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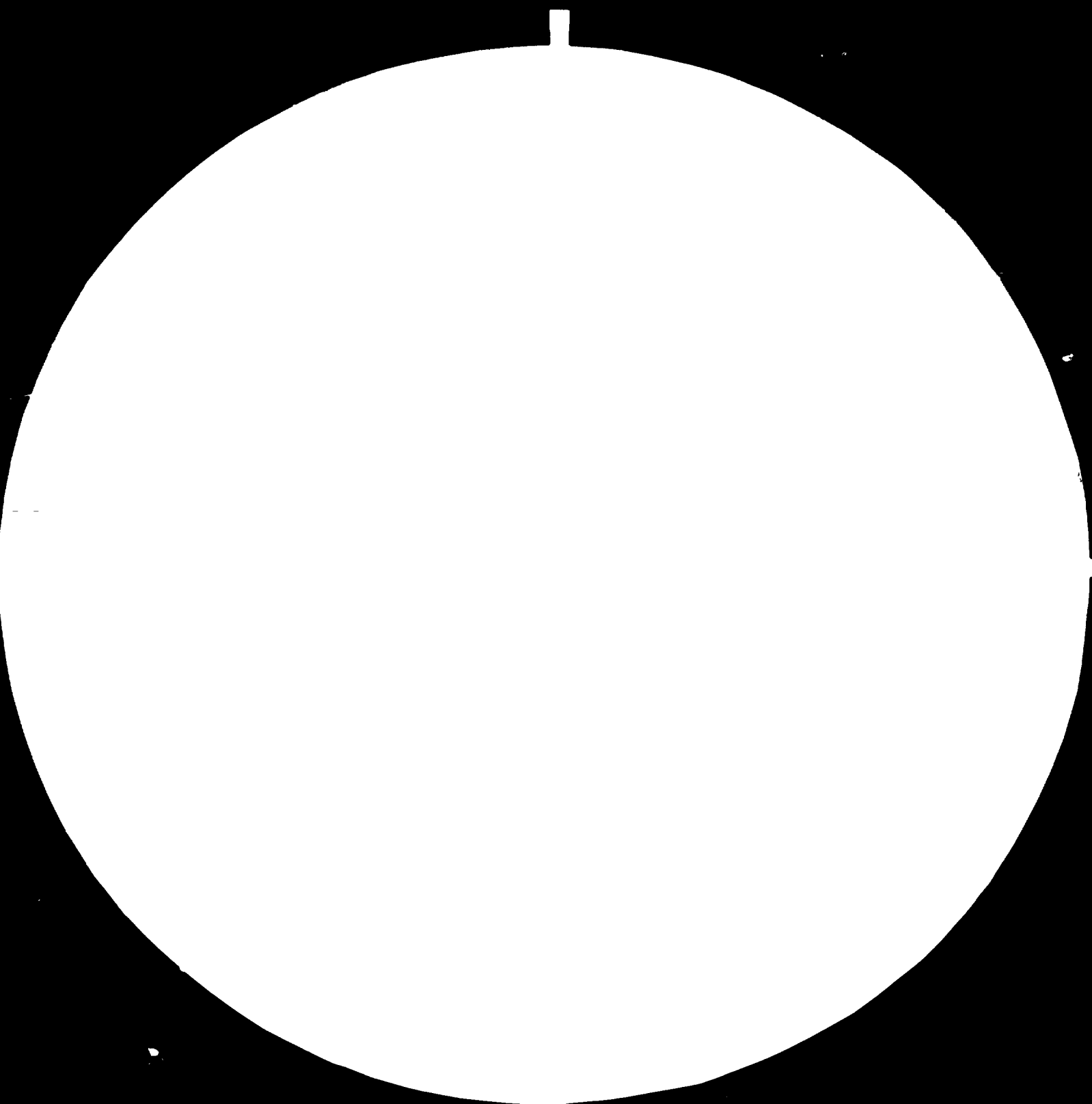

