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FINAL REPORT

TENTH 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 GesmbH

held in Vienna, 2 November to 27 November 1987

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## I. INTRODUCTION

Trained man-power requirements have been continuously increasing during the last years, particularly 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 Organisation (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, has been organizing the training programmes in the fields of plastic technology, synthetic fibres, mould making and mould design.

The in-plant training programme in the field of mould design and mould making was of four weeks duration (2 November to 27 November 1987). It was the tenth course on the subject held at the Schmidberger Factory in Vienna. The course was attended by five participants from Ethiopia, DPR Jemen, Pakistan, Somalia and Vietnam. A full list of participants of this year's training programme on mould design and mould making is given in Annex I. An 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 of the training provided in this particular field.

## II. GENERAL SCOPE OF THE TRAINING PROGRAMME

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

The scope of the programme was accordingly developed, to provide detailed information on theoretical and practical aspects of mould design. Emphasis was given to practical work, both in the workshop for mould making and for production. The participants had the opportunity to get first-hand information on most of the main equipment. Necessary documentation was provided to the participants and several visits to other plants were organized.

## III. DESCRIPTION OF THE TRAINING PROGRAMME

The training programme at Schmidberger started with an introductory visit to the factory where the participants had the opportunity to meet the key staff of the factory. A list of the key staff of the Schmidberger Factory and the main equipment in use on 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 Mould Design

Training provided as regard to this particular topic included the overall phases of selection of suitable materials for various articles. Detailed discussions were held concerning 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.

The design requirements for these kind of material in relation to article design were made and indepth discussions with respect to wall thickness, rounding of outer and inner edges, ribs undercut, screw nuts, metal inserts, etc., were made. Information on practical tests to distinguish various materials, in which simple properties such as hardness, smoke when heated or burnt, and its smell and sound-reflection properties, was provided to the participants.

Various types of machinery available for the mounting and the mould and dye were described. This includes 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 classification and technical specifications were explained.

The main objective of the training was to provide full information on specific topics related to mould and dye design and other related information on Single Cavity, Multiple Cavity, Two- and Three-plate Mould, Four-plate Moulds, Split- and Side-pull Mould, 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; 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 dye design were discussed and reviewed.

### III.2 MOULD-MAKING

The training programme dealing with mould making was mostly undertaken in the workshop. Practical illustrations dealing with various aspects of the use of the milling machine, copy milling machine, boring machine, spark erosion machine, grinding machine, lathe machine, etc., were given. The overall process of mould-making in relation to the above

machinery was shown in the workshop. The participants also had the opportunity to observe actual moulds being made. Furthermore, a number of old dyes 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 their mounting. The final stage of the surface finishing of moulds was shown and different types of surface-finishing methods were discussed. Finally, steel hardening processes involved in mould making were illustrated during a visit made to a plant specialized in steel hardening.

### III.3 PRODUCTION

The training programme concerning production of moulds and dyes was conducted primarily in the form of practical demonstration in the workshop of the Schmidberger Factory. During this part of the training programme, the main types of production machines mentioned earlier were demonstrated.

#### 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 settings (temperature, 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. Auxiliary units used with injection-moulding machines were also described.

#### III.3.2. Thermosetting Moulding Department

Specific topics related to production with thermosetting moulding, such as tableting, pre-heating, metal inserts, etc., were discussed. These production methods were demonstrated to the participants, in addition to the general procedure involved in mould fixing and production setting as earlier described. Also were shown how to produce an good article, depending on time and temperature.

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

Various features particular to the production with extruder and blow-moulding machines; such as sizing dye, cooling bath, take-off equipment, winding and packaging equipment, wall thickness controll equipment, blowing equipment, transporting equipment, etc., were demonstrated.

### IV. INFORMATION ON FURTHER TRAINING ACTIVITIES

It 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 plastics technology.

Furthermore, a number of visits to other factories 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 hoped that the training will prove most useful to the participants in their future activities in this particular field. We would like to express our thanks and appreciation to all institutions involved in the organization of the training programme and simultaneously express our willingness to be the host institute for future training courses.

