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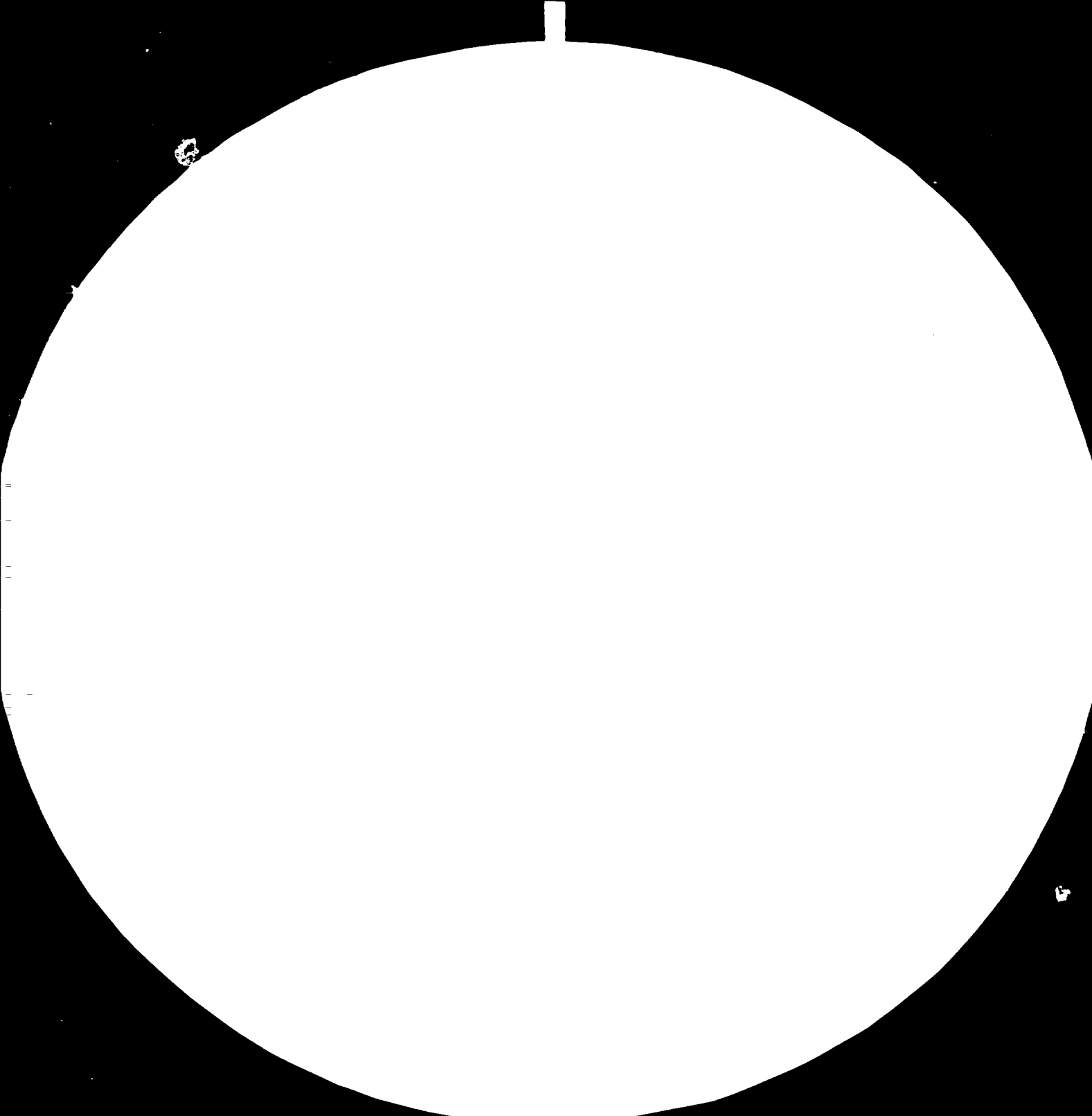

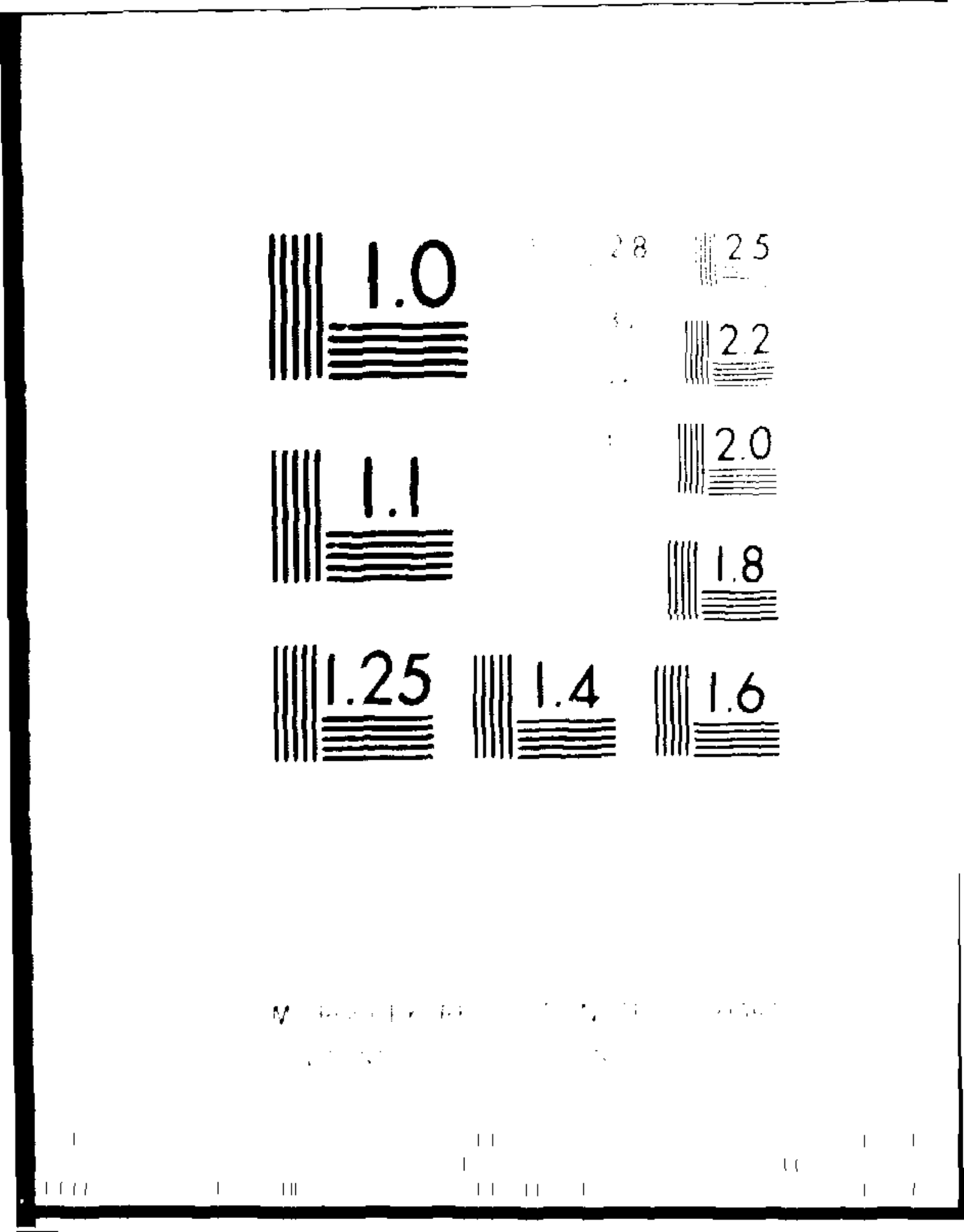
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UNIDO/IO/R.33
28 October 1981

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

ASSISTANCE TO THE LIBYAN CEMENT FACTORY, BENGHAZI

TF/LIB/75/002
LIBYAN ARAB JAMAHIRIYA

Mission report: Progress of project from 10 May 1980 to 31 July 1981

Prepared for the authorities of the Libyan Arab Jamahiriya
by the United Nations Industrial Development Organization

Based on the work of A.R. Marei, project co-ordinator

V.81-31284

Explanatory notes

The monetary unit in the Libyan Arab Jamahiriya is the Libyan dinar (LD). During the period covered by the report, the value of the Libyan dinar in relation to the United States dollar was $US 1 = LD 0.296.

A full stop (.) is used to indicate decimals

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

References to 'tons' are to metric tons

The following forms have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

The following abbreviations of organizations are used in this report:

HMC	Holderbank Management and Consultancy, Switzerland
INDUMONT	KHD Industrieanlagen AG
KHD	Kloeckner Humboldt Deutz, Industrieanlagen AG, Federal Republic of Germany
LCC	Libyan Cement Company
WEDAG	Westfalia Dinendahl Aktiengesellschaft Groppel, Federal Republic of Germany

The following technical abbreviations are used in this report:

kcal/kg	kilocalorie per kilogramme
kWh/t	kilowatt hour per ton
m/sec	metre per second
t/d	ton per day
t/h	ton per hour
t/m^3	ton per cubic metre

Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

ABSTRACT

This project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/75/002), is being carried out for the authorities of the Libyan Arab Jamahiriya by the United Nations Industrial Development Organization (UNIDO) under a trust-fund agreement. This project, which was approved in 1975 and has been operating since 1976, is designed to give direct technical assistance to the cement industry.

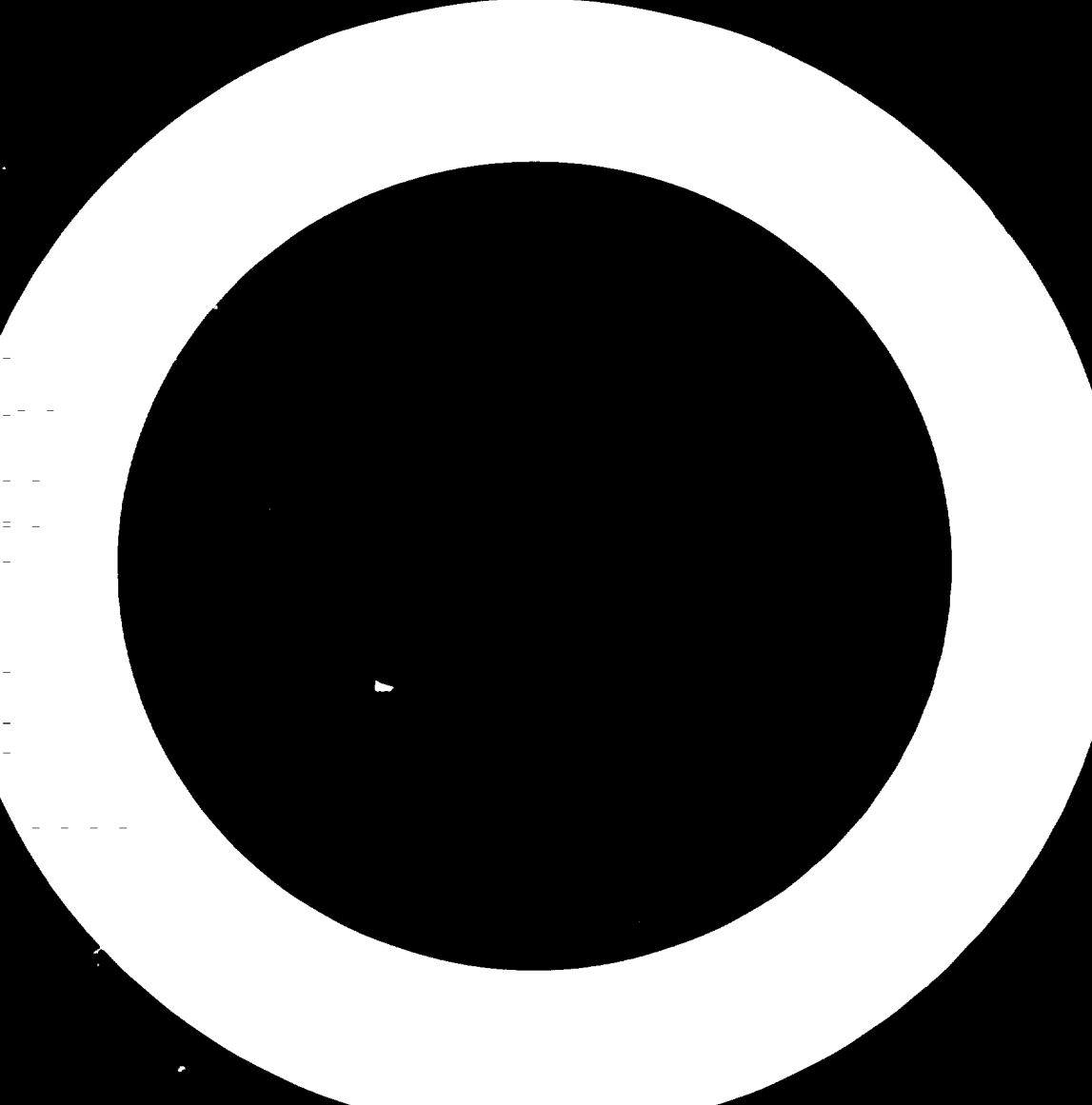
This report covers the mission of the expert who took over as project co-ordinatior in May 1980 and deals with the progress of the project from May 1980 to July 1981. Details are given of the new standby group selected in March 1981, the projected personnel situation up to August 1981 and the initiation of daily and monthly reports. The project faced some major problems over accommodation for the Polish team, supplying the team members with air tickets and the request by Polservice for an increase in the salaries of Polish specialists. A new development in the project has been the authorities' request that the new Fatayeh Cement Project (Derna), should be supplied with a team similar to that serving in the Hawari Cement Plant. In co-operation with UNIDO, the Libyan Cement Company (LCC) arranged to hold a cement seminar in Benghazi in April 1982 and to train three Chinese engineers in LCC plants. The expert also accompanied a LCC delegation to the Federal Republic of Germany to discuss technical problems with the contractor and to Greece to discuss cement specifications.

The success of the technical assistance given by the UNIDO specialists has been reflected in the very satisfactory performance of the Hawari Cement Plant as shown in this report.

The report also covers activities in the field of mechanical and electrical maintenance, the re-alignment of the Benghazi cement kilns and the problems of the lime plants.

Besides assisting with day-to-day operational problems, the co-ordinator also tackled the more permanent problems affecting cement production, including the provision of bypasses for the kilns in the Benghazi Cement Plant and the installation of an additional bucket elevator for transporting clinker to cement mills II and III at Benghazi. Surveys were made of the problems of the formation of cement lumps and aggregation in the cement silos, developing gypsum-ore reserves, introducing the production of sulphate-resisting cements and the establishment of cement terminals in the country. (The results of these surveys are to be issued as separate technical reports within this series. See annex VIII.)

At the request of the Secretary for Heavy Industry, the co-ordinator also acted as a member of the project committee planning the new Southern cement plant.



CONTENTS

Annexes

Figures

INTRODUCTION

This report deals with the activities of the project co-ordinator and the progress of the project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/75/002), through the period May 1980 to July 1981.

This project, carried out by the United Nations Industrial Development Organization (UNIDO) for the authorities of the Libyan Arab Jamahiria, was approved in 1975 and fieldwork began in 1976.

The expert was first fielded for a short mission from 10 May 1980 to 9 August 1980 and his mission was then extended till 9 November 1981. The assignment was financed first under a trust-fund arrangement and then through the overhead costs of the project.

Project background

The Libyan cement industry started in the eastern part of the country with the setting up of the Libyan Cement Company (LCC). This company began its activities in Benghazi in April 1972 with one production line producing 200,000 tons per year of normal portland cement. Consecutive extensions followed with a second production line (600,000 tons per year) which was started up in August 1974. The third production line, with a similar annual production capacity was taken over in January 1977. The last extension in the form of a new cement plant at Hawari with an annual capacity of 1 million tons, was provisionally taken over in August 1978. By this time, the cement production capacity in the Benghazi area had reached a total of 2 million tons per year.

A complex of other building-material industries has also been developed. A lime plant started production in March 1975 with a production capacity of 43,000 tons of hydrated lime per year. This plant was further extended by the installation of a second production line. A paper-bag factory with an installed production capacity of 100,000 paper bags per day started production in June 1975. A second production line was added in December 1978. In June 1978, a concrete-block factory with a capacity of 100,000-120,000 cubic metres per year of finished concrete blocks was put into operation. The complex was completed by the installation of a ceramic-brick factory with a capacity of 60,000 tons per year which was commissioned in June 1979.

With this rapid expansion of industrial projects in the building-materials field, LCC was confronted with a greatly increased need for experienced technical personnel to operate the various factories. UNIDO was requested for assistance in supplying technical personnel and advising on the development and expansion of the industry.

This assistance began in 1976 with the appointment of a building-materials adviser who later acted also as project co-ordinator. By May 1978, a technical-assistance team of 52 experts was in the field and this is now being expanded to include 100 experts with diverse specializations.

The present project co-ordinator took over this function in May 1980. His duties and responsibilities include:

(a) Acting as co-ordinator for all UNIDO technical assistance to the Libyan cement industry;

(b) Being responsible for the administrative, social and public-relations services for the Polish specialists;

(c) Together with national counterparts, overseeing normal daily production and dealing with technical and operational problems which arise;

(d) Giving advice to the technical staff on raw materials, raw-mix designs, quality control, laboratory testing and the evaluation of test results.

RECOMMENDATIONS

1. Priority should be given to erecting the prefabricated buildings for the accommodation of the 100 specialists. Five flats are necessary in Benina Industrial City.

2. The air-ticket problem can be solved if one of the following recommendations is adopted:

(a) That Libyan Airlines in Benghazi should be authorized to issue the air tickets direct. This can be checked by the co-ordinator;

(b) That Polservice should be authorized to buy air tickets for the specialists through its representatives in Benghazi. The cost of the air tickets can be reimbursed on submission of the air-ticket stubs;

(c) That LCC should be authorized to provide vouchers after receiving a telex from UNIDO. The matter can be followed up by the co-ordinator in his monthly reports and by sending the ticket stubs to UNIDO;

(d) That UNIDO should issue a number of vouchers Benghazi-Warsaw-Benghazi or Benghazi-Warsaw which can be submitted to the Libyan Airlines through the co-ordinator when UNIDO gives permission.

3. The recently-established mechanical-planning section should be strengthened to plan and oversee the regular preventive maintenance and to study any new machinery or projects for both plants. The spare parts lists, the orders and the performance of equipment should be checked regularly. All this will help in reaching the production target for 1982 which has been set at 75% of the designed capacity.

4. It is strongly recommended that daily and other periodical meetings should be held between the department managers and the plant manager, to discuss and organize maintenance, spare parts, raw materials, overhauling of equipment and difficulties on any production line.

5. The alignment of the kilns should be checked every year. Local engineers should be trained to take over this job in the near future.

6. Some sections of the Benghazi kilns are in a bad condition. It is recommended that replacement sections should be ordered to deal with the problem of falling fire-bricks, which usually occurs in these deformed sections.

7. There are five kilns serving clinker production and, of these, one at least must be stopped for relining with fire-bricks. It is, therefore, recommended that a special group should be designated to take care of relining kilns with fire-bricks. This group can be assisted by the technicians of the stopped kiln.

8. The overhauling of any production line ought to be properly planned and scheduled in advance at meetings between the managers and the technical personnel responsible. The overhaul programme must be followed to its completion in order to ensure the efficiency of the overhauled producton lines. All the spare parts necessary to carry out the scheduled overhaul ought to be prepared and checked before starting.

9. Periodic preventive maintenance for the Benghazi clinker transport and elevators ought to be done as this system represents the main bottleneck in the Benghazi clinker production.

10. The recommendations indicated in Holderbank's report to LCC about the sized limestone required for the Lime Plant should be implemented. The crusher's motor pulleys should be changed, the direction of the rotor should be periodically reversed, the lowest deck on both Mogensen sizers should be adjusted and the extraction system at the quarry should be changed.

11. As no clear and significant effect is achieved by adding limestone to gypsum during grinding with clinker in order to improve the flowability of cement, it is recommended that further researches should be carried out in the LCC laboratories into the effects of applying different types of additives or adding iron ore or pyrite ash to the raw mix to prevent the formation of cement lumps and accretions in the cement silos. It is not recommended that the inside walls of the cement silos should be painted, nor that the cone structure should be erected before obtaining guarantee figures.

12. It is recommended that preparations should be started for introducing the production of sulphate-resisting cement by the LCC. The feasibility study, submitted some months ago, showed that this would be practicable and advantageous.

(Recommendations 11 and 12 are discussed more fully in separate technical reports on these subjects. See annex VIII.)

I. SUMMARY OF PROJECT PROGRESS AND ACTIVITIES

Progress of the project

1. In general, the technical-assistance projects in all the LCC's plants are making satisfactory progress, and co-operation between national technical personnel and UNIDO team members is developing well.

2. The value of the Polish team working at Hawari in support of LCC personnel was reflected in the performance of the Hawari Cement Plant in 1980 and 1981 which showed a marked improvement despite various difficulties. (For graphs showing a comparison between production figures for 1979 and 1980 at Hawari, see annex I.)

3. The success of the project to date was also reflected in the request from the Libyan authorities that UNIDO should recruit a similar technical-assistance team for the Fatayeh Cement Project (Derna).

4. Further co-operation between UNIDO and the Libyan authorities included arrangements for the Cement Seminar in Benghazi in April 1982 and for the training of three Chinese engineers in LCC plants.

Activities of the project co-ordinator

1. The technical-assistance team

The co-ordinator was responsible for reviewing and up-dating the situation of the technical-assistance team and for dealing with general and personal problems faced by team members in co-operation with Libyan site personnel, with UNDP (Tripoli) and with UNIDO (Vienna). The main problems which occured were:

(a) Accommodation for technical-assistance team members. Fortunately, this problem will be solved within the next few months by the erection of prefabricated buildings;

(b) Supplying team members with air tickets for annual leaves, family visits, repatriation etc.;

(c) The request from Polservice for an increase in the salaries of Polish specialists.

2. Production and maintenance

The co-ordinator was involved in helping to solve day-to-day operational and maintenance problems with the full support and co-operation of the LCC technical staff. Activities included:

(a) Introducing true preventive-maintenance programmes for kilns I and II (Benghazi), the benefit of which was later reflected in improved production figures;

(b) Requesting the realignment of the rotary kilns by the contractors;

(c) Attempting to increase productivity through regular production and maintenance meetings, initiating a daily production report (to be written by the Polish technicians) and reviewing the daily reports and checking equipment with the works manager;

(d) Advising on brick linings, quality of fire bricks, charging the raw and cement mills with grinding media, and similar problems;

(e) Participating in the revision of some tender documents, evaluation of bids and negotiations with tenderers and suppliers.