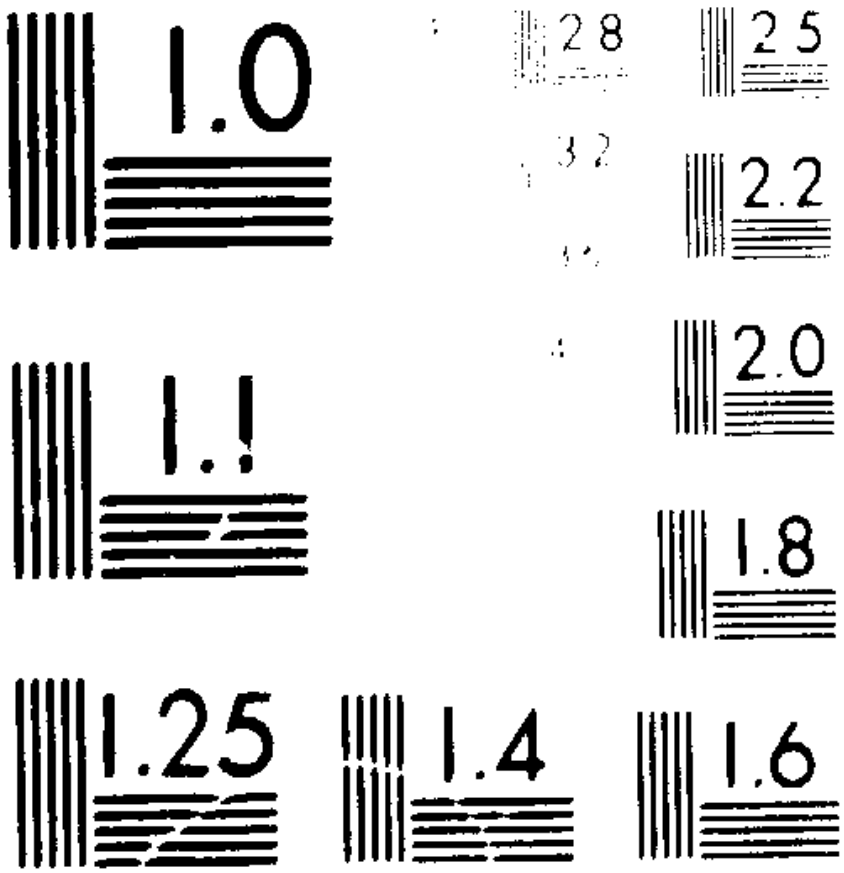
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ASSISTANCE TO THE CEMENT FACTORIES COMPANY

SI/JOR/78/805

JORDAN

Technical report: Operation and maintenance of the plant*

Prepared for the Government of Jordan
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Mehmet A. Basman, mechanical engineer

United Nations Industrial Development Organization
Vienna

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1. SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The semi-Governmental Jordan Cement Factories Company Limited, in order to fulfil its task of supplying country's all cement demands, which are sky rocketing, expanded its Fuhais plant five times in a period of 28 years to reach to a total production capacity of 1.2 million tons of cement per year. A new extension project which would bring the total capacity of the plant to 2.2.million tons in 1983, is being prepared by "Holderbank" Consulting and Management Limited of Switzerland, the consultant of the Company.

The speedy expansion of the plant with the additions of new units of different sizes, concepts and technologies, and the limited resources of the country own experienced industrial engineers and technicians created in the plant's old production lines, particularly production and maintenance deficiencies.

In order to rationalize the plant and to improve the efficiencies of the production lines, the Company has charged Norcem of Norway to carry out studies for the establishment and implementation of preventive maintenance planning, and Holderbank of Switzerland to undertake studies for the rationalization and improvement of the production lines, and for the re-organization of the plant's technical management.

The Company has also requested UNIDO technical assistance for being advised and assisted in the planning and implementation of possible improvement programmes.

The conclusions of this report are as follows :

a) The plant is having difficulties with the maintenance of the equipment of the production lines which is in a poor state due to the accumulated effect of abnormal circumstances, due to the fact that a regular production is required and that line operators have established improper process practices, mostly in order to palliate the state of the equipment.

b) The Company management is aware of these afore said difficulties, it is acting, following a right track, by requesting the assistances of experienced company and consultant for improving the efficiency of its Fuhais plant.

The recommendations of this report are as follows :

a) The re-establishment of proper production process practices.

b) The implementation of the prepared preventive maintenance planning.

c) The soonest gathering of the technical documentations of the production lines.

d) The soonest implementation of the plant's technical management re-organization study results.

e) The close follow up of the plant's old production lines' possible improvement studies.

f) The continuation of UNIDO technical assistance.

2. INTRODUCTION

Cement industry in Jordan was established in 1951, by Jordan Cement Factories Company Limited formed with the sponsorship of the Government of the Hashemite Kingdom of Jordan, as a public shareholding company with special concession.

The share capital of the company was settled to JD one million of which 49.5 % was owned by the Government.

The company started to produce cement in 1954, in its Fuhais plant located at 20 kms North-West of Amman, at the vicinity of a small town of same name, in a valley surrounded by limestone a marl deposits, by a semi-dry process "Lepol" kiln of 200 tons per day clinker productive design capacity.

The company, since its establishment, has the task to meet the country's cement requirements, it is the sole cement import agency of the country. It has to supply its produced or imported cements, whatever it costs the latter, with the same price set up by the Government.

