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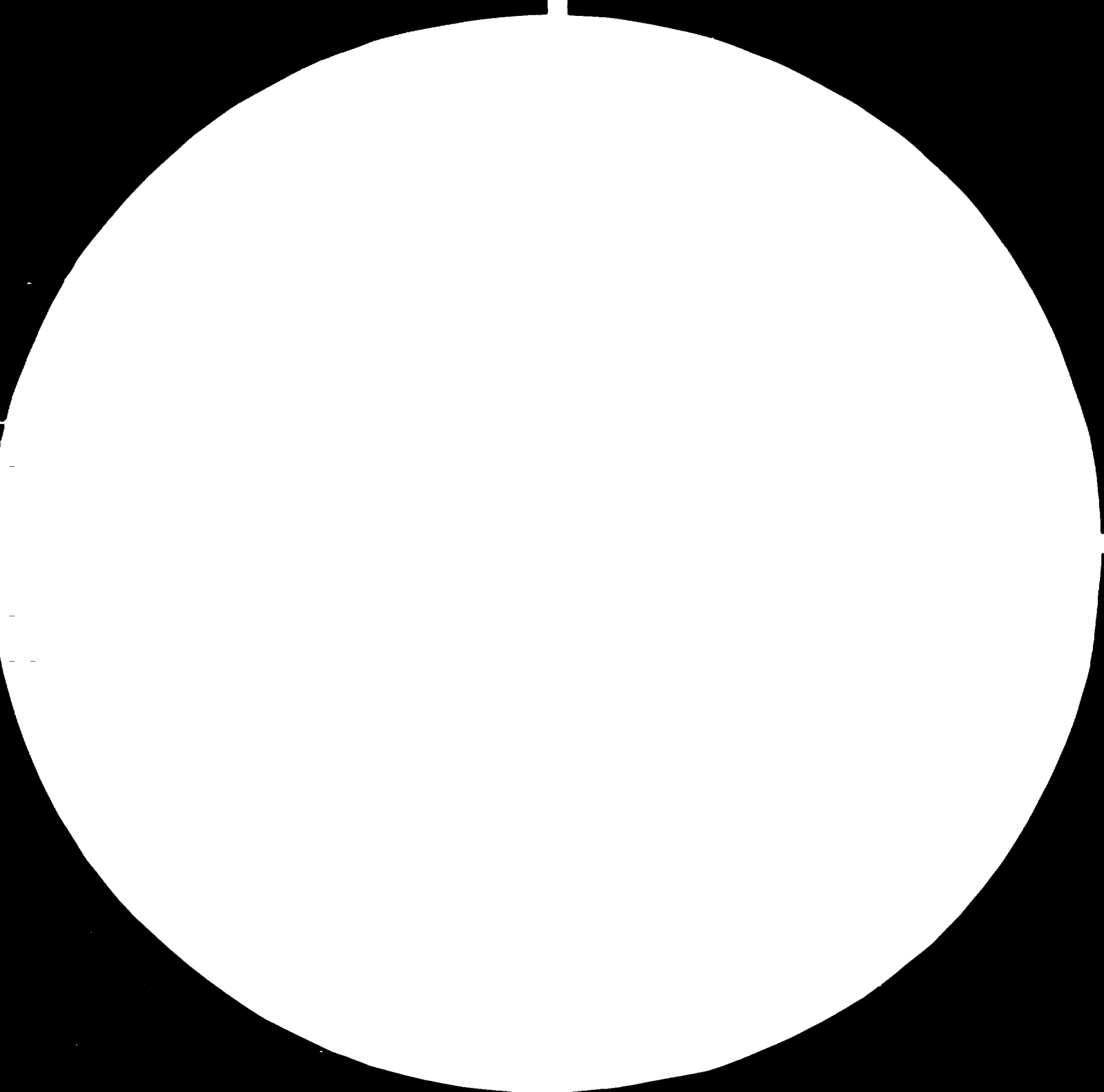

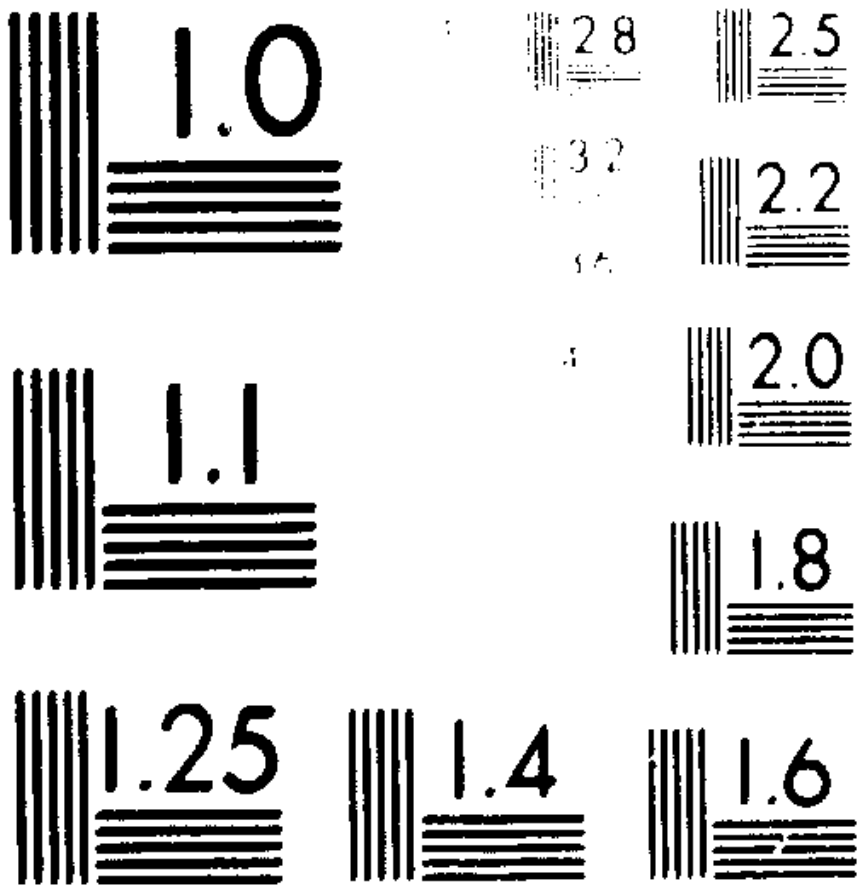

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# ASSISTANCE TO THE GLASS INDUSTRY