3. Missions

The co-ordinator went on several missions at the request of LCC:

(a) To the cement factories Al-Khums I and Al-Kuhms II as a technical consultant;

(b) To the Federal Republic of Germany accompanying an LCC delegation to the contractors, Kloeckner Humboldt Deutz (KHD), to discuss problems concerning the Hawari Cement mills (the cracks in cement mill II, the pinion and girth-gear damage in cement mill I), the new clinker-transport system, technical assistance and other questions. (A detailed protocol of these discussions is given in annex II);

(c) To Greece accompanying the economic manager to discuss the requirements of LCC's customers concerning the technical specifications of sulphate-resisting cement and the possibility of importing pyrite ash, and to visit cement terminals in Greece.

4. Studies and project evaluations

The co-ordinator was also involved in investigating some major and long-term problems in the cement industry and in evaluating new project proposals referred to him by the LCC authorities or by the Secretary for Heavy Industry. These included:

(a) The study of new project proposals for erecting a bucket elevator to Benghazi Cement Mills II and III and erecting bypasses to the Benghazi kilns;

(b) The evaluation of the final reports on raw materials for the cement and lime industry carried out by Polservice in the Wadi Ash Shati and Al-Jufrah areas and participating as a member of the committee of this project in reporting, discussing and negotiating the requirements of the project to be erected in the Al-Jufrah area (Southern cement project);

(c) A study of the problem of aggregation and lump-formation in LCC cement silos, including performance tests and research studies in LCC laboratories on the addition of grinding aids and iron oxides to overcome these problems;

(d) An evaluation of the gypsum-ore reserves necessary for cement production in both the Libyan Cement Company and the Fatayeh Cement Project. A complete technical and economic feasibility study was carried out;

(e) A detailed feasibility study concerning the possibility of producing sulphate-resisting cement (SRC) in the Libyan Cement Company as this type of cement has at present to be imported. This study can be used as a basis for further studies of SRC production in other Libyan cement factories;

(f) A detailed feasibility study concerning bulk cement distribution and the establishment of cement terminals.

(See annex VIII for the titles and numbers of these reports).

II. ADMINISTRATION

A. The technical-assistance team

Technical assistance to the Hawari Cement Plant began at the period of commissioning, acceptance tests and take-over of the new factory in May 1978 with the arrival of the first group of experts at the duty station. The second group arrived in August 1978, followed by the third group in November 1979. The fourth and fifth groups were fielded in Janury 1980, followed by the sixth group in March 1980.

During the period covered by this report, the seventh group arrived in Benghazi in August 1980, followed by the eighth, ninth and tenth groups which joined the team in September 1980, December 1980 and March 1981 respectively.

The technical assistance continued to cover the operation and maintenance of the Hawari Cement Plant as its main focus, but assistance was also given with problems relating to the Benghazi Cement Plant and the lime, concrete-block, ceramic-brick and paper-bag plants.

By the end of 1980, after the arrival of the ninth group and after further personnel had been requested from the standby group, it became clear that there was insufficient personnel on the standby group list. Accordingly, it was agreed that UNIDO, in conjunction with Polservice, should prepare a complete group as requested by LCC through the co-ordinator so that a new standby group list would be ready if any new selections needed to be made.

In March 1981, a delegation from LCC (S. El-Sherif, A. Er-Hayem, S. Shaker and O. El-Emami) travelled to Poland for a meeting with the UNIDO project personnel recruitment officer and Polservice representatives and started interviewing candidates recommended for the project by Polservice. The co-ordinator was expected to accompany the LCC delegation but, in the event, it was necessary for him to remain in Benghazi to take care of the various production problems.

Subsequently, the co-ordinator assembled the results of the interviews and tabulated them according to specialization and budget line. With LCC approval, these tables were then sent officially to UNIDO as the new standby list.

LCC started to select some specialists from this standby list. However, further recruitment was hampered at this point by the whole problem of an increase in the salaries of Polish specialists requested by Polservice. This question had to be at least partially resolved (see section D below) before recruitment could proceed.

A new team leader, A. Medynski, arrived at the duty station on 6 April 1981 to replace K. Jozefowicz. This team leader was fielded by Polservice to carry responsibility for the technical-assistance team on their behalf. The team leader is assisted on the site by two persons:

(a) M. Gorzelanny, dealing with social and public relations matters;

(b) A. Bryczkowski, translator and teacher of English.

Polservice is now providing English language lessons for the specialists to help overcome their language problems.

The development of the technical-assistance team personnel up to 1 May 1981 is given in annex III. At that time, there were 73 Polish specialists at the duty station. Twenty-six specialists had been repatriated at various stages and another 13 repatriations were expected. There was still a requirement for about 40 specialists of whom 23, in the eleventh and twelfth groups, were expected to be fielded shortly.

B. Initiating reporting systems

Monthly administrative reports

From the beginning of this mission, the co-ordinator started sending out a monthly statement showing annual leave, home leave, sick leave and work injury figures with cumulative totals of these given in the same report. The co-ordinator later changed this reporting system so that monthly figures and cumulative totals are reported separately.

At the request of UNIDO, another monthly report was prepared showing the presence or absence of all UNIDO team members on each day of the month with reasons given for absence.

Daily production report (Hawari)

There is a daily production meeting at which it is important to discuss, among other things, the notes on each shift made by the Polish shift leaders. However, this proved very difficult as the notes were written in Polish. The co-ordinator therefore asked the team leader to translate the shift leaders' notes daily. This report, together with the co-ordinator's comments, is then passed on to the works manager, the operations manager, and the managers of the mechanical and electrical departments.

C. Revision of project particulars

During the briefing of A.M. Afify in Vienna in November 1980, a committee headed by M. El-Neihoum, Financial Manager at that time, arrived at UNIDO headquarters (Vienna) to revise the project particulars. The result of this committee's mission was indicated in A.M. Afify's mission report, dated 16 January 1981 (UNIDO/IO.437).

At the request of the LCC authorities and as agreed with the UNIDO project officer, another committee, headed by the present Financial Manager, M. Zayed, and accompanied by the co-ordinator, arrived in Vienna to revise the situation of the project at the end of August 1981.

D. Major problems tackled

Accommodation

The Polish specialists are accommodated in buildings procured by LCC in two separate areas. The first and main area is in the new industrial city at Benina, 18 kilometres from the factory. There, specialists occupy two buildings containing a total of 16 flats. Each flat consists of three rooms. The buildings are recently built using the modern system of precast elements. They have been equipped by LCC with suitable furniture. About 80% of the specialists are housed in these flats. LCC is responsible for transporting the specialists to and from the LCC works, the city shopping centre, the beach (in summer), church etc.

The other housing is in the LCC's residential area, very close to the works. About 20% of the Polish team are selected to live there in case they are needed by the company in emergencies. This selected group occupies two flats containing eight rooms altogether.

All the flats provided in the two areas are only sufficient for 80 or, at a maximum, 85 specialists. Usually, in summer, some of the specialists' families arrive to live with them. Therefore, there are times when the flats are too crowded and the difficult living conditions are probably responsible for several premature repatriations. In any case, there is insufficient accommodation to bring the team up to 100 specialists as originally contracted. The co-ordinator discussed this problem many times with the LCC. LCC personnel are very keen to solve this problem and they have investigated many possible solutions. Finally, they hit on the idea of erecting prefabricated buildings and they started to contact specialized suppliers in this field. This problem was discussed by the UNIDO project officer and A.M. Afify during their last visit to Benghazi in June 1981. LCC promised to solve the problem by erecting prefabricated flats in the company's residential area near the Hawari Cement Plant.

LCC has recently received some offers from Italian companies for the erection of prefabricated flats and they are now considering which best offer. Since the number of specialists who can be fielded at the station must remain limited to a maximum of 80-85 until the accommodation problem is solved, the co-ordinator will continue to pursue this matter and will inform UNIDO of any further progress.

As this report was being finalized, the co-ordinator was informed by M. El-Neihoum, the General Manager, that LCC will provide the group with three more flats in the meantime.

Air tickets

One of the major problems faced by the co-ordinator and the project is the delay in issuing air tickets for the specialists through UNDP (Tripoli) in cases of annual leave, family visits and repatriation. The co-ordinator informed UNIDO about the problems and proposed a solution. He asked UNIDO to authorize the Libyan Arab Airlines in Benghazi to issue the air tickets and the entitlement to excess baggage directly. This arrangement will be more convenient for all the Polish specialists. The UNIDO project officer and A.M. Afify were asked, at their meeting at LCC with the Polish team, to try and solve this problem which has created much inconvenience for all the group members. The solution needs to be one which avoids administrative and financial complications.

Increasing the team's salaries

Early in 1981, Polservice, through UNIDO, asked LCC to increase the salary scales of the Polish specialists already in Benghazi and those due to be appointed. They requested this increase as of July 1981 and according to the following scales:

Grade A:	from $US 2,236 to $US 2,561
Grade B:	from $US 1,806 to $US 2,077
Grade C:	from $US 1,462 to $US 1,681

These scales would represent an increase of about 15%. LCC agreed to a salary increase in principle but did not agree to one of 15% as the cost of living had not increased to this extent either in the Libyan Arab Jamahiriya or in Poland. Polservice then proposed a reduced increase of 12% and a tripartite meeting in Vienna in August 1981 to discuss the matter. LCC also declined the 12% proposal but a tripartite meeting (LCC + UNIDO + Polservice) was arranged at LCC headquarters in Benghazi from 26-28 August 1981. At this meeting, an agreement was signed to increase specialists' salaries by about 5.5%. Another meeting will be held in Poland in July 1982 to study the cost of living increase and adjust salary scales accordingly.

E. Fatayeh Cement Project (Derna)

This new project is under construction. It is designed to have a production capacity of 1 million tons per year. The project site is 19 kilometres from Derna on the Tobruq road. Mitsubishi Heavy Industries (MHI), Japan, are responsible for erecting this new plant on a turnkey basis. Steps had already been taken by A.M. Afify at the request of the Libyan authorities to supply the new project with a technical-assistance team similar to the UNIDO team operating in Hawari.

The co-ordinator followed up these steps and began discussions on the project requirements with A.B. El-Ghazali, Secretary of the Fatayeh Project Committee at the request of A.M. El-Gheriani, the Under-Secretary of Heavy Industries. In these discussions, it was agreed that the project would need 100-150 specialists and a list of the requirements was prepared which was submitted to UNIDO on 11 May 1981. The co-ordinator also suggested that details of the requirements should be fully discussed with A.M. Afify and the UNIDO project officer on their missions to Benghazi in June 1981.

The UNIDO project officer, A.M. Afify and the co-ordinator discussed the matter with A.M. El-Gheriani at Tripoli and with A.B. El-Ghazali at Derna and the requirements were rearranged accordingly. (See annex IV for details of the technical-assistance team required.)

Some of these specialists should be fielded at the beginning of January 1982, in time for the commissioning of machinery and equipment, and the whole group should be at the duty station by the date of readiness-for-acceptance tests. The agreement with UNIDO will follow the same conditions as for project TF/LIB/75/002, except that the 14% overhead costs ought to be decreased.

F. Cement seminar and training Chinese engineers in LCC plants

A letter from A.B. El-Saltani, reporting on the UNIDO cement seminar held in China was sent to the Secretary of Heavy Industry. This letter recommended that:

(a) Chinese engineers should be received for training in LCC Plants in Benghazi;

(b) A cement seminar similar to that held in China should be held in Benghazi under the supervision and organization of UNIDO, to be financed by the Libyan authorities.

These proposals were agreed to by the Secretary of Heavy Industry and UNIDO was informed about them. There was then a misunderstanding in which UNIDO thought that six Chinese engineers would be trained in LCC plants and financed by LCC and that the cement seminar would be financed through project budget TF/LIB/75/002. Accordingly UNIDO put $US 245,217 under budget line 35.00 and $US 180,000 under budget line 31.00 as a possible reserve for financing the two events mentioned.

LCC sent a letter clarifying the situation as follows:

(a) LCC agreed to train only three Chinese engineers for six months each in LCC plants. Financing of their training period should be done through UNIDO or the Chinese authorities. LCC would take care of training plus accomodation;

(b) The cement seminar would be financed through a special budget and not through TF/LIB/75/002. The two proposals were discussed in detail during the mission of the UNIDO project officer to Benghazi.

G. Routine work and activities

The activities mentioned above are just examples of the administrative work carried out by the co-ordinator as and when specific questions or problems arise. The co-ordinator has also to carry out the following routine administrative daily or monthly tasks:

(a) Taking care of the Polish specialists' daily requirements and problems through liaison with both LCC and Libyan officials and with UNDP in Tripoli. It was agreed with the Polish team leader to hold a monthly meeting with the Polish specialists to discuss their problems;

(b) Corresponding with UNIDO (Vienna), UNDP (Tripoli), the Secretariat of Heavy Industries (Tripoli) and the Under-Secretary of Heavy Industries, and the Department for the United Nations and International Organizations of the People's Committee for Foreign Liaison (Tripoli) on matters concerning the project;

(c) Corresponding with UNIDO on other matters, e.g. the participation of LCC representatives in UNIDO seminars, training programmes etc.;

(d) Reception of UNIDO representatives and Senior Industrial Development Field Advisers (SIDFA) on official visits connected with the project;

(e) Attending meetings with the UNDP Resident Representative in Tripoli on project matters;

(f) Contacting the LCC administrative and financial departments to arrange for the transfer of the monthly amounts under the trust-fund agreement.

III. PERFORMANCE OF LCC CEMENT PLANTS, HAWARI AND BENGHAZI, IN 1980

This chapter deals with the performance of both LCC cement plants, Hawari and Benghazi. The performance of each production unit is fully analysed and all the production data are given in annex V.A-Q. These statistics (fully analyzed), and the co-ordinator's comments on them, have already been submitted to the LCC in Arabic.

A brief summary of the production statistics is given below.

Raw-materials sections

At Hawari, the limestone crusher produced 562,232 tons of crushed limestone during 1,416 operating hours, with an average rate of 397 t/h which is 88.2% of the designed capacity.

The clay crusher produced 304,380 tons of crushed clay during 1,489 operating hours, with an average rate of 204 t/h which is 136% of the designed capacity. The performance of both limestone and clay crushers at Hawari has been satisfactory.

At the Benghazi raw-materials department, production data were not available but it can be stated that raw mill II stopped for 33 hours due to a raw-materials shortage (both limestone and clay). Raw mill III stopped for 678 hours due to overhauling limestone crusher III and for 243 hours due to a shortage of limestone and clay.

Raw-mills sections

Raw mills I and II at Hawari produced 844,032 tons during 7,700 hours with an average rate of 110 t/h which represents 100% of the designed capacity. Raw mills I, II and III at Benghazi produced 648,083 tons during 6,769 hours.

Raw mill I produced 77,834 tons during 1,714 hours. Production was estimated at 70% of designed capacity. The ratio of actual to estimated production was 34%. The rate of production was 45.4 t/h which represents 100.9% of designed production rate (45 t/h). The energy consumption was 42 kWh/t.

Raw mill II produced 193,666 tons during 1,822 hours. Production was estimated at 70% of the designed capacity. The ratio of actual to estimated production was 42%. The rate of production was 106.3 t/h which represents 88.7% of designed production rate (119.5 t/h). The energy consumption was 33.3 kWn/t.

Raw mill III produced 377,644 tons during 3,233 hours. Production was estimated at 70% of the designed capacity. The ratio of actual to estimated production was 82%. The rate of production was 117.0 t/h which represents 97.9% of the designed production rate of the mill (119.5 t/h). The energy consumption was 29.0 kWh/t.

The average energy consumption for all Benghazi raw mills was 32.3 kWn/t. The average energy consumption for all LCC raw mills was 32.4 kWh/t.

The raw-mix grinding sections had some difficulties which led to the raw mills stopping. The stoppages are explained in annex V.Q.

Kilns

The total clinker production of Hawari kilns (I and II) was 505,264 tons. The estimated production of the two kilns was 640,000 tons, i.e. the performance of the two kilns was 78.95%. The performance of the kilns in relation to possible production was 50.6%. The mean energy consumption for both kilns was 914 kcal/kg.

Total clinker production of Benghazi Kilns I, II and III was 385,502 tons. The estimated production of the three kilns was 690,000 tons, i.e. the performance of the three kilns was 55.87%. The performance of the kilns in relation to possible production was 38.6%. The mean energy consumption of the three kilns was 884 kcal/kg.

The kilns were stopped due to some difficulties explained in detail in annex V.Q.

Cement-grinding sections

The total cement production of the Hawari Cement Plant (lines I and II) amounted to 537,247 tons during 6,349 hours. The designed performance rate of each mill is 90 t/h. The actual mean performance of each mill was 85 t/h, or 94% of capacity. The rate of energy consumption was 28 kWh/t. Actual production was 71.6% of estimated production.

The total cement production of the Benghazi Cement Plant (lines I, II and III) amounted to 442,497 tons during 6,337 hours. Energy consumption was 43.8 kWh/t. Actual production was 59% of estimated production.

Cement mill I produced 37,004 tons during 1,017 hours at a rate of 36.5 t/h. The designed production rate was 45 t/h. Performance was therefore 80.9% of capacity. Mean energy consumption was 41.7 kWh/t. Actual production was 25% of estimated production.

Cement mill II produced 164,503 tons during 2,083 hours at a rate of 79 t/h. The designed production rate was 90 t/h. The performance was 87.8% of capacity. The mean energy consumption was 46.2 kWh/t. Actual production was 54.8% of estimated production.

Cement mill III produced 240,988 tons during 3,237 hours at a rate of 74 t/h. The designed rate was 90 t/h. Performance was therefore 82.2% of capacity. Energy consumption was 42.4 kWh/t. Actual production was 80.3% of estimated production.

The total production of cement in both plants amounted to 979,744 tons.

The mean energy consumption was 34.97 kWh/t. Actual production was 65.3% of estimated production.

The cement mills had serious trouble with cracks in shells and trunnions and accordingly had to be stopped. The stoppages are explained in detail in annex V.Q.

Packing departments

At the Hawari Cement Plant, the total packed cement amounted to 422,470 tons. The total bulk cement of the Hawari Cement Plant amounted to 106,797.5 tons. The total cement sold (packed and bulk) was 529,267.5 tons. The cement despatched was 70.6% of the estimated amount. Bulk cement was 20.0% of all cement despatched.

At the Benghazi Cement Plant, the total packed cement amounted to 331,949 tons. The total bulk cement of the Benghazi Cement Plant amounted to 111,955 tons. The total cement sold (packed and bulk) was 443,904 tons. The cement despatched was 59.2% of the estimated amount. Bulk cement was 25.2% of all cement despatched.

All the data on production are given in annex V as follows:

A. Raw materials used in raw mix in Hawari (raw mills I and II separately)

B. Total raw materials used in raw mix in Hawari

C. Total raw materials used in raw mix in Benghazi (raw mills I, II and III)

D. Total raw-mill production in LCC plants

E. Hawari raw mills: output, stoppages and energy consumption

F. Hawari kilns I and II: estimated and actual production and consumption of fuel, refractory bricks and energy

G. Benghazi kilns I, II and III: estimated and actual production and fuel and energy consumption

H. Clinker output in LCC plants

I. Hawari kilns: output, stoppages, energy and fuel consumption (1979 and 1980 compared)

J. All LCC cement mills: output, operating hours, stoppages and energy consumption

K. Hawari cement mills: output, stoppages and energy consumption (1979 and 1980 compared)

L. Cement packing and despatch in Hawari and Benghazi

M. Operating hours of the main sections in Hawari and Benghazi

N. Summary of production in Hawari

O. Stock at Hawari

P. Analysis of stoppages in Hawari Cement Plant

Q. Analysis of stoppages in Benghazi Cement Plant

IV. MECHANICAL AND ELECTRICAL MAINTENANCE

Both Hawari and Benghazi Cement Plants' workshops are well equipped with modern machines to carry out the usual plant repairs. The staff in Hawari (Polish team) and Benghazi can carry out maintenance services in a satisfactory way. In Benghazi, there is a shortage of supervisory personnel and an effort was made recently to remedy this.

Routine daily tasks are usually covered but there is not enough time left for inspecting plant equipment and machinery and the planning of regular preventive maintenance has been neglected. A mechanical planning section was recently established with four mechanical engineers whose task will be to plan regular machinery inspection, preventive maintenance and lubrication and to study any new machinery or process.

Partly because the mechanical staff is mostly involved in repair work and the planning section has not yet started to carry out its own functions, unnecessary stoppages occur such as having to stop the kilns for further repairs or relining soon after they have been overhauled.

The co-ordinator believes that the main task of the mechanical and electrical departments is to keep the equipment, machinery and instruments in such good working order that they can continue to operate, and to keep maintenance costs as low as possible. This can be achieved by well-organized and planned regular preventive maintenance for all equipment and machinery.

A. Initiation of a preventive-maintenance programme for Benghazi kilns I and II

The co-ordinator discussed with the plant manager, A. Fathi, the necessity of preventive-maintenance programming especially in order to avoid the frequent stoppages of the kilns even after overhauling. This matter was discussed again with both A. Fathi and A.B. El-Saltani when kiln II at Benghazi was stopped in October 1980 and it was agreed to start a programme for its maintenance. The opportunity to start a preventive maintenance planning programme was the stoppage of Benghazi kiln II, followed by kiln I. The co-ordinator asked B. Wendt, KHD mechanical engineer, who had been asked at that time to set up a mechanical-planning section, to inspect all the equipment and machinery of kiln II, then kiln I, and to submit a report evaluating the situation and the state of these (see annex VI.A and B).

Examples of the maintenance programmes designed for rotary kilns I and II at Benghazi are given in annex VI.C. and D. The author agreed to hold some meetings with the departments concerned to:

(a) Study the reports submitted and prepare a programme for overhauling the equipment;

(b) Assess spare-part requirements;

(c) Issue job orders to the workshop;

(d) Follow up the maintenance, overhauling and bricklining carried out by the mechanical, electrical and operations departments.

Meetings were held every Sunday and Wednesday during the stoppage of the kilns to monitor the planning programme carried out by S. Heikal, the Manager of the mechanical department.

