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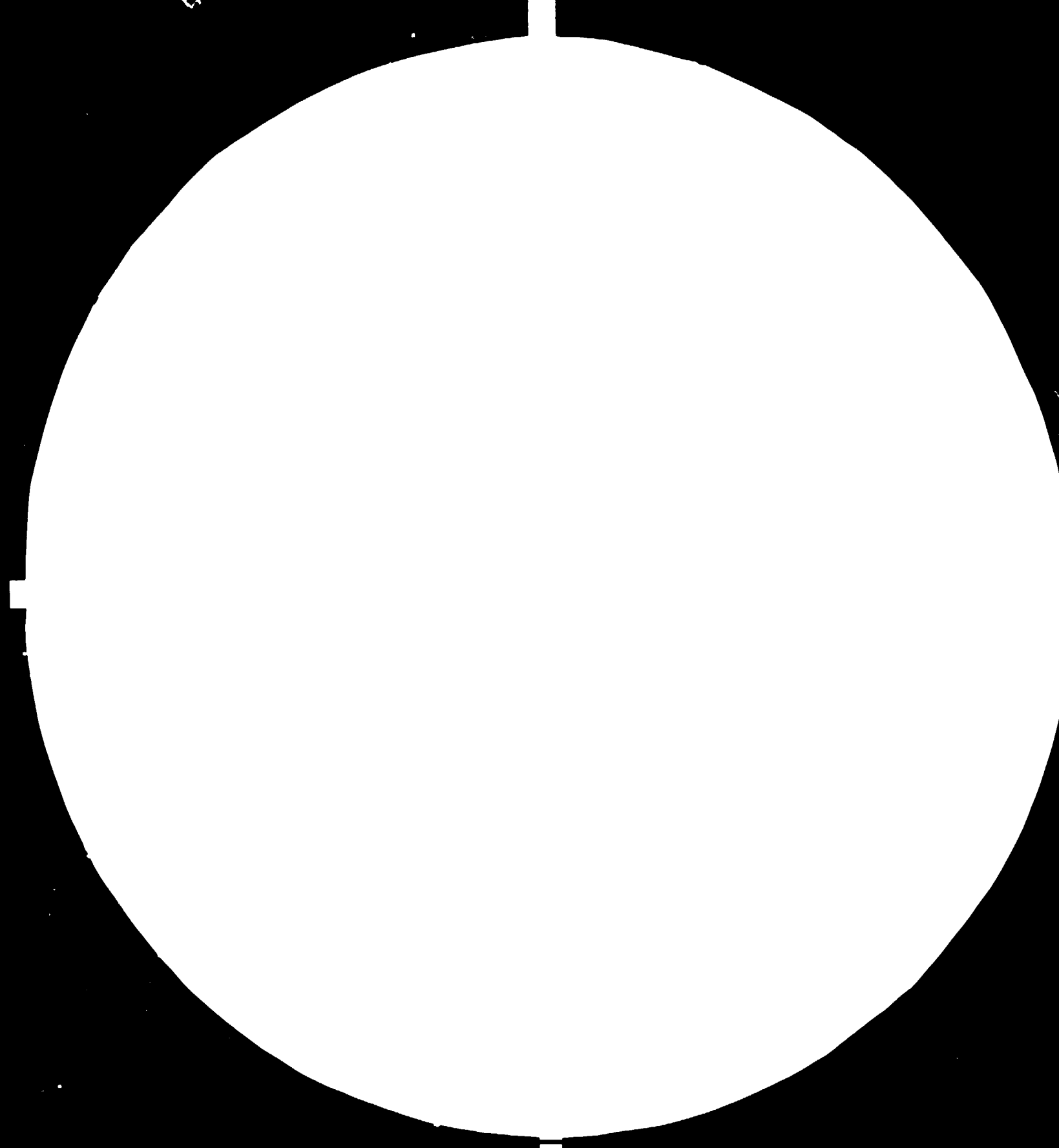