DP/IRQ/78/001

IRAQ

## Technical report: Development of systems for production and quality control of glass products

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

Based on the work of H.R. Persson, expert in the production and quality control of glassware

United Nations Industrial Development Organization
Vienna

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## Explanatory notes

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## ABSTRACT

Project IRQ/78/001, "Assistance to the glass industry", started in August 1979, and except for a short period the Team Leader was the only UNIDO expert at Ramadi, the duty station in Iraq. Glass experts were unwilling to stay for as long as 12 months, and it was proposed that they stay for a shorter period of time.

Six fellowships were included in the project, and although the candidates had been identified by the glass factory they have not yet been cleared by the authorities concerned.

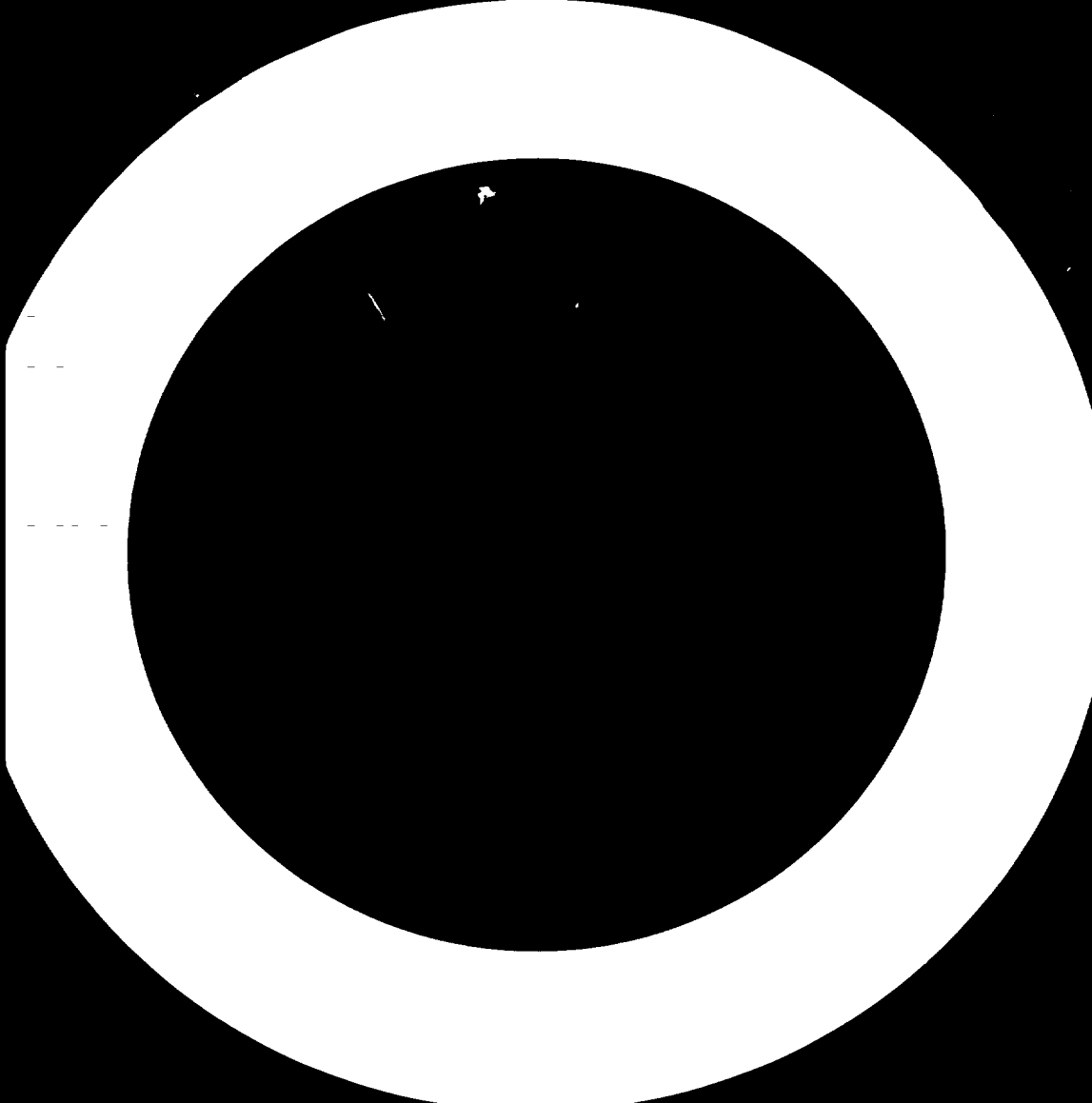
It was possible to utilize a substantial part of the project results almost immediately. In order to implement other results it will be necessary to purchase new machinery and equipment.

The sheet-glass plant was of a low technical standard and the glass produced was of low quality. It was recommended to study the feasibility of a new plant. A new batch plant will be built and it will be in operation in the second quarter of 1981. A new container plant will also be in operation at that time.

Improvements have been suggested regarding raw materials, glass composition, processing and quality control. The reasons for the numerous production problems were:

Lack of skilled people
Insufficient technology and know-how
No preventive maintenance
Spare parts not readily available

These problems and difficulties could not be solved within the present structure of the UNIDO/UNDP project. The Ramadi Glass Factory might find it profitable to make an agreement with a more advanced glass company regarding technical assistance.



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## INTRODUCTION

The project document for project IRQ/78/001, "Assistance to the glass industry", was signed on 12 December 1978.

A description of the Ramadi Glass Factory is given in the work plan (see annex I).

According to the project document, UNIDO should supply the following four experts:

1. Expert in the production and quality control of glassware (the Team Leader).
2. Expert in electronic control devices for the glass industry.
3. Expert in mechanical maintenance of H-28 machines and Lynch presses.
4. Expert in mechanical maintenance of I.S. machines.

