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FINAL REPORT

ELEVENTH 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, 26 September to 21 October 1988

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I. INTRODUCTION

Trained man-power requirements have been continiously 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 Commerc 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 (26 September to 21 October 1988). It was the eleventh course in the subject held at the Schmidberger Factory in Vienna. The course was attended by five participants from Ethiopia, Nigeria, Sudan, Tanzania 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 documation 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 in 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 tabletting, 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 activitied 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 documantation and reports that were available at Schmidberger and various booklets of other factories which were visted 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 smoth and very fruitfull 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 usefull 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 1988

Sisay, Bayu	Addis ababa Foam & Plastics Factory p.o. box 22971 Addis Ababba, Ethiopia
Ibekwe Chuks, Augustine	Afromedia Plastics and Engineering Nigeria Limited, Ajangbadi p.o. box 2377, Lagos, Nigeria
Ali Fadlalla A. Rahman	Industrial Research and Consultancy Centre (IRCC) p.o. box 268 Khartoum, Sudan
Mshana, Godwin Z.	Tanganyika Tegry (Plastics) Ltd p.o. box 2219 Dar-es-Salaam, Tanzania
Hynh Quang, Viet	Union of Plastic Enterprises 274 Ben Ham Tu Q.5 Hochi Minh City Vietnam

ANNEX - II

	75	76	77	78	79	83	84	85	86	87	88
BENIN	-	-	-	-	-	-	-	X	-	-	-
BOLIVIA	-	-	X	-	-	-	-	-	-	-	-
BULGARIA	-	X	-	-	-	-	-	-	-	-	-
BURMA	-	-	-	X	X	-	X	X	-	-	-
CHILE	-	X	-	-	-	X	-	-	-	-	-
CHINA	-	-	-	-	X	-	-	-	X	-	-
COLOMBIA	-	-	X	X	-	-	-	-	-	-	-
COSTA RICA	-	-	-	-	X	-	-	-	-	-	-
CUBA	X	-	-	-	-	-	-	-	-	-	-
CYPRUS	X	-	-	-	-	-	-	-	-	-	-
EGYPT	-	X	X	X	-	-	-	-	-	-	-
ETHIOPIA	-	-	-	-	-	-	-	-	-	X	X
GHANA	-	-	-	-	-	X	-	-	-	-	-
INDIA	X	-	-	X	-	XX	-	X	-	-	-
INDONESIA	X	-	-	-	-	-	-	-	-	-	-
IRAQ	-	X	-	-	-	-	-	-	-	-	-
JORDAN	X	-	-	-	-	-	-	-	-	-	-
KOREA	-	-	-	-	-	-	-	X	X	-	-
MALAYSIA	X	-	-	X	-	-	-	-	-	-	-
MALAWI	-	-	-	-	-	X	-	-	-	-	-
MAURITIUS	-	-	-	-	-	-	-	X	-	-	-
MOZAMBIQUE	-	-	-	-	-	-	X	-	-	-	-
NIGERIA	-	-	-	-	-	-	-	-	-	-	X
PAKISTAN	-	-	-	-	-	-	-	-	-	X	-
PANAMA	-	-	-	-	X	-	-	-	-	-	-
EL-SALVADOR	-	-	X	-	-	-	-	-	-	-	-
SINGAPORE	-	-	-	-	-	-	X	-	-	-	-
SOMALIA	-	-	-	-	-	-	-	-	-	X	-
SRI LANKA	-	X	-	-	-	-	-	-	X	-	-
SUDAN	-	-	-	-	-	-	X	-	-	-	X
SYRIA	-	-	-	-	-	-	-	-	X	-	-
TANZANIA	X	-	-	-	-	-	-	-	X	-	X
THAILAND	-	-	-	-	-	-	-	-	X	-	-
TRINIDAD-TOBAGO	-	-	-	X	-	-	-	X	-	-	-
VIETNAM	-	-	-	-	-	-	-	-	-	X	X
YEMEN	-	-	-	-	-	X	X	-	-	-	-
YEMEN DPR	-	-	-	-	-	-	-	-	-	X	-