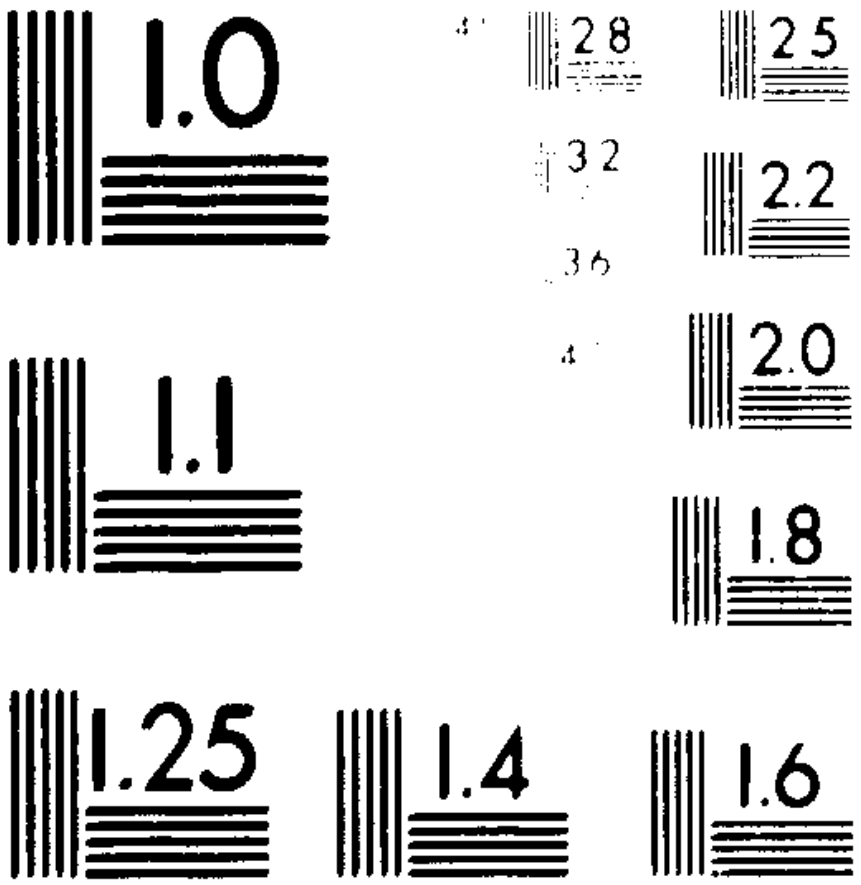

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FINAL REPORT

# SEVENTH IN-PLANT GROUP TRAINING PROGRAMME IN THE FIELD OF MOULD DESIGN AND MOULD MAKING

organized by the

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(UNIDO)

in cooperation with

THE GOVERNMENT OF AUSTRIA AND

HEINRICH SCHMIDBERGER G M B H

held in Vienna, 12 November to 7 December 1984

1984

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## I. INTRODUCTION

The trained man-power requirements has been continiously increasing during the last years, particulary in developing countries, parallel to the observed rate of developments in plastic technology.

In response to this need of trained staff, the United Nations Industrial Development Organization (UNIDO), has been offering training opportunities to technicians and engineers from developing countries in the field of plastic processing. UNIDO, in cooperation with the Austrian Federal Ministry of Education and Fine Arts, the Austrian Federal Chamber of Commerce and the Association of Austrian Industrialists have been organizing the training programmes in the fields of. plastics technology, Synthetic fibres, and mould making and mould design.

Within this context, it is noteworthy to mention that, the Laboratorium fuer Kunststofftechnik at the Technische Gewerbemuseum (LKT/TGM) has held fourteen training programmes since 1970, in the field of plastics technology.

In 1974 training in a synthetic-fibre programme was initiated and a mould-making and mould-design group was included with the overall scope of plastics-technology programme in 1975.

A training programme concerning particular field of mould making and mould design has been conducted since then by Schmidberger.

## II. GENERAL SCOPE OF THE TRAINING PROGRAMME

An in-plant training programme in the field of mould design and mould making was of four weeks duration ( 12 November to 7 December 1984). It was the seventh course on the subject being held at the Schmidberger Factory in Vienna. The course was attended by five participants from Burma, Mozambique, Singapore, Sudan and Yemen (Democratic Republic).

