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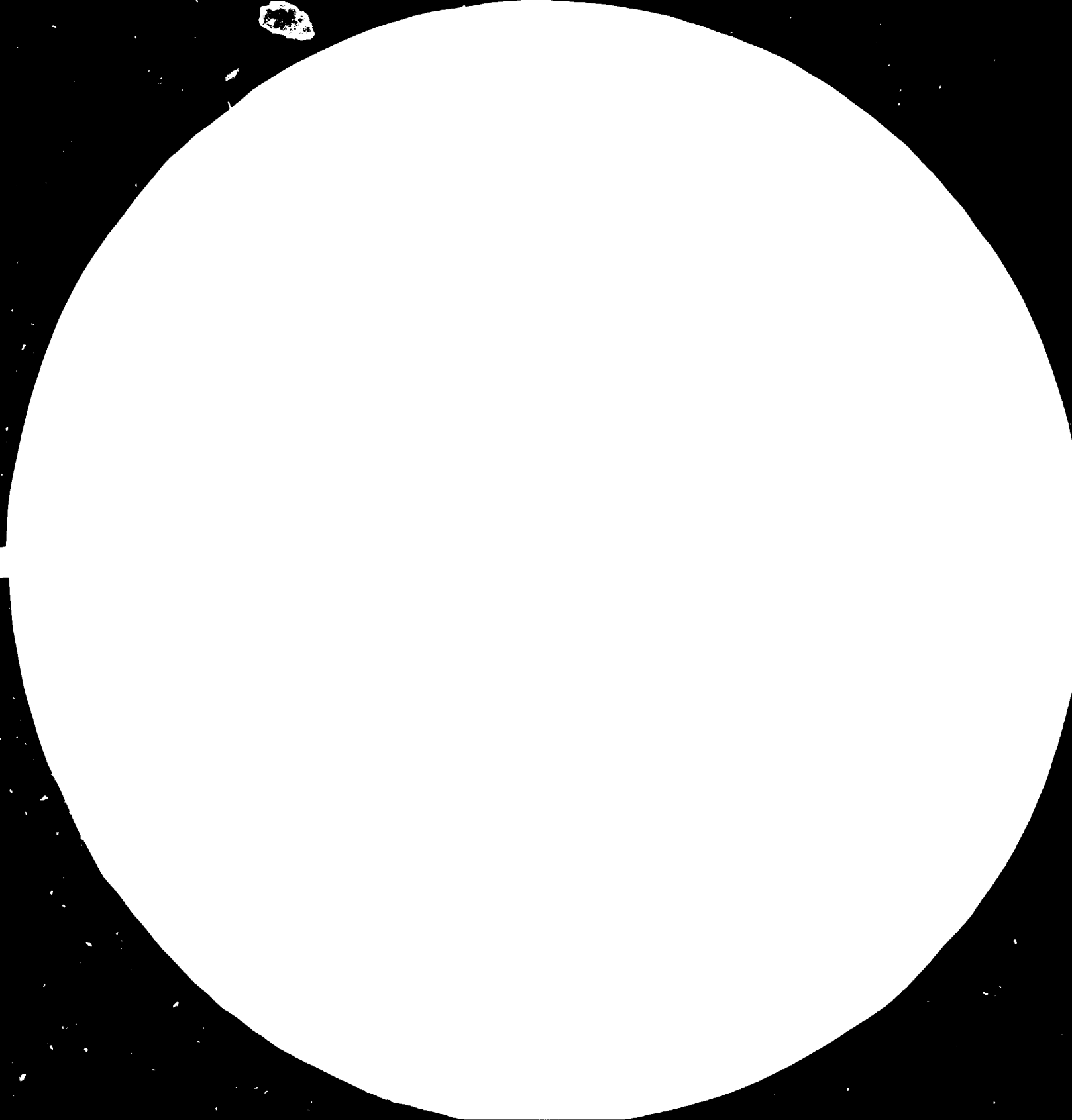
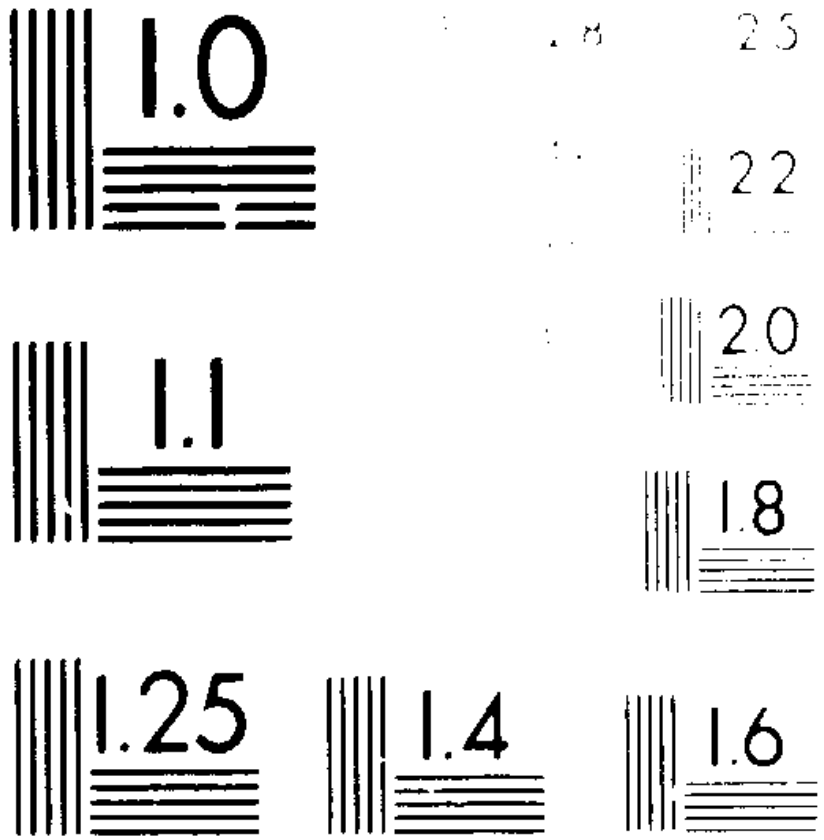
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Libya

ASSISTANCE TO THE LIBYAN CEMENT FACTORY, BENGHAZI

TF/LIB/82/002

LIBYAN ARAB JAMAHIRIYA

Mission report: Progress of project from 1 January 1982 to 30 June 1982

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.83-50636

Explanatory notes

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

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.

The following forms have been used in tables:

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

A blank indicates that the item is not applicable.

The following abbreviations of organizations have been used in this report:

LCC	Libyan Cement Company
SRC	Sulphate-resisting cement

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

ABSTRACT

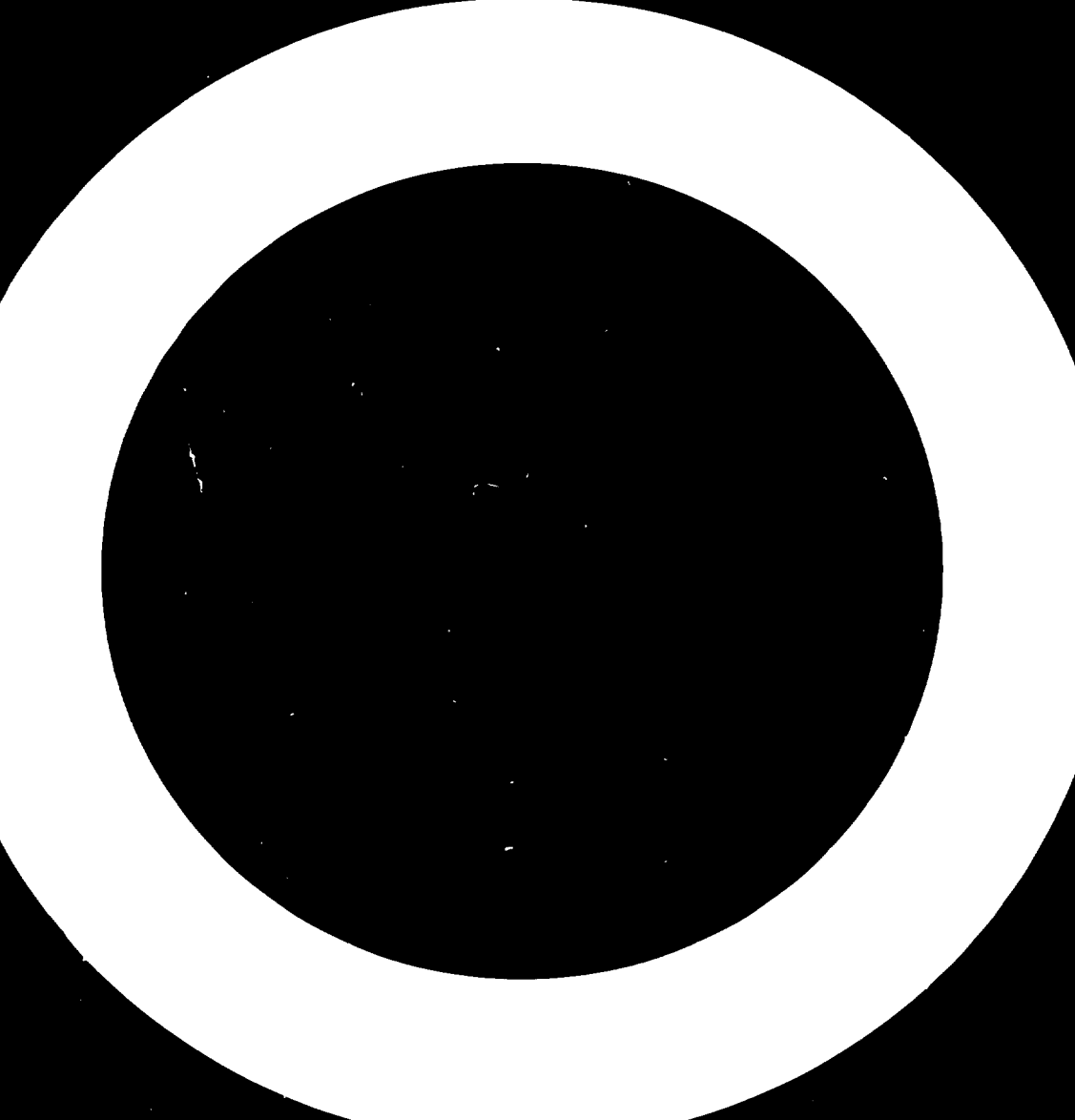
The project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/82/002), is being carried out for the authorities of the Libyan Arab Jamahiriya by the United Nations Industrial Development Organization (UNIDO) under a trust-fund agreement. It is the continuation of project TF/LIB/75/002, which was approved in 1975, has been operating in the field since 1976 and is designed to give direct, long-term technical assistance to the cement industry.

The report covers the progress of the project from 1 January 1982 to 30 June 1982 and describes the administration of the project during this period and the solutions found to the problems of accommodation, salary scales and the discrepancies between the Libyan Cement Company (LCC) and UNIDO budgets. Details are given of the technical-assistance team of which 17 groups had been fielded up to the end of the period covered and the analysis of statistical data on the team is brought up to date. The co-ordinator took part in the selection of new candidates for the standby list in March 1982. The activities of the co-ordinator in setting up training programmes for national technical personnel are also described.

The report gives full details of the performance of the Benghazi and Hawari cement plants in 1981 and the first half of 1982 and describes the progress of the preventive-maintenance programmes.

Advice is given on new cement plants, avoiding cement aggregation in storage silos, the provision of an adequate gypsum supply, the production of sulphate-resisting cement and the feasibility of setting up a plant for ready-mixed concrete and concrete products.

The Interregional Cement Technology Forum, held in Benghazi in April 1982, is also described.



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Annexes

INTRODUCTION

This report covers the activities of the project co-ordinator and the progress of the project "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/82/002) through the period 1 January 1982 to 30 June 1982. This project is the continuation (phase II) of project TF/LIB/75/002, which 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.

The expert was first fielded for a short period from 10 May to 9 August 1980 after the repatriation of the first project co-ordinator A.M. Afify in February 1980. The expert's mission has been twice extended, currently up to the end of 1983. The assignment was first financed through UNIDO trust funds and then through the overhead costs of the project.

This report covers the third period of the co-ordinator's mission. Progress reports on the first two periods have been issued as UNIDO/IO/R.33 and UNIDO/IO/R.34.

Project background

The cement industry started up in the Libyan Arab Jamahiriya in 1968 and since that time has been constantly expanding until it now has a yearly capacity of 4.4 million tons of cement. About half of this quantity (2 million tons) is represented by the yearly cement production of the Libyan Cement Company (LCC) in Benghazi which started its activities in 1972 with the erection of a production line for 200,000 tons per year of normal Portland cement. Consecutive extentions followed with the erection of the second and third production lines (600,000 tons per year capacity each) in 1974 and 1977 respectively. The last extension in the form of a new cement plant, Hawari, with 1 million tons annual production capacity was provisionally taken over during August 1978. With this extension, the total production in the Benghazi area was brought up to 2 million tons per year.

Other building-material industries such as a lime plant with two production lines, a paper-bag factory, a concrete-block factory and a ceramic-brick factory were added over the years to constitute a great building-material complex in the Benghazi area.

With this rapid expansion of industrial projects, 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. A technical-assistance team was built up to 52 experts with the arrival of the first and the second groups in May and August 1978. Up to 30 June 1982, a total of 17 groups have arrived at the duty station to join the technical-assistance team. Up-to-date details of this team are given and evaluated in the report.

Besides the duties and responsibilities described in the previous mission reports, the present project co-ordinator has been involved in the following:

(a) Helping prepare for the Cement Technology Forum in April 1982 in co-operation with the Secretariat of Heavy Industries, the Training Centre and Libyan Cement Company authorities;

(b) Arranging his own special training programmes for trainees from Derna and selected personnel from all the cement factories;

(c) Preparing a complete feasibility study on the possibility of establishing new ready-mixed concrete and concrete-block plants in the Benghazi area;

(d) Accompanying the Financial Manager (LCC) to UNIDO headquarters in March 1982 to review the project budget;

(e) Accompanying the LCC delegation to Poland in March 1982 to interview and select technologists for the standby group.

As a reference guide, a list of all the reports so far issued in connection with this project is given in the last annex.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Administration

1. In general, the co-operation between the LCC authorities and technical personnel and the UNIDO team has been very good. The success of this co-operation is amply demonstrated by the improved performance of the LCC cement plants. (See below).

2. At the request of the Polish team, the co-ordinator asked the LCC authorities to allow the Polish specialists to continue living at the Benina buildings and not to transfer them to the new buildings situated near the LCC factory. The co-ordinator was promised that action to transfer them would be postponed. There are no other problems facing the UNIDO team.

3. The shortage of certain kinds of specialists (control-panel operators and burners) on the standby list from March 1981 was remedied by further interviews in Poland in March 1982 at which 22 technicians in these fields were selected to form a second standby group.

4. To resolve the outstanding differences between the UNIDO and LCC budgets, it was agreed to split the project budget into two phases:

(a) Phase I (TF/LIB/75/002) will cover the project budget until the end of 1981;

(b) Phase II (TF/LIB/82/002) will start at the beginning of the year 1982 to facilitate expenditure control. All the specialists will be transferred to this phase.

During the meeting in March 1982, it was proposed to spread out the budget so that there is one budget line for each expert. The co-ordinator persuaded the LCC to agree to this proposal. A new agreement concerning the splitting of the budget was signed on 31 August 1982. A new budget review meeting is planned in Vienna in the autumn of 1982 to settle any remaining differences.

Training

5. To promote the development of national technical personnel, the co-ordinator, at the request of the Libyan authorities, began to develop his own special training courses covering the whole field of cement production technology. More than 32 persons including students from the El-Fatayeh Cement Project at Derna and selected staff from the LCC and other cement companies have so far been trained through these courses.

Performance of the LCC cement plants Hawari and Benghazi

6. The sucess of the project is demonstrated by the improved performance of the LCC plants, especially Hawari, during the last two years, despite various production difficulties.

Raw mills. Production at Hawari in 1981 increased by 25.7 per cent compared to 1980 while in the first six months of 1982, production increased by 79.9 per cent compared to the first six months of 1981. Production at Benghazi in 1981 increased by 51.4 per cent compared to 1980 while in the first six months of 1982, production increased by 33.8 per cent compared to the first six months of 1981.

Kilns. Production at Hawari in 1981 increased by 26 per cent compared to 1980 while in the first six months of 1982, production increased by 80 per cent compared to the first six months of 1981. Production at Benghazi in 1981 increased by 55 per cent compared to 1980 while in the first six months of 1982, production increased 33 per cent compared to the first six months of 1981.

Cement mills. Production at Hawari in 1981 increased by 30 per cent compared to 1980 while in the first six months of 1982, production increased by 78 per cent compared to the first six months of 1981. Production at Benghazi in 1981 increased by 43 per cent compared to 1980 while in the first six months of 1982, production increased by 34 per cent compared to the first six months of 1981.

7. Concerning the various data on production, it was found that these were not prepared in the proper manner and that it was very difficult for any person to get the correct figure. There is no direct link between nor direct supervision of the data sources.

8. For some equipment, there is a clear difference in energy consumption from one month to the next under normal operating conditions. The performance of some equipment has also fallen below the performance guarantee figures. However, despite this decline, the total energy consumption of the two plants is within the accepted limits and there has been an overall decrease in the total energy consumed.

9. The necessity for preventive-maintenance programming for all machinery and equipment was discussed in the last progress report. Trials in carrying out these preventive-maintenance programmes began in October 1980. These programmes have been developing well and the mechanical department has made good progress resulting in improved production figures.

