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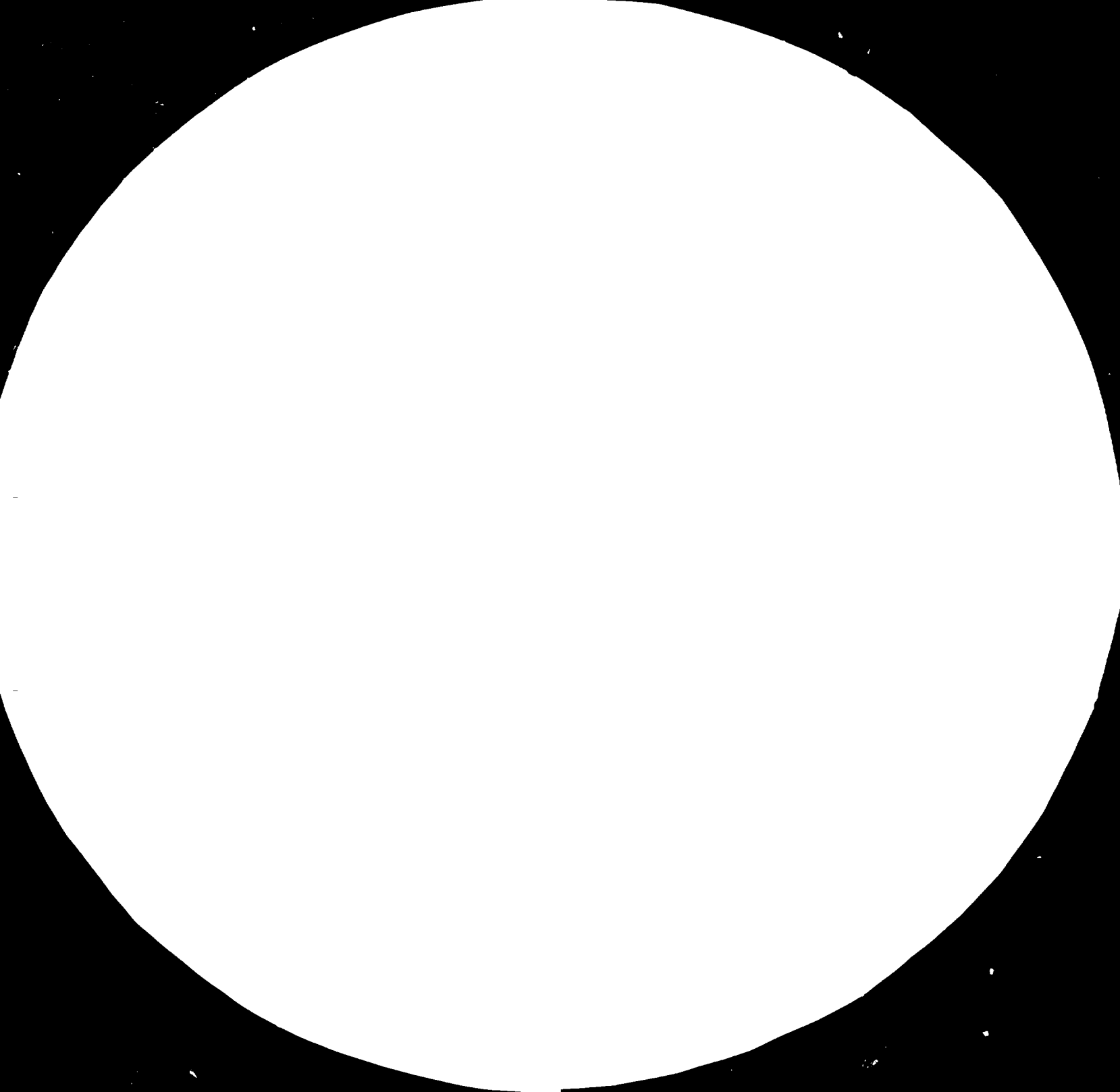