For coping with the sky rocketing cement demand of the country, the company expanded its Fuhais plant by adding, successively, four other production lines :

a) Two lines, again, with semi-dry process "Lepol" kilns of 300 tons per day clinker productive design capacities. Commissioned in 1960 and 1963, respectively.

b) One line with dry process suspended four stage cyclone heat exchanger equipped "Dopol" kiln of 700 tons per day clinker productive design capacity. Commissioned in 1968.

c) One line, again, with "Dopol" kiln of 2000 tons per day clinker productive design capacity. It is being in commissioning phase.

Along with the Fuhais plant expansions, the capital of the company was raised to JD 1.5, 2.0, 4.5 and 15 million in 1960, 1964, 1967 and 1975, respectively. The share of the Government having been kept unchanged.

The plant is already producing 1700 tons of clinker per day by its four old kilns, 200 tons or 13 % more than the total of the daily productive design capacities of the above mentioned kilns, which represents a yearly total cement production of more than 550 thousand tons. However, this year the plant would supply less than 50 % of the local cement market demand.

Though, the ouput of the new production line would increase the total plant productive capacity to 1.2 million tons of cement per year, the company would, again, not be able to cover, completely, the country's cement requirements in few years.

The company, taking into consideration this fact, hired "Holderbank" Management and Consulting Limited of Switzerland for carrying out the feasibility study of a new production line of 3000 tons per day clinker productive design capacity.

The results of the above mentioned study having shown the techno-economical feasibility of a such line, the company decided to go ahead.

The technical specifications prepared by "Holderbank", as consultant of the company, have already been sent to pre-selected cement plant contractors. The dead line of the submissions of the contractor's proposals is in March 1980.

On the other hand, The Government of Jordan is, again, sponsoring a new cement project, the Reshadiyah Project, which consists of a complete cement plant of one million tons per year cement productive design capacity, located at Reshadiyah, a small locality in the shouthern part of Jordan, in mid-way between Amman and Aquaba approximat - ely, and which aims to fill the gap between Jordan's cement demands and supplies, to export Jordan's supply surpluses, and finally, to promote one of the less developed parts of the country.

The participation of the Jordan Cement Factories Company Limited in the new project is under consideration.

All these speedy developments urged the company to restructure its organization and to settle a new policy regarding, particularly, the future of its Fuhais plant.

In this connection, the company charged "Holderbank" for carrying out studies for re-organizing the plant management and for rationalizing the plant's old production lines.

Moreover, the company hired Norcem Company of Norway for preparing a preventive maintenance programme tailored for Fuhais plant.

The company has also requested UNIDO technical assistance for being advised and assisted on its possible production lines' improvement studies or implementations.

3. FUHAIS PLANT DESCRIPTION

The summary descriptions of Fuhais plant's production lines and its main facilities are as follows :

The plant disposes five production lines.

The first three production lines are semi-dry process "Lepol" kilns of one of 200 and two of 300 tons per day clinker productive design capacities.

The fourth and the fifth production lines are dry process suspended four stage cyclone heat exchanger equipped "Dopol" kilns of 700 and 2000 tons per day clinker productive design capacities.

The first four production lines form, in viewpoints of implantation, conception and of facility sharing, a complete production unit called plant's "old production lines".

Raw materials :

All the production lines main raw material requirements are covered by abundant limestone and marl deposits existing in the vicinity of the plant.

These raw materials are quarried by front blastings, transported by dumper trucks loaded by loaders and dumped into the hoppers of the production lines' crushers.

A. The old production lines :

One crusher of 400 tons per hour crushing capacity supplies the old production lines'raw material requirements.

The limestones and the marls are dumped into the Hopper of the crusher with a given proportion of truck loads for providing the crushed raw material mixtures a rough process raw meal composition.

The crushed raw materials are transported by belt conveyors from the crusher outlet to the production lines 1 to 3 and production line 4 raw material storage halls. While their transport, pre-set quantities of corrective raw materials, (sand and iron scale), are added by means of one hopper constructed next to the crusher and equipped with one rotative table feeder designed to feed the first belt conveyor.

The crusher also supplies high grade crushed limestone, as corrective raw material, which is also conveyed by the same system, separately.

The old production lines raw meals are ground by three air swept raw mills of two 32 and one 60 tons per hour raw meal productive design capacities.

The two first raw mills which supply the raw meals of the semi-dry process kilns are equipped with one hot air generator, each, for drying the raw materials during their grindings, and they are sharing one electro-precipitator for dedusting the owerflow of the mills' circulating gases.

Each of these mills are fed with crushed limestone-marl mixture and high grade limestone by three adjustable rotative table feeders, which are fixed underneath of the hoppers of the mills. The hoppers are filled by the grap of the production line 1 to 3 raw material storage hall's over head crane.