The job description for the Team Leader was as follows:

Duration: 15 months

Qualifications: Graduate engineer, at least 10 years experience in production and quality control of a variety of glass products, including household glassware, with experience in H-28 machines and Lynch presses.

Duties: The Team Leader will be attached to the technical manager of the company. He will supervise the work of all the experts, who shall work as a team. He is expected to carry out the following activities:

1. Supervise the work of other UNIDO experts and co-ordinate their activities.
2. Advise on the use of raw materials, and proper batching of all glass producing units.
3. Assist in production planning and programming.
4. Advise on the technology to be utilized, and propose further development of this technology.
5. Assist in removing technological difficulties in production of glass products.
6. Assist in determining amount of waste permitted on production lines and make proposals for minimizing and utilizing the waste.
7. Advise on ways and means of improving production.
8. Advise on more economic handling and packaging of final products.
9. Assist in developing a quality control system and take part in its application.
10. Advise on the feasibility study on a new sheet-glass plant which will be prepared by the company.

11. Train local personnel in the above-mentioned fields of activity.

The work plan (see annex I) based on this job description and the job descriptions for the other three experts were presented by the Team Leader on 8 October 1979.

The following fellowships were part of the project:

1. Production of household glassware. Two fellows, each four months training.

2. Electronic maintenance. Two fellows, each four months training.

3. Mechanical maintenance of H-28 machines and Lynch presses. One fellow, four months training.

4. Mechanical maintenance of I.S. machines. One fellow, four months training.

Three man-months of consultancy were also included in the project budget.

## RECOMMENDATIONS

1. Reduce the period of duty for the three experts from 12 months each to 6 or even 4 months.

2. A new expert for preventive maintenance and to advise on spare parts should be added to the project. It is proposed that he be engaged for 6 months.

3. Increase the consultants' length of stay so as to utilize to the full total allocation for experts and consultants as set out in the original project document.

4. The Team Leader should be available during the period when the other experts are in Ramadi. He should also be present when the new batch plant is in operation and when the new factory has begun production. It should be sufficient for him to be in Ramadi for a maximum period of 3 months on each visit.

5. A new department should be organized and made responsible for inspection and packaging.

6. Carry out a feasibility study for a new sheet-glass plant.

7. Change some of the I.S. machines from single- to double-gob operation during the next furnace repair.

8. Modernize the equipment for mould maintenance and repairs.

9. Begin the use of new standards for raw materials.

10. Change the glass composition for tableware and containers.

11. Improve the packaging of tableware as a result of manual and automatic packing systems.

12. Install an I.S. single-section machine in a machine shop, and begin training of new machine operators.

13. Keep a continuous check on the gas distribution system in the factory. An expert for 6 months is proposed.

14. Invite offers for technical assistance from other more advanced glass companies.

15. Investigate the possibilities of using natural gas instead of oil for heating the glass furnaces.

# I. OBJECTIVES

Two types of objectives are stated in the project document.

## Development objective

The project is expected to increase, qualitatively and quantitatively, Iraq's industrial production in the glass industry with a view to:

1. Ensuring that larger quantities of indigenously produced glassware are available for domestic consumption.

2. Ensuring that domestic demand for high-quality glass products is fully met.

3. Assisting foreign exchange savings through import substitution.

4. Assisting in accelerating increased employment in the industrial sector.

## Immediate objective

The immediate objective of the project is to increase the possibilities for the public company, Glass and Ceramic Industries, and its senior staff to cope effectively with increased demands on productivity and quality standards.

Specifically the project should achieve the following objectives:

(a) Development and application of systems and technological methods for production and quality control for all types of glass products, with particular emphasis on household glassware, raw materials, production programming, reduction of waste and increasing efficiency;

(b) Development of operation and maintenance systems for electronically controlled devices;

(c) Development of maintenance systems for I.S. machines, Hartford 28 machines and Lynch presses;

(d) Training of national counterparts;

(e) Planning of a new sheet-glass plant.

## II. ACTIVITIES

The work plan was followed insofar as the activities of the Team Leader were concerned. Minor activities were also carried out by an expert for the maintenance of I.S. machines. However, since this expert resigned after only 2 months at Ramadi, no substantial work was actually performed.

In addition to the work described in his own job description, the Team Leader also completed some of the duties which should have been done by the other experts. This was possible because of excellent co-operation from the local experts in the glass factory. Other work was also done which was in the job descriptions.

Most of the work has been described in the Team Leader's monthly reports. The following description gives a short summary of the various activities.

### Raw materials

A general review of the raw materials used was carried out. Proposals for new quality standards for sand, limestone, dolomite and soda-ash were presented to the technical management. These standards showed the acceptable chemical composition and the grain size for each raw material.

The sand used was not acceptable. The coarse material proportion must be limited to a maximum of 5% above 0.6 mm. The iron content should be lowered to 0.03% $Fe_2O_3$. This will be possible with the sand treatment to be used in the new batch plant. The dolomite was satisfactory, but the supplier should be instructed not to deliver brown dolomite stones. It would also be advantageous to lower the proportion of fine material as indicated in the new quality standards.

The quality of limestone was unsatisfactory. Chemical analysis varied considerably, and too much fine material was delivered. Limestone was not pure enough and as a result, new contracts have been signed for delivery of limestone of higher quality.

Light soda-ash was used in the factory. Its use was inadvisable and it was recommended that dense soda-ash should be purchased. The light soda-ash was dusty and it spread all over the factory. Soda-ash is harmful if it remains on the tops of furnaces and glass-forming machines

Improved identification and handling of minor raw materials in the batch plant was suggested.

## Batch and cullet handling

Recommendations were provided for the handling of various raw materials in the batch plant. Magnetic separators should be installed on the limestone and dolomite conveyor belts; this has already been done. Cullet handling was improved. Cullet from sheet-glass production was used as an alternative material in the No. 5 furnace, and melting conditions improved as a result.