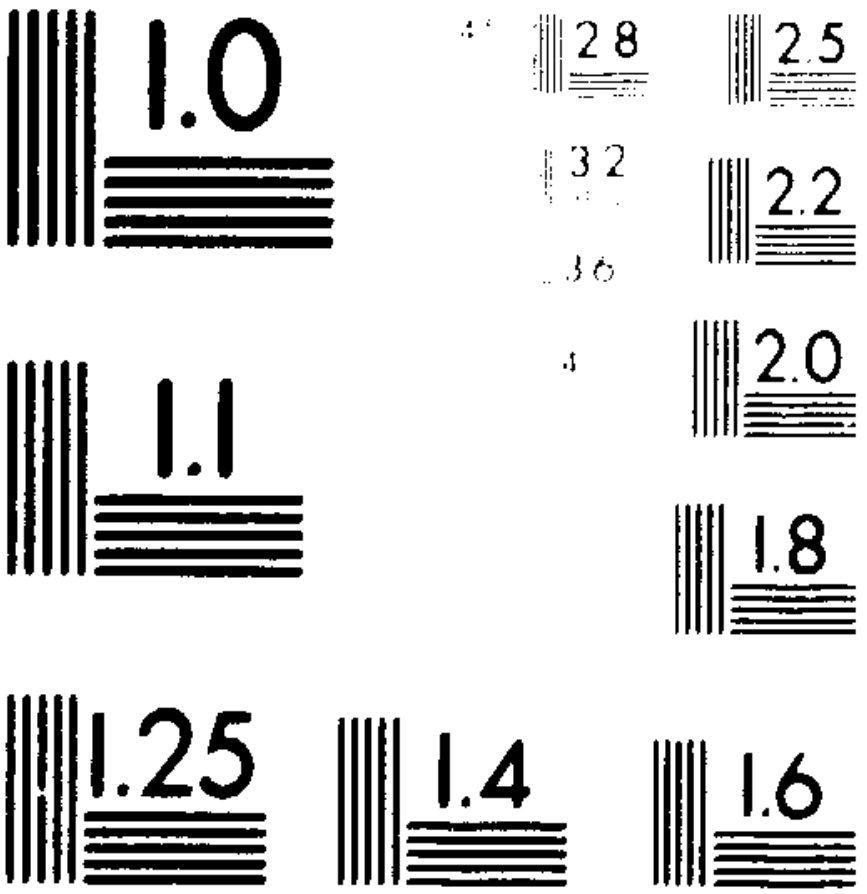

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14527

8th February 1985

PLASTICS PROCESSING

DP/EGY/81/029

EGYPT

Final report*

Prepared for the Government of Egypt

by the United Nations Industrial Development Organization

acting as executing agency for the United Nations Development Programme

based on the work of Sergei A. ARUTJUNOV

expert in plastics processing

Vienna

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* This report has not been cleared with the United Nations Industrial Development Organization which does not, therefore, necessaryily share the views expressed.

List of Abbreviations

PDC	-	Plastics Development Centre
UNDP	-	United Nations Development Programme
UNIDO	-	United Nations Industrial Development Organization
TCDC	-	Technical Co-operation among Developing Countries
CIPET	-	Central Institute of Plastics Engineering and Tools
CHSR	-	Centre for High Studies and Research
LDPE	-	Low Density Polyethylene
HDPE	-	High Density Polyethylene
PVC	-	Polyvinylchloride
PC	-	Polycarbonate
PP	-	Polypropylene
PS	-	Polystyrene
PO	-	Polyolefins
GRP	-	Glass Reinforced Plastics

ABSTRACTS

The objectives of the project "Plastics Development Centre for Agricultural Purposes", DP/EGY/81/029 are to improve and diversify plastic products for agricultural purposes and to support and strengthen the development of the plastics industry for agricultural purposes so that it may make a continuing contribution towards increasing food production in desert areas and thus will promote economic development of the country. The duration of Expert's mission being reported on is one month, icluding briefing and debriefing at UNIDO Headquarters in Vienna, Austria and at the UNDP Office in Cairo, Egypt.

The plastics processing industry of Egypt represented by both state and private companies really faces certain difficulties due to the shortage of trained personnel. There is a permanent complaint of plastics companies that graduates of colleges and higher institutions of learning entering the industry as a rule have no necessary practical experience and knowledge. To improve that situation the following main rec ommendations were given:

- to consider the possibility of training engineers at CIPET, Madras, India.
- to establish at PDC in co-operation with Alexandria High Studies and Reserach Centre and University the system of practial training of University students in processing plastics and testing quality of raw material and finished products.
- to consider the possibility of creation at PDC a specialized school for training workers
- to establish close relations between PDC and technical school for training technicians
- to expand PDS by introducing such processes like rotational forming, thermoforming, welding, compounding and formulation.

