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SYRIAN ARAB REPUBLIC

# Technical report: Upgrading of operation of cement plants and asbestos-cement plants in Syria*

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

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Based on the work of Mr. H. Carlsen,
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Vienna

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* Mention of company names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

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## List of Contents



## List of Abbreviations

| | |
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| GOC | General Organization of Cement and Construction Materials, Damascus |
| HMC | Holderbank Management Consultanrs, Ltd. of Switzerland |
| SKET | SKET veb. Zementanlagenbau, Dessau, DDR |
| UNDP | United Nations Development Programme (New York) |
| UNIDO | United Nations Idustrial Development Organization (Vienna) |

## INTRODUCTION

The present report covers the findings of Mr. Henrik Carlsen, Unido expert for cement technology, collected during his visit to Syria from 11 October to 12 November 1989.

The purpose of the project was originally defined in the job description as follows:

> "The project is aiming at laying the foundation for an upgrading of maintenance and operational routines in different branches of industry including manufacture of asbestos-cement products. The main emphasis is to identify bottlenecks and shortfalls including environmental problems and to participate in improving installations work routines and conditions in co-operation with counterparts and officials".

However, on the first day after the expert's arrival in Syria the scope of work to be carried out by the expert was discussed with the General Organization of Cement and Construction Materials (GOC), and after meetings with representatives from the Ministry of Industry and the Planning Commission it was agreed, that because of recent changes of priorities within the Industry, the scope of duties should be modified to allow the expert to use the major part of his time to assess the actual situation and potentials of some of the cement plants belonging to the GOC group of companies.

The assessment should be made on the basis of a previous study made by Holderbank Management Consultants during a visit to three Syrian cement plants in 1987 (Ref. 1), and should supplement, but not duplicate the work carried out by Mr. H.-H. Brandt in January 1989 (Ref. 2).

For the sake of records the revised duties for the post, as understood by the expert, are summarized as follows:

Duties The expert will be assigned to the General Organization of Cement and Construction Materials (GOC) and delegated to study the operation and the condition of maintenance of some of the major cement plants in Syria, such as the Tartous plant, the Sheikh Said plant and the Adra plant.

The expert will also visit the Asbestos-cement plant in Aleppo in order to make a preliminary assessment of the operation and identify areas for further studies by a later visit by an expert as foreseen in the original job description.

Specifically the expert will be expected to:

1) Study the bottlenecks for the production and other problems described in the report by HMC, comment on the recommendations made in their report and make his own recommendations.

2) After plant visits, submit to GOC a summary list of observations and recommendations for immediate improvements of plant maintenance and operating procedures.

3) Prepare a final report covering his findings and recommendations for immediate improvements, low-cost investments and long-term investments to achieve better plant operation, increased production capacity, and higher efficiency with regard to consumption of fuel, electric power, consumables, and life of equipment.

After the initial meetings at GOC the expert visited the cement plants Tartous and Sheikh Said spending 10 days at each plant. The asbestos-cement pipe plant in Aleppo was visited one day during the expert's stay at the Sheikh Said plant.

Although a visit to Adra cement plant was also envisaged, this was cancelled in order to allow more time for discussions of the alternative possibilities of improving the operation and the installations at Tartous and Sheikh Said plants.

The report is divided into a general part containing "Introduction" and "Summary and Conclusions" followed by three appendices covering the visits to the three plants, viz.:

1. Tartous Cement Plant
2. Sheikh Said Cement Plant
3. Aleppo Asbestos-Cement Factory.

The visitor wish to express his sincere thanks to officials and Company representatives for their kind support and very much appreciated assistance received during the mission.

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Ref. 1: Syria. Energy Efficiency Improvement in the Cement Sector. Volume II. Consultants' Report. July 1989 by Holderbank Management and Consulting Ltd. of Switzerland.

Ref. 2: Improvement of Maintenance and Operational Practices in the Cement Industry including Asbestos Cement Plants. DP/SYR/86/009/11-01/Rev.1 Report dated 10 February 1989 (draft) by Mr. H.-H. Brandt, Cement Plant Expert.

## SUMMARY AND CONCLUSIONS

The following observations and conclusions refer to visits to Tartous and Sheikh Said Cement Plants and Aleppo Abestos-Cement Factory.

The two cement plants have a number of features in common. They are both dry process plants of recent - although not the latest - design, commissioned during the years 1981-86 and with parallel production lines with nominal capacity 1500 - 1600 tpd clinker each.

Both plants have weaknesses in design of plant and equipment which hamper the production, and are likely to continue to do so unless corrected by replacements or modifications as referred to later in this report. However, both plants also have potentials for not only rehabilitation to the rated capacity of production, but also for expansion of the production by further modifications, such as the installation of new or modified kiln preheaters, precalciners, roller presses, high efficiency separators, new fans and certain ancillary equipments.