10. On the co-ordinator's recommendation, LCC asked Kloeckner, Humboldt Deutz (KHD) to send an engineer to realign the Benghazi kilns. This was carried out and the result was reflected in the Benghazi kilns' performance and the state of the lining bricks.

Studies, researches and new projects

11. The co-ordinator continued his research on the problem of cement lumps forming in the storage silos. Laboratory tests showed encouraging results for the use of grinding aids on the flowability of cement. The fineness and compressive strength of the cement were also improved. On the co-ordinator's recommendation, LCC contacted a company to carry out further tests on commercial grinding aids before the end of 1982. (This problem is discussed in more detail in a separate report, see annex VI.)

12. In a report already issued on developing new gypsum deposits to supply both the LCC and El-Fatayeh cement plants (see annex VI), the co-ordinator stated his belief that the Sidi Al Mabruk area is rich in gypsum deposits, that these should extend further into nearby areas, and that additional boreholes should be drilled in the area either by the Industrial Research Centre or by the LCC. The Industrial Research Centre was invited to continue the drilling and, to everyone's satisfaction, the first three boreholes drilled showed positive results.

13. Following the report on the feasibility of producing sulphate-resisting cements (see annex VI), steps have been taken towards starting production at LCC in 1983. It was decided to recruit a Polish group acquainted with the production of sulphate-resisting cements (burners and a chemist). A delegation to interview candidates and to acquire further information about the production of such cements will travel to Poland.

14. At the request of the Libyan authorities, the co-ordinator carried out a feasibility study on setting up plants to produce ready-mixed concrete, building blocks and other concrete products. Full details are given in a separate report (see annex VI).

15. The committee in charge of preparing the Southern Region Cement Project have all the studies, reports and tender documents completed. The committee sent its recommendations to the Secretariat of Heavy Industry and is awaiting their decision to submit the tender documents to selected tenderers.

16. Due to the success of the technical-assistance team in project TF/LIB/75/002, UNIDO has been selected to supply a similar team to the new El-Fatayeh Cement Project at Derna. The co-ordinator was involved in the preparation and signing of an agreement for this new project, TF/LIB/81/008. On this account, LCC, Polservice and UNIDO have agreed to postpone for a year the previously-planned tripartite meeting in Poland to re-examine the salary scales of Polish experts.

Recommendations

Performance of the LCC cement plants

1. Arising from the production data for 1981 and 1982 (January to June) it is recommended that:

(a) The preventive-maintenance programming should be pursued and that the joint meetings between technical personnel (process, mechanical and electrical) should continue;

(b) The same procedure for installing fire bricks should be followed;

(c) Process personnel should check repaired machinery or instruments before putting them back into operation;

(d) Care should be taken in the collection of production data (daily, monthly and periodical) and in registering these data carefully in special files in the Production and Costing Departments so that their data match with each other;

(e) Production data have to originate from one special unit and the data have to be checked periodically.

2. Although the total energy consumption for both plants (Hawari and Benghazi) was satisfactory during the last two years, it is still recommended that a check should be kept on the energy consumed in every department and that a special procedure should be followed for registering, evaluating and checking such data within the Production Department.

Training

3. It is advisable to continue training technical personnel in the Training Centre in all the specialized fields of cement technology.

Studies, researches and new projects

4. In tackling the problem of lumps and accretions in the cement silos, it is recommended that the application of commercial grinding aids should be tested in large-scale production during the grinding of clinker and gypsum in LCC cement mills. Another trial that can be carried out easily in the next few months is to apply iron-oxide ore additive to the LCC raw mix (not more than 0.5 per cent). It will be very easy, after these two trials, to decide which of these methods will be more useful and applicable.

5. As the results of drilling to investigate the gypsum-ore reserves in the Sidi Al Mabruk area were positive, it is recommended that the area should be covered with the boreholes necessary to establish whether the quantities of gypsum in this area are sufficient to serve cement production in both the LCC and El-Fatayeh cement plants for not less than 20 years. After the prospecting results are available, the co-ordinator with the help of a surveyor can prepare a special project study on quarry opening and quarry development for the gypsum ore in the Sidi Al Mabruk area.

6. If LCC and the Secretariat of Heavy Industries agree to go ahead with the production of sulphate-resisting cement in the Benghazi Cement Plant, it is recommended that periodical meetings should be held to plan and co-ordinate the preparations to be made by the various departments concerned. The project co-ordinator will explain and discuss the fundamental technical and economic assumptions of the feasibility study.

7. It is recommended that action should be taken towards setting up ready-mixed concrete and building-bricks plants as these have been shown to be feasible and would be a support to industry in Benghazi and the surrounding area.

8. It is recommended that UNIDO should check and review the progress of the El-Fatayeh Cement Project periodically following the provisional take-over of the plant.

I. ADMINISTRATION OF THE PROJECT

A. Development of project personnel

UNIDO's technical assistance to the Benghazi cement industry began in the Hawari Cement Plant in May 1978 with the arrival of the first Polish group and sixteen further groups have arrived at the duty station up to the end of June 1982.

In his last report, the co-ordinator gave an analysis of the data recorded on the technical-assistance personnel which includes the specialists' names, their budget lines, their group, post titles, duration and requested extensions of their contracts, their residence period at the duty station and the specialists who have been reassigned or promoted. This report brings this statistical analysis up to date based on the seventeen groups who have so far arrived. The analysis according to group number and length of stay is given in full in annex I and can be summarized as follows:

Length of stay (months)	Number of specialists		
	Still at duty station	Repatriated	Total
Less than 6	19	6	25
6-12	29	24	53
13-18	3	37	40
19-24	16	17	33
25-30	6	8	14
31-36	4	2	6
37-42	-	2	2
More than 42	3	2	5
Total	79	99	178
Repatriated and reassigned	-	(-)3	(-)3
Total specialists	79	96	175

The specialists who are still assigned at the duty station and those who have been repatriated can be arranged according to their fielding groups as follows:

Specialists	Group number																	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Still assigned	1	2	4	2	3	1	9	4	3	3	2	6	10	11	3	8	7	79
Repatriated	25	20	5	8	11	7	10	5	4	2	-	1	-	-	1	-	-	99
Total	26[a]	22[a]	9	10	14	8	19	9	7	5	2	7	10	11	4	8	7	178[a]

a/ One specialist from group 1 and two from group 2 were reassigned to later groups, thus reducing the total number of specialists by three to 175.

As can be seen, three groups (15, 16 and 17) with a total of 19 specialists have been fielded since the last progress report. It is anticipated that, from the beginning of July to the end of December 1982, a total of 17 specialists will be repatriated. However, a further 10

specialists are expected to be fielded shortly in the eighteenth and nineteenth groups. A summary of the information on the present state of project personnel is given in annex II and an analysis of all project personnel since the beginning, by budget line, post title and fielding group, is given in annex III.

The specialists can be classified according to their main working plant as follows:

	Number of specialists
Hawari Cement Plant	50
Benghazi Cement Plant	16
Lime plant	10
Ceramic-brick and concrete-block factory	2
Paper-bag factory	1
Total	79

B. Recruitment of standby personnel

As shown in the last mission report (up to December 1981), there was a shortage of technologists on the standby list from March 1981, especially of control-panel operators and burners. LCC and UNIDO agreed to the co-ordinator's suggestion that during the co-ordinator's mission to UNIDO headquarters for a consultation in March 1982, a LCC delegation could also visit Wroclaw in Poland to interview and select the candidates needed for the project. Polservice were asked to prepare for holding the interviews from 14 to 21 March 1982. The co-ordinator accompanied an LCC delegation composed of Mohamed Moftah, Mohamed Azouz and Mohamed Eswawa. Twenty four candidates were interviewed from whom twenty two candidates were selected to form the second list of standby candidates.

A summary list of the candidates selected in March 1982 is given in annex IV, together with the list of specialists remaining on the standby list from March 1981. This has gone down from 113 specialists (in December 1981) to 87, some specialists having in the meanwhile been recruited onto the team. Ten specialists proved to be not available when requested.

C. Revision of the project particulars

During the co-ordinator's consultation mission to UNIDO headquarters in Vienna in March 1982, he was accompanied by a delegation from LCC and the Training Centre composed of Mohamed M. El-Neihoum (General Director, LCC), Ahmed A. El-Dursi (Director of the Training Centre) and Mohamed Ibrahim Zayed (Financial Manager, LCC).

The first two delegates were in Vienna to discuss with UNIDO personnel the arrangements for the Interregional Cement Technology Forum to be held in Benghazi in April 1982. (This is described separately in chapter V.) The main task of LCC's Financial Manager was to review the financial particulars of the project, to finalize the project situation for the years 1980 and 1981 and to discuss all the matters outstanding from the last mission of the LCC delegation to UNIDO headquarters from 6-10 September 1981. (See mission report UNIDO/IO/R.34.)

In order to be ready for this meeting, the co-ordinator in co-operation with Abdel-Majid Mohamed and Mohamed Zayed prepared the following documentation:

(a) An up-to-date analysis of data on all the specialists working on the project in 1981. The data show the specialists' names, budget lines, post titles, home leaves, sick leaves, their old salaries up to the beginning of September 1981 and new salaries as agreed upon in the tripartite meeting (25-27 August 1981) between the LCC, UNIDO and Polservice delegations;

(b) Tables showing the work periods of the Polish specialists during 1981, subdivided into two periods. The first division covers the period 1 January 1981 to 31 August 1981. The second division covers the period from 1 September 1981 to the end of the year. The attendance (man/months) of the Polish specialists during these two periods were multiplied by the old and new salaries respectively and these were again added to check the total man/months and the salaries of all the specialists in 1981;

(c) A unified table summarizing all the data mentioned above.

The data on the project specialists for 1980 had been prepared before by Abdel-Majid Mohamed in co-operation with the co-ordinator and had been discussed by the LCC delegation with UNIDO personnel at the meeting in September 1981.

At the meeting at UNIDO in March 1982, all this prepared data and photocopies of UNIDO computer print-outs for TF/LIB/75/002 were thoroughly examined and checked. Discussion showed up the following facts:

(a) Comparison between UNIDO and LCC budget lines in 1980 showed a total difference of 3.1 man/months which can be considered as an acceptable difference as it represents a very small percentage of the total;

(b) Comparison between UNIDO and LCC budget lines in 1981 showed a total difference of 26.3 man/months.

As attendance figures for specialists in 1981 were sent to UNIDO by the co-ordinator, UNIDO and LCC figures should match completely. The Administrative and Financial Sections (UNIDO) were asked to recheck all the data. After the check was carried out, it was decided that all the figures would be corrected again according to the co-ordinator's calculation of man/months. In this way, the total difference in man/months between UNIDO and LCC for the two years, 1980 and 1981, can be reduced to negligeable proportions.

The main differences which could not be solved at all in the meetings were UNIDO disbursements of $42,878, explained as non-salary obligations which were not taken into account by LCC, and approximately $480,000 in salaries for October, November and December 1981 which were still outstanding. The total difference therefore amounted to $522,878.

All parties tried to overcome this problem by rechecking their documents and Polservice bills but unfortunately no complete solution could be reached. It was repeated that there are completely different ways of treating the financial situation in UNIDO (using a computerized method) and LCC (using the

ordinary financial method) and accordingly there is no possibility of real comparison between the two sets of figures. Endless discussions to find a solution produced no result. The financial manager of the LCC and the co-ordinator were both of the opinion that differences between UNIDO and LCC figures ought to be non-existent since both are calculated from the same data bases, namely the attendance in man/months of the Polish specialists at the duty station.

It was proposed from the UNIDO side that some mutual agreement should be reached on the man/months and expenditure on the whole project (TF/LIB/75/002) up to the end of 1981, and that this should be considered as phase I of the project. A new beginning would be made with phase II under a new project number (TF/LIB/82/002). However, this could only be done on receipt of a revised agreement and budget.

The co-ordinator discussed the matter with LCC authorities and recommended that they should accept the UNIDO proposal. LCC agreed to complete phase I without first settling the differences and problems and to start phase II on the basis suggested by UNIDO to avoid any differences in the future. The co-ordinator informed UNIDO and asked for copies of the new agreement to be sent.

However, on 19 and 20 July, LCC received telexes from UNIDO requesting that in order for UNIDO to go ahead with recruitment of the experts shortly expected to arrive in Benghazi and to avoid double work, LCC should telex their approval of the splitting up of the project as proposed by UNIDO and the transfer of specialists to phase II of the project.

LCC sent its approval to UNIDO by telex on 25 July 1982, hoping to receive the documents to be signed as soon as possible. LCC also asked UNIDO to prepare for the planned review meeting in the autumn to settle the differences outstanding from phase I.

D. Accommodation

It was explained in the last progress report that, in order to solve the housing problems of the Polish experts, LCC had asked a Turkish company, Libko-Turk, to erect new prefabricated buildings in an area adjacent to the Hawari Cement Factory to accommodate 300 single persons. The Polish specialists informed the co-ordinator as well as UNIDO personnel visiting Benghazi in April and May 1982 that they preferred to stay at the Benina buildings and not to be transferred to the new buildings near the factory. This matter was discussed with the LCC authorities who agreed to postpone any decision to transfer the Polish team.

E. Salary increases for the technical-assistance team

At the last tripartite meeting held in Benghazi from 25 to 27 August 1981 between LCC, UNIDO and Polservice representatives, it was agreed that the salary scales of the Polish team should be increased starting from 1 September 1981 and that a new tripartite meeting should be held in Poland in July 1982 to re-examine the increases established at the Benghazi meeting.

In the meanwhile, UNIDO was selected by the Libyan Authorities to supply the El-Fatayeh Cement Plant at Derna with the specialists needed in a similar manner and on the same conditions as for the LCC project (TF/LIB/75/002). The time, therefore, did not appear opportune to finalize the salary scales of the LCC technical-assistance team on which the salaries for the El-Fatayeh project would also depend. Accordingly, the Secretary of the LCC People's Committee and representatives of UNIDO and Polservice agreed in May 1982 to postpone the planned tripartite meeting for a further year.

II. TRAINING AND EDUCATION OF NATIONAL PERSONNEL

Experienced personnel are considered to be the most vital requirement of any industrial project, especially in developing countries. A Special Training Centre to serve the needs of the cement and building-materials industries, based on the most up-to-date technology, was established near the Libyan Cement Company in the Hawari area of Benghazi. This Centre started to train personnel in 1980. Its first objective was to provide training possibilities for students belonging to the El Fatayeh Cement Project in Derna so that they could work in the plant after its taking-over.

Ahmed El-Dursi of the Special Centre asked the co-ordinator to help in training the Derna project's students and this was agreed to by the LCC. The co-ordinator proposed to the Training Centre that he should introduce and conduct training programmes designed by himself as he did not want to rely on the programmes already in use at the Centre. This proposal was accepted.

The co-ordinator divided his training programme into two sections, the first being lectures to the trainees and the second practical training (one day a week) in the Libyan Cement Company plants, Benghazi and Hawari.

Another kind of training was initiated by the co-ordinator to promote the development of national personnel selected from all the Libyan cement companies (18 persons) through upgrading their technical standards. It was hoped to enable each of them, in his own field, to raise his productivity and efficiency and to prepare them to undertake more advanced tasks by acquainting them with up-to-date technological trends in the cement industry. Ultimately, they should be able to replace the foreign technologists provided through technical-assistance agreements.

The lectures section of the training programme, presented by the co-ordinator in Arabic, covers all the following topics:

Chemistry of cement

Classification of cement; chemical composition; mineralogical composition; properties of the major constituents (C_3S, C_2S, C_3A, C_4AF), gypsum, free lime, magnesia, alkali oxides, titanium oxide, phosphorus pentoxide; potential compound composition by the Bugue method; factors influencing the compound content; cooling of the clinker; composition of the ferrite phase; composition of major compounds; determination of compound composition by direct methods; optical microscopy, x-ray diffraction; cement and hardening of cement pastes; hydration of cement; development of structure in cement paste; factors affecting the rate of hydration; age of paste; cement composition; fineness of the cement; water/cement ratio; temperature admixtures.

Types of cements

Normal portland cement, sulphate-resisting cement, super-sulphate-resisting cement, high-alumina cement, slag cement, mixed and pozzolanic cement.

Cement raw materials

Types of rocks, igneous, sedimentary and metamorphic; origin of all types of rocks with special reference to cement raw materials, e.g. limestones, clays, marls, gypsum, sand etc.; structure; prospecting; development; planning the quarrying operations; overburden removal; quarrying; drilling operations; blasting; explosives; quality control of raw-materials; transport equipment.

Fuels and combustion

Types of fuel, solid, liquid and gas; composition; heat value of each type; gas laws; combustion; techniques of combustion and kiln control; CO_2 in the kiln-exit gases; the flame, characteristics and length of the flame; ignition of the fuel, shape of the flame, direction of flame, adjustment of flame direction, temperature of the flame; corresponding temperatures for observed colours; oxygen enrichment; heat transfer in the kiln; heating the feed; heat losses; the kiln feed; chemical and physical properties of raw materials, burnability, influence of raw materials on burnability, the burnability factor; burning; charging and drying; calculation; clinkerizing; cooling; coating formation in burning zone; nature of the coating; operating conditions; movement of raw materials in the kiln; the cooler air circuit; the kiln air circuit; the discharge air circuit; movement of feed through the kiln.