All these action should be assisted by UNIDO through UNDP.

Training of counterparts was carreid out both theoretical and on the machines.

TABLE OF CONTENTS

INTRODUCTION

The expert's activities on this project began on the 16th of January 1985 and lasted till the 16th of February 1985.

This project has a range of objectives which can be described as assistance to the Government of Egypt in supporting and strengthening the development of the plastics industry for agricultural purposes by improvement and diversification of plastics products used in agriculture-development objective - and the raw of immediate objectives such as:

(1) To promote plastics production through testing and pilot scale production.

(2) To establish standards and specifications for plastics raw materials and products.

(3) To carry out field trials to develop applications of plastics in agriculture.

(4) To establish and operate an information service.

(5) To establish operational linkages between Plastics Development Centre and institutions dealing with plastics technology and applications in agriculture.

(6) To train national personnel in the above fields.

Implementation of the project contributes and will contribute in a greater extent in future towards increasing food production in desert areas and thus will promote economic development of the country.

In close co-operation with Mr. K. Mischkowski the counterparts were given very detailed information about blow moulding process. Two stages of the process were elaborated. Practical work on the machine was also carried out. Examples of the effects of incorrect temperature and machine settings on both the output rate and the quality of products were demonstrated. Some batches of products were made at different working paramteres and then tested. Priority for training PDC staff abroad was stressed. Recommendations on further improvement of training system at PDC were given. The list of necessary processing equipment to diversify the activity of PDC as well as the list of training courses and equipment available at CIPET, Madras, India were also given (see Annexes)

RECOMMENDATIONS

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1. Observing carefully the importance of further development of Egyptian Plastics Industry and stressing priority which should be given to the problem of training personnel it is strongly recommended to the Government of Egypt and UNIDO:

   - to provide training for PDC staff (engineers) at CIPET, Madras, India on the basis of TCDC through UNDP and to organize for that purpose preliminary mission to CIPET for PDC Project Director Mr. Osman Abu Zeid and for PDC Deputy Director and Head of Technical Affairs, Mrs. Nadia Nosseir in order to find out all facilities existing at CIPET.
   - to organize on a regular basis practical work on the processing and laboratory equipment available at PDC for students of Alexandria University specializing in the field of polymers.
   - to extend and activate the practice of conducting seminars for postgraduates from both private and state companies.
   - to provide facilities for practical work on the PDC equipment for students of the technical schools training technicians.
   - to consider the possibility to establish at PDC training courses for training workers in the field of plastics processing.
   - in order to dissiminate information about PDC a small team of 2 or 3 PDC technologists whose sole task was to go out and discuss with industrialists and farmers both in state and private sector the services PDC can offer and encourage them to make wider use of those facilities.

2. In order to increase effectiveness of PDC to expand the row of plastics processing equipment available by purchasing equipment for following processes:

   - Flat films and sheets extrusion
   - Thermoforming
   - Welding of plastics;
   - Compounding and formulations
   - Rotational forming

3. Taking into account the fact that widening of working facilities for maintenance and repair of equipment and moulding tool will greatly contribute to successful expansion of PDC, it should be done at the centre

4. In order to increase quality of finished products the following step should be taken:

   - to registrate permanently in the "log-books" all the important processing parameters in order to provide possibility to analyse reasons for rejects and to collect data for statistical analysis of factors affecting quality of finished products;

5. In order to be well informed about up-to-date plastics technology provision of international experts should be given permanently to the PDC staff.

6. An organized visit to a plastics exhibition should be made once a year by PDC Project Director or by Deputy Director and Head of Technical Affairs to keep up dated with the latest achievements in plastics, their testing, processing and applications.

7. Bearing in mind future expansion of PDC and necessity to diversify plastics application in agriculture packaging and construction feasibility study on all the subjects should be prepared with UNIDO/UNDP assistance.

FINDINGS

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A. Project Background

The Egyptian Plastics Industry consumes of 150,000 t.p.a. of polymeric materials, all of which are currently imported. There are more than 500 plastic processors in the country with some 10 companies producing about 60% of the total products. By 1986 the Egyptian Petrochemical Complex will be expected to manufacture 100,000 tons of PVC per annum and a few years later 150,000 tons of PO per annum. Local manufacture of polymers will effect considerably on the pattern of plastics industry growth. The role of PDC is to help manufacturers to formulate new compounds and encourage the use of locally produced polymers with particular reference for agricultural applications. It is important because of the two main reason. The first one is that the population of Egypt is increasing with a growth rate of 2,6% per year and wide introduction of plastics will allow to increase remarkably the output of agriculture. The second one is that the plastics industry has tended to grow at a faster rate than industry as a whole.