Such modifications are in both plants technically feasible because of adequate reserves of good raw materials and because of the spacious layouts with sufficient space for the fitting-in of new equipment.

However, the plants also have some problems in commmon. Both plant are in a very poor state of maintenance, which is in part due to lack of spare parts and consumables and in part due to unfavourable plant design and inadequate routines for operation and preventive maintenance.

Due to these problems, the two plants operate at present at only 60 - 70 % of the rated outputs and with comparatively high consumption of fuel and electric energy.

Another effect of the operation with inadequately maintained equipment is that the equipment is further degraded and the life of the equipment shortened.

As indicated in HMC's report these problems must be solved before full utilisation of the plant capacities can be achieved. The question is how to do this in the present situation, where funds for the necessary parts and consumables are very limited.

According to the recommendations made by HMC, the improvements should be made in three progresssive steps, viz.:

(a) operational improvements;
(b) modifications requiring small investments; and
(c) long-term investments.

This approach seems to be very well chosen for setting guide lines for the course of action to be taken in order to insure the upgrading of the two plants. However, the following points should be taken into consideration when evaluating the specific recommendations for each of the three steps.

Firstly, it should be mentioned that the study made by HMC and the report prepared thereon were aiming primarily on the identification of ways of saving energy, and had the boosting of production as a secondary goal only. This priority reflects the situation two years ago, when there the supply of electric power was limited, and it was important to save fuel and reduce cost of production of cement in order to become competitive on the export market.

Today energy saving is still important, but with the commissioning of new power plants, sufficient electric power is now available, and it is therefore proposed to aim firstly at higher utilization of the plants, which will provide more clinker and cement for export and at the same time will also improve the energy efficiency of the plants and consequently reduce the unit production cost figure for clinker and cement.

High priority should therefore be given to modifications or investments, which contribute to improving the production capacity or the availability of equipment for production, whereas lower priority should be given to modifications, which will save energy only without enabling any increase of the production.

Examples of investments, which should be given high priority, are:

- spare parts needed for the production
- consumables needed for the production (lining bricks, grinding balls, castings for grate coolers, mills and crushers, paper bags for cement)
- flap gate sluice for flash dryer
- replacement of defect instruments

Example of investment, which may be given lower priority:

- replacement of hydrodynamic drives with DC-motor

Secondly, the timing of the actions for improvement of the plant conditions is very important. For example it serves no purpose to refit a kiln with an all new lining unless the raw mix control and the kiln instrumentation are improved at the same time for enabling the kiln operator to control the kiln properly without causing damage to the new lining. Another example is the rehabilitation of a grinding mill system, which should comprise not only the ball mill, but also the separator, pre-grinder, fans, feeders, conveyors as well as cleaning up and repair of leaking ducts, conveyors, sampling points, safety devices and instrumentation.

Because of the need for proper timing it is recommended to prepare an overall plan for the plant rehabilitation work according to which the plant will be cleaned up, repaired, modified and adjusted to optimum performance, department by department and in the right sequence.

The timing is also important for the planning and the implementation of training programmes and the allocation of assistance of technical advisors for the introduction of improved procedures and the commissioning of new or modified equipment and control systems.

The training should not only aim at providing the plant personnel with the necessary technical basis knowledge for proper execution of their duties, but also ensure the building up of a common sense for responsibility and motivation, which is essential for making advances towards and eventually achieving satisfactory plant performance.

In the remaining pages of the summary each of the plants are dealt with separately in order to cover and comment on specific problems related to the relevant plant only.

Tartous Cement Plant.

The present low factor of capacity utilization (about 60 %) is due in part to the general problems already mentioned and in part to difficulties in the handling of the raw materials and the preparation af a homogeneous raw mix for the kilns.

These difficulties are caused mainly by the presence of pockets of clay in the limestone, which causes clogging of crushed limestone in the storage silos and hence erratic rate of feeding to the raw mill as well as considerable variation of the chemical composition of the mill feed.

Some efforts are already made in order to overcome this problem by selective quarrying, mixing of limestone by feeding the crusher alternatingly with material from two or more different benches and the use of air blasters for breaking up sticky material in the bottom of the limestone silos. This all helps to improve the condition for operation of the raw mill, but the chemical composition of the raw meal still varies more than desirable for the preparation of a fully homogeneous kiln feed.

The best long-term solution to this problem may be to build a horizontal store with stacker and mechanical reclaimer for prehomogenizing and storing of limestone. However, this means a major investment and a delay of 2 - 3 years for delivery, construction and erection. It is therefore proposed to pursue other and less costly ways of improving operation, and especially improvements, which can be implemented immediately or within a few months. One such solution is to install the X-ray and Computer equipment already acquired for automatic control of the raw mill feeder settings, but not yet in use because of missing interface equipment for operation with existing feeders.