ANNEX - I

List of participants in the Training programme on Mould-design  
and Mould - Making in 1987

Rabee maher ali	Algundi plastic factory p.o. box no. 4206 aden PDR. Yemen
Wondwossen Ketema	Addis Ababba foam and plastic factory p.o. box 22971 Addis Ababba Ethiopia
Tariq Haroon	Federal chemical and ceramics corporation (pvt) ltd 15 th floor pnscc building Moulvi tamizuddin khan road Karachi Pakistan
Pham thai lai	Vien may long lu va dung cu-lang ha-dong da-ha noi Vietnam
Shamuun abukar omar	Sanai p.o. box 25 Mogadishu Somalia





ANNEX - III

STAFF

Kr Friederike Witt	Director General
Kr Dr Erich Witt	Director
Mag Gabriele Witt	Deputy Manager
Herbert Mayerhofer	Plant Manager
Ing Markus Versnig	Production Manager
Ing Markus Versonig	Training Manager
Heinz Schroedl	Design Department
Roman Brunner	Mould Making Department
Miroslav Radusic	Injection Mould Department
Marjan Tulumovic	Blow Moulding Department
Marjan Tulumovic	Extrusion Department
Margit Hegedues	Compression Moulding Department

ANNEX - IV

**Equipment**

**Mould Making 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
Milling machine	6 T 75
Milling machine	Thiel
Milling machine	FK 086
Horizontal boring machine	HCW
Div drilling machines	
Turning lathe	Heid
Turning lathe	Hopfgaertner
Turning lathe	TOS
Turning lathe	Mils and others
Shaping machines	
Grinding machines	Zocca
Grinding Machines	Elb and others
Sand blast unit	
Electro erosion machine	Dieter Hansen 750/S and others
Diprofil equipment	
Blax equipment	
Measuring equipment	

**Injection Moulding Department**

ENGEL	1200/9000	
ENGEL	7000/650	
ENGEL	4400/550	with robot system
STUEBBE	2000	
ENGEL	1500/500	
ENGEL	1500/500P	
ENGEL	350P	
ENGEL	500/250	
ENGEL	650/250	
ENGEL	650/250	
ENGEL	650/250	
ENGEL	300/150	
ENGEL	150/90	
ENGEL	100/50	
IDRA	MP 10	
ENGEL	90/50	
ENGEL	50/50	
ARBURG	UNIMAT	

and others

Div Conveyer and inking equipment

Div Mills

**Blow Moulding Department**

Kautex	Blow moulding machine up to 50	1
Bekum	Blow moulding machine HBD	BA 2
and others		

Div Conveyer and colouring equipment

Printing Machine DUBUIT  
Printing Machine KAMANN with elevator  
Printing Machine SIMA and others

**Compression Department**

Bucher Guyer	Compression machine up to 150	to
Bucher Guyer	Compression machine up to 150	to
Bipel	Compression machine	
Bipel	Compression machine	
TOS	Compression machine up to 40	to
and some other compression machines from 20 to up to 300 to		

ANNEX - V

Tenth In - Plant group Training Programme in the field of Mould  
Design and Mould Making, Vienna 2 Nov. to 27 Nov. 1987

TIME TABLE

Beginning	08.00 hrs
Lunch	12.00 to 13.00 (except Friday)
End	16.00 (Friday 14.00 hrs)
<b>First Week</b>	
2 November Monday	Visit to the factory
3 November Tuesday	Design department: Discussion with trainees concerning individual interest in the subject matter, questions and answers.
4 November Wednesday	Discussion about different materials which are used in plastic factory. Discussion about steel quality, steel hardness and steel hardening.
5 November Thursday	Plant visit: BEKUM Workshop
6 November Friday	Calculation of mould elements, types of injection moulds
<b>Second Week</b>	
9 November Monday	Plant visit: HASCO Discussion about different mould standards. Design of mould in respect of material, shrinkage and calculation of cooling system.
10 November Tuesday	Plant visit: ENGEL Workshop and injection moulding department
11 November Wednesday	Design of sprue, runners and gates and mould units by using and without using different mould standards

12 November  
Thursday

Calculation of clamping force of injection  
and compression machines  
Workshop and compression moulding department

13 November  
Friday

Discussion about single cavity, multi cavity  
mould, split and side pull mould

Third Week

16 November  
Monday

Plant visit: Sedlak  
Discussion about three plate, four plate mould  
Isolation channel, hot runner mould  
Discussion about two and multi colour moulds  
which were seen at plant visit ENGEL.