Table 1

Comsumption of Plastics Materials in Egypt

	1977 (000 tpa)	1982 (000 tpa)	Increase (%)
PVC	18.0	45.0	150.0
LDPE	20.0	52.0	160.0
HDPE	8.0	38.0	375.0
PP	4.0	7.5	87.5
GP + HIPS	5.0	8.0	60.0
OTHERS	2.0	6.0	200.0
THERMOSETS	1.0	2.0	100.0
TOTALS	58.0	158.5	173.3

Per capita consumption of plastics in 1975 was estimated at no more than 0,75 kg per annum. Today the figure is about 4,0 kg per annum per capita. But the structure of plastics consumption was unproper because most of plastics processing companies produced consumer goods such as PVC shoes, household items and shopping bags. But now some changes have already been done to improve the situation. Application of plastics for packaging is rapidly increasing . But to make its proper contribution to the country's economy some big investments in manpower training and equipment purchasing should be made.

Shortage of qualified manpower is a major obstacle to growth in the industry. Even graduates of higher institutions of learning are suffering from the shortage of specific knowledge and practial experience. The most acute problem is the shortage of technicians. That's why in 1978 the 1st phase of the project was initiated and implemented. The most important output of the 1st phase is an established PDC in a building equipped with a pilot plant, laboratory, with an organized structure. In 1982 January the 2nd Phase of the Project started. There are some achievements made during this phase. At its experimental station and in some private farms and state research stations PDC introduced some examples of plastics usage in agriculture. The results are promissing. Some 35 people from both state and private companies were successfully trained at PDC. At its experimental station PDC implemented the following applications of plastics in agriculture: greenhouses, reservoirs, mulching silage,wind protection, shading and others. For doing that such products like films, pipes, fittings sheets and others made of PE, PVC, PP were used.

B. Existing Plastics Processing Facilities

At the moment of the expert's work on the project the following processing equipment was available at PDC:

- injection moulding machine
- blow moulding machine
- pipe and film extrusion machine
- mill
- granulator;

(For companies which produced the equipment and some characteristcs see Annex 3).

All units of equipment are already mounted. Former UNIDO Expert, Mr. Andrews, provided trianing for PDC staff in injection moulding late last year. But there is only one mould to be installedon injection moulding machine (for specimens). The expert during his work on the project operated blow moulding machine and pipe extrusion machine. Because of the very short mission the expert had no time to put into operation film extrusion machine and provide relevant training of

counterpart staff in the extrusion of blow films.

Testing laboratory at PDC is very well equipped and has already began to provdie services for the plastics processing companies.

C. Plans for Future Expansion

During one of the meetings with Mrs. Nadia Nosseir the PDC Deupty Director and the Head of Technical Affairs, the expert was informed on future expansion of the PDC to widen services which PDC can offer to state and private companies. It includes the following processes:

- Flat films and sheets extrusion
- Thermoforming
- Compounding and formulation
- Welding of plastics
- Rotational forming

Taking into account the wish of Egyptian Government and necessity for PDC to play a proper role in the development of national economy and particularly in agriculture, packaging and construction industries this plan for expansion should and can be proved by the expert except the last point - Rotational forming where the expert does not think it is necessary to pruchase auxiliary equipment to existing "Betol" extruder from "Betol" company. For the recommendations on equipment manufacturers names and addresses see Annex 10.

D. Project Activities and Utilization of the Project Results

1. Training of the Counterpart staff

The counterpart staff (see Annexes 2,4) have been trained in the modern techniques of particularly blow moulding, according to the post job description and upon the request o the PDC Deputy Director and Head of Technical Affairs, in pipe extrusion. Some useful information on films extrusion was given to the counterpart staff. When discussing blow moulding process the counterparts were igven basic theoretical knowledge about different ways op parison producing: extrusion (as it is at the existing blow moulding equipment) and injection moulding. Advantages and limitations of each way were elaborated. The work on the machine was carried out at different technological parameters (temperatures of barrel and cooling water, pressure, scre rotation speed). Some articles from batches of finished product produced at different parameters were

registred, visually inspected and then tested, so the effect of incorrect temperatures and wrong machine settings were shown to the counterpart staff as well as the close interconnection between processing parameters was underlined. All those startings of the machine were taken both with expert's participation and only under his supervision.