The participants were:

A.B. El-Saltani (Manager, operations department, Benghazi)
A.L. Goma (Manager, electrical department)
S. Heikal (Manager, mechanical department)
I. El-Fallah (Manager, kilns department, Benghazi)
A.A. El-Rich (Manager, mechanical department, Bengh
B. Wendt (KHD Technical Assistant)
A.R. Marei (UNIDO co-ordinator and LCC technical con.ltant)

Some meetings were directed by A.M. El-Gheriani, Secretary of the People's Committee and General Director.

After the mechanical department had finished the overhauling and maintenance according to the programme, the operations department was responsible for checking that the equipment was ready for operation.

Another example of the planned preventive maintenance carried out was that done to the clinker transport system of the Benghazi Plant which represents the main bottleneck in the production flow. This transport system gives rise to many problems so that the kilns and the production lines are seriously affected and sometimes stopped.

A.M. El-Gheriani asked the mechanical department to start at once completely overhauling the two clinker elevators of the Benghazi plant. The Polish group were responsible for overhauling clinker elevator no.104 under the supervision of J. Mackowiak.

A report of this overhaul by the Polish Group, extracted from the report submitted by J. Mackowiak, is given in annex VI.E.

B. Alignment of rotary kilns

The co-ordinator observed that the kilns, especially in the Benghazi plant, were in need of realignment. After discussion with A. Fathi, S. Heikal and A. Bakr, B. Wendt was asked to measure the deviation from the correct position of the kilns. According to the measurements, KHD was asked to realign the kilns correctly. LCC was informed that one of KHD's engineers would arrive to carry out the realignment in September 1981.

C. Problems in the lime plants

The lime plants have suffered from a lack of sized limestone since they started operation and are still suffering from this shortage in raw-material supply. This shortage leads to a curtailment in lime production and sometimes to a complete stoppage. As the consultants, Holderbank Management and Consultancy (HMC), had been involved with this problem from the beginning, a telex was sent asking them to participate in solving the problem. Representatives of HMC arrived and joined with the co-ordinator and representatives of LCC to study the problem.

The background to the problem is that crushed limestone between 30 and 60 mm has to be sorted out by sizers and vibrating sieves. A Wedag hammer crusher is used first for crushing the limestone. The vibrating sieves (pair sizers) are set at mesh widths of 100, 80 and 50/25 mm. The material flow is conveyed to the lime plant where the vibrating screens separate the limestone lumps below 30 mm and over 60 mm. These are then conveyed to the reject silo to be dispatched to the limestone-storage hall of the cement plant. Limestone lumps of the required size are led to the raw-storage silo (1500 m^3 working capacity), which can contain a maximum of 2,250 tons of limestone with 1.5 t/m^3 bulk density.

During the visit of the HMC representatives, all the participants analysed the present situation on the site, all the observations made were discussed in detail and the following recommendations, as reported by HMC, were agreed upon.

Drilling and blasting

Since no subdrilling is practiced, the toe of the quarry face never gets clean without ripping and bulldozing. It is recommended to subdrill the quarry floor. According to experience, it should be about 0.3 m of burden.

Furthermore, if the boreholes of the second row are placed between the boreholes of the first row, the spacing can be increased in order to give a better breakage. Another arrangement would be to operate with shallow bore holes between the main holes to give a better breakage of the top of the face and to reduce the amount of boulders which require secondary blasting.

These two solutions are shown in figures I, II and III on the following pages.

The inclination of the face system should be in the magnitude of 70-75° to the horizontal in order to get a more suitable muck pile for loading with a wheel loader and better fragmentation at the toe.

Loading

A main target must be to change the drilling and blasting system in such a manner that loading can be done by wheel loader only. Ripping and bulldozing on the muck pile has to be avoided or kept to an acceptable minimum.

Crushing and screening

The setting devices of the apron feeders have to be repaired. Only then is an exact speed control possible.

The crushers B1 and B3 have to be fed at the nominal rate of 270 t/h. This has to be kept constant in order to have a better control of the final product.

The setting device of the crusher B1 has to be rapaired since it is in a bad condition.

The rotor speed on both crushers is too high with 45 m/sec circumferential speed. It has to be reduced to 38 m/sec by changing the motor pulley to a diameter of 380 mm.

Figure I. Arrangement of bore holes

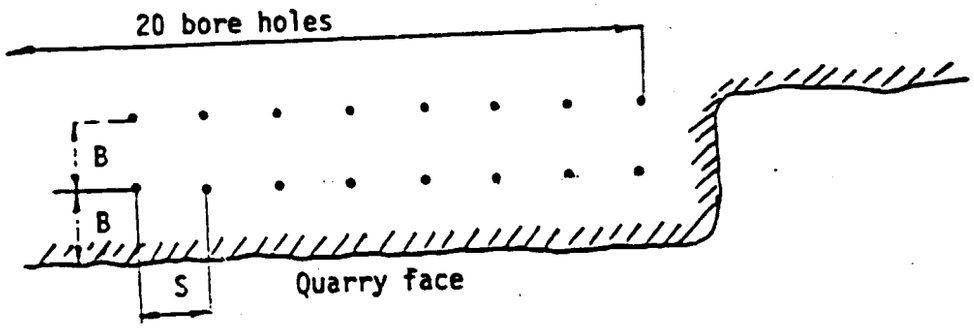
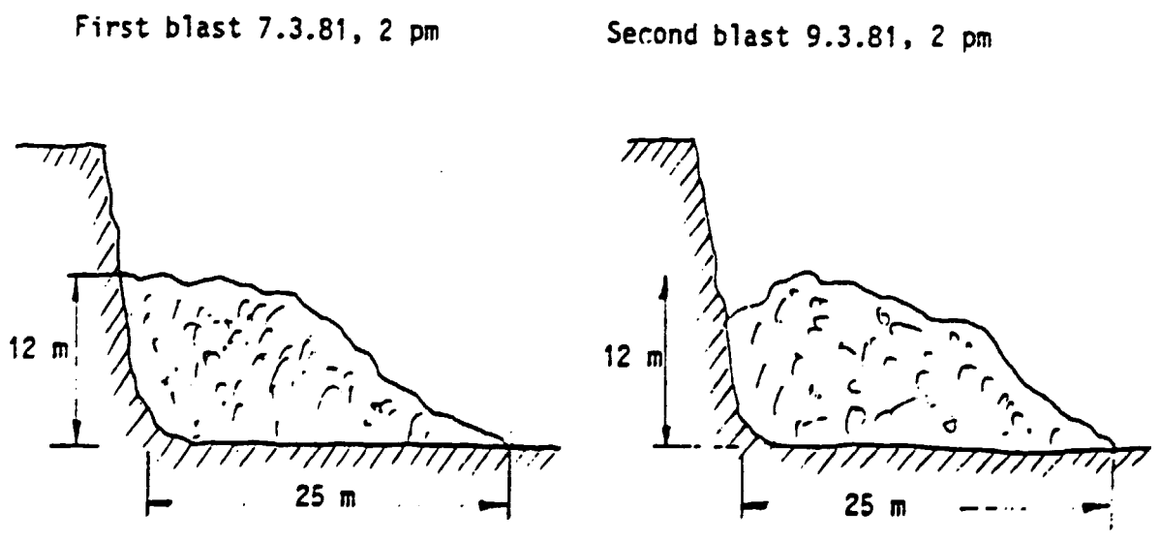


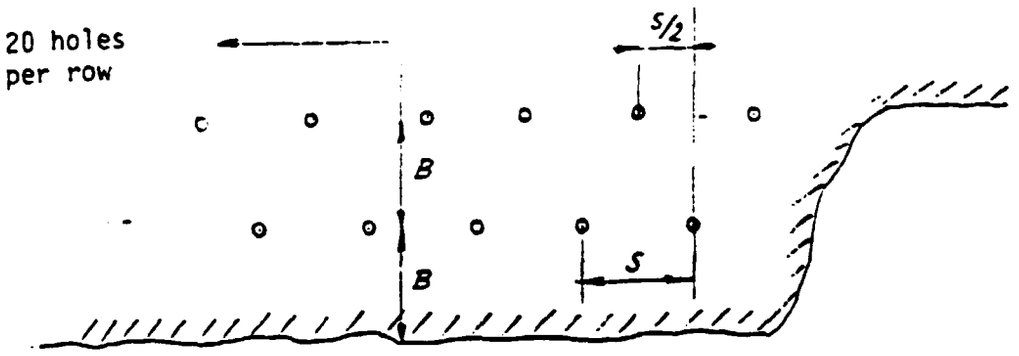
Figure II. Cross-section of the muck piles



Source: HWC report.

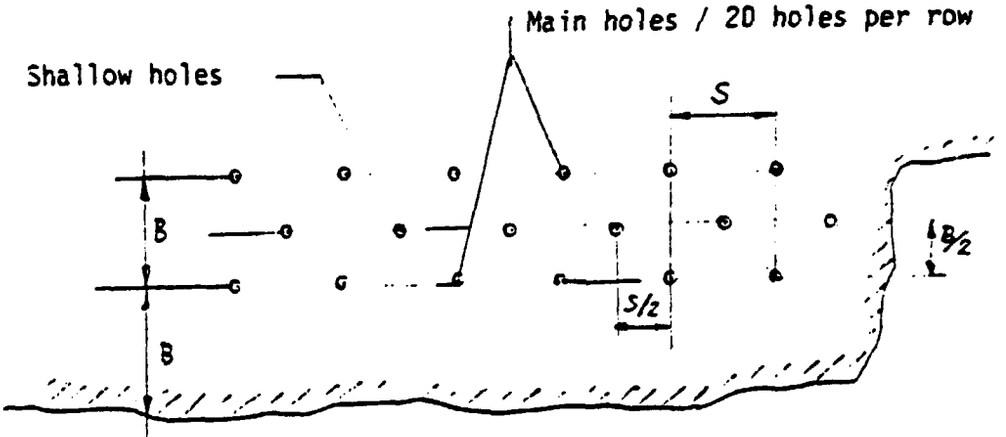
Figure III. Drilling patterns in the limestone quarry

First solution



Quarry face
inclination of the face : 70 - 75°
holes with subdrilling : 0.3 m.B
spacing : 1 - 1,3 m.B

Second solution



Quarry face
inclination of the face : 70 - 75°
main holes with subdrilling: 0.3m B
shallow holes : 2 - 3m B
spacing : 1 - 1,3m B

Source: HMC report.

The influence of this reduction in speed on the final product is shown on the grain-size curve given in the HMC report. According to this curve, the fraction 25-70 mm in the final product of the crusher is in the magnitude of some 25%.

Periodically the direction of the rotor should be reversed in order to wear the hammers equally on both sides. This will result in a more constant grain-size distribution. It is therefore recommended that the required electrical modifications are carried out to make reversing easier. At present, it is done by changing the electrical wires manually.

The lowest deck on both Mogensen sizers has to be changed. The mesh opening should be chosen with a length of approximately 32 mm and width of 22 mm.

Furthermore, it is recommended to operate (after the speed is reduced to 38 m/sec) with a gap setting of 100 mm. Only if the amount of the fraction 25-70 mm is over 25% in the final crusher product, can the gap setting be reduced stepwise by 10 mm. (See figure IV on following page.)

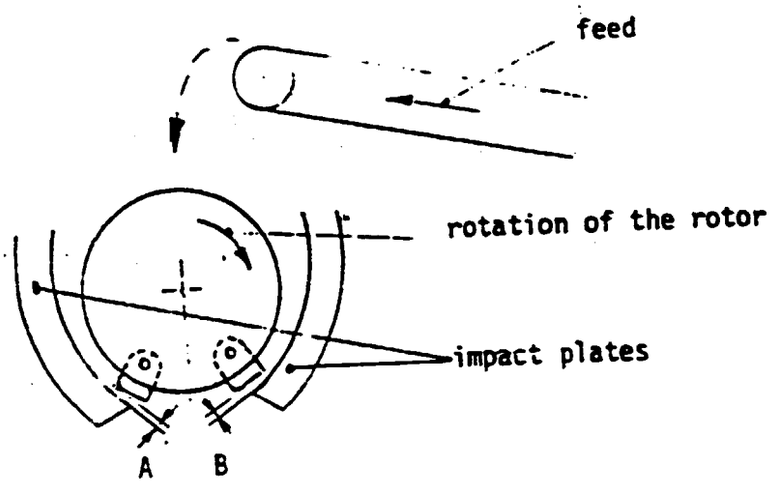
With this method, the optimum operating conditions of the crushing plant can be established.

In an earlier report, HMC recommended the installation of an additional crusher on each plant (Benghazi I and Benghazi III) if the amount and the size of the fraction 25-70 mm is not acceptable to the cement plant. (See figure V.)

The crusher setting has to be done manually since Humboldt Wedag is not in a position to offer the recommended hydraulic setting device.

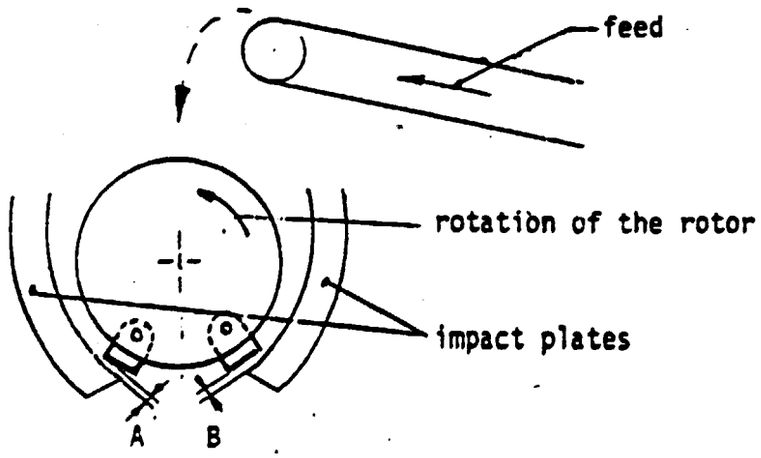
Figure IV. Limestone crusher setting

Benghazi 1



- Gap setting: A = 105 mm
  B = 95 mm

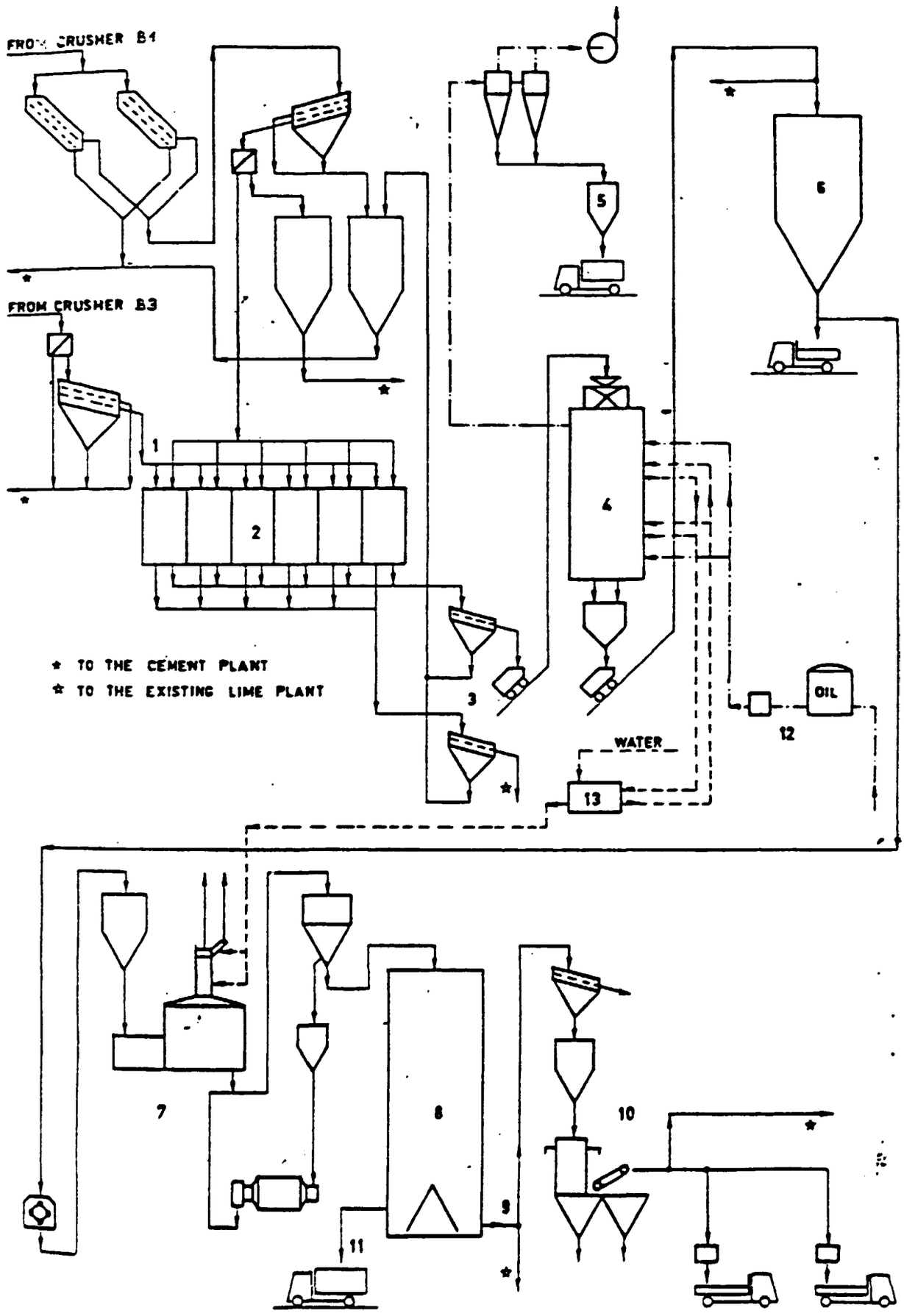
Benghazi 3



- Gap setting: A = 105 mm
  B = 55 mm

Source: IDC report.

Figure V. Benghazi Lime Plant extension



Source: UNIDO report.

V. STUDIES, RESEARCHES AND PROJECT EVALUATIONS

A. Previous studies

The co-ordinator has been studying two major problems since June 1980. These problems have been affecting production and will continue to do so in the future unless solved. These problems are:

(a) The formation of cement lumps and aggregation in cement silos;

(b) Lack of adequate gypsum ore reserves.

Reports on these two subjects have been submitted to UNIDO and the LCC authorities and will be issued by UNIDO as separate reports under this project, with the subtitles; 'Formation of cement lumps and accretions in cement silos' and 'New gypsum deposits' (see annex VIII).

The co-ordinator's activities in dealing with these two problems are summarized below.

The formation of cement lumps and aggregation in LCC silos

The co-ordinator proposed the following:

(a) That the KHD proposal to partially substitute limestone for the gypsum additives should be adopted;

(b) That IBAU, Hamburg, should be asked to send one of their specialists to LCC to discuss with them their offer to install a cone-shape structure inside the cement silo to minimize the dead space between the discharging openings and the silo wall;

(c) That the Holderbank proposal for painting the inside walls of the cement silos should be discussed, including its likely effectiveness in preventing the formation of lumps and accretions;

(d) That suitable grinding aids should be used as additives to clinker before grinding;

(e) That iron-oxide ore or pyrite ash should be added to the raw-mix meal as a third component.

The first three proposals were discussed by the co-ordinator with the firms concerned and with LCC representatives. The studies, researches, discussions, findings and recommendations are given in the separate report.

The fourth and the fifth proposals are now being researched in the LCC laboratories and it is hoped that these researches will be finished in time for the results also to be included in the report.

Preliminary results suggest that the use of suitable grinding aids gives very good results.

Lack of gypsum-ore reserves

On the second major problem, no action was taken except that the As-Sidrah site was visited by A. Fathi accompanied by a representative of the Industrial Research Centre (Tripoli).

The co-ordinator will follow up this problem and take action in the near future to start drilling in the proposed area. The results of this will later be issued as a separate technical report.

B. New studies

KHD proposal to equip Benghazi kilns with bypasses

After studying this proposal from the mechanical point of view with B. Wendt of KHD, and from the chemical point of view, it can be stated that:

(a) The bypass dedusting plants are absolutely sufficient for the Benghazi rotary kilns and for alkali-low clinker;

(b) KHD must give an assurance as to the possibility of changing the kiln-shell segments, tyres, rollers, kiln drive and any part of the kiln drive below the bypass-filter-supporting structure;

(c) The chemical analysis showed the necessity of introducing the bypass technique in the kiln operation;

(d) The costs mentioned are outside the scope of this study and it is up to the LCC to take a decision to accept the proposal on these terms or not;

(e) Now is the time to make a final decision on whether the Benghazi kilns should be equipped with bypasses or not.

Annex VII gives details of this proposal and the discussions on it.

Establishment of an additional bucket elevator for clinker transport to cement mills II and III in Benghazi

The co-ordinator was asked by A. B. El-Saltani, Manager of the Operations Department, Benghazi, to study an offer received from Humboldt Wedag AG (KHD) to erect an additional bucket elevator in the area between the cement building and the clinker storage in the Benghazi Cement Plant. The reason for erecting such a new bucket elevator is to solve the problems caused by the existing bucket elevators and to enable them to be stopped for extensive overhauling.

The co-ordinator studied the offer and submitted a report with his comments which can be summarized as follows:

(a) Erecting such a bucket elevator as is shown in the KHD drawings to supply cement mills II and III and the clinker required for its operation during the period of stoppage of the existing bucket elevators involves not only additional machinery and investment but the problem will still not be finally solved;

(b) The cost estimates were originally submitted in 1978 which means that the cost would be substantially higher at this time;

(c) It is necessary to supply the proposed elevator with clinker which has to be transported from the nearby clinker storage using a wheel loader all the time the existing elevators are out of operation;

(d) The cement mill plant is designed so that 12 hours running time is normally sufficient to cover the total capacity of their production lines, and there would be 12 hours left for maintenance or repair work, i.e. 50% of the mills' operating hours. If the cement mills are stopped for a long time, the production can be made up by operating one cement mill for more than 12 hours;

(e) The Hawari cement mills have had problems with using wheel loaders for the gypsum supply which does not exceed 7-8% of the raw material. As both Benghazi cement mills consume more than 150 t/h of clinker, it is clear that they would have great problems in supplying the new bucket elevator with the required clinker using wheel loaders. Difficulties arise because of the clinker dust and its effect on the driver and the wheel loader's engine and moving parts. The lifetime of these wheel loaders will be decreased by 50% at least;

(f) The area where the proposed bucket elevator would be erected is not covered and, in winter, all the clinker would be liable to partial hydration by rain followed by solidification if left out for some time. Also, this area and nearby areas will be polluted with clinker dust. It was also observed that, if the area is not covered, the lower parts of the bucket elevator would be affected by the action of rain water on the elevator chain, idler and buckets as well as the clinker. It is clear, therefore, that if the proposal to erect a new bucket elevator in this area is accepted, this area ought to be covered, which means more investment, and that a water pump ought to be installed at the bottom of the bucket elevator to get rid of any water gathered there;

(g) The drawing of the proposed bucket elevator shows that the bucket elevator's concrete or steel-structure casing is tied by four belts to the concrete of the cement mill building. The action of vibration of the bucket elevator casing against the wall of the cement mill will itself cause many problems.