The participants, prior to this course on mould design and mould making also attended a six-week training programme on "Plastics Technology" at LKT/TGM. Full list of participants of this year's training programme on mould design and making is given in Annex I. The overall list of participants which have taken part in all the past training courses held at the Schmidberger Factory since 1975 is given in Annex II,

to give an overall view to the training provided in this particular field.

Provision of intensive training covering relevant theoretical and practical aspects of mould-design and mould-making technology and related topics in plastic processing has been the main objective of the training programme as it was the case in earlier years.

The scope of the programme was accordingly developed to provide detailed information on theoretical and practical aspects of mould design and emphasis was given to practical work both in the workshop for mould making and for production, to achieve the above mentioned objective.

The participants had the opportunity to get first-hand information on different equipments used and had also on the job practical training on most of the main equipment. Necessary documentation was provided to the participants and several visits to other plants were organized as an additional activity.

## III. DESCRIPTION OF THE TRAINING PROGRAMME

The training programme at Schmidberger started with an overall visit to the factory during which the participants had also the opportunity to meet the key staff of the factory. The list of the key staff of the Schmidberger Factory and the main equipment available at its premises are given in Annex III and IV.

At the beginning of the training the individual interests of the participants and the general framework of the training programme were discussed and the overall time-table of the programme was finalized. Details of the time-table are listed in Annex V.

The actual in-plant training conducted at Schmidberger covered all three main phases of "Design", "Mould-making", and "Production". The essential training activities of each of these phases are described in the following paragraphs.

### III.1 Activities concerning Mould Design

Training provided as regard to this particular topic included the

overall phases of selection of suitable materials for various articles, detailed discussions and review on major types of available material and their physical and chemical properties. Materials that are most commonly used for this purpose, such as low-density PE, high-density PE, PP, PS, ABS, rigid PVC, plasticized PVC, PA, PC, POM, PMMA, MF, HF, etc. were described and introduced to the participants.

Review of the design requirements for these kinds of material in relation to article design was make and in depth discussions on various considerations with respect to wall thickness, rounding of outer and inner edges, ribs undercut, screw nuts, metal inserts, etc., were made.

Information on practical tests with which various materials can be distinguished comparing simple properties such as hardness, smoke when heated or burnt, and its smell and sound-reflection properties, were also provided to the participants.

Various types of machinery available for the mounting and the mould and die were described. This includes the following detailed discussions on:

1. Injection-moulding machines
2. Thermosetting-mould machines
3. Extruder and blow-moulding machines.

Different types of equipment and units used together with this machinery, their calssification and technical specifications were explained.

The main objective of the training was to provide full information on specific topics related to mould and die design and other related information on Simple Cavity, Multiple Cavity, Two- and Three-plate Moulds, Four-plate Moulds, Split- and Side-pull Moulds, Sprocket-gear Moulds, Two- and Multiple-colour Moulds, Isolation-channel and Hot-runner Moulds, etc.

Moreover, the available types of steel used for mould making were reviewed and criteria for selection of suitable steel for different types of moulds and steel-hardening processes were explained.

Review of various types of mould units, which are mostly standard, were made, their specifications and appropriate use for different purposes were discussed.

Furthermore, various supplementary units of mould design such as; sprues, runner and gates; elements of sprocket-gear moulds; elements used in hot-runner systems; and Cooling systems, etc., were discussed and reviewed and their computational procedure was explained.

The participants were provided also the opportunity to examine, different selected layouts (designs), available at Schmidberger during which all the above mentioned aspects of mould and die design were discussed and reviewed.

## III.2 Activities in Mould-Making

The training programme dealing with mould making was mostly undertaken in the workshop with practical illustrations during which various aspects of the use of the milling machine, copy milling machine, boring machine, spark erosion machine, grinding machine, lathe machine, etc., were covered. The overall process of mould-making and use of the above major machinery were illustrated in the workshop. The participants also had the opportunity to get familiar with their use by observing actual moulds being made in the workshop during their stay at Schmidberger.

Participants were informed on the various types of material used for contruction of a full scale model of an article prior to mould making.

Furthermore, a number of old dies and moulds were dismantled for repair and the participants had the opportunity to observe the details of the moulds, methods of repair of the damaged part of the mould and the re-mounting.