The reasons for possible faults and necessary remedies were discussed. The same routine of mutual the experts and counterpart staffs work on pipe extrusion machine took place. The counterpart staff was given necessary background information on pipe extrusion and then work on the machine was undertaken. Quality control improvement Programme which can be used for all processes was offered to the counterpart staff's attention. All the components of the Programme (see Annex 9) were discussed and their importance was underlined. While discussing it the counterpart staff was given the information concerning the selection of raw materials depending the process, existing equipment and application of the products.

The importance of regular measuring parameters and recording data obtained was stressed. But the machine operators should be instructed once a year and trained in operating particular equipment they are going to work on. For that purpose "Personnel Instruction Card" form and "Draft Plan for Training Programme for Operators of Injection Moulding Machines" (as an example) were prepared. (see Annexes 7 and 8) . Necessity of working out "Flow Chart" for each item of articles to be produced was also stressed.

Taking into account the necessity to introduce plastics products not only to agriculture but also to packaging and construction the following short list of possible plastics application in all these areas is offered below.

The use of plastics in agriculture

1. Mulching - the use of black PE film to retain moisture in the soil and supress weed growth.
2. Irrigation channels in GRP
3. Plastics crates for produce collection and handling
4. Syphon pipes for irrigaiton. Flexible PVC pipes for irrigation Preshaped rigid PVC and HDPE pipes can also be used and others.

The use of plastics in building and housing

1. Pipes and fittings from PE, PP and PVC for water supply and sewerage systems.
2. Polyurethane foam for thermal insulation
3. Windows' and doors' frames and others

E. Further UNIDO/UNDP Assistance to PDC

The plastics processing industry of Egypt has certain difficulties in processing, testing raw materials and finished products, mould designing and mould making because of:

- the shortage of skilled personnel of all levels;
- The shortage of mould designers and mould makers

Successful development and expansion of plastics processing industry in Egypt depends considerably on the earliest realization of training programmes which can be provided by the PDC staff members to all companies, but they first should be trained themselves. Concerning the problem of training the PDC staff members the expert would like to give here some of his consideration on this matter.

Nowadays there are no facilities for training personnel (engineers and technicians) inside the country in the field of plastics, their processing and application, mould design and mould fabrication, testing raw plastic materials and finished products. That is why these facilities should be found abroad.

In that respect Central Institute of Plastics Engineering in Madras, India, seems to be the most appropriate variant for trainees from Egypt because of the following reasons:

- The institute was established by the Government of India with the UNDP assistance late in the 60's. It was called to accelerate the development of Plastics Industry in India. The Institute offers now highly specialized and practical-oriented training meeting requirements of international standards in all aspects of plastics industry;

- India has successfully overcome all the difficulties having faced the country in the way of developing and expanding its industry. It possesses a good experience now, which can be of considerable benefit for Egypt helping to avoid many difficulties on the way of establishing and expanding national Plastics Industry and to gain substantially from that cooperation which can be realized through UNIDO under the TCDC programme;

- The climatic conditions in India are rather similar to these in Egypt and the adaptation of trainees in India will not take much time. That means that they will be able to benefit fully from that training.

Details of the courses offered by CIPET are given in Annex 9 as well as the processing equipment available at CIPET

As to training programmes the expert considers it necessary to provide trainees with basic information on plastics, their properties, classification and their application in industry, agriculture and everyday life. And only after that to begin with the selected programme. List of items to be included in the training programme for trainees to be specialized in plastics processing is given in Annex 6.

