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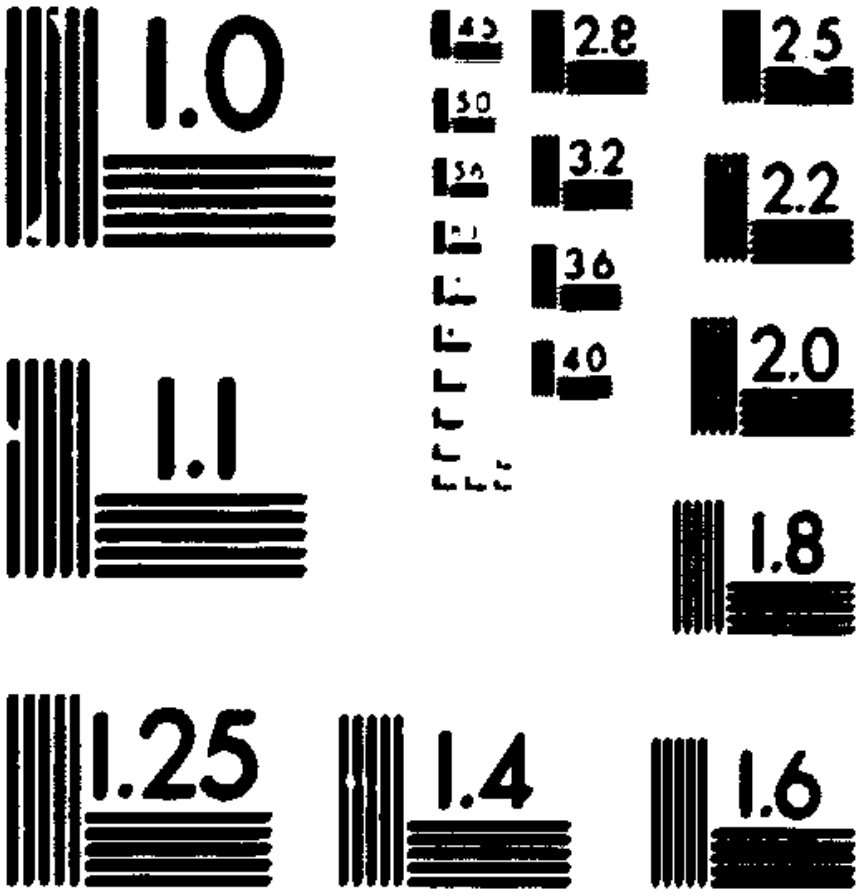

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No 2)

LKT-TGM international
Austrian Laboratory for Plastics Technology

14099

H. Hubeny

Wexstrasse 19-23 · A-1200 Wien · Tel. (0222) 35 21 06-0 · Telex 131824

US/INT/84/078

Final Report.

15th UNIDO In-Plant Group Training Programme in the Field of Plastics Technology

2944

AUSTRIA 1984

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LKT-TGM international
Laboratory for Plastics Technology

Fifteenth UNIDO In-Plant Group Training Programme in the Field of Plastics Technology