Once the raw mill system is brought up to rated output, and a homogeneous kiln feed produced, the kiln production can also be increased to the rated capacity provided that it is possible to operate the shaft preheater with normal efficiency and without clogging problems.

The kiln tube and the grate cooler both have ample capacity and can with relatively small modification be uprated to produce up to 2000 tpd, but this will require modification or replacement of the SKET shaft/cyclone preheater.

The capacities of the raw mill and the cement mill systems can be increased to match the increased kiln production by reconditioning of the mills and auxiliaries, and if necessary by the installation of high efficiency separators or roller presses.

Sheikh Said Cement Plant.

The main obstacle to full utilization of the production capacity at Sheikh Said plant is the poor condition of the raw mill drying and grinding system. The raw materials contain in average approximately 10.0 % moisture, which means that it is necessary to supplement the heat from the kiln exhaust gases with heat from the auxiliary furnace in order to obtain sufficient drying in the raw mill. However, at present the raw mill systems are operated without rotors in the dryer crushers and without diaphragms in the mills and normally without the auxiliary furnaces. The drying capacity of the raw mill systems is therefore too small to match the requirement of the kilns.

In order to increase the drying and grinding capacity of the raw mills it is proposed to repair or replace the dryer crushers and the flap sluices, reinstall the diaphragms in the mills, repair all leakages in the mill and hot gas ducting, and - if necessary - increase the speed of the mill air fan in order to allow simultaneous operation with kiln gases and hot air from the auxiliary furnace.

After implementation of the necessary repairs and modifications within the raw mill systems it will be possible to operate the kilns at the rated output of 1500 tpd. A further increase of the production to 2000 tpd will require some modifications to the cyclone preheaters or alternatively replacement of the existing conventional preheaters with new LP (Low Pressure Drop) type of preheaters with or without precalciner.

The capacities of the raw mill and the cement mill systems can be increased by reconditioning of the existing mill installations and by the installation of high efficiency separators or roller presses to match the increased kiln production.

The kiln capacity could be increased further to 3500 tpd by the installation of a new preheater tower with a bigger separate precalciner/preheater string. However, this will require the installation of new grinding mills, further modifications to the clinker cooler and other additional installations to match the increased flows of materials and gases.

Aleppo Asbestos-Cement Factory.

The Asbestos-Cement Factory located adjacent to the Sheikh Said Cement Plant was down for a major overhaul during the visit on 2 November 1989. However, the visitors were guided on a tour of the plant and saw the fixed installations and the finished products.

The Asbestos-Cement Factory produces high-pressure pipes exclusively using two production lines for 3 m and 5 m pipes respectively. The filter and pipe machines from FARBEN, Italy are conventional "Massa" type units similar to the type of equipment used by other manufacturers of high pressure asbestos cement pipes.

The asbestos is pre-treated in a dry process disintegrator, which it is recommended to replace with an edge runner type machine for "wet" process operation.

The factory employs in total 350 employees when running at full capacity producing 1200 tons of pipes per month, which is reasonable for the type of plant.

The pipes are made with dimensions 80 - 700 mm diameter by 3 or 5 meter long, and to ISO standards. The percentage of rejects was reported to be fairly low.

The management did not seem to have any special problems with regard to production or product quality, but were interested in receiving information regarding the technical development within the asbestos-cement industry in other countries.

Appendix 1

## Tartous Cement Plant.

### 1. General.

The Tartous cement plant is well situated a few kilometers outside the city of Tartous with good intrastructure facilities, and adjacent to large deposits of good quality raw materials. With 4 production lines each with nominal capacity 1600 tpd of clinker, the total capacity of the plant should be up to approximately 2.0 million tpy of clinker assuming that the kilns run at nominal outputs during 320 days per year. However, the clinker production is at present only approximately 1.2 million tons clinker/year corresponding to about 60 % of the total capacity.

The reasons for this low degree of utilisation of the plant are identified in the following together with recommendations for improvement of the plant performance by changing of procedures or modification of plant design or equipment.

### 2. Raw materials, quarry and crushing plants.

According to the raw material report by VEB/SKET (1978) the raw material deposit North of the plant contains proven and workable reserves of limestone and basalt for more than 40 years of production. The average compositions of limestone and basalt are adequate for the preparation of a suitable raw mix for the kilns, but the day to day analysis of limestone from the quarry varies considerably due to variations of the composition of limestone within the deposit and also because of the occurrence of clay pockets, which cannot be separated from the limestone during the quarrying operations.

The variations of the limestone composition are reflected in the composition of the raw meal from the raw mill, and are not always entirely eliminated by the raw meal blending and correction procedures. The composition of the kiln feed therefore varies more than desirable for satisfactory kiln operation.