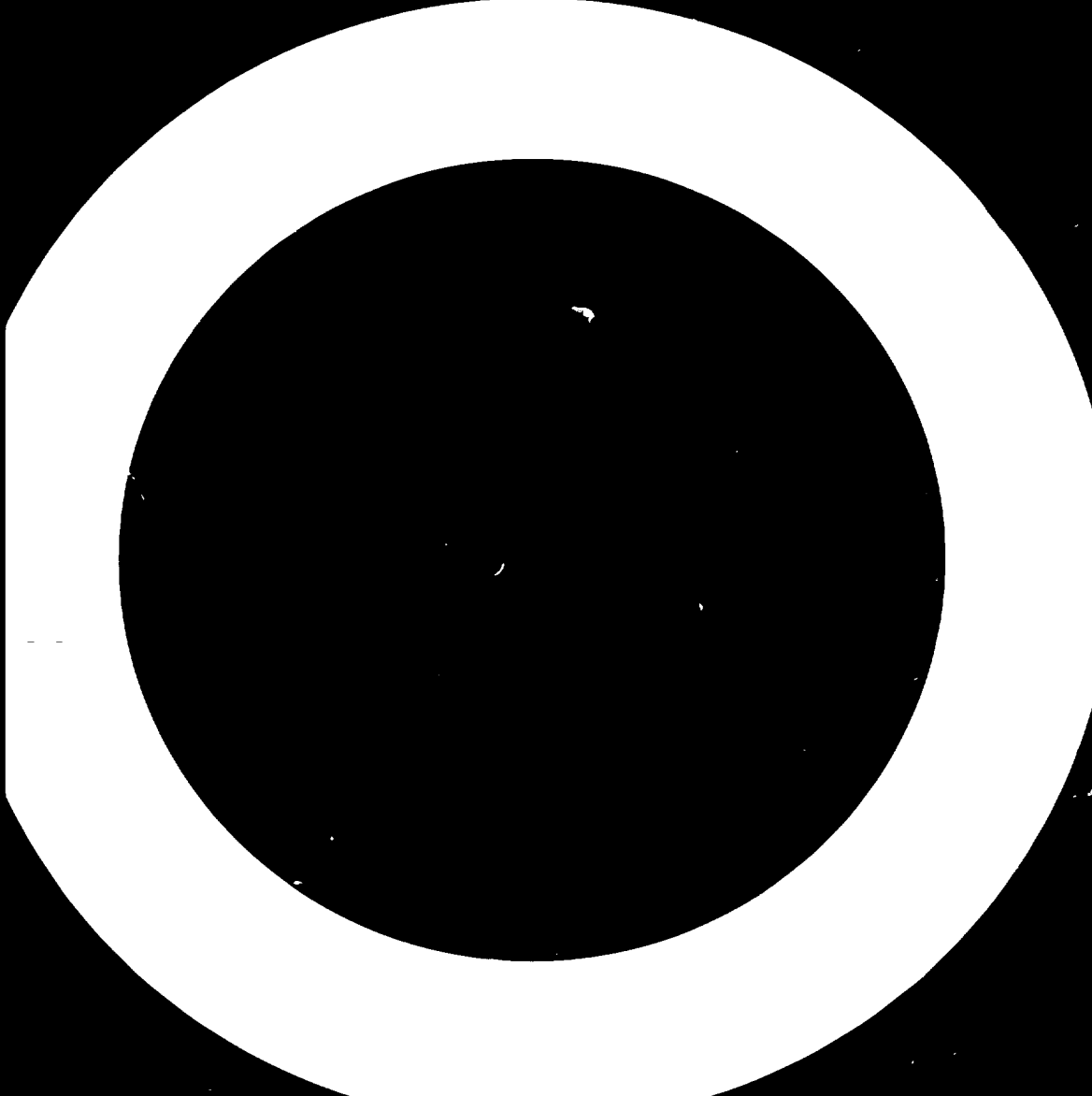
A N N E X E S

ANNEX 1

Job Description

The expert was assigned to the PDC in Alexandria and was expected to:

- Demonstrate the effects of incorrect temperature and machine settings on both the output rate and the actual physical performance of products;
- Demonstrate all safety aspects of equipment usage and provide relevant training;
- To prepare a final report setting out the findingg of the mission and recommendations to the Government on further actions which might be taken.



ANNEX 3

List of Existing Processing Equipment

1. Blow Moulding Machine

VK1-0,7 by Battenfeld Fischer Blasformtechnik-GmbH, West Germany

Container size	-	0,7 l
Mould locking force	-	20 kN
Extruder type	-	50/20

Purchased in 1983

2. Films and Pipes Extrusion Machine

Model 32/25 by Betol, United Kingdom

Screw diameter	-	32 mm
L/D ratio	-	25 : 1

Purchased in 1982

3. Injection Moulding Machine

Model SP 30/50 by GKN Windsor, United Kingdom

Screw diameter	-	35 mm
Injection volume	-	100 g
Clamping force	-	50 tns.