Crushing, homogenization, and grinding of raw materials

Proportioning of total production; methods of prehomogenization, stacking of blending beds, line-type stacking; reclaiming of stock pile, the reclaiming bucket wheel, blending effect. Homogenization of raw mix; Fuller Airmerge System, Polysius Homogenization System, Geyser, Spring method, Moller Shearing stream process, Wiba continuous discharge blending. Crushing; types of crushers; jaw crushers, hammer crusher, gyratory crusher, Symons crusher, roll crusher, impact crusher. Types of mills; open circuit, closed circuit; grinding ball charge; grinding work index according to bond; ball-mill power demand; hardness of grinding balls; wear rates of grinding balls; girth-ring drives; modifications of girth-ring drives; mill shell liners; partitions and diaphragms; finish grinding; coating of grinding media; elimination of coating; admixtures; additives.

III. PERFORMANCE OF THE LCC CEMENT PLANTS, HAWARI AND BENGHAZI, 1981 AND JANUARY TO JUNE 1982

This section deals with the performance of the Hawari and Benghazi cement plants. The co-ordinator collected the production figures from each production department or unit. The data was checked, tabulated and analysed. The co-ordinator's comments on the data were submitted to the LCC authorities.

Some of the information is presented in detail in annex V. A summary of the statistics on the progress of production is given below.

A. Quarry and raw-materials department

The output of this department in both Hawari and Benghazi increased steadily to supply the raw mills with the necessary quantities of raw materials (limestone, marl and gypsum). The raw materials are extracted, crushed and then conveyed to the raw-material stores.

The table in annex V.A. shows the output of the Hawari and Benghazi crushers in 1981 and 1982 (January to June).

B. Raw mills

Total production 1981

The total output of raw mills in both LCC plants in 1981 was 2,041,963 tons. (See annex V.B(i).)

Hawari 1981

Raw mills I and II together produced 1,060,839 tons during 8,936 operating hours at an average rate of 119 t/h which represents 108.2% of the designed capacity (110 t/h). The ratio of actual to estimated production was 92%. (See annex V.B(ii).)

Compared to 1980, the output of Hawari raw mills in 1981 increased by 216,807 tons (25.7%). The raw-mix design was in the range of 63.9 (limestone) to 36.1 (marl) while it was 63:37 in 1980. This can be attributed to the fact that the marl and limestone were mixed at the quarry site in both years.

The average energy consumption of the Hawari raw mills was 28.4 kWh/t.

Benghazi 1981

Raw mills I, II and III together produced 981,224 tons in 11,000 operating hours at an average rate of 89.2 t/h. The ratio of actual to estimated production was 85.3%. (See annex V.B(iii).)

Raw mill I produced 132,822 tons in 3,084 operating hours at an average rate of 43 t/h which represents 61.4% of the designed capacity (70 t/h). The ratio of actual to estimated production of this raw mill was 58%.

Raw mill II produced 381,188 tons in 3,650 operating hours at an average rate of 104 t/h which represents 74.3% of the designed capacity. The ratio of actual to estimated production of this raw mill was 83%.

Raw mill III produced 467,414 tons in 4,266 hours at an average rate of 109.5 t/h which represents 78.2% of the designed capacity. The ratio of actual to estimated production of raw mill III was 101.5%.

Compared to 1980, the output of Benghazi raw mills in 1981 increased by 333,080 tons (51.4%). The raw-mix design was in the range of 65 (limestone) to 35 (marl) while it was 63.9:36.2 in 1980. This can also be attributed to the mixing of marl and limestone at the quarry site.

The average energy consumption of Benghazi raw mills was 29.5 kWh/t.

Total production 1982 (January to June)

The total output of both LCC plants in 1982 (January to June) was 1,303,102 tons. (See annex V.B(iv).)

Hawari 1982 (January to June)

Raw mills I and II together produced 701,475 tons during 4,560 operating hours at an average rate of 126 t/h which represents 114.5% of the designed capacity (110 t/h). The ratio of actual to estimated production was 119.4% (See annex V.B(v).)

Compared to the equivalent period in 1981, the output of Hawari raw mills increased by 311,573 tons (79.9%). The raw-mix design was in the range of 71 (limestone) to 29 (marl) while it was 61.8:38.2 for the same period in 1981. This percentage can be attributed to the fact that in this period, materials (limestone and marl) were not mixed at the quarry site, as the limestone conveyed to the Hawari plant is also used in the lime plant.

The average energy consumption of Hawari raw mills was 26.3 kWh/t.

Benghazi 1982 (January to June)

Raw mills I, II and III together produced 601,630 tons in 6,923 operating hours at an average rate of 86.9 t/h. The ratio of actual to estimated production was 104.6%. (See annex V.B.(vi).)

Raw mill I produced 100,595 tons in 2,277 operating hours at an average rate of 44.2 t/h which represents 63.4% of the designed capacity. The ratio of actual to estimated production of this raw mill was 87.4%.

Raw mill II produced 212,749 tons in 1,975 operating hours at an average rate of 107.7 t/h which represents 76.9% of the designed capacity. The ratio of actual to estimated production of this raw mill was 92.5%.

Raw mill III produced 288,283 tons in 2,671 operating hours at an average rate of 107.9 t/h which represents 77% of the designed capacity. The ratio of actual to estimated production of raw mill III was 125%.

Compared to the equivalent period in 1981, the Benghazi raw mills' output increased by 151,888 tons (38.8%). The raw-mix design was in the range of 62 (limestone) to 38 (marl) while it was 64:36 in 1981 due to the mixing of marl with limestone at the quarry site.

Stoppages

During 1981 and 1982 (January to June), the raw mills were stopped for various reasons as shown below.

(Hours)

Reason for stoppage	Hawari		Benghazi			Total
	I	II	I	II	III	
In 1981:						
Mechanical	462	391	823	954	805	3 435
Electrical	10	-	132	70	279	511
Process	364	323	381	683	639	2 390
Kiln stoppage	1 469	2 965	4 089	2 659	2 344	13 526
Silo filling	133	115	-	535	-	783
Other	557	332	232	209	427	1 757
Total	2 990	5 318	5 677	5 110	4 494	23 794
In 1982 (January-June):						
Mechanical	211	191	348	1 239	824	2 813
Electrical	18	34	238	250	123	663
Process	529	548	224	336	255	1 892
Kiln stoppage	627	611	1 060	371	76	2 745
Silo filling	26	20	-	34	269	349
Other	128	184	197	139	126	774
Total	1 539	1 588	2 067	2 369	1 673	9 236

C. Kilns

Total clinker production 1981

In 1981, the total clinker produced amount to 1,229,471 tons compared to 890, 767 tons in 1980, an increase of 338,704 tons or 38.0%. Fuel consumption amounted to 860 kcal/kg clinker. (See annex V.C(i) which also gives details of stoppages and their causes.)

The energy consumption for the kilns was 35.9 kWh/t compared to 29.9 kWh/t in 1980. The kilns' average production was 45.0 t/h per kiln compared to 43.8 t/h in 1980. The ratio of actual to estimated production was 89.1% compared to 64.54% in 1980.

Hawari 1981

Kilns I and II together produced 637,609 tons in 11,376 operating hours at an average rate of 56.1 t/h per kiln and 1,352 t/d per kiln which represents 90.8% of the designed capacity (1,500 t/d). The ratio of actual to estimated production was 92%. (See annex V.C(ii).)

Kiln I produced 407,522 tons in 7,236 operating hours at an average rate of 56.32 t/ h and 1,342 t/d which represents 89.46% of the designed capacity (1,500 t/d). The ratio of actual to estimated production was 118%.

Kiln II produced 230,087 tons in 4,140 operating hours at an average rate of 55.63 t/h and 1,431 t/d, which represents 95.4% of the designed capacity (1,500 t/d). The ratio of actual to estimated production was 67%.

Benghazi 1981

Kilns I, II and III together produced 591,862 tons in 15,951 operating hours at an average rate of 37.1 t/h and 905 t/d. The ratio of actual to estimated production was 87%. (See annex V.C(iii).)

Kiln I produced 73,988 tons in 4,161 operating hours at an average rate of 17.8 t/h and 427 t/d which represents 71.17% of the designed capacity (600 t/d). The ratio of actual to estimated production was 36%.

Kiln II produced 245,545 tons in 5,647 operating hours at an average rate of 43.5 t/h and 991 t/d which represents 82.58% of the designed capacity (1,200 t/d). The ratio of actual to estimated production was 91%.

Kiln III produced 272,329 tons in 6,144 operating hours at an average rate of 44.3 t/h and 1,031 t/d representing 85.9% of the designed capacity (1,200 t/d). The ratio of actual to estimated production was 99%.

Total clinker production 1982 (January to June)

In 1982 (January to June), the total clinker output amounted to 780,668 tons compared to 504,273 tons in the same period in 1981, an increase of 54.8%. Fuel consumption was 897 kcal/kg compared to 858 kcal/kg in 1981, an increase in fuel consumption of 4.5%. Energy consumption for all kilns in the period January to May 1982 was 39.6 kWh/t compared to 39.2 kWh/t in 1981, about 1.0% more. The average kiln production was 43.8 t/h of clinker compared to 44.7 t/h in 1981. The ratio of actual to estimated production was 113.1% compared to 73.1% for the same period in 1981. (See annex V.C(iv) which also gives details of stoppages and their causes.)

Hawari 1982 (January to June)

Kilns I and II together produced 423,593 tons in 7,347 operating hours at an average rate of 57.66 t/h and 1,384 t/d which represents 92.3% of the designed capacity (1500 t/d per kiln). The ratio of actual to estimated production was 120%. (See annex V.C(v).)

Kiln I produced 216,572 tons in 3,631 operating hours at an average rate of 59.65 t/h and 1,432 t/d which represents 95.46% of the designed capacity (1,500 t/d). The ratio of actual to estimated production was 123%.

Kiln II produced 207,021 tons in 3,715 operating hours at an average rate of 55.72 t/h and 1,337 t/d which represents 89.13% of the designed capacity (1,500 t/d). The ratio of actual to estimated production was 117%.

Benghazi 1982 (January to June)

Kilns I, II and III together produced 357,075 tons in 10,479 operating hours at an average rate of 34.7 t/h and 818 t/d per kiln. The ratio of the actual to estimated production was 101%. (See annex V.C(vi).)

Kiln I produced 54,015 tons in 3,118 operating hours at an average rate of 17.32 t/h and 416 t/d which represents 69.33% of the designed capacity (600 t/d). The ratio of actual to estimated production was 77%.

Kiln II produced 153,935 tons in 3,684 operating hours at an average rate of 41.78 t/h and 1,003 t/d which represents 83.58% of the designed capacity (1,200 t/d). The ratio of actual to estimated production was 109%.

Kiln III produced 149,125 tons in 3,677 operating hours at an average rate of 40.56 t/h and 973 t/d which represents 81.1% of the designed capacity (1,200 t/d). The ratio of actual to estimated production was 106%.

A comparison of total LCC kiln production data for the period January to June in 1981 and 1982 is given in annex V.C(vii).

D. Cement mills

Total cement production 1981

In 1981, the total cement output was 1,359,549 tons compared to 979,744 tons in 1980, an increase of 379,805 tons or 38.8%. The average energy consumption reached 41.6 kWh/t compared to 34.97 kWh/t in 1980.

The average production per cement mill was 1,644 t/d and 68.5 t/h compared to 1,853 t/d and 77.23 t/h in 1980. The ratio of actual to estimated production was 90.6% compared to 65.3% in 1980. (See annex V.D(i), which also gives the number of stoppage hours and the types of stoppages.)

Hawari 1981

Cement mills I and II together produced 695,994 tons of normal Portland cement in 9,254 operating hours at an average rate of 1,805 t/d and 75 t/h per mill, which represents 83.3% of the designed capacity (90 t/h). The ratio of actual to estimated production was 93%. (See annex V.D(ii).)

Cement mill I produced 503,801 tons of normal Portland cement in 6,382 operating hours at an average rate of 1,895 t/d and 79 t/h, representing 87.8% of the designed capacity (90 t/h). The ratio of actual to estimated production was 134%.

Cement mill II produced 192,193 tons of normal Portland cement in 2,873 operating hours at an average rate of 1,605 t/d and 67 t/h, representing 74.4% of the designed capacity (90 t/h). This was due to its production capacity being decreased on account of shell deformation and the operation being restarted after welding with 30 to 50% capacity. The ratio of actual to estimated production was 51%.

Benghazi 1981

Cement mills I, II and III together produced 663,555 tons of normal Portland cement in 10,593 operating hours at an average rate of 1,503 t/d and 62.6 t/h per mill. The ratio of actual to estimated production was 88.5%. (See annex V.D(iii).)

Cement mill I produced 55,793 tons in 1,799 operating hours at an average rate of 744 t/d and 31 t/h, representing 69% of the designed capacity (45 t/h). The ratio of actual to estimated production was 37.2%.

Cement mill II produced 272,206 tons in 3,829 operating hours at an average rate of 1,706 t/d and 71 t/h, representing 79% of the designed capacity. The ratio of actual to estimated production was 90.7%.

Cement mill III produced 335,556 tons of normal Portland cement in 4,966 operating hours at an average rate of 1,622 t/d and 68 t/h, representing 75.6% of the designed capacity. The ratio of the actual to estimated production was 111.9%.

Total cement production 1982 (January to June)

In 1982 (January to June), the total normal Portland cement produced was 890,915 tons compared to 575,946 tons in the same period of 1981, an increase of 154.7%. The average rate of cement production was 1,673 t/d per mill and 70 t/h per mill compared to 1,782 t/d and 72 t/h for the same period of 1981. The ratio of actual to estimated production was 118.8%, compared to 76.8% for the same period in 1981. (Annex V.D(iv) also gives details of the stoppage hours and types of cause of stoppages.)

No overall figure for average energy consumption can be given for this period as reliable data for the three Benghazi cement mills are not available.

Hawari 1982 (January to June)

Cement mills I and II together produced 479,096 tons in 6,113 operating hours at an average rate of 78 t/h and 1,881 t/d per mill representing an increase of 78% over the same period in 1981. (See annex V.D(v).) The ratio of actual to estimated production was 128%.

Cement mill I produced 233,170 tons in 2,957 operating hours at an average rate of 79 t/h and 1,892 t/d. The ratio of actual to estimated production was 124%.

Cement mill II produced 245,926 tons in 3,156 operating hours at an average rate of 78 t/h and 1,870 t/d. The ratio of actual to estimated production was 131%.

Benghazi 1982 (January to June)

Cement mills I, II and III together produced 411,819 tons in 6,664 operating hours at an average rate of 62 t/h and 1,483 t/d per mill, an increase of 34% over the same period in 1981. The ratio of actual to estimated production was 109.8%. (See annex V.D(vi).)

Cement mill I produced 84,749 tons in 2,765 operating hours at an average rate of 30.7 t/h and 736 t/d. The ratio of actual to estimated production was 113%.

Cement mill II produced 98,768 tons in 1,308 operating hours at an average rate of 76 t/h and 1,812 t/d. The ratio of actual to estimated production was 66%.

Cement mill III produced 228,303 tons in 2,773 operating hours at an average rate of 82 t/h and 1,976 t/d. The ratio of actual to estimated production was 76%.

E. Packing and despatch

Total production 1981

The total amount of normal Portland cement despatched was 1,372,238.4 tons from both plants. Of this amount, 1,098,891.8 tons (80.08%) were despatched in bags while 273,346.6 tons (19.92%) were despatched in bulk. (See annex V.E(i).)

Benghazi 1981

The total quantity of normal Portland cement despatched was 665,175.8 tons. Of this 512,590 tons were despatched as packed cement (77.06%) while 152,585.8 tons (22.94%) were despatched in bulk.

Hawari 1981

The total quantity of cement despatched was 707,062.6 tons. Of this quantity 586,301.8 tons (82.92%) were despatched as packed cement while 120,760.8 tons (17.08%) were despatched in bulk.

Total production 1982 (January to June)

The total amount of normal Portland cement despatched was 890,294.8 tons from both plants. Of this amount, 666,167.5 tons (74.8%) were despatched in bags while 224,127.3 tons (25.2%) were despatched in bulk. (See annex V.E(ii).)

Benghazi 1982

The total quantity of normal Portland cement despatched was 413,161.5 tons. Of this, 270,830 tons (65.5%) were despatched as packed cement while 142,331.5 tons (34.5%) were despatched in bulk.

Hawari 1982

The total quantity of cement despatched was 477,133.3 tons. Of this quantity, 395,337.5 tons (83%) were despatched as packed cement while 81,795.8 tons (17.0%) were despatched in bulk.

F. Energy and fuel consumption

Annex V.F(i) gives a summary of the data on energy consumption in the Hawari and Benghazi plants for 1981 and in the Hawari plant for 1982 (January to June). Information on energy consumption in the Benghazi plant in 1982 is not available.

Annex V.F(ii) summarizes the data on fuel consumption in the Hawari and Benghazi plants for 1981 and 1982 (January to June).

G. Alignment of rotary kilns

As described in the co-ordinator's first mission report, LCC asked Kloeckner Humboldt Deutz (KHD to send one of their engineers to carry out a realignment of the LCC rotary kilns, especially of the Benghazi kilns I, II and III. One of the KHD engineers arrived in Benghazi in September 1981 and took action to realign the kilns. Some Libyan engineers and technicians were also involved in this job in order to learn how to correct any future deviation in the kiln alignment. The result of this realignment was reflected in the performance of the Benghazi kilns.

H. Preventive-maintenance programmes

In October 1980, the co-ordinator started trial preventive-maintenance programmes for kilns I and II at the Benghazi Cement Plant. The trial programmes developed well with special care being given to the fire-brick lining. Problems arising from mechanical defects were reduced to normal proportions. It is recommended that co-ordination meetings between the production, mechanical and electrical departments should be held periodically. In addition, all machinery which has been overhauled should be checked by the production engineers before being returned to service.