The most efficient way to overcome this problem is to install a horizontal preblending stores for limestone, which would not only reduce the variations of the limestone analysis but also eliminate feed rate variations due to clogging of sticky material in the silo for crushed limestone.

Appendix 1

The chemical composition of the basalt varies only little and preblending of basalt is therefore not needed for the purpose of improving the raw mix control. However, it should be considered to install a horizontal store for basalt in order to eliminate the need for predrying of this material, which is done at present to facilitate extraction from the silo for crushed basalt.

The installation of horizontal stores is recommended as the ideal long-term solution to the above-mentioned problems, but it is a major modification, which will require further studies as well as substantial investments in equipment and buildings. It will therefore probably take 2 - 3 years to have such stores ordered, built and commmissioned.

In the meantime other solutions should be studied and pursued if found viable. One interesting alternative is to install an improved system for X-ray analysis and computer control of the raw mill feeder settings as discussed in the following under the heading "Raw Mix Control".

Another alternative is to introduce preblending of the limestone by building intermediate heaps of blasted material before it is fed to the limestone crusher. However, this will require double handling of the limestone and should therefore be considered as a temporary solution only.

Some efforts are already made to this effect by the introduction of selective quarrying and mixing of limestone by feeding the crusher alternatingly with material from two or more different benches.

In order to overcome the problem with sticking of moist material in the silos for limestone and clay the quarry operation is planned and executed with due consideration to the presence of clay and with the aim to extract clay mainly during the dry season leaving limestone rock with less clay contamination for wet weather operation.

These endeavors are important and should be continued and pursued in a more systematical way in order to reduce the variations of the chemical composition and the physical properties of the crushed raw materials to a minimum.

The use of air blasters for breaking up sticky material in the bottom of the limestone silos should also be continued, and if not successful followed up by tests with membrane pads or other devices for breaking up of material bridging in silos.

The quarry operation seemed in general to be well organized, however the fragmentation of basalt should be improved to reduce the occurrence of oversize material at the basalt crusher. A drop-ball or a block-buster type of machine is recommended to substitute secondary blasting.

The use of Ammoniumnitrate-Sugar explosive is unusual, but is adopted instead of Ammoniumnitrate-Fuel Oil (AMFO) because it allows the use of locally produced 30 % ammoniumnitrate and requires a minimum of dynamite. The safety aspects of the quarry operation were not discussed, but the procedures seemed to be in accordance with normal regulations.

Long-range planning of the quarry operation based upon already existing and new supplementary core drillings and making use of modern programmes for analysis and evaluation of deposits is strongly recommended in order to ensure optimum utilization of the raw materials and efficient operation throughout the remaining life of the quarries.

The crushing plants for limestone and basalt run very satisfactorily. Each of the two double rotor hammer crushers for limestone produces 500 - 600 tph of crushed stone to approximately 90 % passing 10 mm, and the two-stage crushing plant for basalt with one jaw crusher and one flat cone crusher produces 200 tph crushed basalt to approximately 90 % passing 50 mm.

3. Basalt Dryer.

The basalt dryer installation with screening and secondary crusher plant is used to reduce the moisture of basalt as required in order to avoid sticking of the basalt in the storage silos. The present procedure of drying the material according to the operator's subjective impression of the moisture content is likely to cause vaste of fuel for overdrying because there are no well defined criterias for when to start or stop the dryer. It is therefore recommended to implement regular moisture determinations for basalt from the belt from the primary crusher and for basalt from the dryer, when in operation.

## 4. Raw Meal Preparation.

Actual operating data for one of the raw mills (Line 2) showed that the mill was producing 110 tph dry raw meal or 85 % of the nominal capacity. The sieve residues of the product from the mill separator were 13 % R 0.09 mm and 1.0 % R 0.2 mm, which is normal for kiln feed for dry process kilns. The main reason for the low production is a low ball charge corresponding to a power consumption of 1090 kW at the mill motor shaft or about 70 % of the installed motor power.

The mill production can be increased to at least the nominal capacity (130 tph dry) by upgrading of the mill ball charge and at the same time reconditioning and adjustment of the dryer-crusher and the separator as well as repairs of faulty air lock flaps and other sources of false air infiltration into the raw mill circuit.

The air separator should be dynamically balanced (if necessary) and adjusted to normal speed and a circulating load within the range of 100 to 150 % in order to allow a further increase of the production, and in order to establish normal oprating conditions as the basis for measurement of the separator efficiency.

If the separator efficiency is less than 60 % it may be possible to increase the mill production one step further by the installation of a high efficiency type of separator.