Purchased in 1982

4. Laboratory Mill

Model 150 x 300 M.M. by Francis Shaw Co.

Purchased in 1982

5. Fuchs Knife Granulator

Model FM250 by Fuchs Muehlen

Capacity	-	30 - 150 kg/h

Purchased in 1982

ANNEX 4

Counterpart Staff

1. Mr. MOHAMED KAMAL

He graduated from the Alexandria University Faculty of Engineering Electircal Department in 1979. His main field of study - electricity Has been working at PDC for almost 4 years. Now he works as Processing Plant Section Leader, so he is responsible for the Pilot Plant smooth running. Eight people are working under his supervision including 2 engineers and 6 technicians. Has a good working knowledge of English. He puts considerable efforts into his work.

Has expressed high spirit of co-operation during the Expert's work since 22nd January till 12th February 1985.

2. Mr. IBRAHIM MASOUD

He graduated from the Alexandria University Faculty of Engineering Mechanical Department. Main field of study - mechanics. Joined PDC in 1983. How he is processing plant section Leader's Assistant. Two technicians are supervised by him. He knows English well.

He has given good co-operation and work during the Expert's work on the Project since 22nd January till 12th February 1985.

3 Mr. MAGDY FARAG

He graduated from the Alexandria University Faculty of Engineering Electrical Department in 1978. His main field of study - electricity. Has been working at PDC since 1981. At present time he is Laboratory Section Leader and responsible for the smooth work of Testing Laboratory. Eight people (5 chemists, 3 technicians) are working under his supervision. He knows English perfectly.

Expressed high spirit of co-operation and mutual understanding during the expert's work at PDC.

3. Miss HEBA EL RIFAI

She graduated from the Alexandria University Faculty of Engineering Electrical Department in 1984. Main field of study - electricity. She has been working at PDC for a month in Processing Plant Section. No person supervised. She has a good working knowledge of English

Very eager to know all about plastics and their processing.

She has expressed spirit of co-operation during the expert's work on the project.

ANNEX 5

Details of the courses offered by CIPET

No.	Title of the Course	Duration*
1	Plastics Mould Technology	3 years
2	Plastics Mould Design	1 year
3	Plastics Processing Technology	1 year
4	Plastics Tool Engineering	1 year
5	Plastics Engineering	1 year

* Duration of Courses as well as their programme for each group of trainees can be coordinated well in advance.

Processing Equipment available at CIPET

Injection Moulding Machines (up to 300 tn clamp), Compression Press, Transfer Moulding Press, Thermoset Injection Moulding Machines, Pelletizer, Preheater, Regrinder, Drying Oven, Chilling Plant, Blow Moulding Machine, Vacuum Forming Machine, Ultrasonic Welding Machine, Extruders.

ANNEX 6

List of Items to be included in the Training Programme for trainees to be specialized in Plastics Processing

1. Plastics and their Properties

2. Application of Plastics

3. Structure of Polyerms
3.1. Basic Information of Polymers' structure
3.2. Methods of Producing Polymers
3.3. Reological Properties of Polymers

4. Testing of Plastics
4.1. Methods of Testing
4.2. Technological Properties
4.3. Physical Properties
4.4. Corrosion Resistance of Plastics
4.5. Testing of Finished Products

5. Processing of Thermoplastics
5.1. Injection Moulding
5.2. Extrusion
5.2.1. Pelletizing
5.2.2. Extrusion of sheets and profiles
5.2.3. Extrusion of Pipes and Hoses
5.2.4. Extrusion of Film
5.3. Blow Moulding
5.4. Vacuum Forming
5.5. Welding of Thermoplastics
5.6. Rotational forming
5.7. Printing

6. Processing of Thermosets
6.1. Compression Moulding
6.2. Injection Moulding

7. Compounding and Formulation

ANNEX 7

"Personnel Instruction Card" form *

Instruction	Name of Instructor	Date of Instructing	Signature of employee
Instruction on fire prevention and safety measures			
Machine operationas instruction			

* These Cards for every worker should be filed and kept by the person responsible for training and instructing personnel.