IV. STUDIES, RESEARCH AND PROJECT EVALUATIONS

A. Avoiding cement aggregation in LCC storage silos

This problem was described in the co-ordinator's first mission report in which the following possible solutions were suggested:

(a) That the gypsum additives should be partially replaced by limestone, as proposed by Klockner Humboldt Deutz (KHD);

(b) That a metallic cone should be installed inside the silos, as proposed by IBAU-HAMBURG;

(c) That the inside walls of the silos should be painted with a non-stick coating, as proposed by Holderbank Management and Consultancy (HMC);

(d) That the LCC laboratories should experiment with adding different types of grinding aids to the clinker before grinding with gypsum, as proposed by the co-ordinator.

All these proposals were followed up by the co-ordinator and the results of his research are fully described in a separate report (Formation of cement lumps and accretions in cement silos, UNIDO/IO/R.42).

Tests carried out by KHD on proposal (a) showed that adding limestone to gypsum during grinding with clinker did not produce any great improvement in the flowability of the cement, although other plants had achieved good results with this method. The results of the tests were anyway difficult to assess.

The discussions on proposal (b) came to the conlusion that this solution would not be practicable and would not help to solve the chemical aspect of the problem.

Discussions with HMC on proposal (c) also reached negative conclusions as it was decided that the non-stick coating must be applied before putting the silo into operation.

Proposal (d) involved tests in the LCC laboratories on the behaviour of some types of additives on the flowability of LCC cement. The following additives were tested:

Limestone
Limestone with pure gypsum
Polar chemical compounds (ethylene glycol)
Commercial additives known as HEA
Hydrophopic materials (stearates)

The laboratory results can be discussed briefly as follows.

Limestone

The laboratory tests did not give any different results from the tests carried out under proposal (a) on LCC large-scale production.

Limestone associated with pure gypsum

When limestone is associated with high-quality gypsum, it gives good results, especially using 30% of the normal amount of gypsum added. Here the compressive strength of the cement mortar increases, while the cement also shows better flowability.

Ethylene glycol

Ethylene glycol was used in percentages of 0.02, 0.04, 0.06, 0.08 and 0.1 and the grinding was carried on for 20, 30, 40, 50 and 60 minutes. It was found that the fineness of the cement was increased by increasing the grinding time for all the percentages of ethylene glycol used. The critical percentage was 0.06%. When more was added the blaine (fineness) decreased in all the grinding periods. For the sample ground with 0.06% ethylene glycol, the compressive strength increased by about 14%, after three days and by 10% after seven days.

Commercial additives (HEA)

The same procedure used in testing ethylene glycol was followed. The results were very encouraging in respect of fineness, compressive strength and flowability. The critical percentage was also 0.06%.

Hydrophopic materials

The co-ordinator also tested the use of commercial hydrophopic material in the LCC laboratories but no reliable results were achieved, partly because the materials used had been in storage for an excessively long time (more than 10 years).

The co-ordinator discussed all these results with the LCC and it was agreed to contact the Italian company, GRACE, to ask them to carry out some large-scale tests on LCC cement production. This company agreed to carry out these tests and two of their representatives will arrive in Benghazi in October 1982 to discuss the procedure for carrying out these large-scale tests.

B. Lack of gypsum reserves for both LCC and the El-Fatayeh Cement Company

The co-ordinator's report on this problem has already been issued separately (New Gypsum Deposits, UNIDO/IO/R.53). This report showed the following:

(a) The co-ordinator had reason to believe that the gypsum deposits ought to extend further into the nearby areas of Ar-Rajmah, Hawa-El-Baraq and Sidi Al Mabruk;

(b) The Industrial Research Centre should be asked to continue drilling and exploration in the Sidi Al Mabruk area before any action was taken to exploit the As-Sidrah deposit;

(c) Drilling could be carried out by the LCC under the co-ordinator's supervision if the Industrial Research Centre did not want to carry out the work.

Letters inviting the Industrial Research Centre to continue drilling were sent and, fortunately, after about two years, the Centre accepted LCC's invitation to carry on the job of drilling in the Sidi Al Mabruk area. Encouraging results, as expected by the co-ordinator, were found in all the first three bore-holes drilled up to the time of this report. A further report on this important matter will be submitted to LCC and UNIDO. The results so far are highly satisfactory to both the LCC and the El-Fatayeh Cement Company.

C. Production of sulphate-resisting cement

The co-ordinator had previously carried out a study on the feasibility of producing sulphate-resisting cement in the LCC plants as this type of cement was not produced at all in the Libyan Arab Jamahiriya. His report (Feasibility of producing sulphate-resisting cement, UNIDO/IO/R.17), concluded that such production would be feasible and recommended that Benghazi production lines I or II or both should be used for this purpose. The Secretariat of Heavy Industries agreed to this recommendation and the LCC subsequently started the necessary preparations towards producing this type of cement.

The LCC began by cleaning the clinker storage silos so that they would be ready to receive the sulphate-resisting cement clinker from kiln I or kiln II or from both. This was necessary so that SRC clinker could be stored separately from the normal Portland cement.

Action was taken to adapt raw mill I (Benghazi), mechanically and electrically, to be able to process a third type of raw material, iron-oxide ore or pyrite ash. LCC also started to prepare the area in front of the Benghazi raw mills and clinker-storage facility as an open storage hall.

The co-ordinator had proposed two solutions for obtaining the necessary additives, either that iron-oxide ore should be purchased from the Wadi Ash Shati area in the South-West part of the country or that pyrite ash should be imported from nearby countries. The LCC followed up both these possibilities, asking the relevant Libyan transport authorities to submit an offer including the iron-ore price and the freight charges from the Wadi Ash Shati area and also sending tender documents to pyrite-ash producers in some Mediterranean countries. Prices were received and the LCC decided to send a delegation to Greece in August 1982 to negotiate on the importation of the required quantities of pyrite ash. When the final prices have been received from both the neighbouring countries and the Libyan transport authorities, a comparison between costs will be made and The Secretariat of Heavy Industries will make a decision.

The transport authority in Benghazi, which already supplies the LCC brick factory with sand, agreed also to supply the additional quantities of sand needed for the sulphate-resisting raw mix.

It was agreed with Izzeddin El Ghadamsi, the Secretary of the LCC People's Committee, to provide training for about eight of the Libyan staff (to be selected from the laboratory and quality control, kilns and mills departments) in a SRC-producing company in Turkey or in any European country. This would be arranged through UNIDO. Another approach was made by LCC to the Arab Union for Cement and Building Materials to arrange training for LCC personnel in a SRC-producing company in any Arab country.

The co-ordinator recommended that UNIDO should be asked to supply the LCC with Polish burners and a chemist familiar with SRC production in Poland. LCC agreed and a telex was sent to UNIDO and another to Polservice through the Polish team leader. Polservice agreed to invite a Libyan delegation to attend a new selection interview in Cracow, Poland, where a SRC-producing company exists. This would also give the Libyan delegation a chance to get a better idea of production procedures.

The co-ordinator believes that, by the end of 1982, the LCC will be able to take the first steps in producing SRC cement under his supervision. This should save foreign currency at present spent in importing SRC cement from neighbouring countries. The quantities of SRC cement used in Libyan building projects are large, ranging from 200,000 to 400,000 tons per year. One great project, El Sarir, alone will consume about 700,000 tons per year. This project will start at the beginning of 1984. It may be possible to produce this quantity in the Hawari or Benghazi Cement Plants. This decision will be taken after the success of the initial production of sulphate-resisting cements in LCC plants in 1983 can be assessed.

D. Feasibility study on a plant to produce ready mixed concrete, building bricks and similar concrete products

The Libyan Cement Company received an instruction from the Secretariat of Heavy Industries (5/12/312, 14 January 1982) to take action in co-operation with the National Prefabricated Buildings Company (Benghazi) to study the feasibility of establishing a new sister company in Benghazi for the production of ready-mixed concrete, building bricks and similar concrete products. The need for such a company arises from the recent rapid industrialization and the extension of the basic infrastructure which together represent the main goals of the development plans of the last ten years. The Libyan Authorities have undertaken various economic projects and have ambitious plans for construction, agriculture and industry. Accordingly, the demand for cement, ready-mixed concrete and concrete products has been growing along with the significant growth in the construction industry.

Up till 1969, the entire construction sector in the country had to rely upon cement imported from various countries. Since then, several cement plants have been installed and commissioned in the Libyan Arab Jamahiriya.

The Libyan Cement Company in Benghazi (capacity, 2 million tons per year) and the El-Fatayeh Cement Plant in Derna (capacity, 1 million tons/per year) are located in the eastern sector of the country. These two companies, with a joint capacity of 3 million tons per year, can satisfy the cement market in this area and are expected to produce cement surplus to local requirements. Accordingly, they must try to export cement and to establish new cement-based industries such as the project under study.

After receiving the instruction from the Secretariat of Heavy Industries, the Libyan Cement Company and the National Prefabricated Building Company set up a joint committee with the following membership:

Representing the Libyan Cement Company:

Mohamed Abd Alla Berwin
Abu Bakr El-Abd El-Saltany
Khalifa Mansour El-Ebeidi
Mohamed Zayed Ibrahim

Representing the National Prefabricated Buildings Company:

Farag Ali El-Tarani
Abd El-Moneim Farag El-Dieb
Soliman El-Weheshi
Abu Bakr El-Denali

The joint committee held its first meeting at the Libyan Cement Company headquarters on 6 February 1982. At the second meeting, held on 8 February 1982 the committee asked the co-ordinator to attend their meetings to assist them with his past experience in this field and to advise the committee in studying the feasibility of establishing such an industry in Benghazi.

The co-ordinator accompanied by Abu Bakr El-Saltany and Khalifa El-Ebeidi visited the El Abiar site previously selected by the National Prefabricated Buildings Company as a possible quarry site and where rock investigations had been carried out. It was found that the investigated area was now occupied and had started to be exploited by a Korean company. Checking and investigation showed that there is a homogeneity in the stratigraphy, petrology, overburden and geomorphology of all the area surrounding the previously-investigated quarry site. Accordingly, in the next committee meeting, this matter was discussed and it was agreed that another nearby area should be selected for further investigation by the co-ordinator.

The co-ordinator also started to study the feasibility of establishing such an industry in the Benghazi area. He was assisted by Abu Bakr El-Saltany and Mohamed Berwin who supplied him with the necessary information on prices through their contacts with the machinery producers and with all kinds of general, administrative and secretarial facilities.

The co-ordinator submitted his report which is to be issued separately. (See annex VI which lists all publications issued in connection with this project for ease of reference.) This report should be consulted for full details but the findings of the feasibility study are summarized here, showing the capacity of the various units, type and quantity of equipment required and economic considerations.

Limestone quarry

Calculation of capacity:

Rated capacity of the ready-mixed concrete plant	100 000 m^3/per year
Requirement of aggregate	50 000 m^3/per year
Total production of aggregate of Al Abiar quarry (30% rejected limestone included)	292 000 m^3/per year
(rounded up)	300 000 m^3/per year
Bulk density of aggregate	1.6

Average thickness of the quarry overburden	1.5 m
Average thickness of hard limestone bed	10.0 m
Proposed face length to be opened per week	115.0 m
Total limestone to be excavated per week	5 769 m^3

Ripping of the overburden can easily be done using a bulldozer. Bulldozer type D9G was chosen for this work.

Equipment and machinery. The following factors were taken into consideration when selecting the down-hole type of drill for primary blast holes: nature of rock; diameter of hole; deviation of holes; speed and cost.

For secondary blasting, to reduce the size of over-large boulders resulting from the primary blast, pneumatic hand-held hammer drills, popularly known as jack-hammers, are to be used.

Average height of bench	10.0 m
Average burden and spacing	5.0 m x 5.0 m
Average number of holes to be blasted per week	23
Length of drilling per week (including 10% subgrade drilling)	253 m
Performance of drill per day	90 m
Number of drills required (1 plus 1 spare)	2
Heavy-duty, pneumatic, hand-held drills required for secondary breaking	2

Blasting. The use of nitroglycerine-based explosives is recommended taking into consideration factors such as safety, geological conditions, nature of the deposit and type of rock. This could be changed in future if it proves necessary to use the cheapest explosive (ammonium-nitrate fuel oil). This can be used in conjunction with a nitroglycerine-based gelatinous explosive so that the latter works as a booster, constituting 15-25% of the total explosive requirement.

Subgrade drilling. The subgrade drilling, is normally kept around 10% of the bench height as will be confirmed by using the Langefors bases for calculating subgrade drilling.

Charge calculations. By applying the Langefors bases for calculating the charges for drilled holes, it is estimated that 150 kg/t of explosives will be sufficient in the Al Abiar limestone quarry. The bottom charge has to be placed at the base of the hole and be restricted to a length equal to 1.3% of the burden including the subgrade.

Explosives magazine. The required capacity of the main explosives magazine was estimated to be 24 tons (sufficient for a third of a year's production). For convenience of operation, small day magazines may be constructed near the main magazine, with a capacity of 1-3 tons.

Choosing drill-hole diameter and angle of hole. The diameter of the drill holes influences blasting to a great extent and is based on the bench height. It was found that the suitable drill-hole diameter for the Al Abiar limestone quarry (bench height ranging from 10-12 m) will be in the range of 64-100 mm. As the Al Abiar limestone strata are more or less horizontal, an angle of 8-10° towards the free face should yield good results.

Loading equipment. After studying the various well-known types of loading equipment, the use of front-end loaders (wheel- and crawler-mounted loaders) was recommended as ideal in view of the frequency and distance of movement in the Al Abiar quarry. The number of loaders required would be:

Crawler loader equipped with ripper (bucket capacity 5-6 m^3)	1
One spare (as above)	1
Wheel-mounted loader (bucket capacity 5-6 m^3)	1
Total	3

Transport equipment. After studying the various well-known types of transport equipment and the project's transport requirement, it was found that truck haulage provides the most effective and suitable transportation system under the prevailing conditions.

The maximum haulage distance (one way) would be:

From quarry face to crushing unit	10 km
From crushing unit to plant site at Benina	75.0 km
From sand quarry to plant site	50.0 km
From Libyan Cement Company to plant site	25.0 km
From plant site (Benina) to Benghazi city	15.0 km

The number of dumpers, trucks and semi-trailers required would be:

Required to transport limestone to crushing unit (including spare capacity)	3 dumpers
Equipment available to transport aggregate from Al Abiar quarry to plant site at Benina (including spare capacity)	7 dumpers
Equipment available to transport sand from sand quarry to plant site (including spare capacity)	3 dumpers
Equipment available to transport cement from Libyan Cement Company to plant site (including spare capacity)	2 semi-trailers
Equipment to transport 76,500 m^3 of mixed concrete per year; with 7 m^3 capacity	4 RMC dumpers
with 10 m^3 capacity	4 RMC dumpers

Crushing and screening unit

Jaw and gyratory crushers will both be used in the crushing and screening unit.

The jaw crusher will be used as a primary impact breaker	1,100 x 1,140 mm
Power	220 hp

The gyratory crusher will be used as a secondary crushing unit.

Power	125 hp

The two types of crushing units will be contiguous and connected by belt conveyors and screening units so as to be able to produce all the grades of aggregate according to the specific grain sizes required (0.5 mm, 15-25 mm, 25-50 mm etc.).

Concrete batching and mixing plant

The mixing plant will be equipped with a pan-type mixer with the following specifications:

Pan-type mixer capacity	2,250 litres dry material
Number of aggregate compartments	5

It will be the fully-automatic version with magnetic setting rider control.

Wet concrete output	94.0 m^3/h
Compacted concrete output	78.0 m^3/h

Operation will be fully automatic with a mixing time of 30 seconds.

The plant will also be equipped with vibrators with controls for sand and aggregate, cement weigh-batcher, electrical batch counter, revolving discharge chute for mixer discharge into trucks, beam-dragline scraper, cement screw-conveyor and a cement silo with air-blowing devices.

The plant will work about 4 h/d, 250 d/a to produce about 100,000 m^3/a ready-mixed concrete.

Concrete-block manufacturing plant

This plant will consist of the following machinery and equipment:

Complete fully-automatic block-making machine with automatic oil-cooling system

Moulds for hollow blocks of different dimensions

Concrete loaders with a carrying capacity of 2,400 kg
69 hp forklift truck with a carrying capacity of 3,000 kg

Stone clamp

Economic considerations

The capital investment required would be:

	Libyan dinars
Quarry	1 646 072
Ready-mixed concrete plant	2 007 782
Concrete-products plant	1 445 462
Total	5 099 316

The production costs per unit are estimated as:

	Libyan dinars per m^3
Aggregate	2.8
Ready-mixed concrete	14.5

The volume of production of the plant for concrete blocks and other concrete products will be determined later according to the needs of the market. The cost per unit for this plant can, therefore, only be calculated later based on the volume of production and capacity of the machinery chosen.

However, the normal selling prices for aggregate and ready-mixed concrete prevailing in Benghazi at present are much higher than the costs estimated in the feasibility study. The project is therefore judged to be economically viable.

E. New cement plants

Southern Region Cement Project

A new cement plant is planned for the Southern region of the country. It will be sited at Al Jufrah and will have a capacity of 1 million tons per year. As a member of the committee in charge of preparing this project, the co-ordinator has been involved in preparing, checking and revising documentation, and commenting and advising on the consultants' proposals. The tender documents are now ready to be sent out to selected tenderers after they have been approved by the Secretariat of Heavy Industries.