The produced raw meals are conveyed by means of air slides and elevators or pneumatic transports to the four old, or to the three new mixing silos of 300 tons storage capacity, each, where they are homogenized by recycling or quadrant system, respectively.

The homogenized raw meals are conveyed by air slides and bucket elevators to three storage silos of 1300 tons storage capacity, each.

The third raw mill does an integral part of the production line four. It uses the kiln hot exhaust gases for drying raw materials during their grindings, and it shares the kiln electro-precipitator for dedusting its circulating gas overflows. The mill has also one stand-by hot air generator.

The third mill is fed by crushed limestone-marl mixture and high grade limestone stored in its own raw material storage hall by a system similar to the previously mentioned mills.

The produced raw meals are conveyed, alternatively, by means of [illegible] pneumatic transport to the two mixing silos built on the top of the two homogenized raw meal storage silos, where they are homogenized by quadrant sytem.

The homogenized raw meals are stored in the above mentioned storage silos, they are conveyed to them by means of air slides and chutes. It is also possible to convey these raw meals by means of air slides to the three new raw meal storage silos of the semi-dry process kilns.

The three semi-dry process "Lepol" kilns are equipped with heavy fuel burning system, and with clinker grate coolers. They are dedusted by a commun electro-precipitator which has two parallel chambers.

The kilns are fed with raw meals reclaimed from the previously mentioned storage silos. These raw meals are conveyed by air slides bucket elevators and screw conveyors. Each kiln feed is adjusted by one variable speed screw conveyor, and the feed surpluses are collected in one bin for being recycled.

The produced clinkers are transported by means of individual vibrating conveyors and bucket elevators from the clinker coolers' crusher outlets to the production lines 1 to 3 clinker storage hall, which is the extension of the same lines raw material storage hall.

The fourth kiln is equipped with four stage cyclone heat exchangers and with heavy oil burning system, and it is followed by one clinker grate cooler. The kiln exhaust gases are dedusted, after having dried raw material through the line's raw mill, by one electro-precipitator.

The kiln is fed with raw meals reclaimed from the line's raw meal storage silos. These raw meals are conveyed by means of air slides, bucket elevators and screw conveyors. The kiln feeding is adjusted by one weighing feeder and one stand-by volumetric feeder. The feed surpluses are returned to the storage silos.

The clinkers produced by the kiln are transported from the clinker cooler's crusher outlet to the open clinker storage area of the old plant by vibrating and belt conveyors and bucket elevators.

The old lines' cement grinding section includes four cement mills : One compound mill of 22 tons per hour, two compound mills of 24 tons per hour and one closed circuit mill, (with one static separator and one recycling bucket elevator), of 50 tons per hour grinding capacities. All these mills are dedusted by individual bag filters.

The mills are fed with clinker, gypsum and puzzolane by means of adjustable rotative table feeders, except for the mill 4 which has electric weighing feeders. The feeders are installed to the bottom of the mills' individual clinker and gypsum hoppers which are filled by the grap of the clinker hall's over head crane.

The gypsum which is brought from the plant's stocks by dumper trucks is crushed in the old lines' gypsum crusher and transported by means of one belt conveyor to the hoppers of the mills.

The puzzolane is directly brought by dumper trucks from its quarries to the old production lines' clinker storage hall.

The proportioning of clinker-puzzolane mixture is realized in the hoppers of the mills by filling them with a pre-set ratio of grap loads.

The produced cements are conveyed by means of air slides and bucket elevators to the old production lines' six cement storage silos consisting of three silos of 1500 tons and three silos of 1800 tons storage capacities, each.

The old production lines dispose five bagged cement and one bulk cement dispatching stations.

The five bagged cement dispaching stations, for truck loadings, are fed by two line packing machines of 60 tons per hour, one line packing machine of 70 tons per hour and one rotary packing machine of 80 tons per hour packing capacities. The bulk loading station loading capacity is 80 tons per hour.

B. The new production line :

The crusher of 900 tons per hour crushing capacity supplies the new line limestone-marl mixtures.

The crushed limestone-marl mixtures are transported to the line's pre-homogenization plant by means of belt conveyors which by-pass a part of the mixtures to the production line sampling plant where representative samples of the mixtures are prepared. The samples are sent by one pneumatic conveyor to the X-ray analyser.

The crusher of 250 tons per hour crushing capacity supplies the raw and cement mills of the new line high grade limestone and gypsum, respectively.

The crushed high grade limestone is transported from the crusher to the raw mill's high grade limestone silo by means of belt conveyors.

These conveyors also transport the raw mill's corrective raw materials, the iron scales and the sand, to the raw mill's respective silos by means of a hopper feeding one belt conveyor. The hopper being fed by dumper trucks.