## 5. Raw Mix Control.

The chemical composition of the raw meal from the raw mill system is checked at half hours intervals by CaCO3 titrations, and the raw mill feeders are adjusted in order to compensate for the deviation of the average of the previous titrations for the actual blending silo from the titration set value. Each blending silo is aerated for 2 1/2 hours and the titration checked again and corrected if necessary before the raw meal is emptied into the storage silo.

This control procedure ensures that the titration of the kiln feed is kept within a range of +/- 0.3 % around the set value, but it does not prevent variations of the lime saturation factor LSF or the silica ratio SM, which do occur and do affect the kiln operation. It is therefore recommended to introduce raw mix control by X-ray analysis and computer control of the raw mill feeder settings.

## 6. Kilns and Preheaters.

Each of the four kilns has the main dimensions 4.6 x 67 m and nominal capacity 1600 tpd of clinker. The kiln tubes and the grate coolers are amply dimensioned for this production and should with minor modifications allow an increase of the production to about 2000 tpd, but the shaft type preheaters may not be suitable for operation at this level of production.

The limited time for the visit did not suffice for obtaining a set of comprehensive operating data representing normal operation at the nominal or nearly the nominal level of production, or to obtain design details and a drawing of the shaft preheater. It is therefore not possible to assess the maximum capacity of the preheater, but it is recommended to study the preheater performance in further detail as soon as the reconditioning of the raw mills and the kilns has been carried out and normal conditions for kiln operation established.

The actual kiln operation is hampered not only by the varying composition of the kiln feed, but also by the lack of consumables and by faulty or missing equipment or instruments. Some examples, which require attention, are:

- lack of lining bricks
- kiln shell temperature scanner out of order
- outlet of kiln 2 badly off centre due to thermal deformation of kiln tube
- closed circuit TV for monitoring of burning zone out of order

- Gas analyzers for $O_2$ and CO not working or working with too long time lag

- Recorder for $O_2$ and CO not working

Apart from certain closed loop control circuits for example for cooling air to the grate cooler, the kilns are controlled manually and are subject to the unavoidable differences between the control philosophy applied by each individual shift operator, which makes it difficult to establish and maintain regular and steady kiln operation. It is therefore recommended to install a modern computer control systems for automatic kiln control.

Another important modification is the replacement of the existing plain oil burner with an adjustable type of burner by which it is possible to change the temperature profile in the burning zone and extend the life of the refractory lining.

## 7. Clinker Coolers.

As stated in the report by HMC the grate cooler area is too big for the present low production of 1100 - 1400 tpd of clinker. The cooler is still operated with a thin bed of clinker on the grate and a poor efficiency. It is recommended to reduce the speed of the grate in order to increase the bed thickness. In order to maintain the desired flow of air through the grate over the first cooler compartment it may be necessary to increase the speed of the cooling air fan for this compartment to enable operation with undergrate pressures up to 600 mm WG.

It is important to replace worn or damaged grate plates in order to ensure even distribution of air and to avoid excessive spillage of hot clinker through the grate.

Appendix 1

8. Cement Mills.

Each of the four cement mills have the main dimensions 4.4 x 15 m with two grinding compartments 4.9 m and 9.6 m long, and are arranged for grinding in closed circuit with a 5.0 m diameter SKET separator with 6 cyclones.

The first grinding compartment has step liner and the second compartment classifying liner. The double diaphragm is a weak item, and the mills are stopped and inspected at few days interval in order to detect damaged parts and avoid the loss of grate plates.

The mills have dual pinion drive with two speed reducers and two 2,100 kW motors each.

At present the mills are operated with reduced ball charges and at outputs of approximately 100 tpd, which is less than the nominal capacity of 110 tph at 3000 Blaine, but quite adequate to grind all clinker produced.

The internal water spray is not used because it is believed to cause clogging of material on the outlet grate. This seems to indicate that the spray angle is too wide and needs adjustment. It is recommended to use the internal water cooling when needed in order to keep the temperature of the cement below 120 deg. C, which is necessary to prevent excessive dehydration of gypsum in the mill and in the cement silo.

Pozzolana is not used at present, but should be taken into consideration as an attractive way of increasing the production of cement without the need for new investments.

9. Packing Plant.

The packing plant comprises 16 storage silos for cement, each with capacity 10,000 tons, 2 SKET and 4 Roto-Haver bagging machines, a Beumer palletizer machine as well as the necessary conveyors and bag dispatch equipment.

The bagging machines are idle most of the time due to shortage of paper bags, but cement is shipped in bulk and mainly in open trucks. This causes a considerable loss of cement during the loading into the trucks, and furthermore cement is also lost from numerous leakages of the extraction equipment underneath the cement silos. Cleaning up and maintenance is badly needed in this area.