The co-ordinator therefore concluded that:

(a) This additional machinery is an unnecessary investment as it will not completely solve the problems of the existing bucket elevators, being only intended to operate temporarily;

(b) The acceptance of this proposal would create many new problems for the company as summarized above;

(c) The existing bucket elevators should be overhauled and the store supplied with the spare parts required for preventive maintenance;

(d) A special group from the mechanical department ought to have the preventive maintenance of the existing elevators as their main task and, if necessary, also the maintenance of the conveyors;

(e) Urgent action ought to be taken through the mechanical and purchase departments to order the necessary elevator spare parts.

These recommendations have been accepted by the LCC authorities.

The introduction of sulphate-resisting cements in LCC plants

The co-ordinator carried out a study of all aspects of this question, the results of which were submitted in Arabic to the LCC and were later issued as a mission report by UNIDO subtitled, "Feasibility of producing sulphate-resisting cement". (See annex VIII.)

The production of sulphate-resisting cements (SRC) either in LCC plants or elsewhere in the Libyan Arab Jamahiriya is recommended and the optimum raw-mix composition for producing SRC in accordance with standard specifications and using mainly local materials is discussed.

C. The new southern cement-plant project

In connection with this project, a study was made by Polservice-Geopol, Poland, in March 1979 of possible raw-material reserves for the cement and lime industries. This investigation was carried out in two areas, Wadi Ash Shati and Al Jufrah. The co-ordinator was asked by A.M. El-Gheriani, the Under-Secretary for Heavy Industry, to evaluate the two final reports on these raw-material deposits. The co-ordinator's evaluation was issued by UNIDO as a separate report (see annex VIII) with details of his findings and recommendations.

In summary, these were that it would be preferable to exploit the raw-material deposits in the Al Jufrah area on account of the mechanical properties and chemical composition of the raw materials there and the relative ease of extracting them compared to those in the Ash Shati area. Laboratory tests showed materials from both areas to be suitable for portland-cement production. A study of the potential cement market in the region was recommended to make possible a decision on the most suitable capacity for the new plant. If a plant of less than 300,000 tons per annum capacity were selected, the possible use of small-scale cement technology should be considered. A feasibility study covering infrastruture facilities, economic considerations and further exploration of the extent of the raw-material reserves should be carried out. Reserves of raw gypsum of about 1.75 million tons would have to be established by drilling in the Hun Valley and the drilling of additional boreholes in the Sawknah region is also recommended.

From these findings and recommendation it is clear that the co-ordinator's preference was for building the cement project in the Al Jufrah area.

Representatives of the Heavy Industries Secretariat arrived in Benghazi and discussed the recommendations in the co-ordinator's report in a meeting attended by A. Fathi, the Works Manager.

The co-ordinator was informed by A.M. El-Gheriani that he had been selected by the Secretariat to be one of the four-member committee responsible for this project.

Many committee meetings took place in the Secretariat headquarters in Tripoli. The committee reviewed all the previously-submitted reports and studies on the project. The main object of these meetings was to come to a final conclusion as to which site should be selected for the new cement plant.

On 25 May 1981, a report in Arabic was submitted to A.M. El-Gheriani with the committee's final findings and recommendations as follows:

(a) The Al Jufrah area is the most suitable for erecting the cement plant;

(b) The production capacity proposed by the committee for such a plant is half a million tons.

The committee had asked the consultants the Kuljian Corporation (Engineers and Constructors) Philadelphia, United States of America, to submit a report giving their evaluation of the Polservice reports.

Representatives of the consultants arrived in Tripoli to discuss with the committee their report submitted in May 1981. The consultants' findings were not absolutely clear and decisive and the committee members asked them to submit another report giving a clear recommendation on the selection of a site.

Another report was received in June 1981 and representatives of the consultants arrived to discuss it with the committee members. It was agreed after meetings held in Tripoli and Benghazi between 6 and 8 June 1981, to select the Al Jufrah area as the most suitable for erecting the cement plant and to recommend a plant of half a million tons per year capacity, providing another production line could be added in the future. This requirement for a long-term expansion plan favours the choice of a site near the Al Jufrah upper plateau which has very large proven raw-material reserves. All parties to the meetings agreed on these recommendations. The committee agreed to transfer the report with the agreed recommendations to the Secreatriat of Heavy Industry for approval.

It was agreed that, pending a decision by the Secretariat on both site location and plant capacity, the consultant should start immediately to:

(a) Visit the site, choose a plant site lcoation and carry out soil investigations. Tnis should be finished before the date of calling for tenders as the time factor is very pressing;

(b) Start to prepare the tender documents in co-operation with the committee members and to finish these by the end of September 1981.

The committee will supply the consultant with the previous general conditions offered before in the tender documents. The consulant will examine previous tender documents at the Secretariat for Heavy Industries in Tripoli to see the format and the scope of detail and will work together with the committee members in expediting the tender documents by reducing the time required to review and create the final bidding documents.

Representative raw-material samples will be taken by the consultant who will be responsible for keeping them and making them available, on request, to tenderers.

Besides this, the consultant will continue to prepare the feasibility study of the project based on geological investigations, marketing and economic studies, processing, plant location, capacity, cement consumption, transportation facilities etc. This feasibility study will be submitted later.

Preparation of roads and plans for opening the quarries will be included in the tender document. The quarry equipment will be requested as optional.

A meeting was held with A.M. El-Gheriani, Under-Secreatry for Heavy Industry, to discuss the final findings of both the committee members and the consultants' representatives. The Under-Secreatry agreed with the final decisions made and the Al Jufrah area was finally recommended as the most suitable area for the erection of the cement project. The Under-Secretary informed the Secretary for Heavy Industry of the project situation and told him about the final recommendations for selecting the Al Jufrah area.

The committee members and the consultants' representatives attended a meeting in July 1981 with both the Secretary and Under-Secretary for Heavy Industry. The discussions came to the following alternative recommendations:

(a) To select the Al Jufrah area as the only site; or

(b) To select the Al Jufrah area and also erect a new small-scale plant at Wadi Ash Shati, or

(c) To select the Al Jufrah area and to transfer one of the cement production lines (Al Khums I) to the Wadi Ash Shati area.

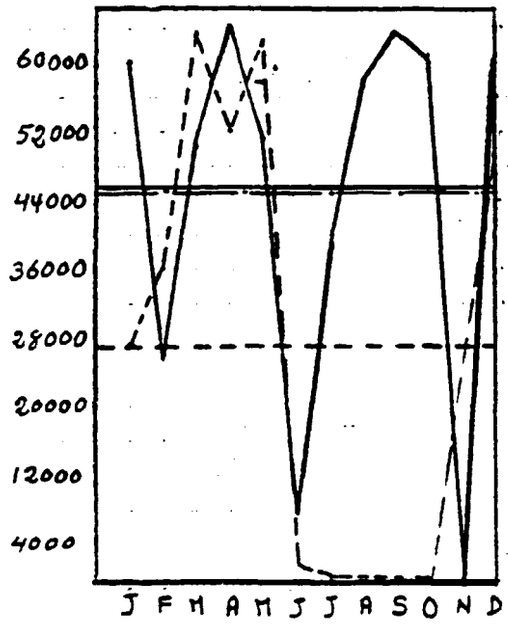
These alternatives, as agreed upon, will be submitted to the General People's Committee who will select one of them. In the meanwhile, as it is clear that the Al Jufrah area would be used in any case, the Secretary asked the committee members and the consultants' representatives to continue planning for Al Jufrah and to wait for a final decision as to whether to erect a small-scale plant in Wadi Ash Shati or not.

Annex I

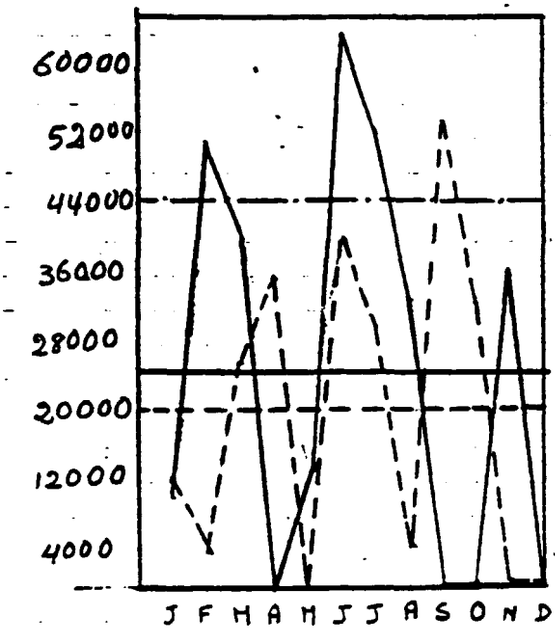
PRODUCTION AT HAWARI IN 1980 COMPARED TO 1979

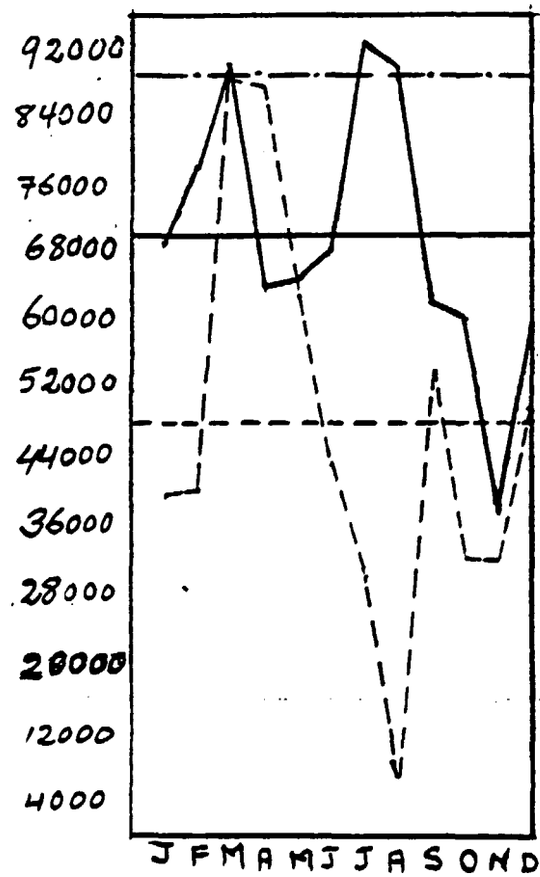
A. Raw mills

Raw mill I. Output 1980 compared to 1979



Raw mill II. Output 1980 compared to 1979





Key

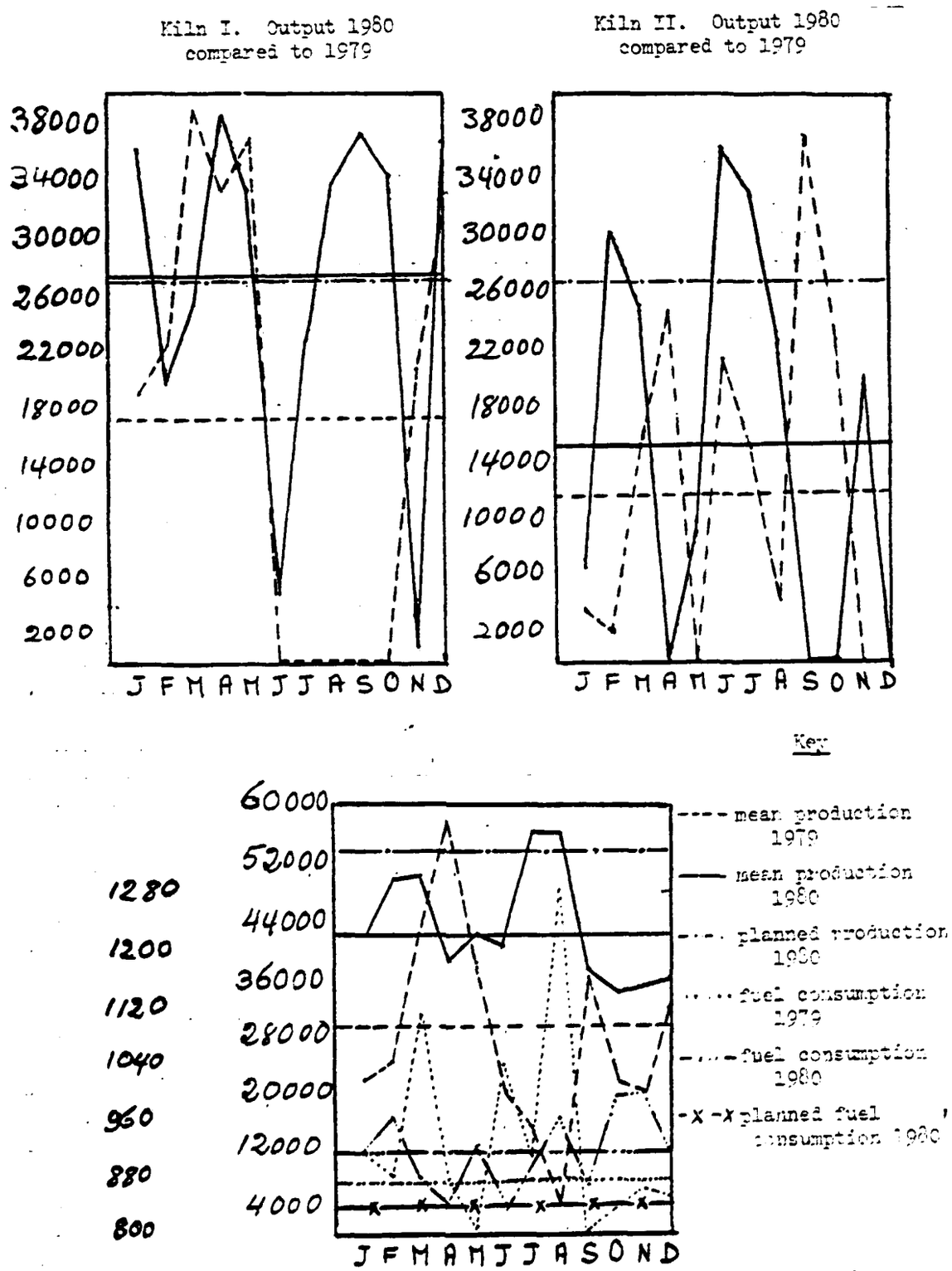
------ mean production 1979

——— mean production 1980

- - - - - planned production 1980

Both raw mills. Output 1980 compared to 1979

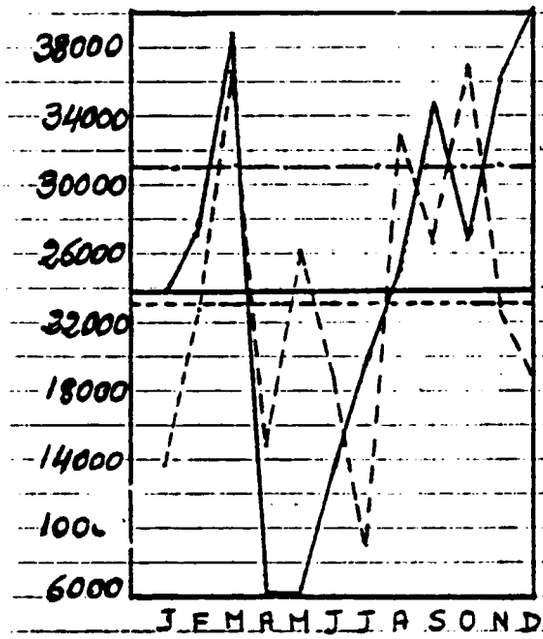
B. Kilns (clinker production)



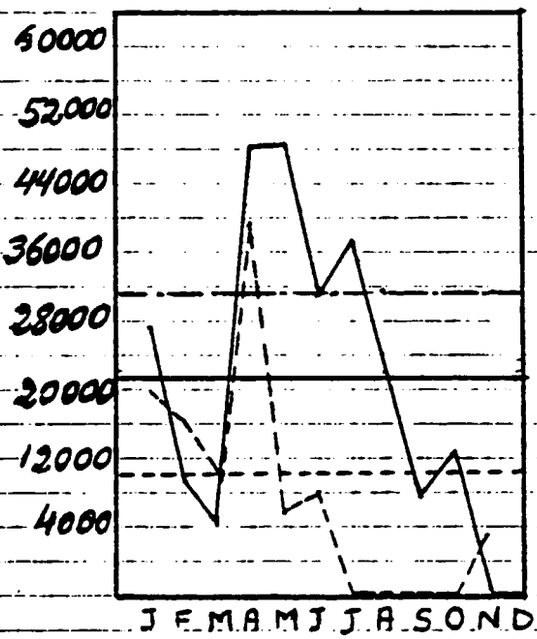
Kilns I and II. Output 1980 compared to 1979.

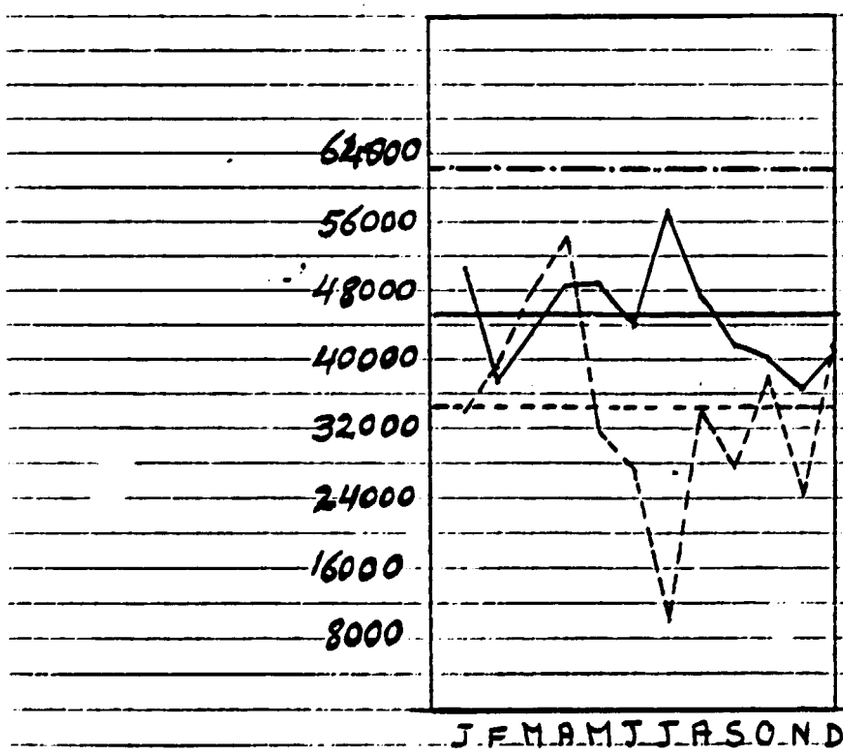
C. Cement mills

Cement mill I. Output 1980 compared to 1979



Cement mill II. Output 1980 compared to 1979

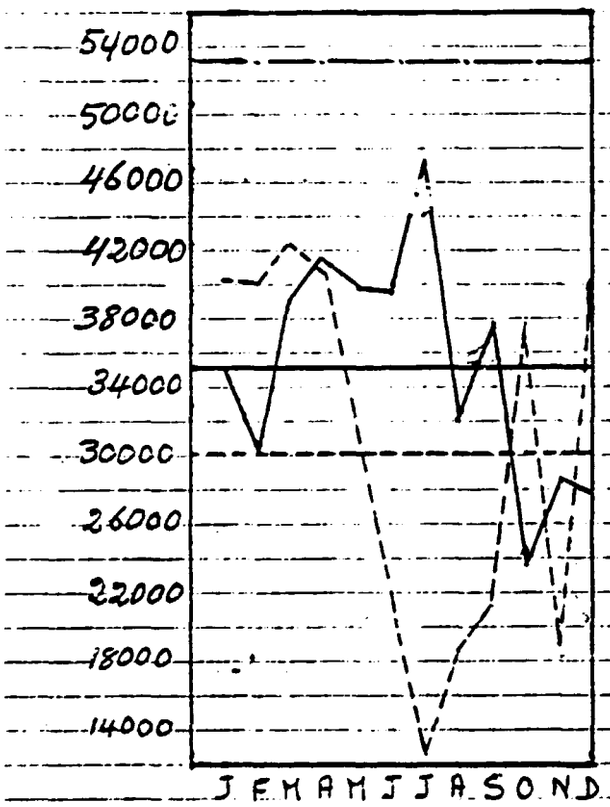




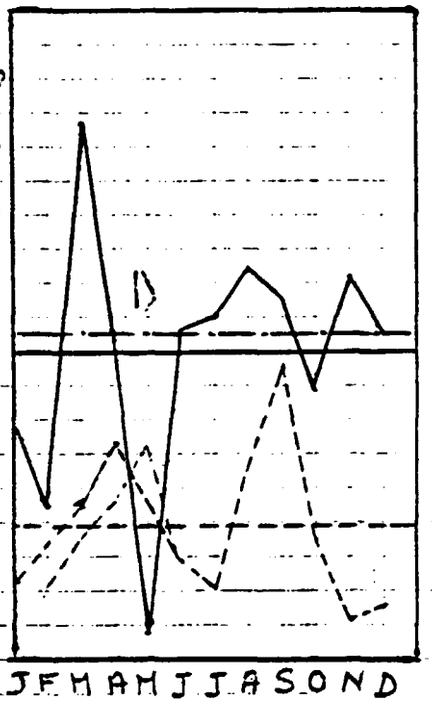
Cement mills I and II. Output 1980 compared to 1979

D. Despatched cement (packed and bulk)

Packed cement 1980
compared to 1979



Bulk cement 1980
compared to 1979

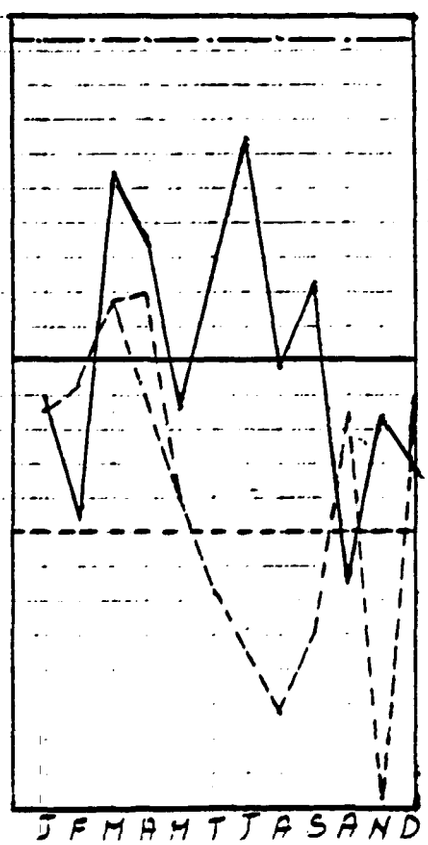


Key

- - - - - - mean despatched 1979

——— mean despatched 1980

—·—·— planned despatched 1980



Packed and bulk cement 1980 compared to 1979

Annex II

PROTOCOL OF THE MEETING IN COLOGNE,
14-17 OCTOBER 1980

The meeting took place between representatives of the LCC accompanied by the UNIDO project co-ordinator and representatives of the contractors, Kloeckner Humboldt Deutz, Industrieanlagen GmBH, and Indumont.