Wexstraße 19-23 · A-1200 Wien · Tel. (0222) 35 21 06-0 · Telex 131824

Organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Government of Austria

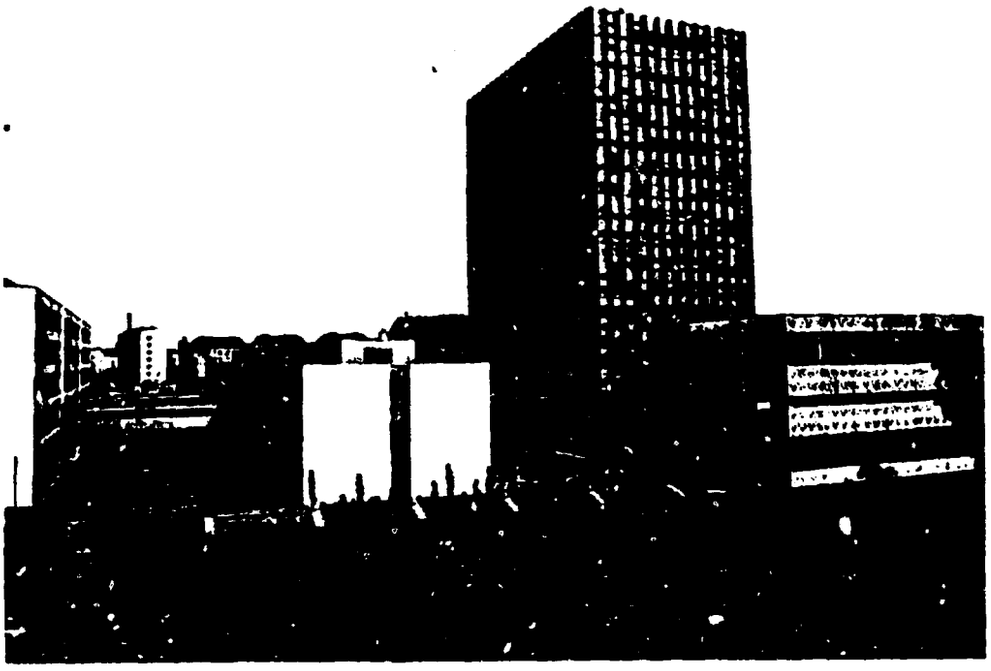
to be held

from 1 October to 9 November 1984 in Vienna, Austria

Final Report

by
H.HUBENY
Programme Director

Zl.ZT 143/Hu/Dö, 9.November 1984



TECHNOLOGISCHES GEWERBEMUSEUM

1. AKNOWLEDGEMENT

The LKT-TGM is deeply indepted to the following institutions for organizing the seminar and for the excellent and successful cooperation.

UNIDO:

Ms.Tcheknavorian-Asenbauer
Ms.I.Iorenzo
Mr.R.Gumen
Mr.Sato
Mr.D.Gardellin
Ms.H.Schindlauer
Mr.H.Pichler
Mr.N.Youssef
Ms.D.Hanny
Mr.E.C.Bull
Mr.K.Sepic
Mr.J.Belo

Austrian Federal Chancellery:

Mr.U.Stacher
Mrs.B.Dekrout

Austrian Federal Ministry of Foreign Affairs:

Mr.F.Schmid
Mr.H.Miltner

Austrian Federal Ministry of Education and Arts:

Mr.W.John
Mr.O.Tischler
Mr.D.Uyka
Mr.F.Plank

Technologisches Gewerbemuseum:

Mr.F.Plöckinger
Mr.A.Hollnsteiner

Austrian Federal Chamber of Commerce: Mr.K.Haas

Austrian Society for Polymer Engineering (GFKT):

Mr.A.Herrman
Mr.H.Margarétha
Mr.E.Papst
Mr.P.Roos
Mr.G.Schwarz
Mr.L.Katzmayer

The Community of Pruggern:

Mr.H.Resch
Mr. and Ms.Perhab
Mr.F.Wohlmutter (Prugger Dorfmusikanten)
Ms.B.Hollwöger (Singkreis Pruggern)
Mr.H.Pichler (d'Freistoana z'Gröbming)

We have of course, also appreciated any contribution towards the programme, in form of free materials, lecturers, invitations and visits presented to us by companies and individual persons in Austria and abroad.

2. BACKGROUND AND OBJECTIVES (UNIDO Aide Memoire)

1. The programme in the field of plastics technology is one of a series of the United Nations Industrial Development Organization (UNIDO) activities on specific sectors of industry which is being organized for the developing countries through the Chemical Industries Branch. This "In-Plant Group Training Programme" has been implemented annually since 1970 through a special contribution of the Government of Austria to UNIDO. The implementation of the 1983 programme as well as the previous ones has been successfully conducted by the Laboratory for Plastics Technology (LKT-TGM) - Laboratorium für Kunststofftechnik.

2. The trend of training activities in the field of plastics technology is characterized by the increasing sophisticated nature of the training programme requiring high level experts, consultants and specialized equipment for the workshop. There is also an increasing demand for visits to plants, companies and institutes which are advanced in their field of specialization. Short consultation meetings to deal with specific technological problems in manufacturing and application is also an important feature of current training activities.