## Improved production technology

Recommendations were provided for improving the colour of the glass in No. 3 furnace. The result was satisfactory and this practice was carried out also in No. 4 furnace.

It was found that the gold colour of the teacups and saucers was not stable when these items were washed in hot alkaline solutions. This was investigated and improvements were made; satisfactory results were then achieved.

In talks each day with the engineers and technical personnel the Team Leader made recommendations and offered suggestions on ways and means of solving various problems and improving production. Good co-operation resulted in solving many of the problems.

## Increased efficiency of personnel and equipment

The Team Leader gave lectures on glass technology to the engineers and the supervisors. These covered the total field of glass technology and offered a better understanding of glass material and glass engineering.

The Team Leader has proposed the acquisition some books on glass technology and ceramics. These books will form part of a library.

With better training and improved knowledge the general interest and ambitions of the workers will increase. Better understanding will also make it possible to operate the equipment in a more efficient way.

## Improved quality control

Quality control was studied with the head of the laboratory and the head of the quality control department.

It was found that a number of new control instruments were needed. Suppliers were contacted and were asked to quote prices and to give estimates of delivery dates of their products.

The major work has now been completed. The next step is to install the new laboratory equipment and to begin using it. To ensure efficient operation of the equipment it may be necessary to employ a physics graduate.

It was stressed that better communications should be maintained between the quality control department and the machine operators. For instance, improved visual inspection at the lehr was needed.

## Packaging

The packaging of products was discussed and the Team Leader requested various suppliers to submit offers and recommendations for the supply of export cartons and shrinkable plastic for tableware.

At the Director General's request this project was enlarged and the Team Leader gave it his special attention and recommended a new way of packaging tableware.

The laboratory manager is presently in charge of inspecting the lehrs. This is unsatisfactory. It was recommended that a new department for inspection and packaging should be formed. The laboratory manager, as head of quality control, should control the final quality of glass products based on statistical quality control methods.

## Spare parts

Spare parts were often unavailable, especially when they were needed. This problem was discussed at various meetings and the Team Leader suggested a system for determining the minimum and maximum number of spares that should be available in the storage department. This system is described in annex II.

The lack of spare parts was a major problem in the glass factory. The production rate of glass products would suffer if spare parts were not in stock.

## Production planning and programming

Nos. 3, 4 and 5 furnaces were already in operation. Nos. 1 and 2 furnaces will begin operating in early 1981. There will then be four presses and one H-24 machine. The old glass plant will mainly be used for manufacturing tableware.

A new batch plant will be in production in mid-1981.

There will be three furnaces in the new container plant, nine I.S. 6 single-gob machines and one batch plant.

Programming and planning these additions were important undertakings by the management of the glass plant. The Team Leader discussed them with the company management and made various recommendations and suggestions.

A serious problem was the lack of skilled personnel. Training was necessary and the Team Leader proposed a number of possibilities. It was also important to select the right machines. The eleven I.S. machines had single gobs. This situation had to be changed immediately. It was possible to change one or perhaps both the machines to double-gob operation at No. 5 furnace, when it was rebuilt. By changing from single-gob to double-gob operation, it meant that the capacity was doubled, without any increase in staff. The new plant with nine single-gob machines could instead have had five double-gob machines. Only half the number of machine operators would be required. It was important to consider this fact before the next rebuilding of the furnaces.

## Preventive maintenance

This activity formed the basis of the job descriptions for the two machine experts. The Team Leader discussed the subject with the managers and engineers concerned, and some activities were begun.

It is important that preventive maintenance be improved. Training in preventive maintenance was part of the programme of fellowships that were offered. It might be worthwhile to discuss with the machine suppliers the subject of a regular preventive maintenance contrast.

The cost of such a contract should be balanced against the losses incurred after production breakdowns. In principle, glass production should only be stopped for overhaul of equipment at certain predetermined intervals.

## Auxiliary systems and equipment

The Team Leader was involved in discussions concerning various pieces of equipment required for both the old and the new plant such as compressors, boilers, waste water treatment plant, fire protection, gas distribution systems, and many other items.

It was possible to solve the problems in practice, and when necessary contact was made with the equipment suppliers.

A proposal to change the fuel for heating and furnaces, from oil to natural gas, was also discussed. Further information on this subject is to be provided by the Team Leader.

## Market evaluation

Rough figures relating to the market requirements of containers, tableware and flat glass were obtained. In future it will be necessary to increase container production capacity in order to meet local demand.

The capacity for tableware is higher than local demand and this allows possibilities for export purposes. A feasibility study for a new sheet-glass plant was not presented to the Team Leader. At present, sheet-glass production is approximately 20,000 tons per year. This was slightly less than local demand. The quality of the sheet glass was low and it was recommended that a feasibility study for a new sheet-glass plant should be carried out.

## Glass analysis

It should only be necessary to provide for three different compositions of glass - tableware glass, container glass and sheet glass.

It was proposed that the following new compositions should be used for container glass and for tableware glass.

| Constituent | Tableware glass (%) | Container glass (%) |
|---|---|---|
| $SiO_2$ | 73.00 | 72.25 |
| $Al_2O_3$ | 1.00 | 1.75 |
| $Fe_2O_3$ | 0.04 | 0.06 |
| CaO | 9.45 | 10.45 |
| MgO | 0.35 | 0.35 |
| $Na_2O$ | 13.50 | 14.90 |
| $K_2O$ | 2.50 | 0.09 |
| $SO_3$ | 0.15 | 0.15 |
| | 99.99 | 100.00 |

The new tableware glass is a "longer" glass than is presently used. The operations of the machines will be somewhat easier. It may be difficult to keep the $Fe_2O_3$ content as low as 0.04%, but it should be tried. This glass will be easy to decolourize and the products will have a nice colourless appearance. This glass should be used for Nos. 1 to 4 furnaces.

The new container glass composition should be used in Nos. 5 to 8 furnaces. This glass is "shorter" and quicker than the present glass. The speed of the glass machines can be increased when using this more modern glass.

## III. IMMEDIATE OBJECTIVES

The various activities carried out in chapter II have improved the development and application of systems and technological methods for production and quality control of glass products. This programme was described in the job description for the Team Leader. Other activities have also been carried out.