The following points were discussed:

1. Cement mills I and II

After the expert advice from Holderbank was received at the beginning of September 1980, completion of the two mill tubes was started. Due to the need to procure special flanges, completion cannot be before the end of April 1981 and after that they can be dispatched.

After arrival of the mill tube at the Hawari works and subsequent erection, commissioning of mill I is expected around October/November 1981.

Mill trunnion head

The mill trunnion head of the cement mill is being manufactured. Delivery can be made after completion at the manufacturer at the beginning of April 1981. To allow mill II to continue to be operated, Indumont will carry out a repair weld on the defective wall.

Partition walls

The complete supporting structure for one partition wall and spare parts for the supporting structure of the second wall will be dispatched. The parts will arrive at the port of Benghazi around 2 November 1980. The time needed for erection will be about two weeks.

Pinion and girth-gear damage on cement mill I

On 22 September 1980, damage was established at the aforementioned girth-gear, pinion and transmission-gear bearings which has been described in greater detail in LCC's letter of 27 September 1980.

To be able to give our opinion on that damage, we received information from Messrs. Wendt and Drenda and also a fragment of a pinion tooth and a broken fastening screw of the transmission-gear bearing. On the basis of the information received and on examining the broken parts, KHD's experts established that first of all the transmission-gear bearing got loose (this can be seen by the chafe points at the screw) and then broke, and that, after that, the pinion moved out of its position. Thereafter the pinion and girth-gear damage occurred.

According to the protocol drawn up by the specialist from Reiner KG in December 1979, the girth gear of cement mill I had a contact portion of 70% which increased to 90% on 7 June 1980. Also when KHD inspected the plant on 3 September 1980, it was established that the flanks condition was good, the contact portion being between 85 and 90%.

KHD stated the following:

(a) The pinion damage is not attributable to damage at the girth gear and pinion but is due to abnormal influences which occured after 3 September 1980 and for which KHD cannot be held responsible;

(b) After discussing this matter with the manufacturer of the gear drive, Thyssen Stahlunion, they will work out comments on lubrication and reconditioning of the gear drive, which will then be passed on to LCC;

(c) To eliminate the damage as quickly as possible, a new pinion will be manufactured for which LCC's order is awaited.

LCC insisted on what had been stated in its letter and emphasized the following:

(a) Scratches, and not pittings, appeared on the girth gears and pinions of cement mill I and raw mill I on May 1978 as stated in the deficiency list of September 1979;

(b) Due to reconditioning of the gears the flanks are no longer oval but straight, which leads to:

(i) Vibration,

(ii) High bending moment on the teeth,

(iii) Non-smooth meshing between pinion and girth gear;

(c) Due to the above-mentioned facts, LCC holds KHD fully responsible for the damage to cement mill I. Furthermore, LCC express their worries about the condition of the gears of raw mill I after reconditioning;

(d) There are no scratches indicated along the bolt thread.

2. Clinker-transport system

KHD will work out an offer for a new clinker-transport system conveying the clinker from kiln I to the new clinker belt conveyor of kiln III. The offer must contain the complete civil portion, including earthwork and erection.

Consultat. with A.M. El-Gheriani has produced the result that KHD are to work out an alternative offer for two bigger elevators which it is intended to install as a replacement for the existing bucket elevators. The two new bucket elevators have to be laid out for a 30% greater conveying capacity compared to the existing ones.

3. Bricklining drawings

KHD have handed over a list of the bricklining drawings for the Hawari plant. LCC will check which drawings are available and which are lacking and will inform KHD which drawings are to be subsequently supplied by KHD.

4. Technical assistance

KHD's proposal, which was made to LCC by telex on 16 September 1980, and the telex reply from LCC dated 25 September 1980 were discussed. KHD confirm that points 1-3 of LCC's telex are accepted whereas point 4 is to be interpreted as follows. The outstanding 29.4 man-months will be utilized as from 28 August 1980 as follows:

(a) Mr. Jahr - 28 August 1980 to 18 September 1980 = 0.7 man-months;

(b) Mr. Knippscheer - 28 August 1980 to mid-December 1980 = approximately 3.6 man-months;

(c) remaining period - Mr. Wendt and Mr. Klause as from 28 August 1980.

5. XRD laboratory unit

Making reference to the discussion carried out in Benghazi in September 1980, the letter from LCC dated 5 August 1980 and the telex dated 25 August 1980, the function of the XRD laboratory unit was discussed once again. It was agreed that KHD should send a specialist for the repair to Benghazi who will have a set of spare parts with him. The parts needed for the repair will be listed in a protocol and paid for by LCC.

6. A water-piping system for cooling, potable water and quenching water

The drawings for this system,

No. 842-50-450 UA potable water and quenching water

No. 842-50-382 UA cooling water

No. 842-50-451 UB potable water, which are in LCC's possession do not reflect the latest developments and do not contain the modifications carried out on the spot. The drawings Indumont have altered must be compared with the aforementioned drawings and the modifications need to be entered in the final drawings. These final drawings are to be inspected by Messrs. Kerschbaum and Wendt on the spot and then passed on to LCC.

The piping drawing and laying of the pipes was checked and accepted by the consultant.

The piping drawing for compressed air No. 842-50-381 UA and the pillard drawings for laying of the oil pipes have to be checked on the spot and modifications, if any, have to be entered.

If necessary, and if modifications have been carried out, only the pipes laid in the ground need to be entered in the section drawings.

7. Mill liner plates

KHD expects from the technical-assistance staff a report and drawing regarding the broken liner plates and the positions where the plates are broken.

Information is also expected about the type and quality of the the new plates.

After this investigation, KHD will take the necessary action to finally settle this problem.

Annex III

STATE OF THE TECHNICAL-ASSISTANCE TEAM ON 1 MAY 1981

Budget line	Post title	Total req.	At duty station	Expected repatr.	Present req
11.06	Shift leader	4	4	1	1
11.07	Control panel operator	4	3	-	1
11.08	Miller	8	10	2	-
11.09	Burner (cement kilns)	8	5	1	4
11.10	Mech. maint. foreman	2	4	1	-
11.11	Fitter	7	7	1	1
11.12	Compressor maint. mech.	1	-	-	1
11.14	Milling macn. operator	1	1	1	1
11.16	Maintenance electrician	7	4	-	3
11.17	Instrumentation specialist	6	7	-	-
11.19	X-ray specialist	1	-	-	1
11.20	Mechanical engineer	3	2	-	1
11.21	Maintenance fitter	2	-	-	2
11.22	Sheet metal fitter	6	2	-	4
11.23	Welder	5	4	-	1
11.24	Elect. maint. engineer	1	-	-	1
11.25	Workshop fitter	2	2	-	1
11.26	Elect. instrumentation engr.	1	-	-	1
11.27	Elect. maint. engineer	1	-	-	1
11.28	Instr. and central foreman	1	1	-	-
11.29	Shift electrician	8	8	3	3
11.30	Instrumentation specialist	4	3	2	3
11.31	Workshop and light elect.	5	1	-	4
11.32	High-tension elect.	2	1	-	1
11.33	Diesel mechanic	3	-	-	3
11.34	Petrol eng. mechanic	-	-	-	
11.35	Quarry equip. elect.	1	-	-	1
11.38	Lime burner	4	4	1	1
11.39	Scraper operator	-	-	-	-
	Total	98	73	13	40

Annex IV

TECHNICAL ASSISTANCE REQUIRED FOR THE FATAYEH CEMENT PROJECT (DERNA)
(Updated to May 1981)

Job no.	Job description	Post title	No. needed
57	11.02	Instrumentation engineer	2
90	11.06	Shift leaders	4
91	11.07	Control attendants	4
96	11.08	Millers (raw and cement mills)	8
102	11.09	Burners (cement kiln operators)	4
5	11.10	Foremen (mechanical maintenance)	4
6	11.11	Mechanics (maintenance and workshop)	6
12	11.12	Compressor maintenance mechanics	1
17	11.13	Foremen (mechanical workshop)	1
27/31	11.14	Workshop machine operators	6
48	11.16	Maintenance electricians	7
59	11.17	Instrumentation specialists	4
127	11.18	Analysts for quality control	8
132	11.19A	X-ray specialists	4
62	11.19B	Raw-materials engineers	2
4/16	11.20	Mechanical engineers	3
8	11.21	Maintenance fitters	2
35	11.22	Sheet-metal fitters	4
41	11.23	Welders (gas and electrical)	3
42	11.24	Engineers (dectrical maintenance)	3
19	11.25	Workshop fitters	6
46	11.27	Foremen (electrical maintainance)	4
57	11.28	Foremen (instrumentation and control)	4
49	11.29	Shift electricians	4
52	11.31	Workshop and light electricians	5
54B	11.32	High-tension electricians	2
72	11.33	Diesel mechanics	6
77	11.35	Electrician for quarry equipment	3
106	11.41	Packing-machine operators	4
118B	11.42	Chemists	2
	Total requirements		120

Annex V

PERFORMANCE OF LCC PLANTS HAWARI AND BENGHAZI IN 1980

A. Raw materials used in raw mix in Hawari (raw mills I and II separately)

Month	Raw mill I					Raw mill II				
	Feed				Output of raw mix (tons)	Feed				Output of raw mix (tons)
	Limestone (dry)		Clay (dry)			Limestone (dry)		Clay (dry)		
	(tons)	(% in raw mix)	(tons)	(% in raw mix)		(tons)	(% in raw mix)	(tons)	(% in raw mix)	
January	37 375	62	22 907	38	60 282	5 869	62	3 597	38	9 466
February	17 393	65	9 243	35	26 636	33 426	65	17 763	35	51 189
March	32 023	64	17 936	36	49 959	26 157	64	14 649	36	40 806
April	39 207	61	25 384	39	64 591	-	-	-	-	-
May	31 090	60	20 730	40	51 825	8 356	60	5 570	40	13 926
June	4 926	61	3 096	39	8 022	38 075	60	23 936	40	62 011
July	25 309	64	14 423	36	39 732	33 957	64	19 351	36	53 308
August	37 279	64	20 969	36	58 248	20 800	64	11 700	36	32 500
September	39 707	63	23 520	37	63 227	-	-	-	-	-
October	40 037	66	20 625	34	60 662	-	-	-	-	-
November	213	70	93	30	306	24 576	66	12 394	34	36 970
December	37 246	62	23 120	38	60 366	-	-	-	-	-
Total	381 810	63	202 046	37	583 856	191 216	63	108 960	37	300 176

B. Total raw materials used in raw mix in Hawari

Month	Feed: Limestone (dry) (tons)	Feed: Limestone (dry) (% in raw mix)	Feed: Clay (dry) (tons)	Feed: Clay (dry) (% in raw mix)	Output of raw mix (tons)
January	43 241	62	26 504	38	69 748
February	50 819	65	27 006	35	77 825
March	59 180	64	32 585	36	90 765
April	39 207	61	25 384	39	64 591
May	39 451	60	26 300	40	65 751
June	43 001	61	27 032	39	70 033
July	59 266	64	33 774	36	93 040
August	58 079	64	32 669	36	90 748
September	39 707	63	23 520	37	63 227
October	40 037	66	20 625	34	60 662
November	24 789	67	12 487	33	37 276
December	37 246	62	23 120	38	60 366
Total	533 026	63	311 006	37	844 032

C. Total raw materials used in raw mix in Benghazi
(Raw mills I, II and III)

Month	Feed: Limestone (dry) (tons)	Feed: Limestone (dry) (% in raw mix)	Feed: Clay (dry) (tons)	Feed: Clay (dry) (% in raw mix)	Output of raw mix (tons)
January	27 405.1	63	16 095.2	37	43 500.7
February	23 914.7	63	13 871.2	37	37 786.0
March	19 628.1	60	13 194.8	40	32 823.0
April	25 169.5	64	13 913.6	36	39 083.1
May	49 552.1	65	27 180.6	36	76 732.7
June	50 909.9	58	36 264.6	42	87 174.5
July	32 565.5	64	18 159.6	36	50 725.0
August	38 081.1	65	20 868.0	35	58 949.1
September	27 997.2	66	14 746.6	35	42 742.8
October	32 274.7	70	13 635.2	30	45 909.9
November	47 996	66	25 730.3	34	73 726.3
December	37 340.6	63	21 649.4	37	58 990.0
Total	412 834.8	63	235 309.3	36	648 144.1

D. Total raw-

Production months	Nawari Cement Plant		
	Est. prod. raw mill I	Est. prod. raw mill II	Actual production I and II
January	56 320	8 845	69 748
February	25 680	49 265	77 825
March	44 595	36 425	90 765
April	62 765	-	64 591
May	48 065	12 915	65 751
June	6 650	51 430	70 033
July	35 990	48 290	93 040
August	53 250	29 710	90 748
September	60 612	-	63 227
October	63 699	-	60 662
November	306	35 775	37 276
December	54 185	-	60 366
Est. prod. total	512 117	272 655	
Actual prod. total			844 032
Operation (hours)	4 865	2 835	7 700
Stoppages (hours)	3 919	5 949	9 868
Assumed prod. (tons)	535 500	536 500	1 073 000
Ratio actual to assum. prod. (%)	101.2	55.9	78.7
Actual production (tons per hour)	112	106	110
Mill capacity (tons per hour)	110	110	110
Ratio production to capacity (%)	102	96	100
Energy consumption (kWh)	17 172 200	10 236 500	27 408 700
(kWh per ton)	31.5	34	32.5

-mill production in LCC plants
(Tons)

Benghazi Cement Plant				
Est. prod. raw mill I	Est. prod. raw mill II	Est. prod. raw mill III	Actual production I, II and III	Total actual production
3 828	18 118	21 054	43 439	113 187.0
10 591	13 066	14 128	37 787	115 611.5
9 170	-	23 654	32 823	123 588.0
-	18 245	20 838	39 083	103 674.1
-	32 611	44 121	76 733	142 483.7
-	24 687	62 488	87 174	157 207.5
7 606	-	43 119	50 725	143 765.0
13 875	7 274	37 800	58 949	149 697.1
7 371	8 690	26 682	42 744	105 970.8
8 029	1 260	36 622	45 910	106 571.9
10 167	24 621	38 938	73 726	111 002.3
7 198	43 594	8 200	58 990	119 356.0
77 834	193 666	377 644		
			648 083	1 492 114.9

1 714	1 822	3 233	6 769	
230 000	460 000	460 000	1 150 000	2 223 000
34.0	42.6	82.0	56.4	67.1
45.4	106.3	117.0		
45	119.5	119.5		
106.9	88.7	97.9		
3 267 250	6 444 100	11 264 000	20 975 350	48 383 050
42	33.3	20.8	32.4	32.4

E. Hawari raw mills: output, stoppages and energy consumption
(1979 and 1980 compared)

Operation	Mill I		Mill II		Mill I and II	
	1979	1980	1979	1980	1979	1980
Output						
Estimated (t)	32 414	512 117	240 528	272 655	563 942	784 772
Ratio 1980/1979 (%)		(158%)		(113%)		(139%)
Actual Prod. (t)	...	543 856	...	300 176	579 550	844 032
Ratio 1980/1979 (%)						(176%)
Operational hours	2 683	4 865	2 148	2 835	4 831	7 700
Ratio 1980/1979 (%)		(181%)		(132%)		(159%)
Stoppages (hours)	6 077	3 919	6 612	5 949	12 689	9 868
Ratio 1980/1979 (%)		(64%)		(90%)		(78%)
Mech. Stop. (h)	219	584	374	644	593	1 228
Ratio 1980/1979 (%)		(267%)		(172%)		(207%)
Elect. Stop (h)	296	290	110	151	406	441
Ratio 1980/1979 (%)		(98%)		(137%)		(109%)
Operat. Stop. (h)	5 562	3 045	6 128	5 134	11 690	8 179
Ratio 1980/1979 (%)		(55%)		(84%)		(70%)
Heating kiln (h)	-	-	-	-	221	204
Ratio 1980/1979 (%)						(92%)
Energy cons. (kWh)	...	17 172 200	...	10 236 500	17 254 223	27 408 700
Ratio 1980/1979 (%)						(159%)
Energy Cons. (kWh/t)	...	31.5	34	34	30	32
Ratio 1980/1979 (%)						(107%)
Rate of Prod. (t/h)	...	112	...	106	120	110
Ratio 1980/1979 (%)						(92%)
Designed energy cons. (kWh)		110		110	110	110
Actual energy cons. (kWh)		102		96	109	100
Ratio 1980/1979 (%)						(91%)

F. Hawari kilns I and II: estimated and actual production and consumption of refractory bricks and energy

Operation	Clinker prod. and fuel consumption of Hawari kilns I and II				Total estimated and actual production and fuel consumption		
	Prod. Kiln I	Fuel Consumption	Prod. Kiln II	Fuel cons.	Estm. prod.	Fuel cons.	Actual prod.
Month	(tons)	(litres)	(tons)	(litres)	(tons)	(litres)	(tons)
January	33 480	3 724 300	6 085	870 600	39 565	4 594 900	42 674
February	17 975	2 136 300	30 560	3 516 100	48 535	5 652 400	49 725
March	25 065	2 767 800	19 890	2 396 900	44 955	5 164 700	50 410
April	39 120	3 827 600	...	...	39 120	3 827 600	38 557
May	31 000	3 441 100	9 115	1 177 000	40 115	4 618 100	42 547
June	4 310	477 600	29 580	3 485 800	33 890	3 963 400	40 724
July	20 940	2 305 200	29 505	3 608 300	50 440	5 913 500	55 821
August	33 725	3 671 200	20 975	2 683 500	54 700	6 354 700	56 033
September	37 252	3 782 600	...	...	37 252	3 782 600	37 252
October	38 445	3 976 200	...	...	38 445	3 976 200	34 013
November	1 113	179 600	19 504	2 264 300	20 617	2 443 900	20 706
December	33 418	3 952 500	...	...	33 418	3 952 800	36 791
Total estimated	315 843	34 242 300	165 214	20 002 500	481 057	54 244 800	
Total actual	323 669	...	181 595	...		...	505 264
	(hours)		(hours)		(hours)		
Operating	6 111		3 825		9 939		
Stoppages	2 670		4 959		7 629		
Type of stoppage:	(hours)		(hours)		(hours)		
Mechanical	637		646		1 283		
Electrical	176		124		300		
Operational	1 653		3 999		5 652		
Heating kiln	204		190		394		
	(kcal/kg)		(kcal/kg)		(kcal/kg)		
Energy consumption	901		938		914 (est.840)		
	(kg/t)		(kg/t)		(kg/t)		
Refrac. bricks consumption							
Burning zone	0.507		0.448		0.486		
Other type	0.028		0.017		0.024		
Total	0.535		0.465		0.510		

	Kiln I	Kiln II	Average I and II	Total
Energy consumption				
(kWh)	8 273 855	5 357 460		13 631 315
(kWh/t of clinker)	25.6	29.5	27.0	
Production rate				
Actual (t/d)	1 271	1 139	1 220	
Possible (t/d)	1 500	1 500	1 500	
Ratio actual/poss. (%)	85	76	81	

3. Benghazi kilns I, II and III:
estimated and actual production and fuel and energy consumption

Operation	Kiln I		Kiln II		Kiln III		Total I, II and III		
	Clinker prod. (tons)	Fuel cons. (litres)	Clinker prod. (tons)	Fuel cons. (litres)	Clinker prod. (tons)	Fuel cons. (litres)	Estm. prod. (tons)	Fuel cons. (litres)	Actual prod. (tons)
Month									
January	2 605	394 300	24 816	2 738 590	-	-	27 421	3 132 890	29 964
February	7 094	918 550	6 293	806 540	8 578	1 049 740	21 965	2 774 830	28 048
March	7 285	729 330	-	-	10 927	1 038 130	18 212	1 767 460	16 876
April	-	-	9 447	1 310 230	17 699	234 770	27 146	3 654 000	36 852
May	-	-	28 040	2 601 827	16 523	1 516 830	44 564	4 118 657	38 528
June	-	-	22 406	2 163 440	29 140	2 603 426	51 548	4 766 866	40 569
July	4 785	521 620	718	68 380	27 334	2 767 300	32 837	3 357 500	32 775
August	7 240	1 012 200	13 292	1 701 350	10 770	1 147 300	31 307	3 860 850	31 307
September	5 724	722 190	3 950	454 530	14 089	1 510 450	23 768	2 687 170	23 768
October	5 669	556 890	756	66 895	20 629	1 843 610	27 054	2 467 395	27 054
November	5 556	749 570	3 192	259 150	33 202	2 997 540	41 950	4 006 260	41 950
December	3 546	520 360	-	-	34 184	2 883 710	37 731	3 404 070	37 731
Total	49 509	6 125 210	112 912	12 170 932	223 080	21 701 806	385 502	39 997 948	385 422