Wadi Ash Shati

It has been decided to construct a smaller cement plant (half a million tons per year capacity) in the Wadi Ash Shati area. The co-ordinator helped to prepare an agreement for this project between the Libyan Authorities and the consultants.

El-Fatayeh Cement Plant

Due to the success of the technical-assistance team working with the Libyan Cement Company in Benghazi, UNIDO has been asked to supply a similar team to the El-Fatayeh Cement Plant now under construction at Derna. The co-ordinator was involved in the preparation and signing of an agreement for this new technical-assistance project (TF/LIB/81/008).

V. INTERREGIONAL CEMENT TECHNOLOGY FORUM

As described in the co-ordinator's first two mission reports, the idea of holding this forum began in January 1981 with a letter from A.M. El-Gheriani, Secretary of the People's Committee and General Director of LCC, to the Secretariat of Heavy Industries, proposing a cement technology forum to be organized and supervized by UNIDO and to be financed by the Secretariat of Heavy Industries. It was proposed to hold this forum in the Training Centre, Benghazi.

The Secretariat of Heavy Industries accepted this proposal and UNIDO was asked in February 1981 to make preparations for holding the forum. Some of the preparatory activities were described in the last mission report (UNIDO/IO/R.34).

The co-ordinator participated in many meetings between personnel of the LCC, the Training Centre and UNIDO, at which the following points were agreed:

(a) Date and duration of the forum (14-20 April 1982);

(b) The programme and lectures;

(c) Invitations to developing countries to participate in this forum;

(d) Invitations to the cement experts of some developed countries and cement equipment suppliers;

(e) Invitations to cement institutes, research centres, consultants and cement union representatives, to attend this Forum and contribute papers.

UNIDO began to invite the participants in October 1981. It was decided that the forum should concentrate mainly on the following subjects:

(a) Recent technological trends in the cement industry;

(b) Problems facing the cement industry and how these problems were dealt with by some cement producers;

(c) Different types of raw materials and their effect on grindability and burnability;

(d) Pollution resulting from the cement industry and how to avoid it;

(e) How to reduce investment and costs of cement production;

(f) Problems facing the cement industry in the fields of maintenance, transport and training and how to overcome them.

In February 1982, a committee to organize and prepare for the forum was selected by A.M. El-Gheriani. The members of this committee were as follows:

Mohamed Moftah El-Neihoum
Salem Bazina
Hassan Abd El-Karim
Ahmed A. El-Dursi
Saad El Arial
El Mahdi Dekheel

The Committee then invited the co-ordinator (representing UNIDO) and the following persons to assist them:

Ali Mekraz
Rustom Lotfi
Abd El-Latif Guima
Ali Fathi

Other subsidiary committees were also set up to help with different aspects of the preparations such as participants' visas, transport and hotels; documentation, printing and typing; the preparation of the conference hall and media coverage.

Some problems, such as entry visas for participants, caused the co-ordinator some difficulty, but with the full support of the Libyan Authorities and especially of A.M. El-Gheriani, these problems were tackled and solved.

Participants

Participants from the following developing counties attended the forum:

Developing country	Number participating
Algeria	2
Angola	1
Chad	2
China	2
Democratic Yemen	2
India	2
Iran (Islamic Republic of)	1
Mozambique	2
Philippines	2
Poland	1
Syrian Arab Republic	1
Thailand	2
Turkey	2
Uganda	1
Total	23

Participants from the following cement-equipment companies, cement research centres, cement organizations, cement consultants and cement unions attended the forum:

Company or organization	Country	Number participating
Centre d'Etudes et de Recherches de L'Industrie de Liants Hydrauliques	France	1
Lafarge Conseils et Etudes	France	1
Beumer	Germany, Federal Republic of	1
Haver and Boecker	Germany, Federal Republic of	1
Kloeckner Humboldt Deutz	Germany, Federal Republic of	3
Mannesmann Demag	Germany, Federal Republic of	1
Refratechnik	Germany, Federal Republic of	3
Academy	Poland	1
Holderbank Management and Consultancy	Switzerland	1
Prospective Engineering Gestion	Switzerland	2
	Total	15

Participants representing various authorities in the host country also attended:

	Number participating
Secretariat of Heavy Industries	7
Research Centre (Gar Yunis University)	1
Industrial Research Centre	2
Secretariat of Planning	1
Secretariat of Housing	1
Secretariat of Public Utilities	2
Training Centre	3
Libyan Cement Company	25
Souk El-Khemis General Cement Company	10
The National Company For Cement and Building Materials	2
Libda Cement Works	2
El-Fatayeh Cement Project (Derna)	9
Total	65

UNIDO provided 10 of the conference personnel and was represented by a member of the secretariat, the project co-ordinator from Benghazi and the advisor to the cement industry from Tripoli.

Lectures given

1. Mining methods and advantages of using hydraulic excavators. (Raymond J. Bonnkirch, DEMAG)

2. Criteria for the selection of grinding mills. (Helmut Wuestner, KHD)

3. Conditions necessary for establishing new cement plants. (Jacques Hoffmeyer and Alfred Brugger, PEG)

4. High-alumina cement as a building material (Kessete Gabre Kidan, GAR Yunis University)

5. Oolitic limestone for use in the cement industry in North Africa. (Abd El-Rahim Marei, UNIDO)

6. Development of rotary kilns with the Humboldt preheater. (Rudolf Kuhs, KHD)

7. Development of the Benghazi Training Centre for cement and building-material industries (Ahmed El-Dursi, TRAINING CENTRE)

8. Performance of volatile substances in the kiln and some problems resulting from high clinker temperatures in cement production (Wieslaw Kurdowski, ACADEMY)

9. Grindability and burnability of oolitic limestone (Abd El-Rahim Marei and Kaissar Hanna)

10. The evolution of cement-burning technology in the rotary kiln and the development of the refractory kiln lining. (Peter Karl Kuppier, REFRATECHNIK)

11. Experience with cement training centres. (K.A. Kayatz, HMC)

12. Pollution and electrofilter problems. (Abd El-Latif Gum'a, LCC)

13. Present state of basic refractory lining of the sintering zone. (Erwin Koetter, REFRATECHNIK)

14. Avoiding cement aggregation in Libyan Cement Company's storage silos. (Ali Fathi, LCC and Abd El-Rahim Marei, UNIDO)

15. The modernization of packing plants with automatic truck-loading equipment and palletless shrink-wrapping lines. (Gernot Schaefer, BEUMER)

16. Installation of the refractory lining and some associated problems. (Eckard Hobrecht, REFRATECHNIK)

17. Cement terminals and new developments in the packing-plant branch. (Hans Georg Lowag, HAVER and BOECKER)

18. WARTAS - an automatic control and information system for inspection and maintenance. (Wilfried Droste, KHD)

19. Improvement of existing cement plants. (Guy Noel Masson, LAFARGE)

20. The development of the cement industry in the Jamahiriya. (A.M. El-Gheriani, SHI)

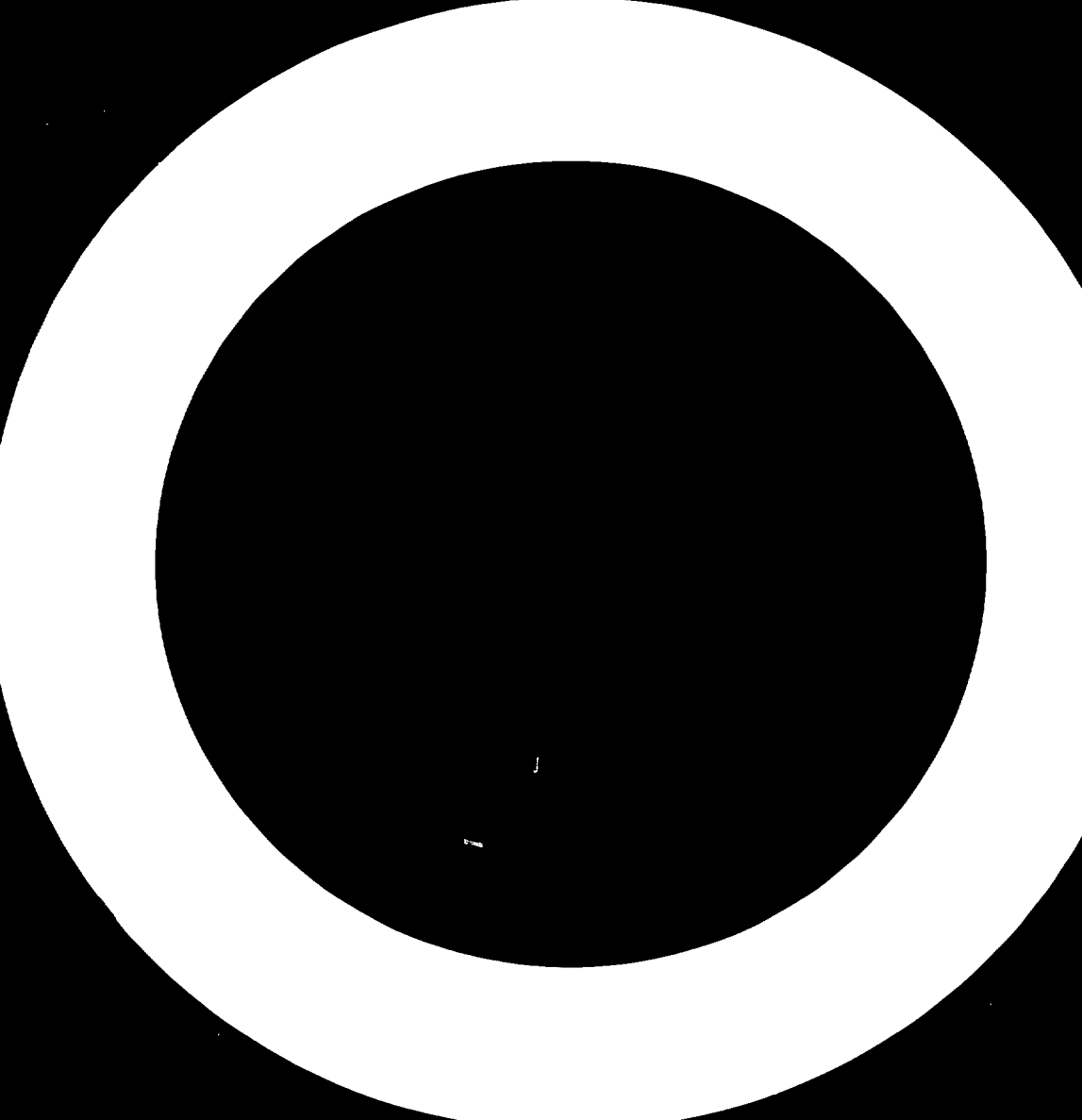
21. UNIDO assistance to development and consolidation of the cement industry in developing countries. (Secretariat of UNIDO)

The forum's first meeting was held on 14 April 1982 in the main hall of the Training Centre, Benghazi. The forum was opened by welcoming speeches from:

Omar El Montaser, Secretary of the Secretariat of Heavy Industries
Mohamoud El-Khafifi, Secretary of the Benghazi Municipality
Ibrahim Bakar, Secretary of the General People's Committee of the Benghazi Municipality
Ali El-Gheriani, Undersecretary of the Secretariat of Heavy Industries
A member of the UNIDO secretariat

The forum lasted for five days and all expectations were fulfilled. The main value of the forum consisted not only in the lectures given but also in the technical discussions and the bilateral technical meetings which took place between the participants.

Thanks are due to all those involved in the preparation of the forum who ensured its smooth running and general success.



Annex 1

STATISTICS OF PROJECT PERSONNEL FROM MAY 1978 TO 30 JUNE 1982

A. Length of stay at the duty station

Length of stay	Group number																	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Less than 6 months															4	8	7	19
Still assigned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repatriated	4	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	6
Total	4	-	-	-	-	-	-	-	1	-	-	1	-	-	4	8	7	25
6-12 months																		
Still assigned	-	-	-	-	-	-	-	-	-	-	2	6	10	11	-	-	-	29
Repatriated	6	8	1	1	1	1	-	3	2	1	-	-	-	-	-	-	-	24
Total	6	8	1	1	1	1	-	3	2	1	2	6	10	11	-	-	-	53
13-18 months										3								3
Still assigned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repatriated	5	4	2	6	7	5	5	1	1	1	-	-	-	-	-	-	-	37
Total	5	4	2	6	7	5	5	1	1	4	-	-	-	-	-	-	-	40
19-24 months							9	4	3	-	-	-	-	-	-	-	-	16
Still assigned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repatriated	3	5	1	1	-	1	5	1	-	-	-	-	-	-	-	-	-	17
Total	3	5	1	1	-	1	14	5	3	-	-	-	-	-	-	-	-	33
25-30 months																		
Still assigned	-	-	-	2	3	1	-	-	-	-	-	-	-	-	-	-	-	6
Repatriatriated	3	1	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	8
Total	3	1	1	2	6	1	-	-	-	-	-	-	-	-	-	-	-	14
31-36 months																		
Still assigned	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Repatriated	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	1	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
37-42 months																		
Still assigned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repatriated	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
More than 42 months																		
Still assigned	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Repatriated	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Total in group	26	22	9	10	14	8	19	9	7	5	2	7	10	11	4	8	7	178

B. Specialists still at duty station according to their attendance periods

Length of stay (months)	Group number																Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Less than 6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	8	7	19
6-12	–	–	–	–	–	–	–	–	–	–	2	6	10[a/]	11	–	–	–	29
13-18	–	–	–	–	–	–	–	–	–	3[b/]	–	–	–	–	–	–	–	3
19-24	–	–	–	–	–	–	9	4	3	–	–	–	–	–	–	–	–	16
25-30	–	–	–	2	3	1	–	–	–	–	–	–	–	–	–	–	–	6
31-36	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4
37-42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
More than 42	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
Total	1	2	4	2	3	1	9	4	3	3	2	6	10	11	3	8	7	79

a/ One specialist reassigned from group 1
b/ One specialist repatriated from group 2 and reassigned in group 10 (still at duty station)

C. Repatriated specialists according to their attendance periods

Length of stay (months)	Group number																Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Less than 6	4	–	–	–	–	–	–	–	1[a/]	–	–	1	–	–	1	–	–	7
7-12	6	8	1	1	1	1	–	3	2	1	–	–	–	–	–	–	–	24
13-18	5	4	2	6	7	5	5	1	1	1	–	–	–	–	–	–	–	37
19-24	3[b/]	5[a/]	1	1	–	1	5	1	–	–	–	–	–	–	–	–	–	17
25-30	3	1	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–	8
31-36	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
37-42	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
More than 42	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Total	25	20	5	8	11	7	10	5	4	2	–	1	–	–	1	–	–	99
																		(-3)
																		96

a/ Repatriated twice from groups 2 and 9
b/ One specialist repatriated from group 1 and assigned again in group 13 and still working

Annex II

SUMMARY OF PROJECT PERSONNEL SITUATION
(updated to 30 June 1982)

Budget line	Post title	Number required	At duty station	Expected repatriations	Required at present (groups 18 + 19)
11.06	Shift leader	4	3	1	2
11.07	Control-panel operator	4	5	1	1
11.08	Miller	8	9	3	2
11.09	Burner (cement kilns)	8	7	1	
11.10	Mechanical maintenance foreman	2	1		
11.11	Mechanical maintenance fitter	7	5	1	
11.12	Compressor maintenance mechanic		1	1	
11.14	Milling machine operator	1			
11.16	Maintenance electrician	7	1		
11.17	Instrumentation specialist	6	8	2	
11.19	X-ray specialist	1	1		
11.20	Mechanical engineer	2	2		
11.21	Maintenance fitter	2	2		
11.22	Sheet-metal fitter	6	8	3	1
11.23	Welder	3	3	1	1
11.24	Maintenance electrical engineer	1			
11.25	Workshop fitter	2	3		2
11.26	Instrumentation electrical engineer	1			
11.27	Electrical maintenance foreman	1			
11.28	Instrumentation and control foreman	1	1		
11.29	Shift electrician	8	3		
11.30	Instrumentation specialist	4	5		
11.31	Workshop and light electrician	5	5	1	
11.32	High tension electrician	2	1		
11.33	Diesel mechanic	2			
11.34	Petrol engine mechanic	1			
11.35	Quarry equipment electrician	1			
11.38	Lime burner	4	5	2	1
11.39	Scraper operator	4			
	Total	98	79	17	10