The final stage of the surface finishing of moulds was shown and different types of surface-finishing methods were discussed.

Steel hardening processes involved in mould making were illustrated during a visit made to a plant specialized in steel hardening.

### III.3 Activities in Production Phase

The training programme concerning production of moulds and dies has been conducted mostly in the form of practical demonstrations in the workshop of the Schmidberger Factory. During this part of the training programme, the main types of production machines mentioned earlier were demonstrated and their use were discussed.

#### III.3.1. Injection Moulding Department

During the training in this department, emphasis was given to the major stages involved in production, such as fixing of the mould, trial manual runs for the selection of the best production setting (temperature, injection pressure, injection speed, post pressure, cooling, timing, etc.).

To illustrate the effects of these parameters on the final production, a series of practical exercises were carried out during which each of the above parameters were intentionally varied.

Furthermore, auxiliary units used with injection-moulding machines were described.

#### III.3.2. Thermosetting Moulding Department

Specific topics related to production with thermosetting moulding, such as tabletting, pre-heating, metal inserts, etc., were discussed and demonstrated to the participants in addition to general procedure involved in mould fixing and production setting as described earlier.

#### III.3.3. Extruder and Blow-Moulding Department

Various features particular to the production with extruder and

blow-moulding machines, such as sizing die, cooling bath, take-off equipment, winding and packaging equipment, wall thickness control equipment, blowing equipment, transporting equipment, etc., were demonstrated in addition to other general aspects as described before.

## IV. INFORMATION ON FURTHER TRAINING ACTIVITIES

As can be noted from earlier described activities the main emphasis of the programme at Schmidberger was theoretical and practical training in mould design and mould making. However, the participants , made brief visits to other relevant departments of the factory, such as compounding, hot-forming, finishing, etc., to have an overall view of the processes involved in plastic technology.

Furthermore, a number of visits to other factories and institutes of interest were also organized. A list of such visits made during the period of training is given in Annex VI. Relevant documentation and reports that were available at Schmidberger and various booklets of other factories which were visited were distributed to the participants. Annex VII lists the documents provided to the participants within this context.

## V. GENERAL COMMENTS

It is noteworthy to mention that the cooperation between the participants and the staff of the Schmidberger Factory was smooth and very fruitful throughout the entire duration of the training programme.

Particular attention was devoted to the design of the scope of the training programme so as to meet the needs of the participants, and it is expected that the training will prove most useful to the participants in their future activities in this particular field.

We would like to convey our thanks and appreciation to all institutions involved in the organization of the training programme and would like to express our willingness to be the host institute for these training courses to be likely held also in the future.

ANNEX-I

List of participants in the Training Programme on Mould-design and Mould-making in 1984

| | |
|---|---|
| KYAW, U Thein | Plastic Factory no. 2<br>Pharmaceutical<br>Industries Corp.<br>29/B Pawdawmu Pagoda Road<br>Thamaing<br>Rangoon |
| DAVID, Mr. Francisco Gabriel F. | Platicos de Mozambique<br>C. P. 2006<br>Maputo |
| SAAT, Mr. Zakariah | Technomer Mouldings Pte. Ltd.<br>24 Gul Drive<br>Singapore 2262 |
| SIDDIG MOHAMAD ALI, Mr. Bahaa Eldin | Industrial Research and<br>Consultancy Centre<br>P. O. Box 268<br>Khartoum |
| BIN SHABEDH, Mr. Awadh Ahmed | Yemen Rubber Manufacturing Co.<br>P. O. Box 30<br>Crater, Aden |