	I	II	III	Total or average
Operation (hours)	2 615	2 761	5 021	10 397
Fuel consumpt. (kcal/kg)	1 054	918	829	884
Consump. of refract. bricks (kg/t of clinker)	0.83	1.58	0.81	
Energy consump. (kWh)	2 082 672	3 855 588	6 212 446	
(kWh/t of clinker)	42.1	34.1	27.8	
Production rate (t/d)	600	1 200	1 200	
Daily average (t/d)	454.3	981.3	1 066.2	
Ratio poss/actual (%)	75.7	81.8	88.9	
Production (t/h)	19	41	44.5	
Ratio prod/capacity (%)				38.6
Ratio actual/ assumed prod. (%)				55.9

H. Clinker output in LCC plants

Operation	Hawari Plant		Benghazi Plant		Total Production	
	Clinker output	Fuel consumption	Clinker output	Fuel consumption	Clinker output	Fuel consumption
Month	(tons)	(litres)	(tons)	(litres)	(tons)	(litres)
January	42 679	4 594 900	27 420	3 132 890	70 099	7 727 790
February	49 728	5 652 400	21 965	2 774 830	71 693	8 427 230
March	50 410	5 164 700	18 212	1 767 460	68 622	6 932 160
April	38 558	3 827 600	27 146	3 654 000	65 704	7 481 600
May	42 547	4 618 100	44 564	4 118 657	87 111	8 736 757
June	40 724	3 963 400	51 548	476 866	92 272	8 730 266
July	55 824	5 913 500	32 837	3 357 500	88 661	9 271 000
August	56 033	6 354 700	31 307	3 860 850	87 340	10 215 550
September	37 252	3 782 600	23 768	2 687 170	61 020	6 469 770
October	34 013	3 976 200	27 054	2 467 395	61 067	6 443 595
November	20 706	2 443 900	41 950	4 006 260	62 656	6 450 160
December	36 791	3 952 800	37 731	3 404 070	74 522	7 356 870
Total	505 264	54 244 800	385 502	39 997 948	890 767	94 242 748
Assumed Prod. (t)	640 000		690 000		1 330 000	
Ratio assumed/ actual prod. (%)	78.95		55.87		66.97	
Ratio actual prod. / capacity (%)	50.6		38.6		44.6	
Energy consumpt. Assumed (kcal/kg of clinker)	840		800			
Actual (kcal/kg of clinker)	914		884			

I. Hawari kilns: output, stoppages, energy and fuel consumption
(1979 and 1980 compared)

Operation	Kiln I		Kiln II		Kiln I and II	
	1979	1980	1979	1980	1979	1980
Output						
Estimated (t)	203 903	315 843	145 399	165 214	349 302	481 057
Ratio 1980/1979 (%)	(155%)		(114%)		(138%)	
Actual prod. (t)	...	323 669	...	181 595	346 248	505 264
Ratio 1980/1979 (%)					(146%)	
Operation (hours)	3 706	6 114	2 929	3 825	6 635	9 939
Ratio 1980/1979 (%)	(165%)		(131%)		(150%)	
Stoppage (hours)	5 054	2 670	5 831	4 959	10 885	7 629
Ratio 1980/1979 (%)	(53%)		(85%)		(70%)	
Mech. stop.	62	637	389	646	451	1 283
Ratio 1980/1979 (%)	(1 027%)		(166%)		(284%)	
Elect. stop.	256	176	191	124	447	300
Ratio 1980/1979 (%)	(69%)		(65%)		(67%)	
Operation stop.	4 515	1 653	5 025	3 999	9 540	5 652
Ratio 1980/1979 (%)	(37%)		(80%)		(59%)	
Heating kiln	221	204	225	190	446	394
Ratio 1980/1979 (%)	(92%)		(84%)		(88%)	
Energy cons. (kWh)	...	8 273 855	...	5 357 460	15 372 286	13 631 315
Ratio 1980/1979 (%)					(89%)	
Energy cons. (kWh/t)	...	25.6	...	29.5	44	27
Rate of production (t/d)	...	1 271	...	1 139	1 252	1 220
Ratio 1980/1979 (%)					(97%)	
Designed energy cons. (kWh)		1 500		1 500	1 500	1 500
Actual power cons.						
Ratio 1980/1979 (%)		85		76	83	81
Fuel cons. (l.)	19 907 600	34 242 300	16 144 700	20 002 500	36 052 300	54 244 800
Ratio 1980/1979 (%)	(172%)		(124%)		(150%)	
(kcal/kg clinker)	...	90	...	938	887	914
Ratio 1980/1979 (%)					(103%)	
Refractory bricks cons.						
Burning zone (kg/t)	...	0.507	...	0.448	...	0.486
Elsewhere (kg/t)	...	0.028	...	0.017	...	0.024
Total (kg/t)	0.340	0.535	1.78	0.465	0.949	0.510

J. All LCC cement mills: output, operating hours, stoppages and energy consumption
(Tons)

Production	Hawari Cement Plant				Benghazi Cement Plant				Total Production	
	C. mill I estim. output	C. mill II estim. output	Total estim. output	Total actual output	C. mill I actual output	C. mill II actual output	C. mill III actual output	Total actual output	Estimated output	Actual output
Month										
January	23 841	27 030	50 870	50 886	-	6 989	29 990	36 979	87 850	87 865
February	28 468	10 656	39 124	37 222	-	16 986	12 386	29 372	68 496	66 594
March	34 770	3 771	38 541	43 173	745	2 888	-	3 633	42 174	46 806
April	-	50 322	50 322	48 672	10 263	15 886	17 111	43 261	93 583	91 933
May	-	51 860	51 860	48 975	382	31 070	39 275	70 727	122 587	119 702
June	13 230	30 280	43 510	44 074	1 927	24 243	25 682	51 852	95 362	95 926
July	18 970	35 712	54 682	57 231	-	20 373	25 333	45 706	100 387	102 937
August	28 395	22 790	51 185	47 706	-	16 472	8 563	25 035	76 220	72 741
September	35 308	7 772	43 080	42 526	6 573	7 430	19 757	33 760	76 840	76 286
October	29 620	14 484	44 104	40 015	7 803	8 [illegible]98	14 573	30 974	75 078	70 989
November	35 924	-	35 924	36 400	307	10 885	24 696	35 888	71 812	72 288
December	40 336	-	40 336	40 367	9 004	2 683	23 622	35 310	75 646	75 677
Est. total	288 862	254 677	543 539							
Actual total	286 437	250 810		537 247	37 004	164 503	240 988	442 497	986 035	979 744

(continued)

	Hawari			Benghazi				Total Benghazi and Hawari
	I	II	Total	I	II	III	Total	
Operation (h)	3 452	2 897	6 349	1 017	2 083	3 237	6 337	12 686
Stoppages (h)	5 332	5 887	11 219	7 789	6 739	5 484	20 012	31 231
Actual prod. rate (t/h)	84	87	85	36.5	79	74	not given	not given
Prod. capacity (t/h)	90	90	90	45	90	90	not given	not given
Ratio actual rate/ capacity (%)	93	97	94	80.9	87.8	82.2	not given	not given
Energy consum. (kWh)	8 608 290	62 751 158	14 883 348	1 541 377	7 607 551	10 224 581	19 373 509	34 256 857
(kWh/t)	30	25	28	41.7	46.2	42.4	43.8	34.97
Assumed prod. (t)	375 000	375 000	750 000	150 000	300 000	300 000	750 000	150 000
Ratio actual/ assumed prod. (%)	76.4	66.9	71.6	25	54.8	80.3	59	65.3

H. Hawari cement mills: output, stoppages and energy consumption (1979 and 1980 compared)

Operation	Mill I		Mill II		Mill I and II	
	1979	1980	1979	1980	1979	1980
Output						
Estimated (t)	270 807	288 862	118 667	254 677	389 474	543 539
Ratio 1980/1979 (%)	(107%)		(215%)		(140%)	
Actual production (t)	...	286 437	...	150 810	408 235	537 247
Ratio 1980/1979 (%)					(132%)	
Operation (hours)	3 522	3 452	1 579	2 897	5 101	6 349
Ratio 1980/1979 (%)	(98%)		(183%)		(124%)	
Stoppages (hours)	5 238	5 332	7 181	5 887	12 419	11 219
Ratio 1980/1979 (%)	(102%)		(82%)		(90%)	
Mech. stop.	2 131	4 177	5 057	4 387	7 188	8 564
Ratio 1980/1979 (%)	(196%)		(87%)		(119%)	
Elect. stop.	337	315	189	427	526	742
Ratio 1980/1979 (%)	(93%)		(226%)		(141%)	
Operation stop.	2 770	838	1 935	1 074	4 775	1 912
Ratio 1980/1979 (%)	(30%)		(56%)		(41%)	
Energy cons. (kWh)	8 608 190		6 275 158		15 627 336	14 883 348
Ratio 1980/1979 (%)					(95%)	
(kWh/t)	...	30	...	25	38	28
Output rate						
(t/h)	...	84	...	87	80	85
Ratio 1980/1979 (%)					(106%)	
Designed capacity	90	90	90	90	90	90
Ratio output/capacity (t/h)		(93%)		(97%)	(88%)	(94%)
Grinding Media used (t)	55	...	51	86	(107%)	

L. Cement packaging and despatch in Hawari and Benghazi

Month	Hawari Cement Plant						Benghazi Cement Plant					
	Packed (t)	Bulk (t)	Total (t)	Packed (no. of bags)	Torn (no. of bags)	Total (no. of bags)	Packed (t)	Bulk (t)	Total (t)	Packed (no. of bags)	Torn (no. of bags)	Total (no. of bags)
January	35 445	6 787.16	42 232.16	708 900	42 500	751 400	29 057.5	7 780.20	36 837.7	581 150	29 495	610 645
February	30 225	4 481.28	34 706.28	604 500	46 600	651 100	22 030.0	9 287.45	31 317.45	440 600	19 636	460 236
March	39 185	15 757.47	54 942.47	783 700	39 080	822 780	3 255.00	1 637.25	4 892.25	65 100	2 178	67 278
April	41 400	8 841.78	50 241.78	828 000	37 500	865 500	27 935.00	11 377.65	39 312.65	558 700	21 205	579 905
May	39 912.5	862.78	40 775.28	798 250	75 750	874 000	44 432.73	22 002.88	71 435.61	988 655	64 813	1 047 613
June	39 520	9 333.83	48 853.83	790 400	82 600	873 000	42 817.5	12 107.94	54 925.44	856 350	33 262	889 612
July	46 900	10 050.72	56 950.72	938 000	102 000	1 040 000	34 871.77	9 047.33	43 919.1	697 435	28 692	726 127
August	32 020	11 436.40	43 456.40	640 400	15 200	655 000	21 037.71	3 809.44	24 847.15	42 754	16 830	437 584
September	37 990	10 681.77	48 676.77	759 900	13 500	773 400	28 522.5	5 772.7	34 295.2	570 450	22 818	593 268
October	23 505	7 810.0	31 315.0	470 100	5 900	476 000	19 760.77	8 631.58	28 392.35	395 215	15 809	411 024
November	28 615	11 141.53	39 756.53	572 300	1 700	574 000	24 266.68	12 561.04	36 827.72	48 534	1 941	50 475
December	27 747.5	9 612.78	37 360.28	554 950	...	...	28 962.50	7 966.19	36 928.69	579 250	23 289	602 539
Total	422 470.	106 797.5	529 267.5	8 449 400			331 949.66	111 954.98	443 904.64	6 638 993	297 440	6 936 433

	Hawari	Benghazi
Ratio of despatched cement/assumed (%)	70.6	59.2
Ratio of bulk cement/despatched(%)	20.0	25.2
Ratio of torn bags/used bags (%)		4.3

M. Operating hours of the main sections in Hawari and Benghazi

	Raw material mills										Kilns										Cement mills									
	Hawari Plant				Benghazi Plant						Hawari Plant				Benghazi Plant						Hawari Plant				Benghazi Plant					
	Mill I		Mill II		Mill I		Mill II		Mill III		Kiln I		Kiln II		Kiln I		Kiln II		Kiln III		Mill I		Mill II		Mill I		Mill II		Mill III	
Month	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)	(h)	(min)
Jan.	531	50	89	25	117	40	195	30	215	05	658	00	151	25	156	10	623	35	-	-	290	45	306	25	-	-	137	15	401	55
Feb.	236	40	494	05	354	10	130	50	147	05	370	50	637	15	442	35	196	30	235	55	331	15	128	15	-	-	228	55	158	45
March	411	30	386	25	227	40	-	-	202	5	497	00	841	00	289	30	-	-	235	45	410	05	49	40	18	05	30	30	-	-
April	578	55	-	-	-	-	212	30	268	10	659	45	-	-	-	-	285	50	520	10	-	-	545	40	329	45	215	00	238	45
May	426	30	137	45	-	-	279	40	272	35	565	05	223	45	-	-	576	15	262	00	-	-	581	10	14	15	355	25	482	10
June	65	25	543	30	-	-	253	50	447	40	77	20	683	40	-	-	472	40	611	10	174	00	368	20	36	05	276	25	372	15
July	347	20	518	35	152	20	-	-	294	20	407	30	690	55	235	35	16	20	629	05	224	00	427	15	-	-	228	55	316	35
Aug.	504	15	305	00	202	30	106	10	274	55	700	10	534	05	433	35	396	35	268	30	316	30	260	50	-	-	195	15	105	10
Sept.	552	00	-	-	144	25	107	40	236	20	695	00	-	-	314	55	106	-	356	45	375	00	80	00	165	05	99	50	242	45
Oct.	607	10	-	-	151	30	8	55	266	10	731	05	-	-	265	-	20	25	417	10	355	30	148	20	198	00	129	10	229	05
Nov.	2	00	360	00	215	25	199	10	350	20	24	00	422	00	235	40	67	30	689	20	431	00	-	-	6	50	150	20	351	25
Dec.	599	40	-	-	148	30	327	45	57	00	727	45	-	-	222	30	-	-	694	5	536	10	-	-	249	10	36	00	338	10
Total hrs.	4 865		2 835		1 714	10	1 822	00	3 232	45	6 114		3 825		2 615	30	2 761	40	5 021	40	3 452		2 835		1 017	15	2 082		3 237	

N. Summary of production in Hawari

Section	Working hours			Production			t/h
	Possible (h)	Achieved (h)	%	Possible (t)	Achieved (t)	%	
Clay Crusher	299 x 15	1 489	33	630 220	304 380	48	204
150t/h 15h/d 6d/w	4 485						
Limestone Crusher	299 x 7.5	1 416	63	960 395	562 232	59	397
450t/h 7,5h/d 7d/w	2 242.5						
Raw Mill I	366 x 22	4 865	60	885 720	512 115	58	105
110t/h 22h/d 7d/w	8 052						
Raw Mill II	366 x 22	2 835	35	885 720	272 655	31	96
110t/h 22h/d 7d/w	8 052						
Rotary Kiln I	366 x 24	6 114	70	549 000	314 391	57	1 234
1500t/d 7d/w	8 784						
Rotary Kiln II	366 x 24	3 825	44	549 000	165 214	30	1 036
1500t/d 7d/w	8 784						
Cement Mill I	299 x 21	3 454	55	565 110	288 860	51	84
90t/h 21h/d 6d/w	6 279						
Cement Mill II	299 x 21	2 896	46	565 110	254 664	45	88
90t/h 21h/d 6d/w	6 219						
Bag Loading	299 x 8	No detailed		956 800	427 380	45	...
400t/h 8h/d 6d/w	2 392						
Bulk Loading	299 x 8	information		833 400	102 873		...
450t/h 8h/d 6d/w	2 392						

Note: 52 days were Fridays, 15 days were other holidays.

0. Stock at Hawari

Item	Possible	Available	%
Clay	21 500 m^3 = 32 000 t	10 350 t	32
Limestone	46 700 m^3 = 70 000 t	30 600 t	44
Raw mix line I	135 t/m = 14 000 t	7 917 t	57
Raw mix line II	135 t/m = 14 000 t	7 367 t	53
Fuel oil	6 000 m^3 = 5 500 t	3 100 m^3	52
Clinker (in hall)	30 000 m^3 = 40 000 t	16 700 t	42
Clinker (outside)	Unlimited	15 000 t	-
Gypsum	1 500 m^3 = 2 700 t	800 t	30
Cement	175 t/m = 50 000 t	13 450 t	27

P. Analysis of stoppages in Hawari Cement Plant

PRODUCTION LINE I

RAW MILL I

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	88
Electrical reasons	106
Process reasons	199

PERIODS WITHOUT INTERRUPTIONS

120 h x 1	=	5 d x 1	=	5 d
72 h x 3	=	3 d x 3	=	9 d
48 h x 7	=	2 d x 7	=	14 d
24 h x 15	=	1 d x 15	=	15 d
			Σ =	43 d
			=	12 %

DESCRIPTION OF FAILURES

Mechanical reasons

170 h = Clay reclaimer
106 h = Repair of mill fan
 70 h = Limestone reclaimer
 60 h = Scheduled inspection and maintenance
 39 h = Elimination of ESP - electrodes
 36 h = Clay belt torn
 35 h = Girth-gear lubrication
 20 h = Limestone weight-feeder - belt maintenance
 18 h = Air-lift troubles
 14 h = Clay weight-feeder - belt maintenance
  5 h = Hammer mill
  3 h = Separator maintenance and inspection

3 h = Raw material belt (222.06)

2 h = Double flap (222.08)

2 h = Flat trouble

1 h = Replacement of bearing at the transporter (221.01)

Electrical reasons

68 h = Contact failures

63 h = Lower failures

60 h = ESP cable broken

58 h = Lower limitation

18 h = Scheduled stop

14 h = Limestone balance check and adjustment

6 h = Clay reclaimer

3 h = Girth-gear lubrication

Process reasons

2 422 h = Kiln stop

387 h = No clay

137 h = No limestone

57 h = Storage silos full

20 h = Air slide problems

9 h = Lack of cooling water

9 h = Air-lift overfilled

3 h = Levelling of new piles of limestone

1 h = Cleaning of the weight-measures chute (221.01)

ROTARY KILN I

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	24
Electrical reasons	57
Process reasons	48

PERIODS WITHOUT INTERRUPTIONS

312 h	x 1	= 13 d	x 1	= 13 d
240 h	x 2	= 10 d	x 2	= 20 d
216 h	x 2	= 9 d	x 2	= 18 d
168 h	x 3	= 7 d	x 3	= 21 d
144 h	x 2	= 6 d	x 2	= 12 d
120 h	x 2	= 5 d	x 2	= 10 d
96 h	x 7	= 4 d	x 7	= 28 d
72 h	x 7	= 3 d	x 7	= 21 d
48 h	x 11	= 2 d	x 11	= 22 d
24 h	x 23	= 1 d	x 23	= 23 d
			Σ	=188 d
				= 51 %

204 h = Warming the kiln 7 %

DESCRIPTION OF FAILURES

Mechanical reasons

402 h = Damage of kiln outlet
83 h = Repair of mill fan
61 h = Elimination of ESP electrodes
27 h = Change of burner pipe
19 h = Air-lift troubles
8 h = Clinker-crusher drive belt torn
8 h = Inspection of ESP electrodes

7 h = Clutch of grate-plate drive
6 h = Rectification of flap (331.01)
5 h = Raw-mix balance
5 h = Main-drive coupling
4 h = Flap trouble
2 h = Girth-gear lubrication

Electrical reasons

72 h = Power failures
39 h = ESP cable
27 h = Contact failures
17 h = Scheduled stop
7 h = Inspection and repairs to ESP
6 h = Voltage drop and preheater fan trouble
5 h = Raw-mix balance
3 h = Oil heater problems

Process reasons

1 197 h = Scheduled stop for relining
202 h = Shortage of fuel oil
199 h = Clinker hall full
30 h = Cyclone blocked
16 h = Air-lift overfilled
7 h = Not enough raw mix
2 h = Lack of cooling water

CEMENT MILL I

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	108
Electrical reasons	133
Process reasons	125

PERIODS WITHOUT INTERRUPTIONS

48 H X 1 = 2 d X 1 = 2 d
24 H X 16 = 1 d X 16 = 16 d
Σ = 18 d
= 5 %

DESCRIPTION OF FAILURES

Mechanical reasons

1608 h = Crack of mill shell
507 h = Tightening lining plates
491 h = Crack of bearing
428 h = Repair of partition wall
308 h = Scheduled stop for inspection & maintenance
129 h = Scheduled stop for mill outlet maintenance & inspection
107 h = Scheduled stop
105 h = Replacement & adjustment of clinker belt (521.02)
94 h = Elevator
93 h = Clinker conveyor maintenance and repair
82 h = Renew grease oil
80 h = Lack of cooling water
51 h = Separator maintenance and repairs
32 h = Bag filter of cement silo (563.05) & (563.06)
24 h = Girth-gear lubrication
14 h = Flap troubles
7 h = Oil filter dirty
6 h = Bag filter-fan V-belts done
5 h = Connection of water pipes
5 h = Overheat of gear box (5235)
1 h = Fan (526-14) rectification

Electrical reasons

164 h = Power limitation
118 h = Contact failures
22 h = Power failures
5 h = Voltage drop
3 h = Clinker balance
2 h = Girth-gear lubrication
1 h = Separator fan faulty

Process reasons

421 h = No gypsum
225 h = Stagnation of trade
96 h = Cleaning mill diaphragm
52 h = No clinker
30 h = Scheduled stop
10 h = Flap trouble
4 h = Change over flaps

PRODUCTION LINE II

RAW MILL II

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	67
Electrical reasons	74
Process reasons	196

PERIODS WITHOUT INTERRUPTIONS

48 h x 3 = 2 d x 3 = 6 d
24 h x 5 = 1 d x 5 = 5 d
Σ = 11 d
= 3 %

DESCRIPTION OF FAILURES

Mechanical reasons

452 h = Replacement of ESP electrodes
61 h = Clay reclaimer
35 h = Clay belt torn
31 h = Girth-gear lubrication

29 h = No grease oil for girth-gear lubrication
14 h = Inspection of mill crusher
12 h = Limestone reclaimer
10 h = Renew grease oil
9 h = Scheduled stop for inspection
5 h = Tightening lining plate
3 h = Limestone balance
2 h = Air-lift
1 h = Inspection of mill fan

Electrical reasons

72 h = Power failures
40 h = Contact failures
26 h = Power limitation
10 h = Girth-gear lubrication
3 h = Limestone reclaimer

Process reasons

4 415 h = Kiln stop
391 h = No clay
166 h = No limestone
88 h = Storage silos full
46 h = Air-lift overfilled
11 h = Screw conveyor overfilled
5 h = Lack of cooling water
4 h = Mechanical filter overloaded
3 h = Changeover flaps
1 h = Hammer crusher overfilled

ROTARY KILN II

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	17
Electrical reasons	44
Process reasons	36

PERIODS WITHOUT INTERRUPTIONS

168	h	X	2	=	7	d	X	2	=	14 d
144	h	X	4	=	6	d	X	4	=	24 d
120	h	X	4	=	5	d	X	4	=	20 d
96	h	X	4	=	4	d	X	4	=	16 d
72	h	X	3	=	3	d	X	3	=	9 d
48	h	X	5	=	2	d	X	5	=	10 d
2'	h	X	15	=	1	d	X	15	=	15 d
								Σ	=	108 d
									=	30 %

190 h = Warming the kiln.