3. With the rapid development over the past 20 years, plastics have been used in almost every industrial field. The pace of development of new plastics has recently slowed down but active research and development for the improvement of plastics and steady discovery of new applications will give plastics almost unlimited potential for utilization in the future. The plastics industry has been very active in research and development for not only general purpose resins such as PVC, polyolefin resins, but also special materials, for example, advanced composite materials including glass fibres and carbon fibres. These materials are now being developed at a rapid pace for application as a component for structural materials in automobiles, aerospace, marine vessels, atomic energy, etc.

4. The increase in the use and application of plastics in industry, agriculture and buildings in recent years has placed plastics among the leading basic materials used for economic development of the developing countries. Parallel to this increase is the demand for plastics products, there are technological difficulties encountered in processing and in acquiring raw materials and finished products.

5. Through the acquisition of technological know-how and skills in the field of mould design and mould-making, the plastics industry could achieve further development. The lack of experienced personnel in this field in the developing countries and the need to acquire and exchange experience, are the main reasons for the organization of this programme. Its aim is also to bring together a group of selected persons whose work is expected to benefit from a concentrated training programme which otherwise could require a long period of training, research and development work. This assistance to the developing countries in the development of their plastics industry and the development of manpower is in accordance with items i, ii and k of Article 58 of the Lima Declaration and Plan of Action as well as in line with the New Delhi Declaration and Plan of Action on development of human resources.

6. It should be noted that a sharp increase of programme delivery with UNIDO assistance in the chemicals and plastics field was maintained recently and considerable experience has been accumulated by the Chemical Industries Branch in the field of plastics during the projects implementation. The programme provides a dialogue for professional exchanges among the participants and possible co-operation among the developing countries. The programme could also lead to further co-operation between Austria and the home countries of the participants as a result of the contacts established through participation in the programme.

7. The programme is designed mainly to emphasize five fields in plastics technology, such as

- injection moulding and mould design;
- extrusion and die design;
- quality control and polymer physics;
- compounding, recycling and polymer chemistry;
- control engineering and trouble shooting.

In order to meet the individual requirements of the participants, one part of the programme will be organized as a seminar for small groups of participants.

8. The programme has received the support of the Austrian Federal Chancellery, the Austrian Federal Ministry for Foreign Affairs, the Austrian Federal Ministry of Education and Fine Arts, the Austrian Federal Economic Chamber and Association of Austrian Industrialists (VOI). The Laboratorium für Kunststofftechnik (LKT-TGM) (Laboratory for Plastics Technology), a leading technological institute, will conduct, utilizing its facilities, the theoretical and practical training in plastics technology. The institute has a staff of highly qualified specialist.

9. The programme will consist of theoretical and laboratory training, study visits and an evaluation session.

10. The theoretical part of the training will cover a general introduction to the plastics industry, the chemical and mechanical technology of plastics, raw materials, utilization of plastics equipment and tools as well as equipment used for mould design and mould making to promote the introduction of modern processing and production methods in the plastics industry. Furthermore, the techno-economic aspects of plastics production processing and application will be covered by the programme.

11. In addition to the theoretical and laboratory training to be undertaken at LKT-TGM, plant visits will be arranged in Austria to provide an opportunity for the participants to see some new developments in materials, processes and applications to exchange technical information with experts as well as to study the possibility of obtaining licences and know-how on processes as well as equipment. During the programme, individual appointments may be arranged for the participants to discuss with UNIDO staff members, problems affecting the development of plastics industry in the participants' home country and, if so required, to formulate technical assistance projects by UNIDO.

Since 1970 LKT-TGM held fifteen programmes with a total of 268 participants from 70 countries.

The regional distribution was the following:

Far East (FE)	88	33 %
Middle/East North Africa (ME)	64	24 %
Latin America (LA)	57	21 %
Africa (AF)	37	14 %
Europe (EU)	22	8 %

64 % of the participants came from companies, 36 % from institutes and government organizations.