ANNEX 8

Draft Plan

for training programme for

operators of injection moulding machines

(Example)

I. Theoretical Course

1. Introduction

2. Plasitcs, their types and properties

3. Basic methods of plastics processing

4. Injection moulding

4.1. Process of injection moulding
4.2. Moulds
4.3. Characteristics of Moulding Compounds
4.4. Advantages and Limitations

5. Injection Moulding Machines

II. Practical Course

1. The Design of Injection Moulding Machines

1.1. Injection Unit
1.2. Clamping Unit
1.3. Auxiliary Equipment

1.3.1. Power Unit
1.3.2. Time Controling Devices
1.3.3. Temperature Controling Devices
1.3.4. Gydraulic system

2. The design of Moulds

2.1. The types of Moulds

2.1.1. Semi-automatic Moulds
2.1.2. Automatic Moulds

2.2. Location of Runners and Gates (single - cavity)
(multiple - cavity)

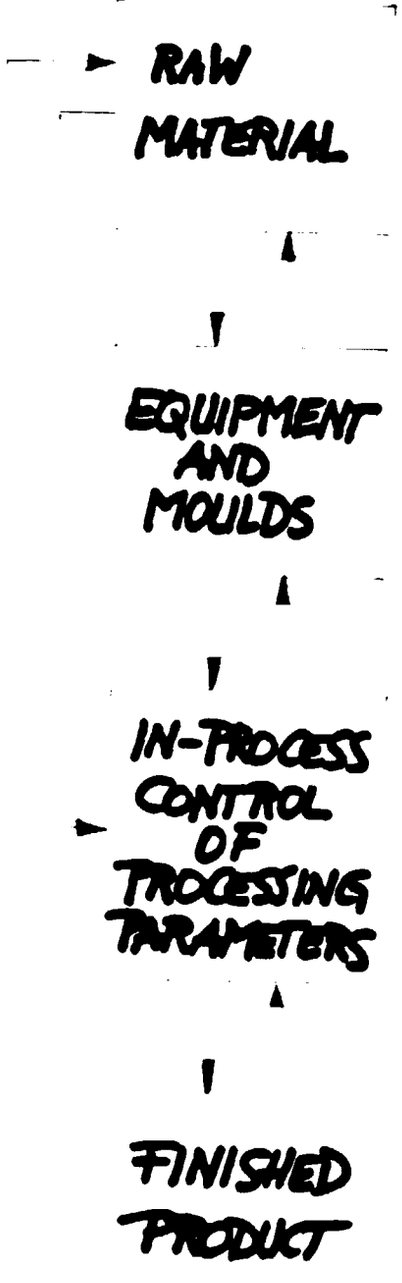
2.3. Ventilation of the Mould Cavity

3. Visual Control of Finished Products

4. How to use the Table of Defects and Remidies

ANNEX 9

Components of Quality Control System



1. Trained Personnel
2. Proper selection of raw materials
3. Purchase of Pilot batches
4. Raw materials quality control
5. Proper storage of raw material

1. Maintenance of Equipment and Moulds
2. Proper stocks of spare parts
3. Repair facilities (workshop)
4. Trained Personnel

1. Trained Personnel
2. Permanent registration of all processing parameters
3. Flow sheets
4. Additional equipment
5. Measuring tools

1. Trained personnel
2. Testing equipment
3. Proper storage

ANNEX 10

List of Manufacturers' Names and Addresses

Compounding and Formulation

BUSS AG, Basel CH-4133 Pratteln/ Switzerland
Telex: 968080

Thermoforming

BROWN MACHINE, 330 North Ross St. BEAVFRTON, MI 48612 (517) 435-7741
Telex: 227488

Recycling

EREMA GmbH, A-4060 Leonding-Linz, Stummerstr. 4
Telex: 143059, 22300

Welding Equipment

SEIDENSHA ELECTRONICS CO, LTD. Tokyo Japan, SEidensha Tokyo
Teles: J32185

Injection Moulding, hot-runner technique

HASCO-NORMALIEN, D-5880 LUEDENSHEID, P.O. Box 1720
Telex 826842

ANNEX 2

List of Counterpart Project Staff

N°	Post Title	Name of Incumbent	Starting Date	Concluding Date
1	Processing Plant Section Leader	Mohamed Kamal	01.85	02.85
2.	Processing Plant Section Leader Assistant	Ibrahim Masoud	01.85	02.85
3.	Laboratory Section Leader	Magdy Farag	01.85	02.85
4.	Electrical Engineer	Heba El Rifai	01.85	02.85