DESCRIPTION OF FAILURES

Mechanical reasons

594 h = Replacement of ESP electrodes
32 h = Change of burner pipe.
6 h = Maintenance of flap (224.03)
5 h = Clinker cooler grate (II) coupling
4 h = Air-lift V-belt troubles
2 h = Bag filter rotary air-lock (239.21)
1,h = Clinker cooler grate-plate (2) brake (365.02

Electrical reasons

56 h = Power failures
27 h = Contact failures
20 h = Kiln drive motor repaired
12 h = Weigh-feeder adjustment
9 h = Inspection & maintenance

Process reasons

2553 h = Scheduled stop for clinker hall full
1009 h = Stand still for relining
362 h = Lack of personnel & shortage of fuel
62 h = Air-lift trouble
8 h = Not enough raw mix
3 h = Cooling water shortage
2 h = Flap troubles

CEMENT MILL II

NUMBER OF INTERRUPTIONS DUE TO

Mechanical reasons	122
Electrical reasons	92
Process reasons	91

PERIODS WITHOUT INTERRUPTIONS

48 h X 3 = 2 d X 3 = 6 d
24 h X 9 = 1 d X 9 = 9 d
Σ = 15 d
= 4 %

DESCRIPTION OF FAILURES

MECHANICAL REASONS

2 842 h = Crack of mill shell
467 h = Scheduled stop for inspection & maintenance
396 h = Partition wall
259 h = Replacement of ESP electrodes
143 h = Replacement of lining plates
135 h = Clinker belt repairs & replacement
74 h = Tightening lining plates
30 h = Girth-gear lubrication
26 h = Repair for clinker belt (521.01)
11 h = Adjustment of clinker weigh-feeder
3 h = Seperator fan (534.03) troubles
1 h = No cooling water

Electrical reasons

312 h = Power limitation
46 h = Power failures
30 h = Contact failures
29 h = ESP cable
9 h = Adjustment of clinker weigh-feeder
1 h = Separator fan faulty

Process reasons

303 h = Scheduled stop (not enough clinker)
258 h = No gypsum

258 h = No gypsum

123 h = Scheduled stop for charging and rearranging grinding media after repair of partition wall

154 h = New charging of mill

118 h = Stagnation of trade

58 h = Cooling water problems

32 h = Clinker hopper blocked

14 h = Change over flaps

9 h = No clinker

5 h = Cleaning mill diaphragm

Q. Analysis of stoppages in Benghazi cement plant

1. RAW MILLS

As a general statement, most of the raw-mill stoppages were due to kiln stoppages. The stoppages of all raw mills were due to the following reasons (the exact time for stoppages are not available):

Raw mill I

The stoppages were due to different mechanical and electrical reasons.

Raw mill II

Maintenance of mill diaphragm and mill lining plates.
Raw mill III operated on line II to secure the limestone necessary for the lime factory.
Maintenance of the balances.
Overhauling the heater plus lining with fire-bricks.
Overhauling the scrapers.

Raw mill III

Maintenance of limestone crusher III.
Mechanical stoppages in scrapers.
Lack of limestone and marl.
Maintenance of balances.
Maintenance of raw mill lining and diaphragm.
Building of raw material rings inside the mill compartment due to high percentage of humidity, especially in winter season.

2. KILNS

Kiln I

The kiln was stopped 3 435 hours in 1980 due to the lack of operating personnel. During this period of time, lining of the kiln with refractory bricks was carried out according as follows:

(a) Relining of the kiln hood;
(b) Relining of the outlet zone (10 344 bricks);

(c) Relining of 6.8 m at the beginning of the burning zone (41,168 kg bricks);

Overhauling the clinker elevators and conveyors (1,000 h);

Clogging of preheaters (450 h);

Deficiency of heavy oil (240 h);

Maintenance of the exhaust fan (140 h);

Defects in balances (120 h).

Kiln II

The kiln stopped for 2,847 hours for relining with fire bricks as follows:

(a) The outlet zone was changed three times (23,290 kg bricks);

(b) 5.9 m in the burning zone (16 m from the outlet) were relined with fire bricks (4,300 kg bricks);

(c) 10.4 m in the burning zone (starting from the outlet) were relined (73,787 kg bricks) in August 1981;

(d) In the burning zone, 9 m (starting from the outlet) were relined with fire bricks (62,822 kg bricks) i.e. the total quantity used in relining the burning zone was 179,188 kg;

(e) In the calcination zone, 3.4 m were relined (30.6 m away from the outlet) and 19,522 kg bricks were used;

(f) In August, 3.7 m were relined (27 m away from the outlet and 22,554 kg bricks were used;

(g) 4.6 m were relined (34 m away from the outlet) and 23,515 kg were used.

The contractor (KHD) changed the outlet segment of the kiln in February, March and April (1,248 hours).

The kiln was stopped for 629 hours due to the overhauling of clinker elevators and conveyors.

Clogging in preheaters (244 hours).

Maintenance of the exhaust fan (181) hours.

Maintenance of kiln revolution instrument recorder (96 hours).

Kiln III

The kiln was stopped for relining with fire-bricks as follows:

(a) Relining of the kiln hood and the outlet zone (7,760 kg bricks);

(b) In September, the outlet zone was relined completely (15,520 kg bricks);

(c) In the burning zone, (January 1980) 12.2 m were relined starting from the burning zone (86,577 kg bricks);

(d) In September, 4.4 m starting from 19 m away from the kiln outlet were relined (31,225 kg bricks). At the same time, the first one metre in the burning zone was relined (7,096 kg bricks);

(e) Starting from the beginning of the burning zone, 9.6 m were relined in October 1980 (62,822 kg bricks).

The kiln was stopped for 552 hours in January due to the clinker conveyor change carried out by the contractor KHD.

Due to the deficiency of heavy oil, the kiln was stopped for 386 hours.

It was stopped also for different reasons connected with the balance, clinker cooler, clinker conveyor, fan etc.

3. CEMENT MILLS

Cement mill I started operation only at the time when cement mill II was stopped in April, September, October and December 1980. It was stopped during this period for mechanical and electrical maintenance of the separator fan and cement pump. There was also the fact that raw mill I and cement mill II cannot operate at the same time as both have one compressor which was changed afterwards to operate both on condition that cement mill I was out of operation.

Cement mill II

A crack was discovered around the mill trunnion.

The mill was stopped in March and April 1980 and in September and October 1980 for 17 and 35 days respectively for welding and changing the welded section.

The mill stopped several times at the beginning of 1980 because of the increase in cement temperature.

Cement mill III

The mill stopped at the beginning of the year because of;

Overhauling of clinker conveyors in March 1980 (24 days),

Welding of a crack in March and April 1980 (18 days),

Changes in speedometer box in March and April 1980 (200 hours),

Overhauling the cement pump in October 1980 (112 hours).

The following tables give details of the stoppages at Benghazi.

Failures of Raw Mill I

Hours	Minutes	Stoppages
5 940	10	Kiln stop
429	40	Scheduled stop
48	-	Maintenance of mill coupling
47	45	Weigh-feeder adjustment
44	-	Relining and tighting lining plates
27	30	Defect of compressor
26	45	Maintenance of pump
61	25	Overfilling of screw conveyor
92	15	Maintenance of mill fan
122	40	Other different stoppages less than 24 hours
6840	10	Total

Failures of Raw Mill II

Hours	Minutes	Stoppages
4 827	35	Kiln stop
425	-	Scheduled stop
424	15	Replacement of lining plates and diaphragm
281	45	Operating Raw Mill II on Line III
163	11	Mechanical defects in scrapers
127	20	Weigh-feeder adjustment
115	25	Heater maintenance
76	20	Addition of grinding media
49	15	Inspection of mill by contractor (KHD)
32	55	Shortage of clay and limestone
32	10	Contact failures
173	30	Other different stoppages less than 24 hours
6 688	40	Total

Failures of Raw Mill III

Hours	Minutes	Stoppages
2 118	35	Kiln stop
1 163	-	Scheduled stop
678	15	Maintenance in limestone crusher
301	35	Mechanical defects in scrapers
243	15	Shortage of clay and limestone
192	-	Operating Raw Mill II on line III
173	-	Weigh-feeder adjustment
64	45	Relining of lining plates and diaphragm
61	30	Elimination of raw-material ring
59	-	Deformation of screw conveyor
39	10	Girth-gear lubrication
32	30	Maintenance in separator
33	30	Heater maintenance
26	50	Chute choked
239	65	Other different stoppages less than 24 hours
5 426	50	Total

Failures of Rotary Kiln I

Hours	Minutes	Stoppages
3 435	-	Shortage of kiln operators
1 018	40	Maintenance of clinker elevators
454	55	Clogging in preheater stages
436	20	Heating kiln
242	25	Shortage of fuel oil
139	5	Defects in mill fan
123	20	Weigh-feeder adjustment
53	-	Maintenance of clinker elevators
48	25	Maintenance in silo I and II flaps
26	10	Heater maintenance
54	15	Other different stoppages less than 24 hours
6 030	5	Total

Failures of Rotary Kiln II

Hours	Minutes	Stoppages
2 847	30	Relining of kiln
1 248	-	Repair in kiln carried by contractor (KHD)
629	50	Maintenance of elevators
271	-	Heating up kiln
244	5	Clogging in preheater stage
181	15	Maintenance of mill fan
96	-	Maintenance of mill speedometer
48	-	Maintenance of diesel motor
48	-	Shortage of ignitor
48	-	Maintenance of kiln bearings
44	5	Clogging and maintenance in raw-mill silos
104	50	Other different stoppages less than 24 hours
5 810	35	Total

Failures of Rotary Kiln III

Hours	Minutes	Stoppages
1 849	25	Relining of kiln
522	-	Maintenance of elevators (KHD)
386	30	Shortage of fuel oil
276	50	Heating up kiln
197	45	Clogging in preheater stage
165	-	Defects of mill fan
90	40	Weigh-feeder adjustment (contractor KHD)
55	15	Maintenance of grate plate
54	5	Maintenance of elevators
45	5	Weigh-feeder adjustment
96	40	Other different stoppages less than 24 hours
3 739	15	Total

Failures of Cement Mill I

Hours	Minutes	Stoppages
7 287	10	Scheduled stop
118	50	Mechanical and electrical maintenance in separator fan
117	40	Defects in fluxo pump
39	20	Weight measures adjustment
32	30	High temperature of cement
37	45	Inspection of mill gear
35	30	Maintenance of belt
26	20	Maintenance of bucket elevator
24	-	Girth-gear lubrication
69	45	Other different stoppages less than 24 hours
7 788	50	Total

Failures of Cement Mill II

Hours	Minutes	Stoppages
2 287	15	Scheduled stop
1 338	5	Shortage of clinker
1 142	10	Welding of cracks and changing ring
751	15	Changes in the clinker conveyor's design
624	-	Crack in the mill trunnion
123	30	Increase of cement temperature
68	20	Girth-gear lubrication
45	26	Chute choked
30	35	Weigh-feeder adjustment
85	55	Defects in electric cables and in cement-conveying system
40	40	Defects of clinker conveyors
	45	Other stoppages less than 24 hours
6 739	56	Total

Failures of Cement Mill III

Hours	Minutes	Stoppages
937	50	Shortage of clinker
2 302	-	Scheduled stop
744	-	Changes in clinker-conveyor's design
340	30	Welding of cracks
199	30	Maintenance of mill speedometer
118	35	Maintenance of cement fluxo pump
245	30	Mechanical maintenance of clinker conveyors
77	25	Rearranging and addition of grinding media
74	25	Girth-gear lubrication
61	25	Weigh-feeder adjustment
54	30	Defects of mechanical filter
40	25	Mecharical defects in air compressor
122	-	Power failure
24	50	Maintenance of the mill entrance
151	25	Other different stoppages less than 24 hours
5 484	20	Total

Annex VI

MECHANICAL AND ELECTRICAL MAINTENANCE IN BENGHAZI

A. Plant inspection report, Benghazi II: Homo silos rotary kiln cooler (29 October 1980)

Heat exchanger fan

Type: A 1300/2050

1. The throttle valve is not in operation.
2. The vibration absorbers do not function due to the fact that the fan frame is not free.
3. The bearings should be cleaned and filled with new oil.
4. Oil change on the gear box WGW SN 4/SO.
5. Grease change on drive motor.
6. E-motor cooling system to be cleaned.
7. Cracks on the blower housing to be welded.
8. Extreme corrosion on the blower housing to be cleaned and painted (heat-resistant paint)
9. General inspection of the whole fan has to be carried out.

Schenck belt weigh-feeder

Type: DMi LS 12/BL.

1. Raw-meal spillage under the belt weigh-feeder.
2. The belt rollers have to be cleaned.
3. The side rubber has to be replaced or re-adjusted.
4. Flex hose pipe for air connection of pneumatic drive of dosing valve is broken.
5. Raw-meal sunker needs a general inspection.
6. The chain drive needs to be cleaned and lubricated.

Equipment under storage and homo silos

1. Water tank is covered with raw meal and the inspection cover is open. A cleaning of the tank is recommended.

2. A big amount of raw meal needs to be removed.

3. All bucket-elevator bearings need to be cleaned and re-lubricated. The seals should be replaced.

4. The drive (gear box) of the bucket elevators needs to be checked and the oil to be changed.

5. The chains, buckets, wheels and all connections should be inspected.

6. The screw conveyors, general check-up.

7. Compressors GMA 11.4, general maintenance.

8. Water-air cooler needs to be cleaned.

9. Compressor VM 210-2, general maintenance.

10. Three water pumps, general maintenance.
The general situation in this part of the plant is horrible.
The screw conveyor from belt weight meter needs general maintenance.
The lift is out of order. Why?
There is a specialist of the manufacturer of this lift (Haushahr) available in this country.

Heat exchanger

Floor No. 1.

1. Aerzener blower, general maintenance.

2. The fresh-air blower for the compressor room under the raw-meal silos is out of order. The blower and filtration facilities should be generally checked and overhauled.

3. Checking of kiln-inlet seal.

Floor No. 2.

4. Checking of flaps in the raw-meal feed-pipe.

Floor No. 3.

5. Checking of 3 flaps.

Floor No. 4.

6. Checking of flaps in air slider to bucket elevators.

7. Checking of cyclone.

8. General overhaul of bucket-elevator drive.

Floor No. 5.

9. Checking of double flaps.

10. Checking cylone.

11. Cracks on cyclone housing need to be welded.

12. Grease change on bucket elevator bearings.

Floor No. 6.

13. Compensator hot-gas pipe need to be repaired.

14. General overhaul of flaps.

15. Bucket elevator needs general maintenance (Station between homo and storage silos)

16. Air slide blower needs replacement of the filters.

17. The silo inspection covers should be sealed.

18. Check-up of all regulating units.

19. Spillage of raw material should be removed.

Floor No. 7.

20. Cracks in the cyclone housing need to be welded.

21. Checking of flaps.

22. Auxiliary chimney, flap and drive need to be overhauled.

Floor No. 8.

23. Overhaul of screw conveyor.

24. A lot of spillage of raw meal has to be removed.

Floor No. 9

25. General maintenance of bucket-elevator drives.

26. All seals on elevator inspection holes need to be replaced.

Floor No. 10.

27. General overhaul and check-up of the silo filters. The filter doors need to be sealed.

28. All blowers should be checked and maintained.

29. The overflow-flaps on the silos need to be checked.

Floor No. 11.

30. Check-up of flap change over drive E4 24/K3 19/D2 05.

31. Was there a explosion of the lift machine-room door?

Floor 12.

32. General maintenance on bucket-elevator drives.

33. The old oil has to be removed.

Rotary kiln

Roller station I.

1. The first roller is deformed and needs to be machined on the lathe machine. Check bearings' tolerances.

2. Manometer for the hydraulic system out of order.

3. The bearings of the kiln-drive main pinion should be cleaned, checked and refilled with new grease.

4. The central lubrication system should be checked and generally overhauled.

5. The auxiliary drive of the kiln (diesel engine) looks horrible. A general maintenance is recommended.

6. The gear box of main and auxiliary drives should be checked and if necessary the oil changed.

7. The lubrication-oil pumps, general maintenance.

8. The oil cooler should be cleaned.

Roller Station II.

9. The bearings should be checked. Cooling-water arrangements controlled.

Roller station III.

10. The bearings should be checked. Cooling-water arrangements controlled.

11. Kiln tyres side stoppers should be checked. It seems that the side play is too much.

Kiln inlet

Material coating has to be removed.

Kiln head

The bricks are in bad condition.

Kiln outlet

Outlet seal lubrication?

Fuel-oil station

1. The general situation is absolutely dangerous due to spillage of a lot of fuel oil.

2. Thermometer and manometer are out of order (broken).

3. All pumps, valves and other connections should be sealed.

Multi cyclone

All screw conveyors, drives, star-feeder flaps and filter inserts should be checked and maintained.

Clinker cooler

1. All cooler plates should be checked and, if necessary, changed.

2. General inspection of cooler blower, drives, drag chains, centre.

3. Lubrication of clinker crushers etc.

Clinker transport

The complete transport from cooler to clinker storage must be checked.

B. Plant inspection report, electrical installations,

Benghazi I and II

Remarks about the instrumentation at kiln no. I

The following measuring points were not working properly:
340.30 Wrong indication
330.30 Bypass belt weigh-feeders, wrong indication
316.50 Temperature grate plates, the feeders are damaged
317.31 Secondary air temperature, wrong indication E109 and E101 counters do not work

Lamps and cassettes for signalization are missing. The panel needs cleaning.
The construction for assembling fuses etc. is very bad, because it is impossible to work with instruments during operation. It needs changing.
General. The operator does not use automatic operation of regulator, only manual.

Remarks about the instrumentation at kiln no. II

The following measuring points were not working properly:
317.30 Clinker temperature, no indication
325.30 Draught at kiln outlet, no indication
326.60 No regulation
326.60 Pressure, clinker-cooler chamber 1, no indication
326.62 Pressure, clinker-cooler chamber 2, no regulation
313.30 Gas temperature, kiln end, no indication
344.60 Air quantity, clinker-cooler chamber I
345.60 Air quantity, clinker-cooler chamber 2
D 280 The counter is missing
D 281 The counter is out of order
341.40 Switch for schenk balance is missing
K 305 Control circuit for chimney flap, malfunction
E 316 Control circuit out of order
The Schenk balance sometimes switches itself off
The switch knob for controlling the dust-conveyance E-filter is missing
316.50 Temperature grate plate, no indication
Temperature indication for kiln's roller bearing nos. 4, 9, and 5 has malfunction.
The signalization box 381.55,381.56 description is no longer readable.
K301 Heat exchanger fan speed control malfunction.
Oil installation. The measuring manometer for primary air is missing.
The shut-off magnetic valve doesn't work. The level indication V 203 has the wrong signalization.

General. The operator does not use automatic operation of regulator, only manual. The pirometer should be protected from shortage of cooling water.

C. Maintenance programme for Benghazi I rotary kiln

The rotary-kiln plant with heat exchanger and clinker cooler.

The number and items are to be followed according to the plant flow sheet, drawing ZV 0402/070.

Item 9.02 - electrostatic precipitator

A complete inside inspection of the filter has to be made
The electrodes have to be checked
The filter mechanism must be checked
Check-up rapping mechanism, hammers and bearing of the hammershafts
The drives of the mechanism, gear boxes general check-up, change oil and control all couplings
Inspect all seals and packing
Inspect and clean-up filter-resting bearings (on the filter foundations)

Item 9.04 worm conveyor, 7,875 metres long

Check-up conveyor blades and all intermediate bearings
Inspect and clean-up, change oil of the worm-conveyor drive (gear box) and control all couplings
Inspect all seals

Item 9.03 worm conveyor, 9.150 metres long

Inspection as for item 9.04

Item 9.05 exhaust-gas fan, type A 1000/1600

Inspect inside of fan rotor and shaft, also the fan housing
Inspect and clean and change lubrication of floating and fixed bearing
Check fan housing for corrosion, cracks and other loose connections
Check fan drive and couplings

Item 9.09 breeches chute, Gr. 30

Inside and outside inspection for wear and spillage.