Batch handling will improve when the two new batch plants begin operation in early 1981.

It was possible to start all the activities relating to the new system for quality control. The problems were identified, but in certain instances new instruments and equipment were required.

Improved automatic inspection equipment will be installed in No. 5 furnace when it is rebuilt at the end of 1980. Similar equipment should also be installed at the lehrs in the new plant. The laboratory should be equipped with instruments for the measurement of glass viscosity. More modern instruments for the measurement of the dimensions and mechanical strength of containers will also be acquired.

As stated in the job descriptions of the three experts who have not yet arrived at the duty station, maintenance of electronically controlled devices and glass-forming machines should be developed.

A single-section I.S. machine is to be purchased and it will be used to train machine operators in the glass factory's new training centre. This training will be of much interest to new machine operators.

The Team Leader also recommended that the mould shop should be modernized. Two glass machinery suppliers were asked to provide quotes for new equipment and for the training of personnel.

The method of packaging tableware was changed. Glass products from the Lynch presses are now inspected and packed into cartons at the lehrs. Previously, the products were pre-inspected at the lehrs, placed in plastic baskets, transferred to a packaging table, re-inspected and finally, placed in cartons. The old method required eight to ten workers, while the new method needs only six to do the work. After further training and the improvement of equipment at the lehr, four or five workers should be able to carry out the inspection and the packaging. These workers operate in four shifts, and therefore, 16 employees at every lehr can be transferred to other work.

It was suggested that single liners should be installed for packaging tumblers from the H-28 machines. One glass-plant supplier has offered to quote for this method, and it will also allow substantial savings in the number of workers employed.

Future developments include automatic packaging of tableware and containers. Suppliers of packaging systems have already been contacted and asked to make quotations. Some of the products might be packed in cartons and some in shrinkable plastic. A combination of both these methods might also be advisable.

## IV. UTILIZATION OF PROJECT RESULTS AND FINDINGS

Most of the equipment and processing machinery at the Ramadi Glass Factory was modern and was in good condition. The exceptions were the batch plant and the sheet-glass plant.

A new batch plant will be opened in 1981, and plans might soon be prepared for a new sheet-glass plant.

One of the main problems at Ramadi was the lack of skilled workers at all levels. This handicap made it difficult to utilize the modern machinery and to run and maintain the glass factory in the most efficient way.

In general, it could be said that the follow-up of the project results was positive. There was an occasional time-lag because of the need to order new instruments and equipment. After many discussions, and as a result of his lectures, the Team Leader believes that the general knowledge of glass technology had increased.

Lack of skill and lack of preventive maintenance caused production problems far too often. For these reasons many managers and engineers did not have the time to plan ahead. They were fully occupied in solving the day-to-day problems.

In general, the company was run on the principle of "management by crisis". This must be changed to the modern version of running the company, the principle of "management by objectives".

It was regrettable that machine and electronic experts had not been located. Among their duties would have been that of starting a system of preventive maintenance. This would have reduced many of the production problems, and in addition, a well-organized system for spare parts would have made it possible to carry out the repair work faster and more efficiently. It was realized that finding experts for the glass factory would prove difficult and it was recommended that their job descriptions should be altered. It should be easier to find experts who are willing to stay at the factory for a shorter period of from 4 to 6 months. The factory has an urgent need for an expert to work on preventive maintenance and on a system for spare parts. An expert in this field should also be located. Job descriptions are included in annex III.

The technology of manufacturing glass changes continuously. In order to help the Ramadi Glass Factory to become an efficient company in the production

of high-quality glass consideration should also be given to obtaining help from a more modern glass company. Many new glass companies sign agreements with other glass firms in order to get a good start. An intensive investment programme is under way at present in the Ramadi Glass Factory, and there are no technical agreements regarding follow-up once the installations have been finished.

Such an agreement should include training. There is no shortage of wokers at the Ramadi Glass Factory, but there is a shortage of skilled personnel. This could be overcome by technical assistance from another glass company. Training instructors could be sent to Ramadi and if needed, engineers and operators might also be sent to the glass plant. The costs involved could easily be recovered from increased production of high-quality glass products.

## Annex I

## WORK PLAN

### General

The project document which was signed on 12 December 1978 contained the background information and justification for the project. The production schedule, as described in the document, is different from the actual production schedule being followed in the glass factory.

The job descriptions for the four experts were based on the production background as outlined in the project document. Logically, it will be necessary in some instances to change the job descriptions. The expert for electronic control devices should, for example, according to item 2, "Assist, especially in the operation of the fully automatic electronic batching house". The new batch plant has not yet been built and will not be in operation before 1981. However, there were a number of other activities which the electronics engineer could perform. The Team Leader was the only expert to arrive at the duty station. The expert in mechanical maintenance of I.S. machines had been selected and he was expected to arrive in November 1979. UNIDO was finding it difficult to locate qualified candidates for the other two expert positions. No candidates were presently being considered by the project management. To improve the situation and make it possible for the Team Leader to fulfil his obligations, he presented an alternative solution regarding candidates and consultants (see annex III). In principle, this solution was accepted by the management of the glass factory and the office of the Resident Representative, Baghdad. Final discussions will be carried out between the Team Leader and his counterpart, Mr. Kamil Datash.

This Work Plan was prepared on the assumption that experts and consultant will arrive at the glass factory according to the proposal in annex III.

### Present and future production

At present there is no glass production at Nos. 1, 2 and 4 furnaces. The present production programme is as follows:

#### Sheet glass

Sheet glass is being produced according to a modified Fourcault process. The sheet-glass plant was erected and started by experts from the Union of Soviet Socialist Republics. Representatives from the USSR are still working in the plant. Saleable glass is at present about 20,000 tons per year.

Container glass

Glass containers are produced in No. 5 furnace. The total capacity of this furnace is approximately 50 tons per day. There are two I.S. 6 machines at this furnace. Both of these machines operate with single gobs. One is a press and blow machine which makes 720 ml jars for tomato ketchup. Approximately 45,000 jars are produced per day. The other machine works according to the blow and blow system and makes approximately 40,000 soft drink bottles of 270 ml capacity per day. This gives an annual output of about 11,200 tons of saleable glass containers.