ANNEX-II

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|
| BOLIVIA | - | - | x | - | - | - | - |
| BULGARIA | - | x | - | - | - | - | - |
| BURMA | - | - | - | x | x | - | x |
| CHILE | - | - | - | - | - | x | - |
| CHINA | - | - | - | - | x | - | - |
| COLOMBIA | - | - | x | x | - | - | - |
| COSTA RICA | - | - | - | - | x | - | - |
| CUBA | x | - | - | - | - | - | - |
| CYPRUS | x | - | - | - | - | - | - |
| EGYPT | - | x | x | x | - | - | - |
| GHANA | - | - | - | - | - | x | - |
| INDIA | x | - | - | x | - | x x | - |
| INDONESIA | x | - | - | - | - | - | - |
| IRAQ | - | x | - | - | - | - | - |
| JORDAN | x | - | - | - | - | - | - |
| MALAYSIA | x | - | - | x | - | - | - |
| MALAWI | - | - | - | - | - | x | - |
| MOZAMBIQUE | - | - | - | - | - | - | x |
| PANAMA | - | - | - | - | x | - | - |
| EL-SALVADOR | - | - | x | - | - | - | - |
| SINGAPORE | - | - | - | - | - | - | x |
| SRI LANKA | - | x | - | - | - | - | - |
| SUDAN | - | - | - | - | - | - | x |
| TANZANIA | x | - | - | - | - | - | - |
| TRINIDAD-TOBAGO | - | - | - | x | - | - | - |
| YEMEN | - | - | - | - | - | x | x |

ANNEX-III

STAFF

| | |
|---|---|
| KR Friederike WITT | Director General |
| KR Dr. Erich WITT | Director |
| Magist. Gabriele WITT | Deputy Director |
| Herbert MAYERHOFER | Plant Manager |
| Ing.Marcus WERSONIG | Production Superviser |

| | |
|---|---|
| Training Manager | Training Assistant |
| Ing. Ing. Batu ÖZHAN | Ing. Marcus WERSONIG |

| | |
|---|---|
| Designing Dept: | Ing.Ing.Batu ÖZHAN |
| Mould Making Dept: | Roman BRUNNER |
| Injections Mould Dept: | Miroslav RADUSIC |
| Blow Moulding and Extrution Dept: | Anton SPRENGNAGEL |
| Press Moulding Dept: | Ingeborg KOMAREK |

ANNEX-IV

EQUIPMENT

Mouldmaking workshop:

| | |
|---|---|
| Copy-milling machine | 2000 x 1000 mm TOS |
| Copy-milling machine | 1000 x 1200 mm TOS |
| Copy-milling machine | Deckel KF 1 |
| Milling machine | Deckel FP 1 |
| Milling machine | Deckel FP 2 LB |
| Milling machine | 6 T 75 |
| Milling machine | Thiel |
| Milling machine | FK 086 |
| Horizontal boring machine | HCW |
| Div. drilling machines. | |
| Turning lathe | Heid |
| Turning lathe | Hopfgärtner |
| Turning lathe | TOS |
| Turning lathe | Nils and others. |
| Shaping machines | |
| Grinding machine | Zocca |
| Grinding machine | Elb and others. |
| Sand-blast unit | |
| Electro-erosion machine | Dieter HANSEN 750/S and others |
| Diprofil equipment | |
| Biax equipment | |
| Measuring equipment | |

Injection Moulding Dept.

| | |
|---|---|
| TRIULZI | 10 Kg. |
| ENGEL | 1200/900 |
| IDRA | MP 85 |
| BATTENFELD | 3000 |
| STÜBBE | 2000 |
| ENGEL | 1500/500 |
| ENGEL | 500 P |
| IDRA | MP 40 |
| IDRA | MP 35 |
| ENGEL | 350 P |
| IDRA | MP 30 |
| NETSTAL | 350 |
| ENGEL | 500/250 |
| ENGEL | 250/650 |
| ENGEL | 300/150 |
| ENGEL | 150/90 |
| IDRA | MP 10 |
| ENGEL | 100/50 |
| ENGEL | 90/50 |
| ENGEL | 50/50 |
| ARBURG | UNIMAT |
| BATTENFELD | 7,5 gr. |
| BATTENFELD | 2 gr. |

and others

Div. Conveyor and inking equipment

Div. Mills

Blow Moulding Dept.

KAUTEX Blow-Moulding Machines up to 50 L.

BEKUM Blow-Moulding Machines HBD BA 2

and others.