The pre-homogenization plant of the line has circular blending bed, and central feeding and reclaiming systems. It's total storage capacity is 55,000 tons.

The pre-homogenized mixtures are transported to the raw mill's mixture storage silo which is aligned with the previously mentioned high grade limestone, sand and iron scale silos.

The raw mill of the production line is an air-swept mill of 175 tons per hour grinding capacity. It is equipped by one static separetor. It uses the exhaust gases of the kiln for drying the raw materials, and it is connected to the kiln's electro-precipitator. It has

also, as stand-by, one hot air generator.

The mill is fed with previously mentioned raw and corrective materials by means of belt conveyors and adjustable weighing belts fixed to silos' outlets. Its produced raw meals collected in its electro-precipitator are conveyed by screw conveyors and one pneumatic pump to the mixing and storage silo of 7,500 tons storage capacity where the raw meals are homogenized while their reclaiming.

The homegenized raw meal is transported from its silo to the kiln by means of screw conveyors, air slides and pneumatic pumps. The kiln feed is regulated by one weighing vessel.

The line's kiln of 2000 tons per day clinker productive capacity, is equipped with one set of four stage cyclone pre-heater, one electro-precipitator preceded by one conditioning tower , and with one clinker cooler followed by one clinker crusher.

The produced clinker is transported from the outlet of the cooler to the main clinker storage silo of 30,000 tons storage capacity or to the open storage area of 250,000 tons capacity, by means of bucket and belt conveyors.

The clinker is ground in the closed circuit cement mill of 160 tons per hour capacity, equipped with one bucket elevator and two dinamic separators. The mill's inside is cooled with water injections. It is dedusted by its individual electro-precipitator.

The mill is fed with clinker and gypsum stored in two separed silos of 1300 tons storage capacity, each, by means of weihing reclaimers and one belt conveyor.

The above mentioned clinker silo is fed with the clinkers reclaimed from the main clinker storage silo by means of reclaimers or from the open clinker storage area by means of loaders. These clinkers are conveyed to the feed silo by belt and bucket conveyors.

The above mentioned gypsum silo is fed with gypsum crushed in the second crusher of the line; It is transported by means of the same belt conveyors which convey reclaimed clinkers.

The produced cements are stored in three silos of 4,000 tons of storage capacity, each. The transport of the cements are carried out by air slides, bucket elevators and pneumatic pumps.

The line disposes three packing machines of 75 tons per hour bagging capacity, each, and two bulk cement loading station of 100 tons per hour filling capacity, each.

In the new production line, provisions exist for feeding the old production line with pre-homogenized raw mixtures and crushed gypsum.

The plant's power station :

The plant which is also connected to the national power grid is generating electrical power covering its old lines' power requirement. The power house disposes twelve diesel-generators whose total productive capacity ammounts to 16.3 MW.

The plant's workshops :

The plant disposes of one large and well-equipped mechanical workshop enabling the plant to maintain and to repair most of its heavy equipment. It also disposes one well-equipped electrical and one vehicle maintenance workshop.

4. FUHAIS PLANT'S PROCESS EQUIPMENT'S CONCEPTION

It proceeds from the plant description that the Fuhais plant's old production lines' equipment, concepted and supplied by one contractor, has been selected among simple, easy operable and strong cement producing and material handling equipment.

The material flows of the production lines are simple, and no bottle necks exist.

The design capacities of these production lines' equipment particularly of those of the kilns, contain relatively high contractor safety margins which, unfortunately, seems to have been reduced in the newer lines, step by step, along with the contractor's growing experience with the Fuhais plant, and particularly, with the plant's raw materials.

In fact, the first semi-dry process "Lepol" kiln's real production capacity reaches 140 % of the kiln's design capacity, and those of the second and third kilns' reach only 110 % .

On the other hand, the fourth dry process "Dopol" kiln's production levels attain, with difficulties, the rated capacity.

In this suspended cyclone heat exchanger equipped "Dopol" kiln, besides the contractor's safety margin reductions, more important factors, which are dealt with in this report separately, cause such production levels of the production line.

Concerning the conception of the equipment of the plant's new production line, it can be said that it has been selected, again by the same contractor, among the most modern and sophisticated cement producing and material handling equipment.

The line is being in commissioning phase. Its production reaches its design capacity easily.

5. FUHAIS PLANT'S PROCESS EQUIPMENT'S STATE

With regard to maintenance, the Fuhais plant's old production lines' equipment and the premises are, in general, in a relatively poor condition.

Although most of the main equipment of the lines, as mills, kilns, etc, are in relatively good mechanical conditions, their appertaining and all other lines' equipment is not in good maintenance state. Moreover, most of their electrical remote control and command devices and their electrical interlockings are out of operation.