Annex III

ALL PROJECT PERSONNEL UP TO 30 JUNE 1982, BY BUDGET LINE, POST TITLE AND GROUP

Budget line	Post title	Group number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total assignments	Total persons
11-06	Shift leader	4		1				1						1	1				8	8
11-07	Control panel operator	4		2				1	1						1				9	8
11-08	Miller	4		1			1	4	1		2				4				17	17
11-09	Burner (cement kilns)	4		2			1	3						3	1	1			15	15
11-10	Mechanical maintenance foreman	3	2				1							1					7	7
11-11	Mechanical maintenance fitter		13				2	2	1	3	1				3				25	23
11-12	Compressor maintenance mechanic	1												1					2	2
11-14	Milling machine operator		1				1												2	2
11-16	Maintenance electrician	3	5	1			1		1				1						12	12
11-17	Instrumentation specialist	2	1	2	1					2		1	2						11	11
11-19	X-ray specialist	1											1						2	2
11-20	Mechanical engineer							2											2	2
11-21	Maintenance fitter					2				1	1			1			1		6	6
11-22	Sheet-metal fitter					5								3				4	12	12
11-23	Welder					3			1								1	1	6	6
11-24	Maintenance electrical engineer				1														1	1
11-25	Workshop fitter					2											1	1	4	4
11-26	Instrumentation electrical engineer								1										1	1
11-27	Electrical maintenance foreman											1							1	1
11-28	Instrument and control foreman							1											1	1
11-29	Shift electrician				3	1	1	1									1	1	8	8
11-30	Instrumentation specialist				1			2	1				2				1		7	7
11-31	Workshop and light electrician				2					1			1			1	2		7	7
11-32	High tension electrician				2						1								3	3
11-33	Diesel mechanic							1											1	1
11-34	Petrol engine mechanic																			
11-35	Quarry equipment electrician																			
11-38	Lime burner					1		1	2						1	2	1		8	8
11-39	Scraper operator																			
	Total	26	22	9	10	14	8	19	9	7	5	2	7	10	11	4	8	7	178	175
	Date of arrival at duty station	23-7-1978 31-5-1978	31-8-1978	3-11-1980	9-1-1981	16-1-1981	12-3-1981 2[illegible]-4-1981	6[illegible]20-8-1081	25-9-1981 2-10-1981	3-12-1981	26-3-1981	24-7-1981	7-8-1981	3-9-1981	8-10-1981 29-10-1981	1-3-1981	1-4-1982 22-4-1982	10-6-1982		

Annex IV

SUMMARY LIST OF STANDBY CANDIDATES

A. Those remaining from interviews in March 1981

Budget line	Post title	Number on list
11.06	Shift leader	1
11.08	Raw or cement miller	6
11.11	Maintenance mechanic	15
11.14	Milling machine operator	3
11.16	Maintenance electrician	9
11.19	X-ray specialist	1
11.20	Mechanical engineer	6
11.22	Sheet-metal fitter	1
11.23	Welder	7
11.25	Fitter	5
11.29	Shift electrician	6
11.30	Instrumentation specialist	8
11.31	Workshop and light electrician	8
11.32	High tension electrician	3
11.33	Diesel mechanic	6
11.34	Petrol engine mechanic	1
11.38	Lime burner	1
	Total	87

B. Candidates selected in March 1982

11.07	Control panel operator	8
11.08	Cement miller	2
11.09	Burner	6
11.38	Lime burner	6
	Total	22

Annex V

PERFORMANCE OF LCC PLANTS HAWARI AND BENGHAZI IN 1981 AND 1982 (JANUARY TO JUNE)

A. Raw-materials department: Hawari and Benghazi, output of crushers

(Tons)

Month	1981					1982				
	Hawari		Benghazi			Hawari		Benghazi		
	Limestone	Marl	Limestone	Marl	Gypsum	Limestone	Marl	Limestone	Marl	Gypsum
January	41 001	17 217	31 392	12 921	4 617	67 472	44 001	76 639	39 042	20 338
February	29 391	22 375	42 789	28 720	2 211	66 213	36 570	69 244	45 263	15 303
March	33 694	49 506	52 816	42 957	6 958	81 694	38 624	67 388	38 034	11 507
April	44 290	5 010	59 097	33 686	8 899	67 654	20 008	65 165	29 164	17 701
May	37 714	31 605	70 918	25 998	8 374	106 460	42 537	67 135	37 362	13 543
June	56 606	17 240	48 312	25 536	7 607	97 746	27 796	76 591	33 057	7 315
July	44 505	48 565	53 319	16 334	10 269					
August	85 656	42 455	63 477	26 255	8 059					
September	58 689	37 411	63 085	32 513	10 561					
October	65 146	24 753	48 605	22 885	10 146					
November	89 178	38 736	61 402	32 601	10 401					
December	82 010	43 533	89 336	46 382	12 698					
Total	667 884	378 405	684 548	346 789	100 800	487 239	209 536	422 162	221 922	85 707

B(i). Raw mills: total LCC production, 1981
(Tons)

Month	Hawari			Benghazi				LCC
	Raw mill I	Raw mill II	Total	Raw mill I	Raw mill II	Raw mill III	Total	total production
January	47 930	6 538	54 468	-	-	38 293	38 293	92 761
February	57 770	-	57 770	-	36 398	41 944	78 342	136 112
March	66 199	-	66 199	3 132	41 347	52 887	97 366	163 565
April	76 300	-	76 300	8 245	40 478	26 236	74 959	151 259
May	45 211	20 108	65 319	15 724	35 693	45 051	96 468	161 787
June	4 621	65 225	69 846	12 798	26 496	25 017	64 311	134 157
July	72 836	31 234	104 070	14 872	48 260	7 508	70 640	174 710
August	63 697	50 414	114 111	14 838	29 257	36 788	80 883	194 994
September	38 951	58 149	97 100	11 142	33 427	48 284	92 853	189 953
October	56 688	55 211	111 899	6 199	27 290	44 104	77 893	189 492
November	69 440	59 174	128 614	27 295	12 077	44 521	83 893	212 507
December	64 636	50 507	115 143	18 577	50 465	56 481	125 523	240 666
Total	664 279	396 560	1 060 839	132 822	381 188	467 114	981 124	2 041 963
Operation (hours)	5 765	3 171	8 936	3 084	3 650	4 266	11 000	19 936
Estimated production (t/a)	575 000	575 000	1 150 000	230 000	460 000	460 000	1 150 000	2 300 000
Ratio actual to estimated production (%)	115.5	69	92	57.74	82.87	101.55	85.3	88.87
Production rate (t/h)	115.0	125.0	119	43.06	104.4	109.5	89.2	102.42
Mill capacity (t/h)	110	110	110	70	140	140		
Ratio production to capacity (%)	104.5	113.6	108.2	61.4	74.3	78.2		
Energy consumption:								
(kWh)	18 646 557	11 468 091	30 114 648	43 391 501	2 745 500	12 955 930	30 040 580	601 555 228
(kWh/t)	28.1	28.9	28.4	32.7	33.4	27.7	30.6	29.5
Grinding media:								
(tons)					31	20	51	
(kg/t)					0.081	0.043	0.051	

B(ii). Hawari raw mills: 1981 production compared to 1980

Month	1980 Raw-mix feed Limestone (dry) (t)	(%)	Marl (dry) (t)	(%)	1980 Total output (t)	1981 Raw-mix feed Limestone (dry) (t)	(%)	Marl (dry) (t)	(%)	1981 Total output	Operating hours (h)	(min)	Mean production (t/h)	Ratio actual to estimated production (%)	Production compared to 1980 (t)	(%)
January	43 244	62	26 504	38	69 748	34 151	62.7	20 317	37.3	54 468	530	15	103	57	-15 280	78
February	50 819	65	27 006	35	77 825	36 395	63.0	21 375	37.0	57 770	558	10	104	60	-20 055	74
March	58 180	64	32 585	36	90 765	38 693	58.5	27 506	41.5	66 199	630	-	105	69	-24 566	73
April	39 207	61	25 384	39	64 591	49 290	64.6	27 010	35.4	76 300	554	30	138	80	+11 709	118
May	39 451	60	26 300	40	65 751	39 714	60.8	25 605	39.2	65 319	520	20	126	68	-00 432	99.6
June	43 001	61	27 032	39	70 033	42 606	61.0	27 240	39.0	69 846	545	05	128	73	-00 187	100
July	59 266	64	33 774	36	93 040	61 555	59.1	42 515	40.9	104 070	869	25	120	109	+11 030	112
August	58 079	64	32 669	36	90 748	75 656	66.3	38 455	33.7	114 111	921	50	124	119	+23 363	126
September	39 707	63	23 520	37	63 227	70 689	72.8	26 411	27.2	97 100	762	45	127	101	+33 873	154
October	40 037	66	20 625	34	60 662	68 146	60.9	43 753	39.1	111 899	1 060	30	106	117	+51 237	184.5
November	24 789	67	12 487	33	37 276	84 628	65.8	43 986	34.2	128 614	1 038	05	124	134	+91 338	345
December	37 246	62	23 120	38	60 366	76 110	66.1	39 033	33.9	115 143	945	15	122	120	+54 777	191
Total	533 026	63	311 006	37	844 032	677 633	63.9	383 206	36.1	1 060 839	8 936	10	119	92	+216 807	125.7
Total first six months 1981						240 849	61.8	149 053	38.2	389 902	3 338	20	117	68		

Total estimated production 1981 = 95,800 tons per month or 1,150,000 tons per year.

Designed capacity of raw mills I and II = 110 tons per hour each.

B(iii). Benghazi raw mills: 1981 production compared to 1980

Month	1980					1981										
	Raw-mix feed				Total output (t)	Raw-mix feed				Total output	Operating hours		Mean production (t/h)	Ratio actual to estimated production (%)	Production compared to 1980	
	Limestone (dry)		Marl (dry)			Limestone (dry)		Marl (dry)								
	(t)	(%)	(t)	(%)		(t)	(%)	(t)	(%)		(h)	(min)			(t)	(%)
January	27 405.4	63	16 095.2	37	43 500.7	25 082	65.5	13 211	34.5	38 293	278	3	137.5	40	-5 207	88
February	23 914.7	63	13 871.2	37	37 786.0	46 222	59.0	32 120	41.0	78 342	743		105.4	82	+40 556	207
March	19 628.14	60	13 194.84	40	32 822.98	55 109	56.6	42 257	43.4	97 366	1 004		97.0	102	+64 543	297
April	25 169.54	64	13 192.59	36	39 083.13	49 923	66.6	25 036	33.4	74 959	786		95.4	78	+35 876	192
May	49 552.05	64.5	27 180.62	35.5	76 732.68	66 370	68.8	30 098	31.2	96 468	1 193		80.9	101	+19 375	126
June	50 909.9	58	36 264.58	42	87 174.48	44 374	69.0	20 037	31.0	64 311	945		68.1	67	-22 864	74
July	32 565.45	64	18 159.55	36	50 725.0	48 106	68.1	22 534	31.9	70 640	675	30	104.5	74	+19 915	139
August	38 081.12	65	20 867.98	35	58 949.1	55 728	68.9	25 155	31.1	80 883	1 049		77.1	84.4	+21 934	137
September	27 997.2	65.5	14 746.6	34.5	42 742.8	63 790	68.7	29 063	31.3	92 853	1 001		92.8	96.9	+50 110	217
October	32 274.66	70	13 635.24	30	45 909.9	48 108	62.0	29 485	38.0	77 593	953		81.4	81.0	+31 683	169
November	47 996.00	66	25 730.3	34	72 726.3	53 692	64.0	30 201	36	83 893	991		84.7	87.5	+11 167	115
December	37 340.6	63	21 649.4	37	58 990.0	81 841	65	43 682	35	125 523	1 381		90.9	131.0	+66 533	213
Total	412 834.76	63.9 [64.0]	235 309.31	36.2 [36.0]	548 144.07	638 345	65	342 879	35	981 224	11 000		89.2	85.3	+333 080	151.4
Total first six months 1981						287 080	63.8	162 759	36.2	449 739	4 949.30		90.0	78		

Total estimated production 1981 = 95,833 tons per month.

B(iv). Raw mills: total LCC production 1982 (January to June)

(Tons)

Month	Hawari			Benghazi				LCC
	Raw mill I	Raw mill II	Total	Raw mill I	Raw mill II	Raw mill III	Total	Total production
January	59 710	66 163	125 873	16 982	45 774	51 744	114 500	240 373
February	44 135	49 948	94 083	17 127	27 443	49 807	94 377	188 460
March	45 898	69 920	115 818	19 834	38 544	43 860	102 238	218 056
April	70 306	35 356	105 662	16 734	34 725	45 269	96 728	202 393
May	69 560	69 937	139 497	16 312	34 799	57 636	108 747	248 244
June	57 652	62 890	120 542	13 606	31 464	39 967	85 037	205 579
Total	347 261	354 214	701 475	100 595	212 749	288 283	601 627	1 303 102
Operation (hours)	2 804	2 756	5 560	2 277	1 975	2 671	6 923	12 483
Estimated production (t/a)	287 500	287 500	575 000	115 000	230 000	230 000	575 000	1 150 000
Ratio actual to estimated production (%)	120.78	123.2	122	87.43	92.5	125.34	104.63	113.3
Production rate (t/h)	123.84	128.52	126.26	44.2	107.7	107.9		
Mill capacity (t/h)	110	110	110	70	140	140		
Ratio production to capacity (%)	112.58	116.84	114.69	63.14	76.9	77		
Energy consumption: (kWh)			15 291 333					
(kWh/t)			26.3					
Grinding media: (tons)				10	157			
(kg/t)				0.09	0.738			

B(v). Hawari raw mills: 1982 production (January to June) compared to 1981

Month	1981					1982									
	Raw-mix feed				Total output (t)	Raw-mix feed				Total output	Operating hours		Mean production (t/h)	Ratio actual to estimated production (%)	Production compared to 1981	
	Limestone (dry)		Marl (dry)			Limestone (dry)		Marl (dry)								
	(t)	(%)	(t)	(%)		(t)	(%)	(t)	(%)		(h)	(min)			(t)	(%)
January	34 151	62.7	20 317	37.3	54 468	78 936	62.7	46 937	37.3	125 873	1 033	-	122	128.6	+71 405	231.0
February	36 395	63.0	21 375	37.0	57 770	60 357	64.2	33 726	35.8	94 083	871	35	108	96.1	+36 313	162.9
March	38 693	58.5	27 506	41.5	66 199	82 662	71.4	33 156	28.6	115 818	870	45	133	118.3	+49 619	175.0
April	49 290	64.6	27 010	35.4	76 300	75 654	71.6	30 008	28.4	105 662	834	25	126	107.9	+29 362	138.5
May	39 714	60.8	25 605	39.2	65 319	105 460	75.6	34 037	24.4	139 497	976	10	143	142.5	+74 178	213.6
June	42 606	61.0	27 240	39.0	69 846	94 746	78.6	25 796	21.4	120 542	974	25	124	123.1	+50 696	172.6
Total	240 849	61.8	149 053	38.2	389 902	499 815	71.0	203 660	29.0	701 475	5 560	20	126	119.4	+311 573	179.9

Total estimated production for both raw mills I and II for the first six months of 1982 = 587,508 tons.

B(vi). Benghazi raw mills: 1982 production (January to June) compared to 1981

Month	1981					1982									
	Raw-mix feed				Total output (t)	Raw-mix feed				Total output	Operating hours		Mean production (t/h)	Ratio actual to estimated production (%)	Production compared to 1981	
	Limestone (dry)		Marl (dry)			Limestone (dry)		Marl (dry)								
	(t)	(%)	(t)	(%)		(t)	(%)	(t)	(%)		(h)	(min)			(t)	(%)
January	25 082	66	13 211	34	38 293	69 105	60	45 395	40	114 500	1 278		89.6	117	+76 207	299
February	46 222	59	32 120	41	78 342	58 514	62	35 863	38	94 377	1 154		81.8	96	+16 035	120
March	55 109	57	42 257	43	97 366	61 854	61	40 384	39	102 238	1 229		83.2	104	+4 872	105
April	49 923	67	25 036	33	74 959	58 714	61	38 014	39	96 728	1 158		83.5	99	+21 769	129
May	66 370	69	30 098	31	96 468	70 685	65	38 062	35	108 747	1 131		96.2	111	+12 279	113
June	44 274	69	20 037	31	64 311	56 380	66	28 657	34	85 037	973		87.4	87	+20 726	132
Total	286 980	64	162 759	36	449 739	375 252	62	226 375	38	601 627	6 923		86.9	102	+151 888	134

C(i). Kilns: Total LCC production, 1981

Month	Hawari			Benghazi			Total LCC		
	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)
January	34 776	946	1 222	26 516	707	1 214	61 282	842	1 218
February	35 779	820	1 300	46 394	848	1 033	82 173	836	1 135
March	37 421	871	1 222	56 338	874	954	93 759	872	1 045
April	45 129	707	1 523	41 732	803	958	86 861	753	1 187
May	37 588	788	1 424	63 125	956	825	100 713	893	978
June	44 127	832	1 481	35 358	1 085	648	79 485	946	975
July	62 160	836	1 411	40 782	646	801	102 942	760	1 280
August	69 908	839	1 378	47 627	1 018	801	117 535	911	1 067
September	64 105	885	1 183	55 016	926	836	119 121	903	993
October	60 466	940	1 135	50 132	1 015	799	110 598	972	953
November	77 712	812	1 462	54 344	730	944	132 056	836	1 193
December	68 448	812	1 480	74 498	847	875	142 946	851	1 088
Total	637 609	840	1 345	591 862	881	890	1 229 471	860	1 080
Operation (hours)		11 376			15 951			27 327	
Stoppages (hours)		6 144			10 329			16 473	
Mechanical		606			4 657			5 263	
Electrical		103			282			385	
Process		2 336			3 787			6 123	
Heating		412			763			1 175	
Fuel-oil deficiency		46			515			561	
Cement sales		744			-			744	
Mill deformation		1 897			-			1 897	
Others		-			325			325	
Fuel consumption (litres)		62 937 360			61 277 169			124 214 529	
Refractory-brick consumption:									
Burning zone (tons)		419.3			(data not				
Other types (tons)		50.4			available)				
Average production per kiln (tons per hour)		56.7			37.1			45.0	

C(ii). Hawari kilns: 1981 production compared to 1980

Month	Kiln I						Kiln II						Total					
	Output		Comparison 81/80 (%)	Ratio actual to estimated production 1981 (%)	Operation		Output		Comparison 81/80 (%)	Ratio actual to estimated production 1981 (%)	Operation		Output		Comparison 81/80 (%)	Ratio actual to estimated production 1981 (%)	Operation	
	1981 (t)	1980 (estimated) (t)			1981 (h)	1980 (h)	1981 (t)	1980 (estimated) (t)			1981 (h)	1980 (h)	1981 (t)	1980 (actual) (t)			1981 (h)	1980 (h)
January	29 898	33 480	89	104	576	659	4 868	6 085	80	17	106	151	34 766	42 674	81	61	683	810
February	35 779	17 975	199	124	661	370	-	30 560				637	35 779	49 728	72	62	661	1 008
March	37 421	25 065	149	130	735	497	-	19 890				481	37 421	50 410	74	65	735	978
April	45 129	39 120	115	157	711	660	-	-					45 129	38 557	117	79	711	660
May	25 743	31 000	83	90	438	565	11 845	9 115	130	41	196	224	37 588	42 547	88	65	634	789
June	5 092	4 310	118	18	82	77	39 035	29 580	132	136	633	684	44 217	40 724	108	77	714	761
July	45 023	20 940	215	157	742	408	17 137	29 505	58	60	316	691	62 160	55 824	111	108	1 058	1 100
August	41 901	33 725	124	146	693	700	28 007	20 975	133	97	524	534	69 908	56 033	125	122	1 217	1 234
September	33 883	37 252	91	118	673	695	30 222	-		105	627	-	64 105	37 252	172	111	1 300	695
October	35 108	38 445	91	122	710	731	25 358	-		88	568	-	60 466	34 103	178	105	1 278	731
November	38 368	1 113	3 448	133	648	24	39 344	19 504	202	137	627	422	77 712	20 706	375	135	1 276	446
December	34 177	33 418	99	117	567	728	34 271	-		119	543	-	68 448	36 791	186	119	1 109	728
Total	407 522	315 843	129	118	7 236	6 114	230 087	165 214	139	67	4 140	3 825	637 609	505 264	126	92	11 376	9 939
		323 669 (actual)	126 (actual)					181 595 (actual)	127 (actual)									

Designed capacity, 1,500 t/d per kiln. Estimated production of both kilns, 57,500 t/m or 690,000 t/a.