Item 9.08.01 Precipitator dust-conveyor pump, Gr. 10

Check the worm (wear)
Check bush (wear)
Check nozzle (wear)
Check shaft sealing
Check and clean, new grease filling of the two shaft bearings.
Check drive and coupling
Check pump housing, raw-meal bunker, valves, pressure gauges and pipes

Item 9.08.03 rotary piston blower, type GHa 12,4

General check-up, cleaning and oil change of the blower
Check coupling and drive
Check valves, pipes and pressure gauge

Item 9.01 evaporating cooler, 195 metres high

Check the complete water spraying system with all pipes, nozzles, pumps, valves and pressure gauges
Check the vibrator arrangement
General inspection of the whole steel structure including all seals

Item 6.01 screw conveyor, 22.5 metres long
Check the screw blades (wear)
Check all bearings
Inspection, clean-up and oil change of the worm-conveyor drive (gear box) and control all couplings
Inspect all seals

Item 6.02 bucket elevator, 22.8 metres high
The complete drive unit has to be checked
Inside inspection of the gear box, oil change
Inside inspection of the bucket elevator, all bearings, coupling, top wheel elevator, bottom wheels, elevator chains, bucket-elevator housing, seals of inspection doors, deducting pipe

Item 6.03 raw-meal bin, 8.5 metres high
Inside inspection of the bunker and complete steel structure

Item 6.04 rotary piston blower, GSL 039.1
General check up, cleaning and oil change of the blower
Check coupling and drive
check valves, pipes and pressure gauge

Item flat shut-off slide valve
Check the whole mechanism of this valve

Item 6.04 solenoid valve
General overhaul of the valve

Item 6.06 belt weigh-feeder, DMis 16/V (Schenk)
Check condition of belt, if necessary, changing, also side rubber
Check bearings for drive and return drum, clean and regrease
Check, clean and relubricate the complete belt weigh-feeder drive
Recalibrate (measuring and control department)

Item 6.07 worm conveyor, 3.2 long
Check the screw blades (wear)
Check all bearings
Inspection, clean up, and change oil of the worm-conveyor drive (gear box) and control all couplings
Inspect housing and all seals

Item 6.08 bypass for belt weigh-feeder regulator
Check aereating cloth, seals, regulating unit and housing of bypass

Item 6.08 rotary piston blower, GSL 039.1
General check up, cleaning and oil change of the blower
Check coupling and drive
Check valves (safety), pipes and pressure gauges

Item 6.09 bucket elevator, 45 metres high
The complete drive unit has to be checked
Inspect inside of gear box, change oil
Inspect inside of the bucket elevator, all bearings, top wheels, bottom wheels, elevator chains, bucket-elevator housing, seals of inspection doors, dedusting pipe

Item 6.11 worm conveyor, 4.7 metres long

Check the screw blades (wear)
Check all bearings
Inspect clean-up and change oil the worm conveyor drive (gear box) and control all couplings
Inspect housing and all seals

Item 6.12 multi-cyclone heat exchanger

Check all corrugated-tub expansion joints according to documentation sheet 6.12.01
Pos. 1 corrugated exp. NW 300 - 2 pieces
Pos. 4 corrugated exp. NW 400 - 2 pieces
Pos. 7 corrugated exp. NW 400 - 2 pieces
Pos. 10 corrugated exp. NW 500 - 2 pieces
The joints must be checked to see if there are cracks and also the seals should be checked to avoid false air-inlet drag
Check all flap valves in heat exchanger according to documentation sheet 6.12.02/1
Pos. 1 flap valve NW 200 - 4 pieces
Pos. 7 flap valve NW 400 - 1 piece
Pos. 13 flap valve NW 250 - 2 pieces
Pos. 19 flap valve NW 300 - 1 piece
The following parts should be checked:
the flap housing, the flap, the two seals, the two pressure springs
Check all dip pipes in the heat exchanger according to documentation sheet 6.12.03
Pos. 1 Dip pipe stage I - 2 pieces
Pos. - Dip pipe stage II - 1 piece
Pos. 5 Dip pipe stage III - 2 pieces
Pos. 8 Dip pipe stage IV - 1 piece
The dip pipe must be checked for proper seat, deformation and wear
Check the complete steel structure of cyclones, there are some cracks
All seals of inspection doors and packing holes must be checked and, if necessary, changed
Check swirl chambers I and II, spreader cone
Check expansion joint for rising pipe seals and cracks
Check protective plates for rising pipe
Check start chimney and the whole mechanism
Check feed-end housing complex and feeding segments
Check kiln-inlet seal between kiln and inlet chamber
Check gas probe and its arrangements

Item 6.13 rotary kiln, 53 metres long

Check kiln-inlet seal as for 6.12 above
Check kiln-outlet seal and protecting segments
Check all supporting roller bearings and, if necessary, change oil
Inspect supporting roller surfaces
Inspect thrust rollers, all oil leakages should be sealed
Inspect firing head for cracks
Inspect the complete kiln drive, checking and cleaning the two pinion-shaft bearings, oil change. Check condition of pinion and gear wheel
All couplings must be checked
The gears of the main gear box should be checked and, if necessary, the oil changed. The auxiliary gear box, SC 2.5, should also be inspected
General maintenance for the auxiliary diesel engine

Inspect the double shoe brake (lining)
Check-up lubrication system including pumps, valves, fitters, cooler, pressure gauges and all seals
Toothed rim for kiln with attachment, all bolts and nuts, should be checked to see if they are tight
Central grease-lubrication system for kiln drive must be cleaned and, in some places, have a sealed test run
Inspect kiln tyres, surface-tyre shoes and side clearance
General inspection of the kiln shell

Item 6.14 cooling fan, type 280/500/45°
Check kiln-outlet seal, fan housing, impeller and pipes

Item 6.15 heat-exchanger fan, type A 1100/1780
Inspect fan housing for cracks
Inspect, clean and lubricate, change the bearings
Check the impeller (wear)
Check shaft and coupling

Item 7.05 primary air fan, type 250/750/90°
Check fan housing, impeller and pipes

Item 8.01 clinker cooler, Gr. 644
Inspect all cooler plates including all fastening units and main frame
Check all cooler grate rollers and bearings
Inspect the cooler drive including gear box and chain drive
Inspect the whole steel structure
General check-up of drag chain including drive
Outside inspection for corrosion and heat deformation
Inspect bricks and pipe (duct) connection to multi-cyclone
Item 8.01.01 cooling air fan No. 1, type A 350/560
Item 8.01.02 cooling air fan No. 2, type C 560/790
Item 8.01.03 cooling air fan No. 3, type C 890/1260
Inspect fan housing, impeller shaft, two bearings, (cleaning and re-lubricating) and V-belt drive

Item 8.02 clinker crusher
Inspect crusher-housing rotor, hammer tow bearings, shaft, and V-belt drive

Item 8.03 multi-cyclone dust collector (Tubix)
Outside and inside inspection of the dust collector (wear)
Check out all dust sluices and sluice drives
Item 8.03.01 exhaust-air fan, type B 1425/2000
Inspect fan housing, impeller, shaft, two bearings (cleaning and re-lubrication) and V-belt drive

Item 8.04 worm conveyor, 7.7 metres long
Check the screw blades (wear)
Check all bearings
Inspect, clean-up, and change oil of the worm-conveyor drive (gear box) and control all conveyors
Inspect housing and all seals

Item 8.05 box-type conveyor 630 mm, 49.44 mmltc
Inspect gear box WGW KCH 4.5
Inspect coupling multi-mont MM 25
Inspect, clean, and re-lubricate drive-shaft bearing, self-aligning roller bearings 222284
Inspect drive shaft with chain sprockets
Completely inspect the return-end equipment including bearings, self-aligning roller bearings 22224, shaft with chain sprocket, take-up screws and buffer springs
All buckets with shafts, angular plate chains, rollers and fastening units must be checked carefully
Check-up rails and complete steel structure
All chute flaps and the complete dedusting system must be checked
General. A general clean-up should be carried out, i.e. all dust, spillage, rubbish and waste materials should be removed

D. Maintenance programme for Benghazi II rotary kiln

1. Homo and storage silos
   Silo covers to be sealed
   All connections to and from silos checked for spillage

2. Raw-meal transport to silos
   Airslides to be checked
   Airslide blowers to be checked
   All flaps and changeover devices to be checked
   General check-up of bucket elevators

3. Raw-meal transport from silos to heat exchanger
   Airslides to be checked
   Airslide blowers to be checked
   All flaps and changeover devices to be checked
   General check-up of bucket elevators
   Inspect raw-meal balance

4. Fluidization system for silos
   Air distributors to be checked
   If silos empty, checking porous cloth
   General check-up of fluidization blower

5. Mechanical filters
   All doors must be sealed
   Inspect filter mechanism
   Inspect filter hoses
   All flaps and valves must be checked
   Inspect filter fans
   Inspect screw conveyor and rotary feeders

6. Heat exchanger (cyclones, pipes, flaps)
   Weld cyclone cracks
   Inspect all flaps
   Inspect raw-meal feed pipe
   Seal all doors and covers
   Check all expansion joints
   Check the whole pipe system
   General inspection of passenger lift

7. Heat-exchanger fan
   Check antifriction bearings
   Check couplings
   Check gear box
   Check oil-cooling system
   Check blower housing
   Check impeller and shaft
   Check frame and vibration absorbers

8. Rotary kiln
   Kiln inlet to be checked
   Take measurements from all kiln rollers
   Check-up bearings of kiln rollers
   Check-up trust rollers
   Check-up hydraulic system
   Check-up kiln tyres
   General inspection of kiln drive
   Inspect central lubrication
   Kiln outlet to be checked (segments)
   Kiln hood to be checked
   Planning of kiln re-alignment

9. Clinker cooler
   Check all cooler plates
   Inspect cooler drive
   Inspect drag chains
   Inspect hammer crusher
   Inspect all fans
   Inspect multi-cyclone filter
   Inspect chute to clinker transport

10. Clinker-cooler fan
    Inspect fan housing
    Inspect all bearings
    Inspect couplings
    Impeller and shaft
    Regulating flaps

11. Clinker transport
    General inspection of the whole transport system

12. Kiln-firing plant
    Check all pumps
    Check all valves and pipes
    Check whole heating system
    Check all burner pipes and nozzles
    Check all air blowers
    Check replacement of all broken thermometers and pressure gauges

E. General overhaul of clinker elevator no. 104, Benghazi
(Extracted and rearranged from the report of J. Mackowiak)

Technical characteristics of bucket elevator no. 104;

Height	42.62 m
Capacity	130 t/h
Bucket length	630 mm

The overhaul was carried out between 16 December 1980 and 16 March 1981 (with some interruptions) by the UNIDO team of Polish specialists directed by J. Mackowiak.

The condition of the elevator made it necessary to replace 26 parts of the load-bearing walls and to replace completely the chain guides, the buckets, chain-driving wheels and jockey-chain wheels. Three elevator chutes had also to be replaced.

The elevator chain was completely worn out and it was useless. Excessive clearance between the chain links caused the chain to tighten unequally and a deviation in the position of the buckets. LCC had not any spare chain and so it was necessary to recondition the old one by replacing 18 outside links, 20 inside links and all the distance sleeves and bolts (550 of them). After the installation of these spare parts, the condition of the chain was improved.

There were no spare parts for the elevator and accordingly the overhaul team had to manufacture all the required spare parts by themselves in the LCC workshop. In the course of the overhaul, the team manufactured the following parts:

26 pieces of load-bearing wall 3 000 x 1 660 mm
2 chain-driving wheels
2 jockey-chain wheels
1 jockey shaft
2 chain stops
2 tightening screws
3 clinker chutes
350 chain distance sleeves
350 m of chain guides
3 elevator face walls
18 straining beams
2 staffing boxes

The variety and quantity of the materials used gives some idea of the scale of the overhaul. It must be also noted that only the 176 buckets were made in the mechanical workshop of the Benghazi Cement Plant and that all the remaining spare parts were manufactured by the Polish team themselves under field conditions.

Constant shortage of material and long waits for its delivery made the overhaul time so long. The shortage of proper material made various changes in the overhaul schedule necessary.

Since it was not possible for LCC to buy 350 metres of angle steel 130 x 65 x 10 mm for the chain guides, the team was forced to manufacture the guides from the angle steel 120 x 120 x 12 mm and flat bars by welding which was a very time-consuming job. The new chain guides, 160 mm high, make it impossible for the moving chain to wear out the elevator side walls, as happened before.

To dismantle the elevator, manufacture all the necessary parts and to reassemble the whole thing, required 7,518 working hours.

In conclusion, the following recommendations should be made:

1. In future, prior to an overhaul, documentation should be prepared including;

   (a) Scope of the overhaul;

   (b) List of necessary spare parts in stock;

   (c) List of parts which should be made before overhaul.

2. The time before an overhaul should be used for preparing the material.

3. An overhaul should not be started unless all the spare parts are available.

4. The chain which has been reconditioned in the elevator should be replaced by a new one as soon as possible. Its present condition does not ensure the long life of the elevator. At present, the chain is the weakest element in the elevator.

Annex VII

DISCUSSION OF THE KHD PROPOSAL TO EQUIP THE BENGHAZI KILNS WITH BYPASSES

A meeting about the bypass-filter plants for Benghazi I, II and III was held between A. Marei, LCC and UNIDO co-ordinator, and B. Wendt, the KHD technical assistant in the Mechancial Planning Department.

The following points were discussed and cleared up:

(a) The general layout in accordance with the proposal and offer from KHD;

(b) The possibility of another location of the bypass plants;

(c) The possibility of using the existing main dedusting filters for bypass dedusting;

(d) The fear of the head of Mechanical Department that there would be big problems if maintenance or repair work has to be carried out on the kiln-inlet side.

A. The general layout according to the proposal and offer received from KHD

After studying the layout drawings 841-12-173-UA/174-UA/175-UA, it was found that this design would be the only possible one to avoid additional disturbance in the general layout of the factory.

The filter plants are integrated in each production line with a minimum of additional building area. The free passages between the kilns would still exist for transportation of machinery and maintenance of the plant.

The open steel structure also assures good access for maintenance and there will be no temperature barrage in the inlet zone of the kiln shells.

B. The possibility of another location of the bypass plants

There are other possibilities for the location of the new bypass filters, but these would have the following drawbacks:

(a) Far away from the kiln-inlet chambers;

(b) Additional long pipelines;

(c) Occupying of additional free space in the factory compound;

(d) Impeding the free passages in the factory.

C. The possiblity of using the existing main dedusting filters for bypass dedusting

This point had been explained in a telex dated 28 November 1980 from KHD, department IS-SP 1. In general, there was nothing more to be added on this subject as all the advantages and disadvantages had been made very clear. In one of the past discussions with representatives from LCC, it was pointed out that the existing main E-filters of Benghazi I, II and III are not sufficient. In the co-ordinator's opinion, this is a reason not to use these filters in the planned bypass system. These filters were calculated by WEDAG representing KHD with a sufficient efficiency for the plants concerned. If they are generally overhauled and maintained, these filters will work to LCC's satisfaction.

D. The fears of the head of the Mechanical Department

Above the inlet chamber and inlet seal there is the concrete floor no. II and past experience has shown that production and maintenance staff are not able to execute all kinds of maintenance and repair work in this area.

A clear assurance must be given that it is possible to change the kiln-shell segments, tyres, rollers and any part of the kiln drive below the bypass-filter-supporting structure.

KHD should be asked to give a clear statement on this matter, with an explanation of how to change and maintain the above-mentioned kiln section. Otherwise, the KHD proposal appears to give in all situations a disturbance - free maintenance.

If, one day, the road situation in the factory is improved, the big new DEMAG mobile crane will be able to reach all places in this area.

E. Chemical analyses

In order to come to a proper decision about equipping the kilns at the Benghazi Cement Plant with bypasses, the chemical implications have to be considered. Accordingly, seven samples were sent to KHD, HUMBOLDT WEDAG to be tested in their laboratories as follows:

Benghazi Production Line III
1 - Raw meal
2 - Hot meal underneath cyclone IV
3 - Clinker (representing the raw and hot meals).

Hawari Production Line II
4 - Raw meal
5 - Hot meal underneath cyclone IV
6 - Bypass filter dust
7 - Clinker (representing the raw and hot meals)

A laboratory report was received on 3 March 1981 through B.W. Wendt, the KHD technical assistant. The test results can be summarized as follows:

1. Chemical analysis of raw meal:

(Percentage)

Components	Benghazi III		Hawari II	
LOI	35.00		35.18	
SiO_2	14.94	22.99	14.69	22.67
Al_2O_3	3.83	5.89	3.80	5.87
Fe_2O_3	1.55	2.39	1.57	2.42
TiO_2	0.23	0.35	0.23	0.35
CaO	41.09	63.22	41.43	63.92
MgO	1.90	2.93	1.83	2.83
SO_3	0.21	0.32	0.17	0.26
K_2O	0.72	1.11	0.72	1.11
Na_2O	0.2	0.31	0.22	0.34
Cl	0.02		0.03	
P_2O_5	0.03	0.04	0.03	0.05

Lime standard	86.8	88.8
Silica ratio	2.78	2.74
Silicic-acid ratio	3.90	3.87
Alumina ratio	2.47	2.42

2. Chemical analysis of the critical components sulphate, alkalies and chloride of the hot meal and bypass filter dust:

(Percentage)

	Hot meal		Bypass filter dust
Component	Benghazi III	Hawari II	Hawari II
SO_3	0.38	0.60	1.39
K_2O	4.38	1.71	8.07
Na_2O	0.32	0.24	0.54
Cl	2.63	0.45	3.65

From this chemical analysis, the following can be stated:

1. The laboratory investigation and test carried out by KHD ignored the results of the clinker tests as being of no importance for designing a bypass. We believe, however, that the clinker test would give clear information on the comparison between the clinker produced (with the same raw meal) in Hawari with a bypass and that from Benghazi without a bypass.

2. The alkali and chloride contents of the raw meals are somewhat high and, accordingly, require kiln operation with a bypass to avoid troubles with formation of accretions.

3. The chloride and alkali contents of the hot meals of Benghazi III indicate that trouble should be expected during kiln operation resulting from accretions formed in the inlet chamber and cyclone IV. Hawari II hot meal indicated that problems were not to be expected.

4. The analysis of the bypass filter dust of Hawari II showed the fact that installing a bypass will assist in eliminating much of the alkali as well as sulphate and chloride contents through the kiln operation, thus helping to avoid the formation of lumps in the inlet chamber as well as cyclone IV and decreasing the alkali as well as the sulphate and chloride contents of the clinker produced (low-alkali clinker).

5. Alkali and sulphate infiltration through the lining bricks of the Benghazi kilns is always shown on the bricks (deposition of salt and sulphur crystals along the cracks, joints and on the inner surface of the kiln shell). These alkali and sulphur crystals show trouble due to splitting of the bricks along the cracks and the decreased life expectancy of the bricks, especially in the burning zone. The installation of bypasses will help in eliminating such problems.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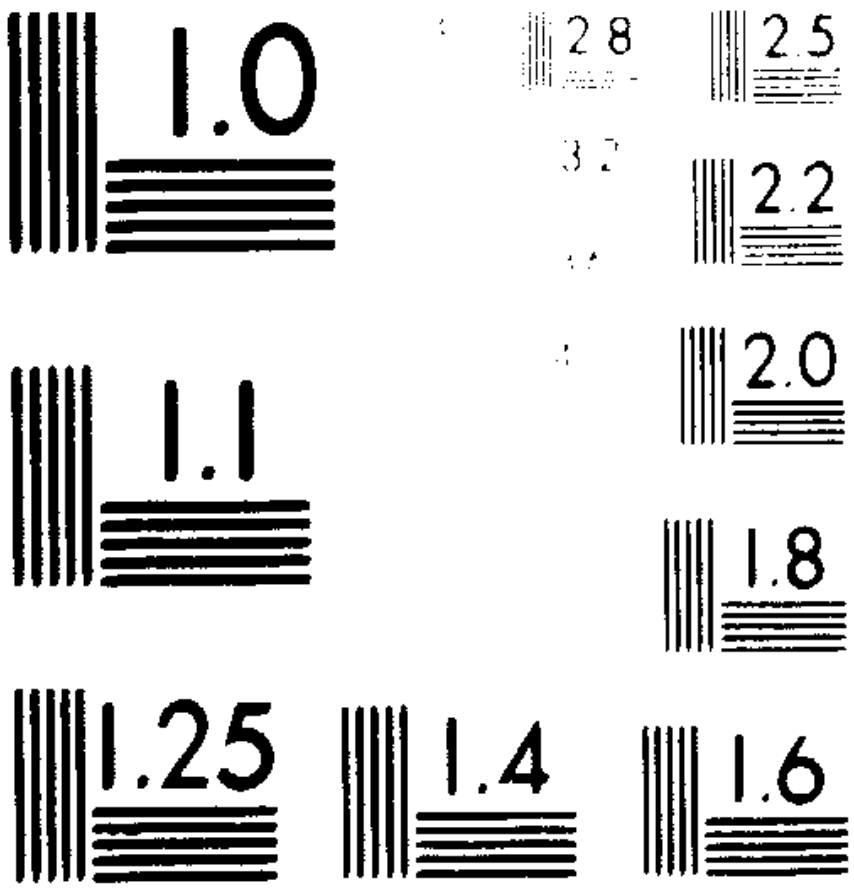
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Annex VIII

REPORTS ISSUED UNDER THE PROJECT TF/LIB/75/002

UNIDO/IOD.37 24 May 1976	Report on the first part (February to April 1976) of a year's mission by a building-materials adviser to the cement industry in Benghazi Aly Afify
UNIDO/IOD.174 11 July 1977	Report on the second part (November 1976 to August 1977) of a year's mission by a building-materials adviser to the cement industry in Benghazi Aly Afify
UNIDO/IOD.264 1 August 1978	Planning a system of mechanical maintenance Alfred Madsen
UNIDO/IOD.345 16 March 1979	Preventive maintenance planning in the mechanical maintenance service Mehmet A. Basman
UNIDO/IOD.354 15 August 1979	Assistance in instrument maintenance Boguslaw J. Walczenko
UNIDO/IOD.361 12 December 1979	Report of the project co-ordinator for the period up to October 1979 A.M. Afify
UNIDO/IO.383 16 September 1980	Assistance to the electrical engineering staff in organizing and carrying out electrical maintenance Boguslaw J. Walczenko
UNIDO/IO.437 16 January 1981	Report on a one-month mission (from 11 November 1980) to review and evaluate the progress of the project A.M. Afify
UNIDO/IO.475 13 March 1981	Instrument maintenance systems at the the Bengnazi complex: final summary Boguslaw J. Walczenko
UNIDO/IO.472 6 July 1981	Report on a one-month mission (from 19 May 1981) to review and evaluate the progress of the project A.M. Afify
UNIDO/IO/R.7 30 July 1981	Raw materials deposits at Wadi Ash Shati and Al Jufrah Abd El Rahim Marei
UNIDO/IO/R.14 17 December 1981	Preliminary study for long-term technical advice A.M. Afify

UNIDO/IO/R.33 28 October 1981	Progress of the project from 10 May 1980 to 31 July 1981 A.R. Marei
UNIDO/IO/R.17 2 November 1981	Feasibility of producing sulphate-resisting cement A.R. Marei
UNIDO/IO/R.29 26 March 1982	Replacing cylpebs by grinding balls in Benghazi I and Havari cement mills A.R. Marei
UNIDO/IO/R.34* 26 March 1982	Progress of the project from 1 August 1981 to 31 December 1981 A.R. Marei
UNIDO/IO/R.42* 26 March 1982	Formation of cement lumps and accretion in cement silos A.R. Marei
UNIDO/IO/R.43* 26 March 1982	New gypsum deposits A.R. Marei

*Forthcoming

C-133