This is mainly due to the accumulated effect of abnormal circumstances, and to the production and maintenance routines established within the plant by the production lines' operators and labourers, since the very beginning of the operation of the lines.

This is also due to the dusty environment of the plant. The dust being generated in the covered and open clinker storages.

Concerning the plant's new production line, it is in commissioning phase, the old lines' dusty environment affects the new line equipment.

6. FUHAIS PLANT'S OLD LINES' PROCESS AND MAINTENANCE PRACTICES

Fuhais plant's old production lines' operations are followed by the Process and Material Handling manager, together with the Quarry Operation manager and the Plant Laboratories chief. The production management function is for time being assumed by the Works manager.

The production operations are carried out with three production shifts per day, without permutating fourth shift.

These shifts besides their main production tasks are also in charge of the lubrications of the lines' equipment, and during the night shifts, of the maintenance and the repairs of the production lines. They may get maintenance workshop assistances following their requests.

The maintenance of the production lines'equipment and those of the plant facilities are carried out by the maintenance service of the plant headed by the maintenance manager. The service includes mechanical, electrical and vehicle repair and servicing workshops, all headed by engineers.

Most of the engineers, being newly graduated, have limited experiance on cement manufacture and, on cement producing and material handling equipment as well.

The production practice of Fuhais plant consists of keeping the kilns in operation, as much as possible, and forcing the kilns, as far as possible, in order to get highest clinker productions.

This practice of keeping the kilns and their appertaining equipment running without any complete overhaul which reconditions the equipment of the line, but, with summary overhauls consisting mostly of refractory brick layings and repairs of defective equipment, and with provisional repairs in emergency cases, has established within the plant new production and maintenance routines which reduce the lines' efficiencies, the products qualities while increasing, the operational and the maintenance costs of the plant.

This practice converts the maintenance service of the plant to a repair workshop complying only with the daily requests of the production service. As a result, it does not allow the maintenance service to carry out its main task, the preventive maintenance planning.

This practice also constraints the production service to content itself with the poor states of the process and control equipment and to find out and to settle new procedures and methods of operations non-conforming with the cement production process.

For instance, the practice of proportioning the raw meal components in the raw mills' hoppers by means of the over head crane grab loads has became a production routine which is carried out even when the mill's all adjustable rotary table feeders are in good working conditions.

Again, the practice of homogenizing the raw meals without using the sequences of the quadrant mixing blending system has also became a production routine. Consequently, all the mixing silos' sequence remote control and command devices have been removed.

These routines cause raw meal quality fluctuations which, in turn, pertubate the productions of the kilns, particularly the fourth kiln because, it is a dry process kiln equipped with cyclone heat exchangers which is sensitive to raw meal quality and quantity fluctations.

As a result of these routines and their likes, the maintenance state of the plant deteriorates while the plant's maintenance costs increase.

7. PLANT'S OLD PRODUCTION LINES' POSSIBLE IMPROVEMENTS

A. Semi-dry process "Lepol" kilns' possible improvements

It proceeds from the previous paragraphs that the plant's old production lines' semi dry process "Lepol" kilns' production levels are limited by equipment failures and by raw meal composition fluctations.

From the same paragraphs, also, it can be drawn the conclusion that regular production levels can easily be obtained from the three semi-dry "Lepol" kilns by re-installing the proper process routines suiting the equipment supplier operation instructions, and by implementing a preventive maintenance planning.

Furthermore, it can also be drawn the conclusion that higher and regular production levels could be easily obtained from the above mentioned kilns after their complete reconditioning, together with some modernization and improvement programmes, as the modernization of the kiln's out of date fuel pumping station, as the improvement of the dust generating lines' raw material and clinker storage hall.

The scope of these reconditioning and modernization works have not to be enlarged. However, due to the years' neglect accumulations, these works might require a relatively high re-investment.

Nevertheless, it seems, as a first approach, that the costs of clinkers to be produced by these three, relatively high specific fuel consuming, semi-dry process "Lepol" kilns, after being reconditioned and modernized, including also the re-investment depreciations, would be lesser than the cost of the clinker to be produced in a new, low specific fuel consuming, dry process kiln which would have a productive capacity equivalent to the total of those of semi-dry kilns, and which would substitute them, because, the investment depreciations of a such kiln would be very high.

B. Dry process "Dopol" kiln's possible improvement

From the previous plant and process practice descriptions, it could also drawn the conclusion that the dry process "Dopol" kiln's production levels could also be increased and stabilized by re-installing the proper process routines suiting to the equipment constructor operation instructions, by implementing preventive maintenance planning and by bringing some modifications to exhaust gas pipings of the kiln which would allow independant kiln operations.