Photos: H.Schermann

Place	Region	Programme 1.-10.	11.
Afghanistan	ME	-	-
Algeria	ME	2	-
Argentina	LA	2	1
Bangladesh	FE	3	-
Bhutan	FE	-	-
Bolivia	LA	3	-
Bulgaria	EU	1	-
Brazil	LA	3	-
Burma	FE	1	-
Chile	LA	2	-
China	FE	5	1
Colombia	LA	4	-
Costa Rica	LA	3	-
Cuba	LA	4	-
Cyprus	EU	3	-
Dominicanian Republic	LA	-	-
Ecuador	LA	-	-
Egypt	ME	8	-
El Salvador	LA	2	-
Ethiopia	AF	-	-
Ghana	AF	3	-
Guatemala	LA	-	-
Guyana	LA	1	-
Honduras	LA	1	-
Hongkong	FE	1	-
Hungary	EU	3	-
India	FE	6	-
Indonesia	FE	6	2
Iran	ME	18	-
Iraq	ME	8	-
Israel	ME	3	-
Jamaica	LA	1	-
Jordan	ME	1	-
Korea	FE	1	-
Korea DPR	ME	-	-

12.	13.	14.	15.	Total
1	-	-	-	1
-	-	-	-	2
-	1	-	1	5
-	2	-	1	6
-	-	-	2	2
1	-	1	-	5
-	-	-	-	1
-	-	-	2	5
-	-	-	1	2
-	-	1	-	3
5	-	1	-	12
-	-	-	-	4
-	-	-	1	4
-	-	-	-	4
-	-	-	-	3
-	1	1	-	2
-	-	1	1	2
4	2	-	-	14
-	-	-	-	2
1	1	-	1	3
-	-	1	-	4
-	-	1	1	2
-	-	-	-	1
-	-	-	-	1
-	-	-	-	3
-	2	4	-	12
1	-	-	1	10
-	-	-	-	18
-	-	1	-	9
-	-	-	-	3
-	1	-	1	3
1	-	-	-	2
-	-	-	-	1
-	-	1	1	2

Lebanon	ME	1
Madagascar	AF	1
Malawi	AF	-
Malaysia	FE	1
Malta	EU	-
Mauritius	AF	-
Morocco	ME	-
Mozambique	AF	-
Nepal	FE	-
Nicaragua	LA	1
Nigeria	AF	4
Pakistan	FE	6
Paraguay	LA	2
Peru	LA	3
Philippines	FE	3
Poland	EU	5
Romania	EU	2
Saudi Arabia	ME	-
Senegal	AF	-
Singapore	FE	3
Somalia	AF	1
Sri Lanka	FE	1
Sudan	AF	2
Syria	ME	5
Taiwan	FE	2
Tanzania	AF	4
Thailand	FE	6
Trinidad Tobago	LA	1
Turkey	EU	4
Uruguay	LA	6
Vietnam	FE	-
Yemen PDR	ME	-
Yugoslavia	EU	2
Zambia	AF	-
Zimbabwe	AF	-
	(70)	166

1	-	-	-	-	2
-	-	-	-	-	1
1	-	1	-	-	3
-	1	-	1	-	3
-	-	1	-	1	2
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-	-	-	-	-	4
-	-	1	-	1	2
-	-	-	-	1	2
-	-	-	-	-	1
9	22	20	26	25	268

Photos: H.Schermann

3. PARTICIPANTS

3.1. Participants Financed by AUSTRIA

COUNTRY	NAME	CONTACT ADDRESS	ADDITIONAL CONTACT ADDRESS
. Bhutan	JUNEY, Mr. Pema	c/o Mr. Raj K. Dar Resident Representative United Nations Development Programme (UNDP) P.O. Box 162 Thimpu	Deki Polythene Company Ltd. Phuntsholing
. Burma	KYAW, Mr. U Thein	c/o Mr. E. Dessau Resident Representative UNDP P.O. Box 650 Rangoon	Plastic Factory No. 2 Pharmaceutical Industries Corporation 29/B Pawdawmu Pagoda Rd. Thamaing Rangoon
. Ecuador	RAMON, Mr. Santiago Enrique	c/o Ms. S. R. Siegel Resident Representative a.i. UNDP P.O. Box 4731 Quito	Plasticos Palmau Cia. Ltda. Via Carcelén Apartado 2287 Quito
. Korea, Dem. People's Republic	SIN U, Mr. Hong	c/o Mr. S. Ristic Resident Representative UNDP P.O. Box 27 Pyongyang	Hamhung Plastic Processing Factory Hamhung City
. Ethiopia	HAGOS, Mr. Solomon	c/o Mr. K. King Resident Representative UNDP P.O. Box 5580 Addis Ababa	Ethioplastic P.O. Box 2340 Addis Ababa
. Guatemala	PORRAS CALDERON, Mr. Horacio N.	c/o Mr. E. Perrin Resident Representative UNDP P.O. Box 23-A Guatemala City	Sterling Products International S.A. 9 Ave. 0-09 zona 4 Guatemala City
. Malaysia	YAHYA, Mr. Ishak Bin	c/o Mr. Y. Y. Kim Regional Representative UNDP P.O. Box 2544 01-23 Kuala Lumpur	SIRIM P.O. Box 35 Shah Alam Selangor