Household ware

In No. 3 furnace, glass for household ware is produced. The H-28 machine at this furnace makes approximately 60,000 teacups per day. A Lynch press has been installed in the second line of this furnace. Test runs are being carried out on this press at present. It is proposed to make saucers for the teacups in this press for the remaining part of this year. The capacity of this furnace is 35 tons a day.

Alkali silicate

No. 1 furnace is not used to melt glass. Approximately 10,000 tons of alkali silicate is produced per year for the soap and oil industries.

Contracts were signed recently with overseas suppliers for new equipment. A new batch plant will be ready in June 1981. Nos. 1 and 2 furnaces will then have been rebuilt and equipped with new machines. There will be four presses and one H-24 machine for household ware. At the beginning of 1980, No. 4 furnace will be in operation with two H-28 machines and one press. In addition to these production lines, there will be nine lines in operation in 1982 in a new glass factory. This factory will contain three furnaces, each having three I.S. 6 machines for containers.

Nos. 1 and 2 furnaces will be in operation before the new batch plant is completed. Allowances must be made as this may create additional problems in the old batch plant.

## Technical problems to be solved

Water

Unclean waste water from the factory is passed into the Euphrates river. According to new regulations, waste water must be purified and the project management considers it important to help the factory with this problem. It

will also be necessary to increase the quantity and to improve the quality of the incoming water used in the factory. A third water problem is found in the batch plant where a natural water supply disturbs the handling of raw materials. It is essential to dispose of this water.

Fuel

A new storage plant for oil and liquid petroleum gas (LPG) is being built by the company. Construction is in the final stages and the project team has been asked to help select suppliers for some of the equipment. In addition, it is necessary to find a consultant qualified to check the safety of the plant.

Fire protection

The project team has also been requested to help select companies for the supply for fire protection equipment and who will also give assistance in solving the probelm of fire protection.

Glass raw materials

All the raw materials required need to be assessed. Quality specifications should be stated for each of them. The grain size of some of the materials is too fine, creating dusty conditions. Weighing and mixing these materials satisfactorily has proved difficult.

Some of the materials are hygroscopic, and problems arise as a result.

Chemical, physical and mechanical analyses of the raw materials can be carried out by the works laboratory.

Batch plant

The conditions in the batch plant are not satisfactory. The management has, therefore, decided to build a new plant.

While the old batch plant is in use, it is important that the batch preparation is as accurate as possible.

The project team will examine the conditions of the batch plant and recommend improvements wherever possible. The handling of culket will also be improved.

Glass

The melting of glass in the furnaces must be controlled and improved. In some cases electronic devices have been installed but are not in operation.

The laboratory should begin better quality control so that early indications are available of the melting conditions in the furnaces. This is especially necessary in No. 5 furnace which has been in operation for three years.

Chemical control of the glass appears quite satisfactory. Unfortunately, the viscosity of the glass cannot be measured. This problem must be solved. The viscosity curves will indicate the working indices of the glass and their relative machine speeds.

The colour of the glass is also not satisfactory. The method of decolourizing should be improved.

Glass machines

The glass machines are modern and have been installed by competent firms. However, there are two problems:

Spare parts

Training of personnel

It is encouraging to note how the maintenance departments carry out the repair work despite the lack of the necessary spare parts. The project team recommends action on the following activities:

Preventive maintenance

Storage of spare parts

Mould repair

In-plant training

Quality control of finished products

Some quality control on finished products is carried out, however, it will be necessary to increase such activities, and to improve some of the measurements. In some cases it will be necessary to obtain new instruments. Customers will increase their demands for better quality glass products, especially for containers for the food industry and from the bottling plant for soft drink bottles. The system of quality control will be discussed and suggestions made for improvements.

Production planning and programming

Production planning is simplified by the fact that the number of different types of glass products which are required by the glass market is limited. Nevertheless, these different types are required in large numbers.

Production planning, however, is severely threatened by machine breakdowns. Some of the stops in production could be overcome by better preventive maintenance.

To improve production planning and programming it will be necessary to take note of market requirements during the next 12 months in respect of the different types of products.

It will then be possible to plan the overhaul and repair of machines and other equipment. This means that spare parts should always be available.

Market requirements

Reports concerning market requirements for household ware, containers and sheet glass are needed. Contacts with market institutions should be maintained.

Library

Few books on glass are available in the factory. A library is required, especially for the laboratory staff. The company does not receive glass journals periodically. The possibility of setting up a small library stocked with a number of important books on glass manufacturing should be evaluated.

Training

Personnel should be trained at all levels. This will be done by the various experts and consultants.

Two courses on glass technology (at low and advanced levels) will be presented by the Team Leader with the help of national and international experts. Approximately 10 lectures in each course will be given.

Daily in-plant training will be given by the experts and consultants. It is important that the experts demonstrate to their counterparts the solution to various problems, so that the local operatives can be trained to solve the problems themselves. The importance of team-work cannot be over-emphasized.

Fellowships

The project document stipulates the following fellowships (each of 4 months):

1. Production of household glassware (2 fellows).
2. Electronic maintenance (2 fellows).
3. Mechanical maintenance of the H-28 machines and Lynch presses (1 fellow).
4. Mechanical maintenance of I.S. machines (1 fellow).

The management of the glass company has suggested the following fellowships:

1. Production of household glassware (3 fellows, each 3 months).

2. Electronic maintenance (2 fellows, each 3 months).
3. Mechanical maintenance of H-28 machines and Lynch presses (1 fellow, 2 months).
4. Mechanical maintenance of I.S. machines (1 fellow, 2 months).
5. Glass-furnace repairs (1 fellow, 2 months).
6. Glass-mould design and repair (1 fellow, 3 months).

The fellowships will be discussed by the Team Leader and his counterpart. Efforts to begin these fellowships have started and it is planned that the programme is carried on into the first half of 1980.