C(iii). Benghazi Kilns: 1981 production compared to 1980

Month	Kiln I Output 1981 (t)	Kiln I Output 1980 (t)	Kiln I Comparison 81/80 (%)	Kiln I Ratio actual to estimated production 1981 (%)	Kiln I Operation 1981 (h)	Kiln I Operation 1980 (h)	Kiln II Output 1981 (%)	Kiln II Output 1980 (%)	Kiln II Comparison 81/80	Kiln II Ratio actual to estimated production 1981 (%)	Kiln II Operation 1981 (h)	Kiln II Operation 1980 (h)
January	-	2 605	-	-	-	156	3 413	24 816	14	15	73	624
February	-	7 094	-	-	-	443	25 911	6 293	412	113	603	197
March	2 265	7 285	31	20	122	390	27 340	-	-	119	647	-
April	4 132	-	-	36	217	-	24 121	9 447	255	105	547	286
May	7 575	-	-	66	450	-	27 081	28 040	97	118	683	533
June	7 178	-	-	62	456	-	16 548	22 408	74	72	461	473
July	8 999	4 785	189	78	351	236	28 562	718	398	124	465	16
August	8 763	7 240	121	76	520	434	17 003	13 292	128	74	380	397
September	7 262	5 724	127	63	456	315	20 521	3 950	520	89	476	109
October	3 969	5 669	70	17	254	255	21 488	756	284	93	564	20
November	13 043	5 556	230	112	705	254	2 119	3 192	65	9	48	68
December	10 802	3 546	303	94	630	223	31 438	-	-	137	700	-
Total	73 988	49 509	153	36	4 161	2 706	245 545	112 912	222	91	5 647	2 720

Month	Kiln III Output 1981 (t)	Kiln III Output 1980 (t)	Kiln III Comparison 81/80 (%)	Kiln III Ratio actual to estimated production 1981 (%)	Kiln III Operation 1981 (h)	Kiln III Operation 1980 (h)	Total Output 1981 (%)	Total Output 1980 (%)	Total Comparison 81/80	Total Ratio actual to estimated production 1981 (%)	Total Operation 1981 (h)	Total Operation 1980 (h)
January	23 103	-	-	100	451	-	26 516	27 421	97	46	524	780
February	20 483	8 578	239	89	474	236	46 394	21 965	211	81	1 077	876
March	26 733	10 927	245	116	649	235	56 338	18 212	309	98	1 418	625
April	13 479	17 699	76	59	281	520	41 732	27 146	154	73	1 045	806
May	28 469	16 523	172	124	704	384	63 125	44 564	142	110	1 837	917
June	11 632	29 140	40	51	324	611	35 358	51 548	69	61	1 241	1 084
July	3 221	27 344	12	14	57	629	40 782	32 837	124	71	873	881
August	21 861	10 770	203	95	527	269	47 627	31 307	152	83	1 427	1 100
September	27 233	14 089	193	188	647	357	55 016	23 768	231	96	1 580	778
October	24 675	20 629	120	107	688	417	50 132	27 054	185	87	1 506	692
November	39 182	33 202	116	167	628	687	54 344	41 950	127	93	1 381	1 011
December	34 344	34 184	94	140	713	695	74 498	37 731	197	129	2 043	918
Total	272 329	223 080	122.2	99	6 144	5 042	591 862	385 502	155	87	15 951	10 468

Designed capacity: Kiln I = 600 t/d
Kilns II and III = 1,200 t/d each

Estimated production: Kiln I = 11,500 t/m, 138,000 t/a
Kilns II and III = 23,000 t/m, 276,000 t/a each
I, II and III = 57,500 t/m

C(iv). Kilns: total LCC production, 1982 (January to June)

Month	Hawari			Benghazi			Total LCC		
	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)	Production (t)	Fuel consumption (kcal/kg clinker)	Mean production (t/d)
January	77 733	894	1 374	65 064	870	874	142 797	883	1 090
February	51 533	977	1 336	56 809	894	811	108 342	903	997
March	73 731	861	1 473	61 136	932	806	134 867	892	1 071
April	62 826	896	1 398	58 619	933	822	121 445	913	1 045
May	86 468	813	1 438	65 968	894	854	152 436	848	1 110
June	71 302	903	1 278	49 479	1 041	731	120 781	959	978
Total	423 593	876	1 384	357 075	922	818	780 668	897	1 051
Operation (hours)		7 346			10 479			17 825	
Stoppages (hours)		1 342			2 553			3 895	
Mechanical		279			326			605	
Electrical		41			381			422	
Process		755			1 019			1 774	
Heating		129			506			635	
Others		138			321			459	
Fuel consumption (litres)		43 574 000			38 675 300			82 249 300	
Refractory-brick consumption:									
Burning zone (tons)		157.4			(data not available)				
Other types (tons)		76.7							
Average production per kiln (tons per hour)		57.66			36.6			43.8	
Ratio performance to capacity (%)		92.3			78.0			83.7	

C(v). Hawari kilns: 1982 production (January to June) compared to 1981

Month	Kiln I						Kiln II						Total					
	Output		Comparison	Ratio actual to estimated production	Operation		Output		Comparison	Ratio actual to estimated production	Operation		Output		Comparison	Ratio actual to estimated production	Operation	
	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1982 (h)	1981 (h)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1982 (h)	1981 (h)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1982 (h)	1981 (h)
January	36 429	29 898	122	124	615	576	41 304	4 868	848	141	743	106	77 733	34 766	224	132	1 358	683
February	26 943	35 779	75	92	458	661	24 590			84	468		51 533	35 779	144	88	926	661
March	34 160	37 421	91	116	515	735	39 571			135	686		73 731	37 421	197	125	1 201	735
April	43 480	45 129	96	148	690	711	19 346			66	389		62 826	45 129	139	107	1 079	711
May	41 506	25 743	161	141	719	438	44 962	11 845	380	153	724	196	86 468	37 588	230	147	1 443	634
June	34 054	5 092	669	116	634	82	37 248	39 035	95	127	705	633	71 302	44 127	162	121	1 339	714
Total	216 572	179 062	121	123	3 630	3 203	207 021	55 748	371	117	3 715	935	423 593	234 810	180	120	7 345	4 138

Designed capacity: 1,500 t/d per kiln Estimated production: 29,375 t/m, 176,250 t/6 months per kiln
58,750 t/m, 352,500 t/6 months, total both kilns

C(vi). Benghazi kilns: 1982 production

Month	Kiln I Output 1982 (t)	Kiln I Output 1981 (t)	Kiln I Comparison 82/81 (%)	Kiln I Ratio actual to estimated production 1982 (%)	Kiln I Operation 1982 (h)	Kiln I Operation 1981 (h)	Kiln II Output 1982 (t)	Kiln II Output 1981 (t)	Kiln II Comparison 82/81 (%)	Kiln II Ratio actual to estimated production 1982 (%)	Kiln II Operation 1982 (h)	Kiln II Operation 1981 (h)
January	9 139		78	78	520		30 121	3 413	883	128	681	73
February	10 654			91	570		26 811	25 911	103	114	634	603
March	11 433	2 265	505	97	597	122	23 048	27 340	84	98	544	647
April	8 441	4 132	204	72	492	217	24 972	24 121	104	106	601	547
May	7 916	7 575	105	67	504	450	27 707	27 081	102	118	644	683
June	6 432	7 178	90	55	435	456	21 275	16 548	129	91	580	461
Total	54 015	21 150	255	77	3 118	1 245	153 935	124 414	124	109	3 684	3 014

Month	Kiln III Output 1982 (t)	Kiln III Output 1981 (t)	Kiln III Comparison 82/81 (%)	Kiln III Ratio actual to estimated production 1982 (%)	Kiln III Operation 1982 (h)	Kiln III Operation 1981 (h)	Total Output 1982 (t)	Total Output 1981 (t)	Total Comparison 82/81 (%)	Total Ratio actual to estimated production 82/81 (%)	Total Operation 1982 (h)	Total Operation 1981 (h)
January	25 804	23 103	112	110	586	451	65 064	26 516	245	111	1 787	524
February	19 344	20 483	94	82	477	474	56 809	46 394	122	97	1 681	1 077
March	26 655	26 733	100	113	680	649	61 136	56 338	109	104	1 821	1 418
April	25 206	13 479	187	107	618	281	58 619	41 732	140	100	1 711	1 045
May	30 345	28 469	107	129	706	704	65 968	63 125	105	112	1 854	1 837
June	21 771	11 632	187	43	610	324	49 479	35 358	140	128	1 625	1 241
Total	149 125	123 899	120	106	3 677	2 883	357 075	269 463	133	101	10 479	7 142

Estimated production: Kiln I = 11,750 t/m
Kiln II and III = 23,500 t/m
Total Kilns I, II and III = 58,750 t/m, 352,500 t/6 months

Table 1. Kilns: Comparison of 1982 production data for the period January to June in 1981 and 1982

Item	Benghazi									Total		
	Kiln I			Kiln II			Kiln III					
	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)
Actual output (tons)	54 315	21 150	256.4	153 435	142 414	108.1	144 125	123 899	120.4	351 875	269 463	130.6
Operation (h)	1 118	1 245	250.4	3 684	3 014	122.2	3 877	2 882	127.6	10 479	7 142	146.7
Production capacity (t/d)	416	408	102	1 303	1 134	88.4	973	1 031	94.4	813	905	90.4
Stoppages (h)	1 226	3 099	39.6	660	1 330	49.6	667	1 461	45.7	2 553	5 890	43.3
Mechanical	171	2 077	8.2	82	699	11.7	73	378	19.3	326	3 154	10.3
Electrical	135	41	329.3	123	46	289.1	113	29	389.7	381	116	328.4
Process	832	783	67.9	261	246	106.1	226	520	43.5	1 319	1 549	85.8
Heating	160	159	163.5	107	159	67.3	139	124	112.1	506	442	114.5
Fuel-oil deficiency	-	-		-	139		-	376		-	515	
Cement sales	-	-		-	-		-	-		-	-	
Mill deformation				-	-		-	-		-	-	
Others	128	39	328.2	77	41	187.8	116	34	341.2	321	114	281.6
Fuel consumption (Kcal/kg)	1 063	1 135	93.7	874	872	100.2	921	860	107.1	922	888	103.8
Production rate (t/h)	17.3	17.0	102	41.8	47.3	88.4	40.6	43	944	34.1	37.7	90.4

Item	Hawari									Total IOC		
	Kiln I			Kiln II			Total					
	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)	1982	1981	Ratio 82/81 (%)
Actual output (tons)	116 372	179 062	121	207 021	55 748	371.3	423 593	234 810	180.4	780 668	504 273	154.8
Operation (h)	3 631	3 203	113	3 715	935	397.3	7 346	4 138	177.5	17 825	11 280	158.0
Production capacity (t/d)	1 432	1 342	107	1 337	1 431	93.4	1 384	1 362	101.6	1 051	1 073	98
Stoppages (h)	713	1 141	62.5	629	3 409	18.5	1 242	4 550	29.5	3 395	10 440	37.3
Mechanical	120	116	189.7	59	388	15.2	279	504	55.4	605	3 658	16.5
Electrical	22	-	-	19	-	-	41			422	116	363.8
Process	339	1 025	33.1	416	380	109.5	755	1 405	53.7	774	2 954	26.2
Heating	78	-	-	51	-		129	-		635	442	143.7
Fuel-oil deficiency	-	-	-	-	-		-	-		-	515	
Cement sales	-	-	-	-	744		-	744		-	744	
Mill deformation	-	-	-	-	1 897		-	1 897		-	1 897	
Others	54	-	-	84	-		138	-		439	114	402.6
Fuel consumption (Kcal/kg)	844	812	104.0	909	857	106.1	876	823	106.4	897	858	104.6
Production rate (t/h)	59.65	55.9	107	55.7	59.9	93.4	57.7	56.74	101.6	43.8	44.7	98.0

D(i). Cement mills: total LCC production 1981

	Hawari				Benghazi				Total LCC			
	Output	Operation	Mean production		Output	Operation	Mean production		Output	Operation	Mean production	
Month	(t)	(h)	(t/d)	(t/h)	(t)	(h)	(t/d)	(t/h)	(t)	(h)	(t/d)	(t/h)
January	32 276	500	1 549	65	21 940	362	1 455	61	54 216	862	1 510	63
February	34 062	408	2 004	83	31 772	555	1 374	57	65 834	963	1 641	68
March	47 821	619	1 824	77	52 415	824	1 527	64	100 236	1 443	1 667	70
April	45 344	472	2 306	96	70 618	944	1 795	75	115 962	1 416	1 966	82
May	58 509	657	2 137	89	65 461	889	1 767	74	123 970	1 546	1 925	80
June	50 779	876	1 391	58	64 949	896	1 740	78	115 728	1 772	1 567	65
July	52 742	779	1 623	68	37 874	557	1 631	68	90 616	1 337	1 626	68
August	51 511	578	2 097	87	43 169	669	1 549	65	94 380	1 247	1 822	76
September	77 951	1 061	1 763	73	73 591	1 294	1 365	57	151 542	2 355	1 544	64
October	79 363	1 152	1 654	69	72 671	1 237	1 410	59	152 034	2 388	1 531	64
November	83 149	1 061	1 880	78	51 788	893	1 392	58	134 937	1 954	1 657	69
December	82 487	1 090	1 817	76	77 307	1 473	1 260	53	159 794	2 563	1 496	62
Total	695 994	9 254	1 805	75	663 555	10 593	1 503	62.6	1 359 549	19 847	1 644	68.5

Stoppages: (hours)			
Mechanical	627	4 203	4 830
Electrical	-	284	284
Process	1 209	3 986	5 195
Cement sales	-	4 634	4 634
Mill deformation	5 050	-	5 050
Others	1 377	2 581	3 958
Total	8 263	15 688	23 951

D(ii). Hawari cement mills: 1981 production compared to 1980

Month	Cement mill I							Cement mill II							Total						
	Output		Comparison	Ratio actual to estimated production		Grinding media used		Output		Comparison	Ratio actual to estimated production		Grinding media used		Output		Comparison	Ratio actual to estimated production		Grinding media used	
	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981 (t)	1980 (t)	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981 (t)	1980 (t)	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981 (t)	1980 (t)
January	32 276	23 841	135	103	76	12.0	-	-	27 030			87	-	-	32 276	50 870	64	52	81	12.0	-
February	34 062	28 468	120	109	91	3.5	-	-	10 656			34	-	-	34 062	39 124	87	55	63	3.5	-
March	47 821	34 770	138	153	111	-	-	-	3 771			12	-	216	47 821	38 541	124	77	62	-	216
April	45 344	-	-	145	-	-	-	-	50 322			161	-	-	45 344	50 322	90	73	81	-	-
May	58 509	-	-	187	-	2.0	-	-	51 860			165	-	-	58 509	51 860	113	94	83	2.0	-
June	40 595	13 230	307	130	42	-	-	10 183	30 280	34	33	97	16.0	-	50 779	43 510	117	81	70	16.0	-
July	41 863	18 970	221	133	61	5.0	-	10 879	35 712	31	35	114	-	-	52 742	54 682	96	84	88	5.0	-
August	49 863	28 395	176	160	90	-	-	1 648	22 790	7	5	73	-	-	51 511	51 185	101	82	82	-	-
September	41 553	35 308	118	133	113	-	-	36 398	7 772	468	117	25	17.0	-	77 951	43 080	181	125	69	17.0	-
October	39 527	29 620	133	127	95	-	-	39 836	14 484	275	127	46	30.0	-	79 363	44 104	180	127	71	30.0	-
November	38 682	35 924	108	124	115	-	-	44 467	-		142		8.5	-	83 149	35 924	232	133	58	8.5	-
December	33 705	40 336	84	108	129	-	-	48 782	-		156		-	-	82 487	40 336	205	132	65	-	
Total	503 801	286 437	176	134	76	22.5	-	192 193	250 810	77	51	67	71.5	216	695 994	537 247	130	93	72	96.0	216
Estimated production		288 862							254 677							543 539					