	COUNTRY	NAME	CONTACT ADDRESS	ADDITIONAL CONTACT ADDRESS
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9.	Morocco	ZNIBER, Mr. Yahya Mohammed	c/o Mr. J. C. Petitpierre Resident Representative UNDP Casier ONU, Rabat-Chellah Rabat	Societe Nationale d'Electrolyse et de Petrochimie BP. 94 Mohammedia
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12.	Vietnam, Soc.Rep.	TU TRUNG, Mr. Thanh	c/o Mr. K. Englund Resident Representative UNDP Thailand P.O. Box 618 Bangkok	Paint and Plastic Co. Hochiminh City
13.	Yemen, People's Dem.Rep.	BIN SHABEDH, Mr. Awadh Ahmed	c/o Mr. W. B. Wannop Resident Representative UNDP P.O. Box 1188 Tawahi, Aden	Yemen Rubber Manufacturing Co. P.O. Box 30 Crater, Aden
14.	Zambia	KAPONDA, Mr. Stuart Windu	c/o Mr. D. Dragic Resident Representative UNDP P.O. Box 31966 Lusaka	Foam Plastics Ltd. P.O. Box 21686 Kitwe
15.	Zimbabwe	HAWA, Mr. Akber	c/o Mr. A. Ambatchev Resident Representative UNDP P.O. Box 4775 Harare	Treger Industries (Pvt) Ltd. P.O. Box 8076 Belmont Bulawayo

3.2. Participants Financed by UNIDO/UNDP Projects/at Own/Company Expense

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17.	Bangladesh (DP/BGD/81/032)	SIKDER, Mr. Shahjahan	c/o Mr. W.R. Holzhausen Resident Representative UNDP G.P.O. Box 224 Dhaka	Plastics Technology Centre BITAC Tejgaon I/A Dhaka
18.	Bhutan (DP/BHU/83/025)	DORJI, Mr. Geden	c/o Mr. Raj K. Dar Resident Representative UNDP P.O. Box 162 Thimpu	Deki Polythene Co. Ltd. P.O. Phuntsholing
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25.	Singapore	SAAT, Mr. Zakariah	c/o Mr. Y. Y. Kim Regional Representative UNDP P.O. Box 2544 01-23 Kuala Lumpur	Technomer Mouldings Pte.Ltd. 24 Gul Drive Singapore 2262

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Ing.W.Michel
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B.Dörr

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Prof.Ing.Dkfm.H.Graf
Ing.R.Hillisch
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FL Ing.F.Mennerstorfer
Ing.W.Michel
Ass.Ch.Neustifter
Ass.A.Revesz
Ing.H.Schermann

5. SUBJECT LIST

General Part

Theory

TTD	Technology Transfer and Development	2
PCT	Plastics Chemical Technology	8
PPT	Plastics Physical Technology	14
MEM	Mechanical Engineering and Mould Design	18
PAE	Plastics Application Engineering	6
PPH	Polymer Physics	8
CEN	Control Engineering	4
	Subtotal Theory	60

Practice

CC	Compounding and Calandering	8
CE	Computation Engineering	8
CT	Control Techniques	8
EX	Extrusion	12
FI	Finishing	4
FO	Foaming	6
IC	Injection and Compression Moulding	12
MF	Machining and Forming	8
MM	Mould Making	4
PC	Polymer Chemical Analysis	4
PP	Polymer Physical Analysis	8
QC	Quality Control	8
RF	Reinforced Plastics	4
TS	Trouble Shooting	4
	Subtotal Practice	98
	Total General Part	158