In fact, the plant's suspended four stage cyclone heat exchanger equipped "Dopol" kiln, as its likes, is sensitive to quantity and quality fluctations of the raw meals.

For getting a regular production in such kilns, the quantity of the raw meals , in viewpoints of chemical compositions and physical properties, particularly, the fineness, should be kept within given limits.

With the existing raw meal preparation practice, the raw meal qualities can, never, comply with those of the recommended dry process raw meals.

With the existing raw meal kiln feeding practice, which consists of feeding the kiln by means of it's stand-by, volumetric feeder instead of it's main weighing feeder, because the latter being not in working condition, the quantities of raw meals poured into the kiln, in weight, can, never, be kept within the limits recommended for dry process kilns.

With the existing kiln exhaust gas pipings, continuous kiln operations cannot be carried out.

In fact, as it is also indicated in the plant description of this report, the kiln exhauts gas pipings are not directly connected neither to the kiln's electro-precipitator nor to the kiln's stack. The kiln exhaust gases have to pass continuously through the kiln's raw mill.

Due to one missing by-pass connection, the kiln operations are directly linked to the mill's working hours. Mill stops cause kiln shut downs.

Fortunately, as the kiln's raw mill is also supplying raw meals to the semi-dry process "Lepol" kilns, raw mill stoppages due to the raw meal silo blockages do occur rarely.

However, mill maintenance stoppages, which cannot be avoided, cause kiln shut downs. They are reduced to a strict minimum.

8. FUHAIS PLANT'S OLD LINES' EFFICIENCY IMPROVEMENTS

From the previous chapter, it is clearly seen that for increasing the efficiency of Fuhais plant old production lines, at the first instance :

a) The existing production practices and routines have to be to reviewed, and those which differ from equipment supplier recommendations or from general chemical and mechanical engineering practices have to be corrected consequently; and,

b) A preventive maintenance planning has to be settled, implemented and followed closely.

Along with these works, detailed surveys and studies including alternative solutions should be carried out in order to plan the plant's old lines' possible improvement works.

For the materialization of the above mentioned first works :

a) The equipment suppliers' operation and maintenance instructions should be completed;

b) The preventive maintenance planning prepared for Fuhais plant by Norcem should be implemented; and,

c) The plant technical staff re-organization should be undertaken.

9. EQUIPMENT SUPPLIERS' LINE OPERATION AND MAINTENANCE INSTRUCTIONS

The plant's technical services are facing difficulties while performing their tasks, because, most of the old production lines' technical documentations including the equipment suppliers' operation and maintenance instructions are not available in the plant.

These documents which are very important for the plant operations and plant maintenance are a must for settling the preventive maintenance planning, for re-installing production practices and routines. and, for carrying out the studies of the old production lines' possible improvement works.

For these above mentioned reasons, it is strongly recommended to the plant to give all efforts for obtaining these documents, as soon as possible.

It would be even worth, to request the assistance of the main equipment supplier which would delegate one of its specialist, for a given period, for collecting all the plant documentations.

It would, also, be worth, while considering the size of Fuhais plant and its future extension, to establish inside the plant a documentation center headed by an engineer who would bear the responsibility of keeping and updating all the technical documentations of the plant.

10. NORCEM'S PREVENTIVE MAINTENANCE PLANNING

Jordan Cement Factories Company, in order to implement a preventive maintenance planning in its Fuhais plant has hired the Norcem Company of Norway, for preparing a preventive maintenance planning system to be tailored to its plant, and for assisting the plant in the implementation of the said system.

The preventive maintenance planning implementation time schedule, which was forseing mid-August as its starting date and one year for the complete implementation of the system, has been partially followed. After schedule's few preparative works, because of many reasons, as the non-availabilities of equipment data, of suppliers' operation and maintenance instructions, of experienced staff etc. and mainly because, of the limited technical assistance forseen for the implementation of the planning in the Norcem contract consisting of few weeks in one year, no steps forward have been undertaken.

The soonest establishment of the preventive maintenance planning in Fuhais plant, particularly with the addition of a new modern production unit, becames a must for the cement factory.

To continue the preventive maintenance implementation, a new time schedule has to be settled by the plant, and the plant maintenance manager who would be in charge of following the schedule closely, should be assisted, continuously, by an maintenance adviser from Norcem, preferably.

Along with the implementation of the preventive maintenance planning, the Company should carry out studies for settling a comprehensive, technical monthly and yearly plant operation cost system whose implemation would allow the plant maintenance service and the other services as well, to keep the costs of their services within their forecasts,

to analyse their service costs for revealing their weak points and for improving them, consequently, and, finally, to prepare their yearly budgets.