Consumption of grinding media:

	1980	1981
Cement mill I	-	44.7 grammes per ton (g/t)
Cement mill II	861 g/t	372 g/t
Both mills	402 g/t	135 g/t

D(iii). Benghazi cement mills: 1981 production compared to 1980

Month	Cement mill I					Cement mill II					Cement mill III					Total				
	Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production	
	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981 (t)	1980 (t)	81/80 (%)	1981 (%)	1980 (%)	1981	1980	81/82	1981	1980
January	1 139	-	-	9.1		4 215	6 989	67.5	18.9	28	16 086	29 990	53.6	64.1	120	21 940	36 979	59.3	35.1	59.2
February	231	-	-	5.8	-	11 279	16 986	66.4	45.1	67.9	19 762	12 386	159.6	79	49.5	31 772	29 372	108.2	50.8	47
March	2 965	745	395.3	23.6	6.0	24 750	2 888	857	99	11.6	24 720	-	-	98.9	-	52 415	3 633	1 442.9	83.9	5.8
April	424	10 263	4.1	3.4	82.1	37 357	15 886	235.2	149.4	63.5	32 837	17 111	191.9	131.3	68.4	70 618	43 261	163.2	113	69.2
May		382		-	3.1	35 113	31 070	113	140.5	124.3	30 348	39 275	77.3	121.4	157.1	65 461	70 727	92.6	104.7	113.2
June	1 494	1 927	77.5	12	15.4	34 488	24 243	142.3	138	97	28 967	25 682	112.8	115.9	102.7	64 949	51 852	125.3	104	83
July	-	-	-	-	-	21 963	20 373	107.8	87.9	81.5	15 911	25 333	62.8	63.6	101.3	37 874	45 706	82.9	60.6	73.1
August	-	-	-	-	-	20 678	16 472	125.5	82.7	65.9	22 491	8 563	262.7	90	34.3	43 169	25 035	172.4	69.1	40.1
September	8 021	6 571	122	64.2	52.6	29 952	7 430	403.1	119.8	29.7	35 618	19 757	180.3	142.5	79	73 591	33 760	218	117.7	54.0
October	13 825	7 803	177.8	111	62.4	23 200	8 598	269.8	92.8	34.4	35 596	14 573	244.3	142.4	58.3	72 671	30 974	234.6	116.3	49.6
November	11 808	307	3 846.3	94.5	2.5	7 906	10 885	68	29.6	43.5	32 574	24 696	131.9	130.3	98.8	51 788	35 888	144.4	82.9	57.4
December	15 356	9 004	170.5	122.8	72.0	21 305	2 685	793.5	85.2	10.7	40 646	23 622	172.1	162.6	94.5	77 307	35 310	218.9	123.7	56.5
Total	55 703	37 006	150.8	37.3	24.7	272 206	164 503	165.5	90.7	54.8	335 556	240 988	139.2	111.9	80.3	663 555	442 497	150	88.5	59

D(iv). Cement mills: total LCC production 1982 (January to June)

	Hawari				Benghazi				Total LCC			
Month	Output (t)	Operation (h)	Mean production (t/d)	(t/h)	Output (t)	Operation (h)	Mean production (t/d)	(t/h)	Output (t)	Operation (h)	Mean production (t/d)	(t/h)
January	84 067	1 121	1 800	75	67 092	1 160	1 388	58	151 159	2 281	1 590	66
February	61 334	788	1 868	78	67 796	921	1 767	74	129 130	1 709	1 813	76
March	81 609	1 005	1 949	81	67 698	1 075	1 511	63	149 307	2 080	1 723	72
April	71 653	943	1 824	76	72 249	1 261	1 375	57	143 902	2 204	1 567	65
May	94 319	1 166	1 941	81	75 327	1 208	1 497	62	169 646	2 373	1 715	72
June	86 114	1 090	1 896	79	61 657	1 039	1 424	59	147 771	2 130	1 665	69
Total	479 096	6 113	1 881	78	411 819	6 664	1 483	62	890 915	12 778	1 673	70

Stoppages:						
(hours)	(1982)	(1981)	(1982)	(1981)	(1982)	(1981)
Mechanical	693	225	1 653	2 811	2 346	3 036
Electrical	242	-	586	221	828	221
Process	1 300	426	2 748	902	4 048	1 328
Cement sales	-	-	800	4 158	800	4 158
Mill deformation	-	3 909	-	-	-	3 909
Others	338	596	399	470	737	1 066
Total	2 573	5 156	6 186	8 562	8 759	13 718

D(v). Hawari cement mills: 1982 production (January to June) compared to 1981

Month	Cement mill I							Cement mill II							Total						
	Output		Comparison	Ratio actual to estimated production		Grinding media used		Output		Comparison	Ratio actual to estimated production		Grinding media used		Output		Comparison	Ratio actual to estimated production		Grinding media used	
	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982 (t)	1981 (t)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982 (t)	1981 (t)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982 (t)	1981 (t)
January	36 658	32 276	114	117	103	-	12	47 409	-		152	-	-	-	84 067	32 276	260	135	52	-	12
February	24 896	34 062	73	80	109	6	3.5	36 438	-		117	-	-		61 334	34 062	180	90	54	6	3.5
March	40 869	47 821	86	131	153	-	-	40 740	-		130	-	-	-	81 609	47 821	171	131	77	-	-
April	29 306	45 344	65	94	145	-	-	42 347	-		136	-	-	-	71 653	45 344	158	115	73	-	-
May	52 652	58 509	90	169	187	-	2	41 667	-		133	-	-	-	94 319	58 509	161	151	94	-	2
June	48 789	40 595	120	156	130	-	-	37 325	10 183	367	119	33	15	16	86 114	50 779	170	138	81	15	16
Total	233 170	258 608	90	124	138	6	17.5	245 926	10 183	2 415	131	5.4	15	16	479 096	268 791	178	128	72	21	33.5

Consumption of grinding media:

	1982 (Jan to June)
Cement mill I	27.8 g/t
Cement mill II	439 g/t
Both mills	193 g/t

D(vi). Benghazi cement mills: 1982 production (January to June) compared to 1981

Month	Cement mill I					Cement mill II					Cement mill III					Total				
	Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production		Output		Comparison	Ratio actual to estimated production	
	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982 (t)	1981 (t)	82/81 (%)	1982 (%)	1981 (%)	1982	1981	82/81	1982	1981
January	16 372	1 139	1 437	131	9.1	11 134	4 715	236	45	19	39 586	16 086	246	158	64	67 092	21 940	306	107	35
February	15 042	731	2 058	120	5.8	15 492	11 279	137	62	45	37 262	19 762	188	149	79	67 796	31 772	213	108.5	51
March	12 863	2 945	437	103	23.6	18 955	24 750	77	76	99	35 880	24 720	145	143.5	99	67 698	52 415	129	108.3	84
April	15 678	424	3 698	125	3.4	23 120	37 357	62	92.5	149	33 451	32 837	102	134	131	72 249	70 618	102	116	113
May	14 312	-	-	114.5	-	19 585	25 113	56	78	140	41 430	30 348	136.5	166	121	75 327	65 461	115	120.5	105
June	10 482	1 494	702	83.9	12.0	20 482	34 488	30	42	138	40 694	28 967	140.5	163	116	61 657	64 949	95	98.7	104
Total	84 749	6 733	1 259	113	9.0	98 768	147 702	67	66	98.5	228 303	152 720	149.5	76	51	411 819	307 155	134	109.8	81.9

E(i). Packing and despatch: total LCC production 1981

Month	Benghazi			Hawari			Total LCC		
	Packed (t)	Bulk (t)	Total (t)	Packed (t)	Bulk (t)	Total (t)	Packed (t)	Bulk (t)	Total (t)
January	20 895	2 316.9	23 211.9	16 075	10 705.6	26 780.6	36 970	13 022.6	49 992.5
February	24 970	4 730.4	29 700.4	27 430	9 974.5	37 404.5	52 400	14 704.8	67 104.0
March	42 250	10 906.4	53 156.4	33 165.7	9 320.6	42 486.3	75 415.7	20 227.0	95 642.7
April	57 885	11 380.9	69 265.9	39 653.3	11 947.5	51 600.8	97 538.3	23 328.4	120 866.7
May	58 255	10 344.3	68 599.3	55 752	12 596.7	68 348.7	114 007	22 941.0	136 948.0
June	46 905	18 097.3	65 002.3	49 745	1 533.7	51 278.7	96 650	19 631.0	116 281.1
July	27 745	7 919.6	35 664.6	37 580	11 441.0	49 021.0	65 325	19 360.6	84 685.6
August	34 455	11 022.1	45 477.1	41 603.3	13 569.1	55 172.4	76 058.2	24 591.2	100 649.5
September	56 770	16 445.1	73 215.1	64 275	13 546.2	77 821.2	121 045	29 991.3	151 036.3
October	52 020	19 616.3	71 636.3	66 070	7 250,0	73 320	118 090	26 866.4	144 956.3
November	38 830	11 764.1	50 594.1	77 325	13 900.1	91 225.1	116 155	25 664.2	141 819.2
December	51 610	28 042.4	79 652.4	77 627.5	4 975.7	82 603.2	129 237.5	33 018.1	162 255.6
Total	512 590	152 585.8	665 175.8	586 301.8	120 760.8	707 062.6	1 098 891.7	273 346.6	1 372 238.4

E(ii). Packing and despatch: total LCC production 1982 (January to June)

	Benghazi			Hawari			Total LCC		
Month	Packed (t)	Bulk (t)	Total (t)	Packed (t)	Bulk (t)	Total (t)	Packed (t)	Bulk (t)	Total (t)
January	45 285	21 522.870	6 807.870	58 692.5	17 387.320	76 079.820	103 977.5	38 910.190	142 887.690
February	43 980	24 163.520	68 143.520	57 190	9 269.480	66 459.480	101 170	33 433	134 603
March	46 180	22 454.320	68 634.320	63 730	20 212.060	83 942.060	109 910	42 666.380	152 576.380
April	43 105	27 136.36	70 241.360	60 140	8 878.000	69 018.000	103 245	36 014.360	139 259.360
May	52 255	25 140.090	77 395.090	83 020	10 402.960	93 422.960	135 275	35 543.050	170 818.050
June	40 025	21 914.350	61 939.350	72 565	15 645.980	88 210.980	112 590	37 560.330	150 150.330
Total	270 830	142 331.510	413 161.51	395 337.5	81 795.800	477 133.3	666 167.5	224 127.310	890 294.810

F. Summary of energy and fuel consumption: LCC plants 1981 and 1982 (January to June)

(i) Energy consumption

	Hawari			Benghazi			Total LCC		
Year	Total energy consumed (kWh)	Output of cement (t)	Average energy consumption (kWh/t)	Total energy consumed (kWh)	Output of cement (t)	Average energy consumption (kWh/t)	Total energy consumed (kWh)	Output of cement (t)	Average energy consumption (kWh/t)
1981	85 600 137	707 062	121.06	82 412 852	665 176	123.9	168 244 879	1 372 238	122.6
1982 (Jan-June)	54 400 000	479 096	115.6	(data not available)					

(ii) Fuel consumption

Year	Hawari (litres)	Benghazi (litres)	Total LCC (litres)
1981	62 937 360	61 277 169	124 214 529
1982 (Jan-June)	43 574 000	38 675 300	82 249 300

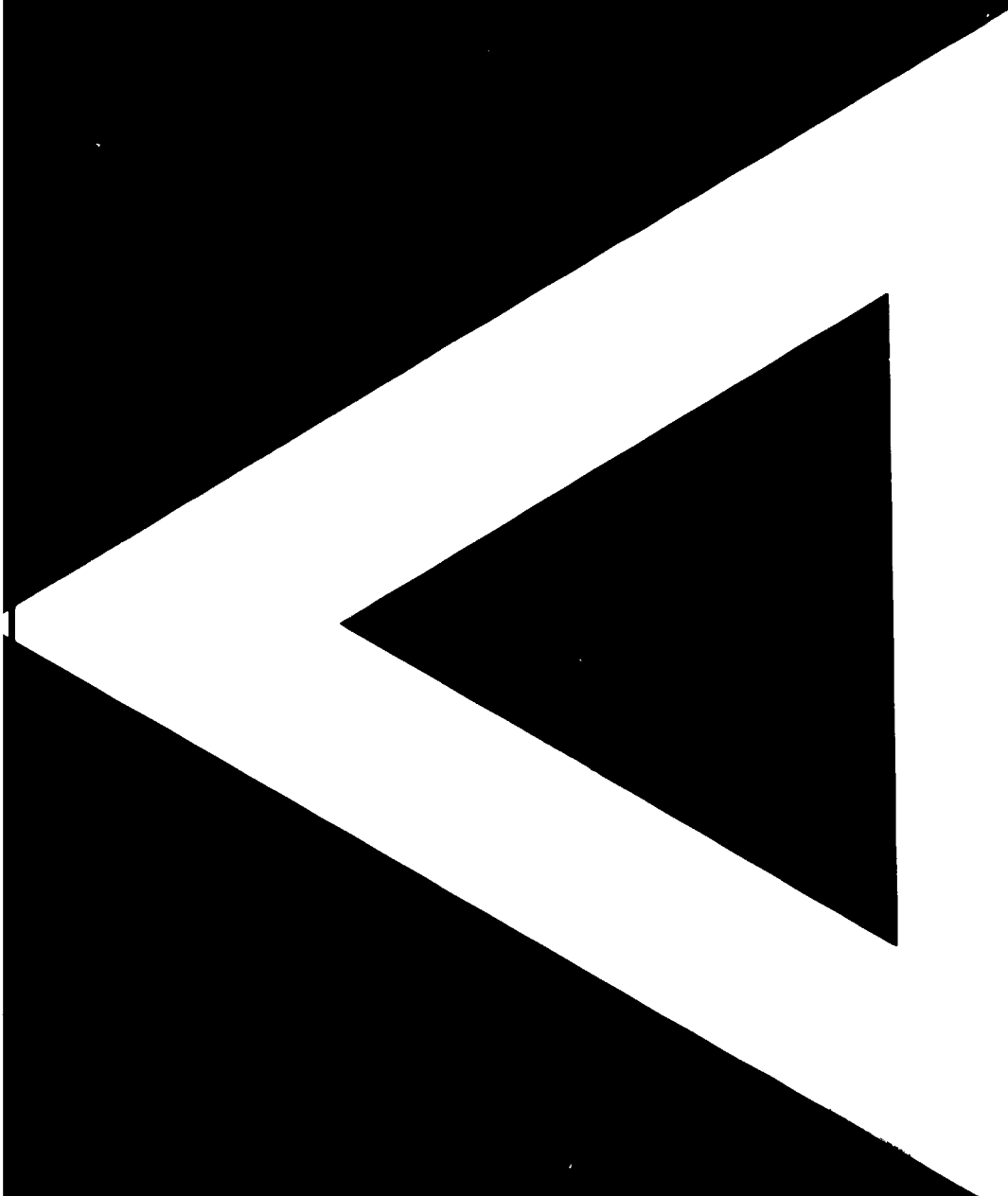
Annex VI

REPORTS ISSUED UNDER THE PROJECT TF/LIB/75/002 or TF/LIB/82/002

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/IOD.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 Benghazi complex: final summary Boguslaw J. Walczenko
UNIDO/IO.472 6 July 1981	Report of 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 R. 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 Hawari 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.53 26 March 1982	New gypsum deposits A.R. Marei
UNIDO/IO/R.84 24 January 1983	Progress of project from 1 January 1982 to 30 June 1982 A. R. Marei
UNIDO/IO/R.85 24 January 1983	Feasibility study on plant for ready-mixed concrete and prefabricated concrete products A.R. Marei
UNIDO/IO/R.99* 27 October 1983	Evaluation of the raw material situation of the Al Khums I Cement Plant A.R. Marei

* Forthcoming.



ABSTRACT

The project, "Assistance to the Libyan Cement Factory, Benghazi" (TF/LIB/82/002), 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. It is the continuation of project TF/LIB/75/002, which was approved in 1975, has been operating in the field since 1976 and is designed to give direct, long-term technical assistance to the cement industry.

The report covers the progress of the project from 1 January 1982 to 30 June 1982 and describes the administration of the project during this period and the solutions found to the problems of accommodation, salary scales and the discrepancies between the Libyan Cement Company (LCC) and UNIDO budgets. Details are given of the technical-assistance team of which 17 groups had been fielded up to the end of the period covered and the analysis of statistical data on the team is brought up to date. The co-ordinator took part in the selection of new candidates for the standby list in March 1982. The activities of the co-ordinator in setting up training programmes for national technical personnel are also described.

The report gives full details of the performance of the Benghazi and Hawari cement plants in 1981 and the first half of 1982 and describes the progress of the preventive-maintenance programmes.

Advice is given on new cement plants, avoiding cement aggregation in storage silos, the provision of an adequate gypsum supply, the production of sulphate-resisting cement and the feasibility of setting up a plant for ready-mixed concrete and concrete products.

The Interregional Cement Technology Forum, held in Benghazi in April 1982, is also described.