Div. Conveyor and Colouring Equipment

Printing-machines DUBUIT

Printing-machines KAMANN witt elevator

Printing-machines SIMA and others

ANNEX-V

Seventh In-Plant group Training Programme in the field of Mould Design and Mould Making, Vienna 12. Nov. to 7. Dec. 1984

TIME TABLE

| | | |
|---|---|---|
| Beginning | 08.00 hrs | |
| Lunch | 12.00 to 13.00 | (except Friday) |
| End | 16.00 hrs | (Friday 13.00 hrs) |

First Week

| | |
|---|---|
| 12 November<br>Monday | Visit to the factory;<br>Design department:<br>Discussion with trainees concerning individual interest in the subject matter, questions and answers. |
| 13 November<br>Tuesday | Calculation of mould elements, types of injection moulds. |
| 14 November<br>Wednesday | Design of mould in respect to material, shrinkage, cooling system, design of sprue, runners and gates and mould units. |
| 15 November<br>Thursday | Workshop and injection mould department. |
| 16 November<br>Friday | Single-cavity, multi-cavity mould. |

Second Week

| | |
|---|---|
| 19 November<br>Monday | Split, side pull mould. |
| 20 November<br>Tuesday | Three-plate, four-plate mould.<br>Workshop and injection mould department. |
| 21 November<br>Wednesday | Isolation channel, hot runner moulds. |
| 22 November<br>Thursday | Workshop |
| 23 November<br>Friday | Sprocket gear moulds. |

Third Week

| | |
|---|---|
| 26 November | |
| Monday | Sprocket gear moulds. |
| 27 November | |
| Tuesday | Two and multi colour moulds. |
| 28 November | |
| Wednesday | Workshop and injection mould department.<br>Technical mould designs. |
| 29 November | |
| Thursday | continued from the above. |
| 30 November | |
| Friday | Workshop. |

Fourth Week

| | |
|---|---|
| 3 December | |
| Monday | Thermosetting materials, design of thermosetting moulds, transfer moulds.<br>Thermosetting department. |
| 4 December | |
| Tuesday | Extruder machines, design of dies and blow moulds.<br>Blow mould department. |
| 5 December | |
| Wednesday | Foaming - expanded polystyrol mould of expanded materials. |
| 6 December | |
| Thursday | Copies of interesting designs for the trainees.<br>Discussion with substantive officers at UNIDO. |
| 7 December | |
| Friday | Workshop.<br>Individual discussions,<br>Closing session. |

ANNEX-VI

PLANT-VISIT

| | | |
|---|---|---|
| 13 Nov. Tuesday | CINCINNATI | WIEN 23 |
| | S C S (Shopping) | Vösendorf |
| | " Lunch | " |
| 15 Nov. Thursday | Hasco Mould Units | Guntramsdorf |
| 19 Nov. Monday | BATTENFELD | Kottinbrun |
| 21 Nov. Wednesday | Ing. Stefan Pöltner K.G. Steel hardening | WIEN 22 |
| 27 Nov. Tuesday | Bernklau Modelmaker | WIEN 14 |
| | Petro Chemie Danubia | Schwechat |
| 29 Nov. Thursday | Kunststoffinstitut Research and Test Laboratory | WIEN 3 |
| 4 Dec. Tuesday | Dieringer Modern mould-making and Injection-moulding com. | WIEN 23 |
| | Fa. LEDL Reinforced Plastics com. | Tattendorf |
| 5 Dec. Wednesday | Porit Hartschaum GmbH Foaming-Expandet Polystyrol | (Schmidberger) |
| 6 Dec. Thursday | Dinner | |

ANNEX-VII

## Special Papers

ICI
BASF
HÜLS
Hoechst
Plastic Service
General Electric
Happel - Daikin
Prospects of visited factories

## Social Events

Lunch - Shoping City Süd (Schmidberger)
Dinner - Gösser Bier Klinik (Schmidberger)

ANNEX-VIII

FACTS ABOUT SCHMIDBERGER

HISTORY

The company was founded in 1922 by Mr. Heinrich SCHMIDBERGER.

Mr. Schmidberger, who died in 1965, foresaw the importance of plastics in the earliest stages of his activities.

A number of production sites that had originally been located in different areas were concentrated at the Vienna-Liesing plant in 1960.

This plant, which covers an area of 73.000 m2 includes 2 large workshops sized about 27.000 m2. The company's management and administration are located in their own office-building in Vienna II.

The company management is headed by Mrs. F. Witt, the founders daughter, and Dr. Witt, her husband.