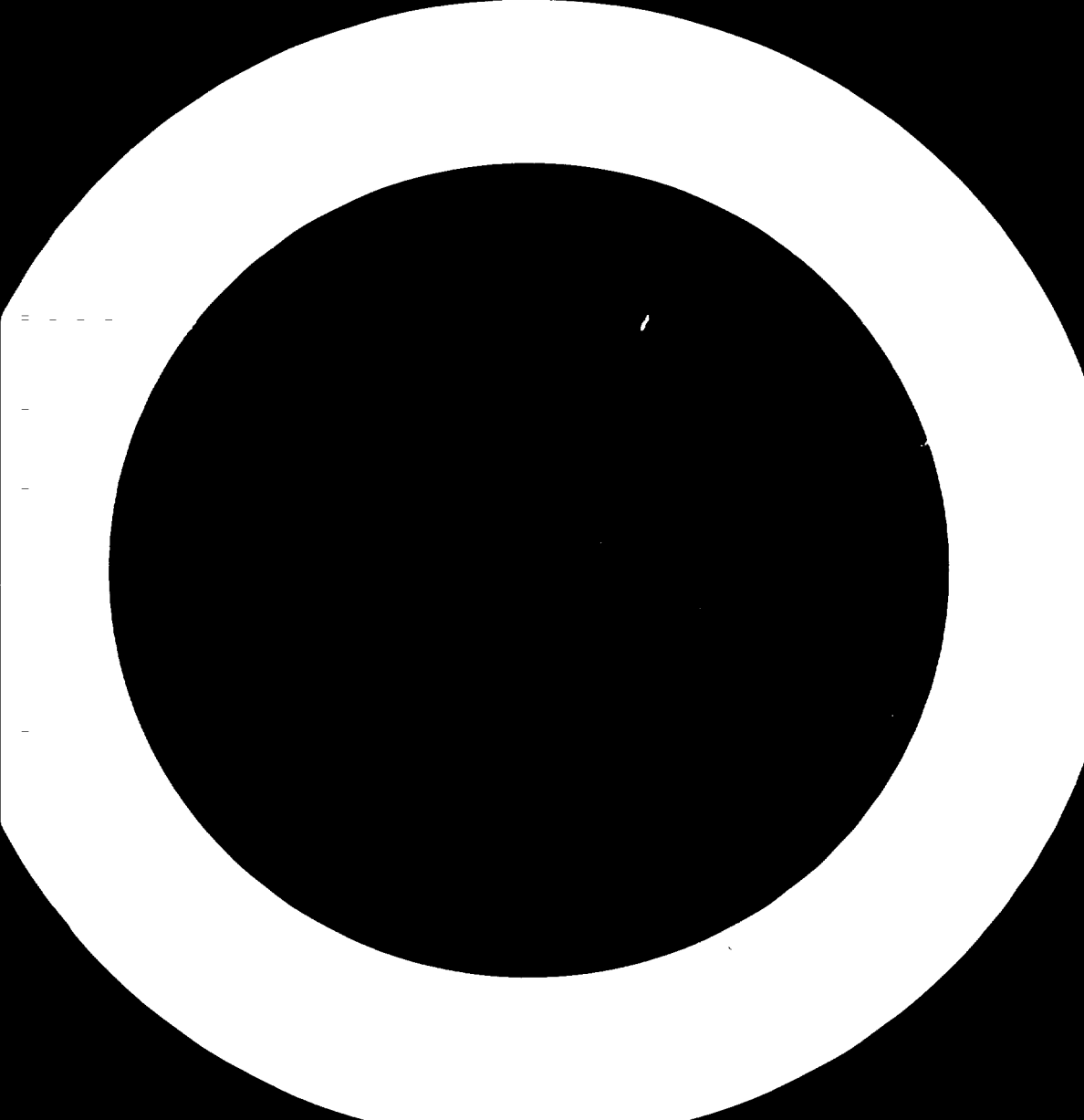
Electrical workshop

The electrical workshop should include: a dynamic balancing machine for rotors; equipment for locating defects in cables; a furnace for baking the coils for electrical motors and transformers after varnishing; an autotransformer to test motors; a vibration measurement device; an insulation testing panel; an air compressor; a stand-by generator 1,000 kVA for the raw mill and shaft kiln or 500 kVA for the shaft kiln only.

Mechanical workshop

If the plant is expanded, the quarry will have to produce four times more than it does now and repair and maintenance of quarrying equipment will require careful attention. The workshop should include: tyre-servicing equipment; a hydraulic press, 100 t; a turning lathe, 200 mm$^{\phi}$ x 1,500 mm; a heavy-duty grinding

machine; a heavy-duty hydraulic extractor; a welding machine, DC, 350 A; a compressor, 95 litres per second; a universal engine tester; compressed-air tools such as an impact wrench, a vertical grinding machine, 6,000 rev/min, and lubricating equipment.



Annex

FUEL COSTS IN NEPAL
(December 1979)

Fuel type	NRs/l	kg/l	NRs/t	GJ/t	NRs/GJ
Bunker "C"	2.28	0.95	2,400	40	60
Diesel fuel	3.50	0.82	4,272	42	102
Gasoline	7.00	0.75	9,336	42	222
Coke breeze			500	21	23
Petrolcoke[1/]			792	33	24
Charcoal				27	

1/ May be available if a refinery under study is set up in Nepal.