The writer of this report, during his mission, upon the request of the Company has prepared, for indicative purposes, the guidelines of one technical cost analyse system for Fuhais plant's production lines.

11. PLANT TECHNICAL MANAGEMENT'S RE-ORGANIZATION

As it can be seen from the previous chapters, the old production lines' possible improvement programmes mainly consist of the re-establishments of the usual plant operation and maintenance procedures, which have been deviated, and the re-conditionings of the production lines' equipment, which has been mishandled. Both of these improvement works result from the plant technical staff qualification and, particularly, organization deficiencies.

The addition of the new modern sophisticated production line, which requires new skills and close follow-ups, the existing technical management organization of the plant would not be efficient and sufficient for operating and for maintaining the new line.

The Jordan Cement Factories Company being aware of its plant organization and of its manpower has charged "Holderbank" Consulting and management Limited for carrying out studies for restructuring Fuhais plant technical management.

In these re-organization studies of the Fuhais plant technical management the following points should be, particularly, taken into consideration :

a) The plant's production, maintenance and quality control functions should be properly defined and be carried out by independant services headed by managers under the supervision and coordination of the works manager while allowing functional relations between same rank staff of these three services.

b) A close follow-up and an adequate reporting system should be established within these afore said services.

c) A training center with the tasks of organizing outside and inside basic and recycling trainings should be foreseen within the plant organization, and,

d) A documentation center with the duties of keeping all plant technical documentations and following cement industry's technical developments should also be foreseen within the company organization.

Furthermore, in these re-organization studies, the plant shift system should be re-arranged with four shifts system including the fourth permutating shift which would allow the production service a smoother and a more flexible operation.

12. UNIDO TECHNICAL ASSISTANCES

The speedy expansion of Jordan Cement Factories Company's Fuhais plant and the limited resources of the country's own experienced industrial engineers and technicians do the Company in need of technical assistances, continuously.

In fact as it is indicated in the body of this report, the Company has hired the Norcem Company of Norway, which is also delegating to the plant one quarry specialist and one kiln supervisor with one year contract, for preparing the plant's preventive maintenance planning and to assisting to its implementation, and the Company has charged "Holderbank" Consulting and Management Limited, which is the Company's consultant for the plant's new extension project, for carrying out studies for improving the plant's old production lines and for re-organizing the plant's technical management.

Concerning UNIDO technical assistances, upon the request of the Government of Jordan, two technical assistance programmes and two training programme scholarships was granted to Jordan Cement Factories Company by UNIDO, in 1979.

Two Company's engineers granted with UNIDO scholarships participated to the UNIDO organized Cement Industry Training Programme of one month duration, in November 1979, in Ankara, Turkey.

The first UNIDO technical assistance programme of two month duration was carried out by UNIDO expert Mr. Beckton in May-June 1979.
The mission was foreseen for assisting and advising the Company's production service on quality control procedures.
During this mission plant's pollution problems have also been dealt with.

This mission is the second UNIDO technical assistance programme of two month duration which was foreseen for assisting and advising the Company in its improvement programme plannings and implementations.

Further UNIDO technical assistance programmes to the Company could be foreseen in many fields, as preventive maintenance implementation, industrial instrumentations, industrial management, ect, provided that the Government technical assistance requests indicate clearly the job description and the time schedule of the requested technical assistances, together with the qualifications of the expert.

It is recommended to continue the UNIDO technical assistance programmes for Jordan Cement Industry with a new technical assistance project starting with a mission of one cement expert who would have the tasks of assisting and advising Jordan Cement Factories Company and the Government of Jordan as well, during the preparations, appraisals and implementations of the Company's technical management re-organization, plant rationalization and extension works, and finally, of organizing further specific UNIDO technical assistance programmes.

13. RECOMMENDATIONS

The recommendations which are given in the body of this report can be summarized as follows :

a) The existing production and maintenance practices should be reviewed and those differing from the equipment suppliers' operation or maintenance instructions or differing from the general chemical and mechanical engineering practices should be corrected.

b) All efforts should be given by the plant for the soonest establishment of the preventive maintenance planning prepared by Norcem. During its preparative works and its implementation a continuous technical assistance from Norcem should be seriously considered.

c) The plant's production lines' technical documentations and equipment suppliers' operation and maintenance instructions should be completed, in a short notice. They should be gathered in one new department to be created within the plant organization.

d) Priorities should be given to the studies on the plant's technical management re-organization, and on the plant's training programmes, for their soonest implementations.

e) Old production lines' possible improvement studies including alternative solutions should be closely followed and appraised before their eventual implementations.

f) Further UNIDO technical assistance programmes should be requested by the Company for being assisted and advised during the preparations, the evaluations and the implementations of the above mentioned works.