ANNEX - III

STAFF

Kr Friederike Witt	Director General
Kr Dr Erich Witt	Director
Mag Gabriele Witt	Deputy Manager
Ing Bernd Kozlik	Executive Manager
Herbert Mayerhofer	Plant Manager
Ing Markus Wersonig	Production Manager
Ing Markus Wersonig	Training Manager
Roman Brunner	Mould Making Department
Franz Bauer	Injection Mould Department
Marjan Tulumovic	Blow Moulding Department
Marjan Tulumovic	Extrusion Department
Miroslav Radusic	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	Nils 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	
Biax 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	
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 l
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

Eleventh In - Plant Group Training Programme in the field of Mould Making and Mould Design, Vienna 26 Sept. to 21 Oct. 88

TIME TABLE

Beginning	08.00 hrs
Lunch	12.00 to 13.00 (exept Friday)
End	16.00 (Friday 14.00 hrs)

First Week

26 September Monday	Visit to the factory
27 September Tuesday	Design department: Discussion with trainees concerning individual interest in the subject matter, questions and answers.
28 September Wednesday	Plant visit: Fuji Metallveredelungs GesmbH Discussion about different materials which are used in plastic factory. Discussion about steel quality, steel hardness and steel hardening.
29 September Thursday	Discussion about different mould design. Workshop
30 September Friday	Calculation of mould elements, types of injection moulds
1 October Saturday	Intertool: A big fair about mould making and about mould making machines.

Second Week

3 October Monday	Discussion about different mould standards. Design of mould in respect of material, shrinkage and calculation of cooling systems.
4 October Tuesday	Workshop and injection moulding department

5 October Wednesday	Plant visit: ENGEL Design of sprue, runners and gates and mould units by using and without using different mould standards
6 October Thursday	Plant visit:Battenfeld Calculation of clamping force of injection and compression machines Workshop and compression moulding department
7 October Friday	Discussion about single cavity, multi cavity mould, split and side pull mould
Third Week	
10 October Monday	Plant visit: Sedlak Discussion about three plate, four plate mould Isolation channel, hot runner mould Discussion about two and moulti colour moulds which were seen at plant visit ENGEL.
11 October Tuesday	Plant visit: PCD-Schwechat Discussion about different moulds which were seen at Battenfeld, discussion about sprocket gear mould
12 October Wednesday	Plant visit: Cincinnati-Milacron Plant visit: Gatriel chemie Extruder machines, design of dies and blow moulds
13 October Thursday	Blow mould department Discussion about flexible pipes (core inside) Technical mould designs. Foaming - expanded polystyrene, mould of expanded materials
14 October Friday	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

17 October Monday	Plant visit: BEKUM Plant visit: Porit Discussion about designing of thermosetting moulds, and transfer moulds.
18 October Tuesday	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
19 October Wednesday	Plant visit: Umreich Closing session in the head quarter of Schmidberger company including the closing session of UNIDO. Workshop
20 October Thursday	Copies of interesting moulds and designs for the trainees, discussion about moulds for technical parts.
21 October Friday	Individual discussions in the factory about special questions.

ANNEX - VI

PLANT - VISIT

28 September Wednesday	Fuji Metallveredelungs GesmbH Steel hardening	Wien 22
01 October Saturday	Intertool A big fair	Wien-Prater
05 October Wednesday	ENGEL Injection machines	Schwertberg
06 October Thursday	Battenfeld Injection machines	Kottingbrunn
10 October Monday	Sedlak Modern mould maker	Wien 23
11 October Tuesday	PCL- Schwechat Chemical industry	Schwechat
12 October Wednesday	Gabriel Chemie Chemical industry	Wien 23
12 October Wednesday	Cincinnati Milacron Extruder and injection machines	Wien 23
17 October Monday	BEKUM Blow moulding machines	Traismauer
17 October Monday	Porit Expanded polystyrene	Wien 23
19 October Wednesday	Umreich Modern mould maker	Wien 23
19 October Wednesday	Dinner - Benediktinerhof Keller Heuriger	Gumpoldskirchen

ANNEX - VII

Special Papers

HASCO	Mould making standards
HUELS	Injection moulding technology Part I: Design of mouldings Part II: Mould construction
HOECHST	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 - Benediktinerhof Keller (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 differant areas were concentrated at the Vienna - Liesing Plant in 1960.
This plant, which covers an area of 73.000 m² includes two 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.