Appendix 2

<u>Sheikh Said Cement Plant.</u>

<u>1. General.</u>

The Sheikh Said dry process plant with two 1,500 tpd production lines is located adjacent to the older wet process plant and the limestone and basalt quarry. The wet process plant was not visited and will not be discussed in this report.

The dry process plant was supplied by a Romanian Contractor and commissioned in 1981. It comprises common crushing plants and storage plants for raw materials, two production lines with raw milling plants, kilns with conventional 4-stage cyclone preheaters, grate coolers and cement mills as well as a common packing plant.

The nominal production capacity of the plant is 960,000 tpy of clinker or approximately 1.1 million tpy of cement with the addition of gypsum and pozzolan. However, during the last three years 1986-1988 the clinker production was only 60 - 70 % of the nominal capacity, whereas the specific consumptions of fuel and electric energy were markedly higher than average figures for this type of cement plant.

The reasons for this low degree of utilisation of the plant are identified in the following together with recommendations for improvement of the plant performance by changing of procedures or modification of plant design or equipment.

<u>2. Raw materials, quarry and crushing plant.</u>

The main components of the raw mix, limestone and basalt are quarried from benches in the deposit adjacent to the plant. The quantities of good quality and workable materials seem to be adequate for many years of operation. However, the depth of the layers of limestone and basalt changes as the quarry faces advance, and the future development of the quarry should therefore be studied and planned in detail.

Limestone is blasted from an up to 24 m high bench and basalt from an underlying somewhat lower bench. Poorly fragmented rock is broken up by means of a heavy "Blockbuster" mounted on a modified excavator on caterpillar belts. The rock is loaded into 13 tons dumpers by hydraulic excavators and hauled to one of the four hammer crushers in the crushing plant.

The four identical crushers are single symmetrical hammer crushers with flat belt drives and reversible drives. One of the crushers is used exclusively for basalt and for limestone for the wet process plant, whereas the other three crushers are used for limestone.

The capacity of each crusher is 250 -270 tph of limestone or 200 - 220 tph of basalt. The feed rate for each crusher is controlled by a control loop, which adjusts the speed of the laminated apron feeder according to the power consumption of the crusher motor.

The crushed limestone is stored in a covered and fully automatic PHB portal scraper store, capacity 2 x 10,000 tons, and the basalt is stored in a covered longitudinal bunker with bottom extraction by wheel reclaimer.

The operation of the quarry, crushing plant and the stores for crushed material is well organized and does not seem to cause any serious problem. However, some coarse basalt observed at the extraction from the store indicated a need for adjustment of the basalt crusher.

Some dust is generated when crushed basalt is discharged into the store. This problem could be solved by spraying the basalt with a wetting agent at the discharge point.

## 3. Raw Meal Preparation.

The main reason for the low degree of utilization of the capacity at the Sheikh Said plant is the poor condition of the raw mill drying and grinding system. The raw materials contain in average approximately 10.0 % moisture, which is too high for drying by means of the heat in the hot gases from the cyclone preheater.

Appendix 2

Heat calculations for raw mill/ kiln systems with 4-stage cyclone preheaters show that the heat in the preheater gases suffice for the drying of raw materials with up to about 8 % moisture only. For plants where the moisture content of the raw materials exceeds 8 %, it is necessary to supplement the heat from the kiln gases with heat from an auxiliary furnace or from other sources in order to obtain sufficient drying in the raw mill system.

The raw mill system at Sheikh Said plant does include an auxiliary furnace with the necessary ducting for operation of the raw mill and the dryer crusher with hot gases from the furnace, but according to the plant personnel it is at present impossible to operate the system with a mixture of preheater gases and gases from the furnace.

Furthermore it appears that the capacity of the auxiliary furnace is not big enough for drying of the raw materials without the use of preheater gases. It is therefore not possible to produce enough kiln feed for the nominal kiln production, even at the cost of additional fuel for operation with the auxiliary furnace.

This problem must necessarily be solved by rehabilitation or modification of the equipment and the installations within the raw mill system.

One of the reasons for the difficulties is the infiltration of excessive volumes of false air into the mill system and especially into the dryer-crusher through the double flap gates, which are not closing properly or not functioning at all. The infiltration of cold air reduces the negative pressure at the inlets to the mill and to the dryer-crusher, which hampers the operation of the auxiliary furnace and reduces the temperature of the drying gases.

Another reason is that the rotors have been removed from the dryer crushers, which are now used as flash dryers, still with some potential as dryers, but less efficient than before.

Furthermore, the fans for dryer-crusher and raw mill may give too low differential pressure to insure the necessary flow of gases through the mill system.