Study tours

The management of the company has recommended study tours for 5 technical managers for 3 to 4 weeks. This suggestion was not included in the original budgetary proposals, but some changes within the budget framework may be possible. Some study tours can perhaps take place in April.

Tripartite review

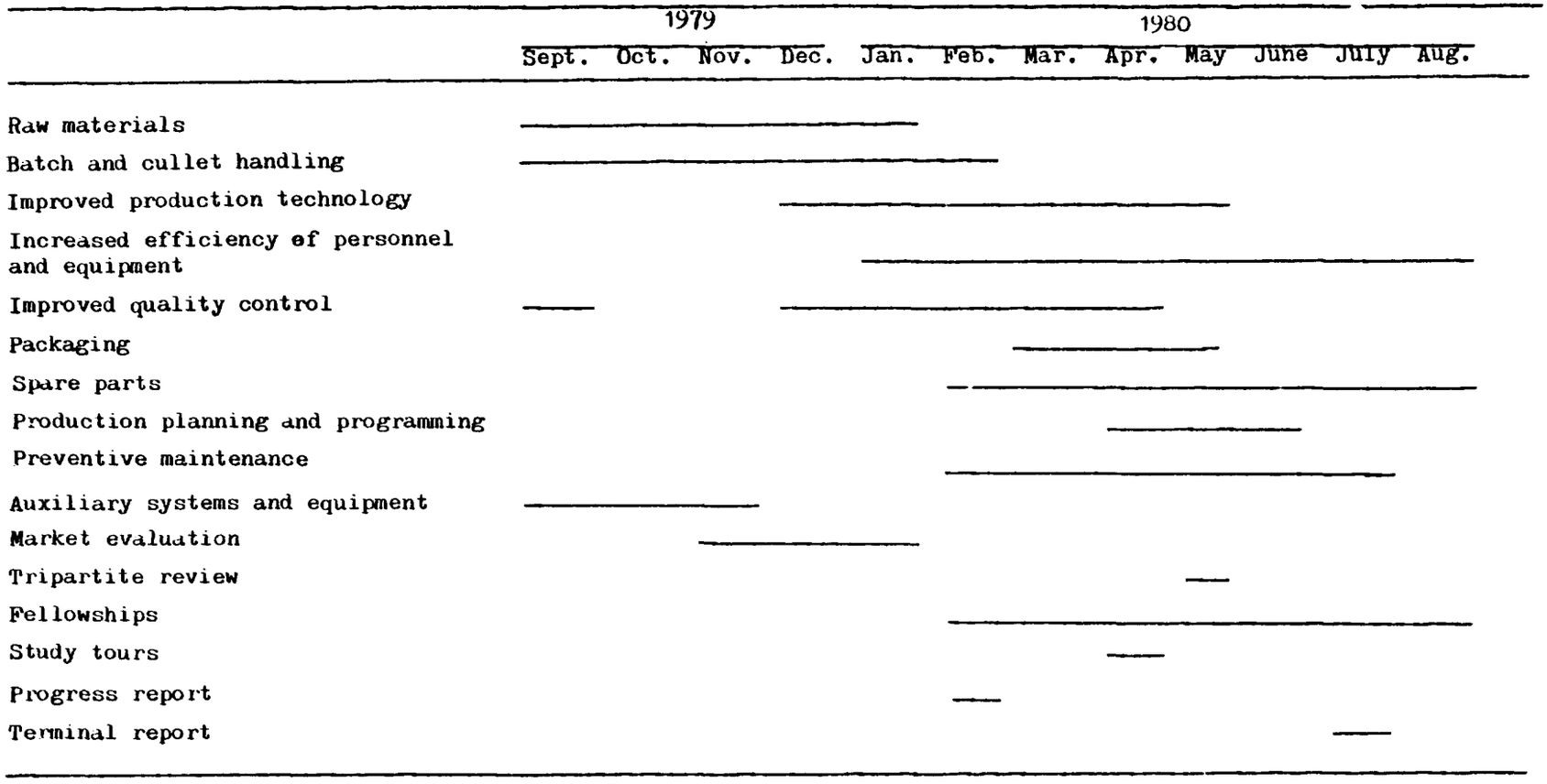
It is suggested that a tripartite meeting be held in May 1980.

Reports

Technical reports will be prepared on each important activity. A progress report will be presented in February 1980 and a terminal report in July 1980. To some extent these dates will vary according to the arrival date of experts.

The various activities that will be carried out are shown in the figure.

Progress chart in accordance with work plan



## Annex II

## PROPOSAL TO REORGANIZE HANDLING OF SPARE PARTS

It has been mentioned by many departmental managers that one of their most difficult problems is that relating to spare parts. The Team Leader has discussed this probelm with them and it is obvious that this is a problem that must be eliminated as quickly as possible. Production will suffer if no spare parts are available in the factory.

The following suggestion has emerged from the discussions:

Spare parts must be given an identification number that can be used in a computer. An expert group from the State is dealing with this, and the Ramadi representative is Mr. Rubad.

The storage department has worked out a new system for identification and classification of materials for the whole glass factory on the basis of the identification numbers.

The technical departments often indicate that spare parts are not available when they are needed. The purchasing department is then asked to order spare parts as quickly as possible. This means many small orders. This is inefficient, unsatisfactory and expensive.

It should first be determined how many spare parts and what quantity of material should be available in the factory. When the material and spare parts have been defined and given a number, it should also be determined what quantities should be kept in the store. A maximum and minimum value should be given for each material and spare part.

For example, imported material might require a maximum quantity equal to that needed for 24 months' consumption. The minimum value could be equal to 12-14 months' consumption. For locally produced material, it may be appropriate to have a maximum value equal to the consumption over a period of 12 months and a minimum value of approximately 6 months.

It will be necessary to evaluate the various categories of material and spare parts. This should be carried out as a joint effort by the purchasing department and the department that is the main user of the material or spare parts. In this evaluation it will be necessary to consider time of delivery,

maximum time of storage from a quality point of view and the consequences for production if a special part is not available. Different groups should immediately be formed in order to carry out this evaluation.