17 November  
Tuesday

Plant visit: Battenfeld  
Discussion about different moulds which were  
seen at Battenfeld, discussion about sprocket  
gear mould

18 November  
Wednesday

Plant visit: General Motors Austria  
Discussion about fully automatic plants like GM  
Extruder machines, design of dies and blow  
moulds

19 November  
Thursday

Plant visit: Fuji Metallveredelungs GesmbH  
Blow mould department Discussion about flexible  
pipes (core inside)  
Technical mould designs. Foaming - expanded  
polystyrene, mould of expanded materials

20 November  
Friday

Plant visit: Porit  
Compression department, production of plates  
and cups, how to produce articles from  
different materials and how to produce plates  
from melamine with photos and pictures fixed  
in the part. Practice work on one compression  
machine to show how to produce melamine  
articles with better quality and shorter cycle  
time.

Fourth Week

23 November  
Monday

Plant visit: Wess  
Discussion about designing of thermosetting  
moulds, and transfer moulds.

**24 November  
Tuesday**

**Plant visit: PCS - Schwechat  
Workshop and injection mould department ,  
Practice work on one injection machine which  
was prepared by the trainees. Discussion  
about the timing on an injection machine,  
discussion about the different pressure setting  
Production with this mould**

**25 November  
Wednesday**

**Plant visit: CINCINNATI Milacron  
Copies of interesting moulds and designs for  
the trainees, discussion about technical moulds**

**26 November  
Thursday**

**Workshop. Closing session in the head quarter  
of Schmidberger company including the closing  
session of UNIDO. Workshop.**

**27 November  
Friday**

**Individual discussions in the factory about  
special questions.**

ANNEX - VI

PLANT - VISIT

05 November Thursday	BEKUM	Blow moulding machines	Traisnauer
09 November Monday	HASCO	Mould units	Guntramsdorf
10 November Tuesday	ENGEL	Injection machines	Schwertberg
16 November Monday	Sedlak	Modern mould maker	Wien 23
17 November Tuesday	Battenfeld	Injection machines	Kottingbrunn
18 November Wednesday	General Motors' Austria		Wien Aspern
19 November Thursday	Fuji Metallveredelungs GesmbH	Steel hardening	Wien 22
20 November Friday	Porit	foaming - expanded polystyrene	Wien 23
23 November Monday	Vess	Modern mould maker	Gloggnitz
24 November Tuesday	PCS - Schwechat	Chemical industry	Schwechat
25 November Wednesday	CINCINNATI Milacron	Extruder and injection machines	Wien 23
12 November Thursday	Dinner - Melkerhof Heuriger		Gumpoldskirchen
25 November Wednesday	Dinner - Holzinger Restaurant		Traiskirchen



ANNEX - VII

Special Papers

- HASCO            Mould making standards
- DME             Mould making standards
- HUELS           Injection moulding technology  
Part I: Design of mouldings  
Part II: Mould construction
- HORCHST        Introduction to the technology of plastics  
Part I: The structure and properties of plastics  
Part II: The processing of plastics
- Regloplas      Edition 9  
Recommended moulding and processing temperatures  
of plastics and rubbers.  
Manual for temperature control by means  
of fluid media
- Degussa        Special papers about steel hardening
- Some papers about materials (steel and plastic)
- Prospects of visited factories
- Some copies about interesting moulds and mould designs

Social Events

- Dinner - Melkerhof Heuriger    (Schmidberger)
- Dinner - Holzinger Restaurant (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 m<sup>2</sup> includes two large workshops sized about 27.000 m<sup>2</sup>. 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.