Appendix 2

In order to correct the drying problem in the raw mill system it is recommended to make the following rehabilitations and modifications:

- repair all leakages within the raw mill system
- repair the dryer-crusher, or if not feasible replace it with a different type of dryer-crusher or flashdryer with efficient airsluices
- repair instrumentation and control for the auxiliary furnace
- study alternative modifications for improvement of raw material drying and grinding system comprising:

  (a) separate gas flow circuits for kiln gases and gases from auxiliary furnace for drying in the raw mill and in the flash dryer respectively

  (b) utilization of hot air from the grate cooler for drying purposes

  (c) increasing the temperature of kiln gases by partial bypassing of the uppermost first stage of the cyclone preheater

  (d) predrying of the raw materials in a separate dryer installation

When the drying capacity of the raw mill system is restored the grinding capacity should also be increased by the re-installation of the grinding mill diaphragm, replacement of the grinding charge with the specified mix of ball sizes for each grinding compartment, and adjustment of the separator to normal circulating load.

The capacity of the raw mill systems can be increased further by the installation of high efficiency separators or roller presses if needed to match the kiln production.

Appendix 2

4. Raw Mix Control.

The chemical composition of the raw meal from the raw mill is checked by CaCO3 titration and the kiln feed is tested by X-ray analysis every hour, when the X-ray equipment is working. As the limestone is prehomogenized and the raw mill is fed by reliable weighing feeders, it is possible to maintain the composition of the kiln feed within specified limits by means of titrations. However it is recommended to introduce regular X-ray analysis of raw meal from the raw mills as a better basis for automatic control of the raw mill feeders.

5. Kiln and Preheaters.

The two identical kilns with main dimensions 4.6 x 75 m have conventional 4-stage cyclone preheaters and grate coolers, and nominal capacity 1500 tpd of clinker.

As mentioned in the discussion of the raw mix preparation the kiln production is limited mainly because of the low production of raw meal. However, the production is also hampered by other shortcomings of which especially the following call for attention.

- lack of essential instruments, which are out of order or not reading correctly. Examples are:
    - oil flow meter
    - kiln shell temperatur scanner
    - recorders for kiln motor power and O2/CO
- shortage of lining bricks
- stops due to break down of equipment in a bad condition of maintenance (kiln drives, V-belt drives for cooling air fans, clinker drag chain conveyors, etc.)
- lack of common kiln control philosophy and control system

The size of the kiln tube and the grate area of the clinker cooler are ample for production at the nominal capacity, and will with relativly small modifications suffice for a further increase of the production to 2000 tpd or a total of 1.28 million tpy of clinker for the two production lines.

Appendix 2

In order to reach this capacity it will be necessary to modify or replace the cyclone preheaters, install an adjustable type of oil burner, and increase the capacity of the grinding mill systems.

It is possible to increase the capacity of the existing preheaters by changing parts of the bottom cyclones and by replacing the top cyclones with LP type cyclones. However, this will require a prolonged kiln stop for the modification work. Alternative solutions are the replacement of the existing cyclone preheater with a new LP preheater, or the addition of a new separate precalciner/preheater string without removing the existing one.

The modification of the preheater can be designed for a kiln production of 2000 tpd of clinker. If the solution with a precalciner is chosen the production could be increased even further, but this may require the installation of new grinding mills, further modifications to the clinker cooler and other additional installations to match the increased flows of materials and gases.

## 6. Clinker Coolers.

The clinker coolers were already modified in 1985 for a capacity of 2000 tpd of clinker each . However, they should be operated with a thicker bed of clinker in order to improve the thermal efficiency and prolong the life of the grate plates. The cooling air fan for the first cooler compartment should be modified if necessary to enable operation with up to 600 mm WG air pressure.

The cooler speed should be set to automatic control by the undergrate pressure.

## 7. Cement Mills.

The two cement mills with main dimensions 4.2 x 10.75 m produce each about 90 tph of cement with 3 % gypsum and 6 % pozzolana when grinding to 2800 Blaine. This is well above the nominal capacity of 80 tph, and the capacity can probably be increased to 100 tph or more by optimizing the internal fittings, the composition of the ball charges and the separator settings.

Appendix 2

The capacity of the cement mills may therefore be adequate for grinding up to 2000 tpd of clinker from the upgraded kiln systems, even without the need for the installation of new separators or roller presses.

The mills run normally without internal water cooling because the moisture in the pozzolana provides the necessary cooling to keep the temperature of the mill product below 120 degr. C. This is normal and acceptable, but it is still important to monitor the temperature of cement from the mill. If the cement temperature exceeds 120 degr. C, the internal water cooling should be started, and if the temperature is less than 105 degr. C, the temperature should be increased by using pozzolana with less moisture content or by using hot clinker.

8. Packing Plant.

The packing machines were not used during the visit because of lack of paper bags. All dispatch of cement was done by bulk loading into rail- or road-tankers or into common lorries. The loss of cement during the bulk loading into common lorries should be stopped by the use of a temporary cover and dedusting arrangement at the loading station, until it can be eliminated by the provisioning of paper bags and by encouraging the customers to introduce lorries with bulk hoppers or - at least - top covers with openings for bulk loading.