Special consideration must be given to the spare parts needed for the annual maintenance of various machines. This is part of the preventive maintenance programme, and the spare parts should be ordered well before the planned maintenance.

Some spare parts already in store will never be used; these belong to machines that have been taken out of production. It may either be possible to sell these spare parts, or if this is not possible, to dispose of the spare parts and to destroy the material.

The number of spare parts may vary from year to year. The purchasing department needs to be informed of the requirement for the following year as soon as possible. This information will also be needed by the budgeting and financial departments. Since the budget should be prepared in July for the coming year it is suggested that each department should state its needs for material and spare parts in May.

It is important for the glass factory to organize the handling of spare parts efficiently. If this is administered correctly, it will result in a more effective way of utilizing the machinery. This will give higher productivity and lower the cost of production.

The reorganization of the supply of spare parts will mean the need for qualified staff for its implementation, and it may be necessary to employ some new staff for this purpose.

It is suggested that a system based on this proposal begin as soon as possible. This can be achieved as soon as the maximum and minimum amounts for various spare parts have been decided upon.

## Annex III

## NEW JOB DESCRIPTIONS OF UNIDO EXPERTS

Qualified experts have been difficult to find for the glass factory for a mission of 12 months duration. It is proposed that:

1. The experts in electronic control devices and mechanical maintenance of glass-forming machines should stay for a period of 6 months instead of 12 months. Their job descriptions should be changed slightly.

2. An expert or a consultant in preventive maintenance and on a storage system for spare parts should be attached to the glass factory for 6 months.

3. An expert in control and safety regulations for distribution systems for fuel and gas should be added to the project. His period of duty should be 6 months.

4. A consultant in electronic engineering should be assigned to the project in August 1980. He should remain for 3 months.

Job descriptions for the above-mentioned experts are on the following pages.

JOB DESCRIPTION

Post title: Expert in electronics control devices for the glass industry

Duration: 6 months - starting January 1981.

Qualifications: Graduate engineer with at least 5 years' experience in electronic control of processing industries; some experience of the glass industry.

Duties: The expert will be a member of a team under the supervision of the Team Leader. He will be attached to the head of the maintenance department and will be expected to carry out the following activities:

1. Assist in the operation of electronic devices for the entire plant.

2. Assist in identifying faults or difficulties in the electronic devices, and give guidance in rectifying these faults and overcoming these difficulties.

3. Assist in repair work of electronic devices.

4. Assist in testing and calibrating all the plant's electronic devices.

5. Assist in determining the spare parts needed by the company with respect to automatic and electronic devices as well as determining the minimum and maximum requirements for storage.

6. Forming and training a team for the repair and maintenance of all electronic devices.

JOB DESCRIPTION

Post title: Expert in mechanical maintenance of I.S. machines

Duration: 6 months - starting October 1980.

Qualifications: Graduate engineer with long experience in mechanical maintenance and operation of I.S. machines.

Duties: The expert will be a member of a team under the supervision of the Team Leader. He will be attached to the head of the maintenance department and will be expected to carry out the following activities:

1. Prepare maintenance programmes and assist in their application.

2. Assist in identifying mechanical faults or difficulties and give guidance in rectifying these faults and overcoming these difficulties.

3. Give guidance in mechanical repair work.

4. Assist in determining the spare parts needed for the machines as well as in determining the minimum and maximum requirements for storage.

5. Forming and training a team for the repair and mechanical maintenance of I.S. machines.

JOB DESCRIPTION

| | |
|---|---|
| Post title: | Expert in mechanical maintenance of H-28 machines and Lynch presses |
| Duration: | 6 months - starting October 1980. |
| Qualifications: | Graduate engineer with good experience of H-28 machines and Lynch presses. |
| Duties: | The expert will be a member of a team under the supervision of the Team Leader. He will be attached to the head of the maintenance department and will be expected to carry out the following activities: |

1. Prepare maintenance programmes and assist in their application.

2. Assist in identifying mechanical faults or difficulties and give guidance in rectifying these faults and overcoming these difficulties.

3. Give guidance in mechanical repair work.

4. Assist in determining the spare parts needed for the machines as well as in determining the minimum and maximum requirements for storage.

5. Forming and training a team for the repair and mechanical maintenance of the machines.

JOB DESCRIPTION

Post title: Expert in preventive maintenance and storage of spare parts for the galss industry

Duration: 6 months - starting January 1981.

Qualifications: Graduate engineer with extensive experience in preventive maintenance and storage of spare parts in processing industries; some experience of the glass industry.

Duties: The expert will be a member of a team under the supervision of the Team Leader. He will be attached to the head of the maintenance department and will be expected to carry out the following activities:

1. Study the maintenance programme for the complete glass factory.

2. Forming and training a team for the preventive maintenance of the entire plant.

3. Give advice on spare parts for the factory and assist in determining the minimum and maximum requirements for storage.

4. Advise the machine departments on the repair and maintenance of glass-mould equipment.

5. Forming and training a team for mould maintenance and repair.

6. Co-operate with the expert in electronic control devices and give supplementary assistance regarding preventive maintenance and spare parts to the production departments.

7. Identify faults regarding preventive maintenance of other technical departments and give guidance in rectifying these faults.

8. Present a final report regarding all activities that have been carried out and give recommendations for further work.

JOB DESCRIPTION

Post title: Expert in control and safety regulations for distribution systems for fuel and gas in processing industries

Duration: 6 months - starting January 1981

Qualifications: Graduate engineer with extensive experience of installations and safety regulations regarding distribution systems of fuel and gas in the processing industries.

Duties: The expert will be a member of a team under the supervisicn of the Team Leader. He will be attached to the head of the technical service department and will be expected to carry out the following activities:

1. Study the distribution system of fuel and gas in the glass factory.

2. Forming and training a team for testing the gas distribution system.

3. Give advice on the necessary equipment and instruments for testing the distribution system.

4. Prepare a manual on testing procedures, and give instructions on how the testing should be carried out.

5. Give instructions on how to rectify the distribution system when the tests indicate inadequate safety.

6. Give instructions on how to act in emergency situations.