Appendix 3

Aleppo Asbestos-Cement Factory.

The Asbestos-Cement Factory located adjacent to the Sheikh Said Cement Plant was down for a major overhaul during the visit on 2 November 1989. However, the visitors were guided on a tour of the plant and saw the fixed installations and the finished products.

The Asbestos-Cement Factory produces high-pressure pipes exclusively using two production lines for 3 m and 5 m pipes respectively. The raw materials are Portland Cement and a mix of white asbestos (Chrysotile Serpentine) and blue asbestos (Crocidolite Amphibole). The mix ratios are approximately 1 part of asbestos mix per 6 parts of cement, and 3 parts of blue asbestos per 7 parts of white asbestos.

The asbestos is received in plastic lined bags which, are opened in a bag cutting machine with dedusting filter. After pretreatment in a disintegrator the asbestos is mixed with cement and water in a tank mixer to the specified density and fed to the two pipe production lines.

The filter and pipe machines from FARBEN, Italy are conventional "Massa" type units with filter drums, vacuum boxes, pipe building-up and calandering stations, curing tunnel and roller conveyor for initial curing and hardening.

After 15 days hardening in water basins the pipes are finished by machining and testing for strength and tightness at the specified pressure.

The pipes are made with dimensions 80 - 700 mm diameter by 3 or 5 meter long, and to ISO standards.

The factory employs in total 350 employees when running at full capacity producing 1200 tons of pipes per month.

Appendix 3

The management did not raise any special questions with regard to production or product quality, but were interested in technical information regarding the development within the asbestos-cement industry in other countries. However, it was proposed to replace the asbestos disintegrator with an edge runner type machine for "wet" operation, which causes less damage to the asbestor fibres and also reduces the risk of emission of asbestos fibres into the production building.

Environment protection against the effect of air-suspended asbestos fibres and the trend towards replacement of asbestos with other and less harmful fibres were also discussed. It was recommended to monitor the development in other countries in order to benefit from the experience gained within these fields.

The regulations for control with the emission of asbestos fibres have stopped the manufacture of asbestos cement in some countries or called for extensive protection and control procedures for the manufacture, application and especially the maintenance and demolition of asbestos cement products and the handling and disposal of asbestos waste.

In order to prevent damages to health caused by asbestos fibres it is necessary to measure the content of fibres in samples of air from buildings or areas where asbestos is used. The samples are collected by pumping air through special filters and counting the fibres by means of optical phase contrast microscopy or preferably by the use of Electron Microscopy and X-ray equipment for detection and identification of all fibres down to 0.1 micron in thickness.

Whereas corrugated sheets and other sheet products are today manufactured successfully without asbestos, it has been more difficult to find suitable fibres to substitute asbestos in high pressure pipes. However, because of the reluctance to use asbestos products the trend is now to use pipes of other materials such as steel, concrete or plastic instead of asbestos cement pipes.

Appendix 4

List of officials and management staff personnel met during the mission.

| Name | Title |
|---|---|
| Al-Leham | Director, Ministry of Industry |
| Al-Sibai | Director, Planning Commission |
| Hani H. Nabulsi | Director, General Organization for Cement and Building Materials (GOC) |
| Salim Issa | General director, Tartous Cement Co. |
| Adnan Fakhri | Technical director, Tartous C.Co. |
| Hussein Kordie | General director, Arab Cement Co. |
| Riad Mimi | Manager projects, Arab Cement Co. |
| A. Fouad Khayat | Ass. General Director, Aleppo Asbestos Cement Co. |

Appendix 5

## Travel and Work Schedule

Post: DP/SYR/86/009/11-12 (Revised)
Name of expert: Mr. Henrik Carlsen
Duration: 9 oct - 14 nov 1989

| | |
|---|---|
| 09 oct | Travel to Vienna |
| 10 oct | Briefing in Vienna |
| 11 oct | Arrival in Damascus |
| 11 - 15 oct | Meetings at Ministry of Industry, Planning Commission, GOC and UNDP in Damascus |
| 15 oct | Travel to Tartous |
| 15 - 25 oct | Visit to Tartous Cement Plant |
| 25 oct | Travel to Aleppo |
| 26 oct - 5 nov | Visits to Sheikh Said Cement Plant and Aleppo Asbestos-Cement Factory |
| 5 nov | Travel to Damascus |
| 5 - 12 nov | Meetings at GOC, Ministry of Industry and UNDP |
| 12 nov | Travel to Vienna |
| 13 nov | Debriefing in Vienna |
| 14 nov | Travel to Copenhagen |