Individual Part

Selection of one item in both, seminar and practice, in the following fields:

		Seminar(S)	Practice(P)
IM	Injection Moulding and Mould Design	8	8
ED	Extrusion and Die Design	8	8
QP	Quality Control and Polymer Physics	8	8
CP	Compounding, Recycling and Polymer Chemistry	8	8
CS	Control Engineering and Electrical Trouble Shooting	8	8
	Total Individual Part		16

GRAND TOTAL 174

6. LECTURE NOTES

6.1. DESIGN OF LECTURE NOTES

The lecture notes have been adapted and developed in accordance with UNIDO, with the participants and with the experience of fourteen programmes since 1970.
To meet the general, practical and theoretical needs of the participants three levels of comprehensive information are offert in form of

- general lecture notes (1023 pages) including working papers
- special lecture notes (279 pages) and
- research papers (60 pages)

For this programme the following lecture notes have been edited or revised:

Plastics Physical Technology (Supplement, 84 pages)
Plastics Application Engineering (46 pages)
Polymer Physical Analysis (24 pages)
Quality Control (30 pages)
Finishing (28 pages)

6.2. GENERAL LECTURE NOTES (THEORY)

TECHNOLOGY TRANSFER AND DEVELOPMENT (TTD)

H.Hubeny

The Global Situation (selected Indicators):

World Development Report - Population - Non-Renewable Resources - Energy - Education - Income

Principles of Development:

Historical Models - Development Analysis

Technology Transfer:

Assumptions - Definitions - Concepts - Cost of Technology Transfer - Characteristic Stimuli and Barriers - Effects

Documents:

Code of Conduct - OECD Classification - National Paper of Austria

Models of Execution:

Macro-Level Conditions - Micro-Level Conditions - Plastics Technology - Plastics Development Activities

Personal Questions:

References:

PLASTICS CHEMICAL TECHNOLOGY (PCT)

E.Wogrolly

Classification of plastic materials
Formation reactions
Functionality
Polymerization reactions: Addition polymerization (free radical mechanism - ionic mechanism) - Condensation polymerization - Copolymerization - Auxiliary materials for polymerization.

Physical Behavior of Plastics
Secondary Bonds: Dispersion Forces - Dipolar-orientation forces - Induction forces - Hydrogen bridges.

Transition States: Hard-elastic state - Setting or Softening range - Glass transition - Brittle Point - Elastomeric state.

Polyolefines - Polyethylene (PE)-Modified Polyethylene--Chlorinated Polyethylene (CPE)-Sulfochlorinated Polyethylene--Crosslinked-Copolymers with Ethylene-Ethylene/Vinylacetate (EVA)-Ethylene/Vinylalcohole (EVAL)-Ethylene/Ethylacrylate (EEA)-Ethylene/Butene or Hexene (see also LLDPE)-Degradation of Polyethylene-Polypropylene (PP)-Modified Polypropylene--Copolymers with Ethylene (EPM and EPDM)-Polybutene -1 (PB)--Polyisobutylene (PIB)-Poly-4-methylpentene -1 (PMP)--Unsaturated Polyolefines-1,2-1,4-Polybutadiene-Polypentenamer--Polyoctenamer-Ionomers-Other Polyolefines,Trends in research and development.

Polyvinylchloride (PVC) - Plasticized PVC-Modified PVC--Compounds (Blends) with CPE-Compounds with EVA and graft polymers of EVA with VC-Compounds with Acrylo/Polymers-Copolymers with Vinylidenechloride VDC/Acrylonitrile-Copolymers with Maleic-imide.

Polystyrene (PS) - Unipolymers-Copolymers-Copolymers with α-Methylstyrene-Copolymers with Acrylonitrile (SAN)-High impact Polystyrene-Styrene/Polybutadiene graft polymers--Styrene/Acrylonitrile-butadiene-Styrene/Maleic Anhydride (SMA)-Expanded polystyrene (EPS).

Acrylics - Polyacrylonitrile (barrier plastics)-Polyacrylates--Polymethylmethacrylates (PMMA)-Polymethacrylimides--Reclamation of MMA from Acrylic wastes.

N-Vinylpolymers

Polyethers - Polyoxymethylene (POM)-Polyethyleneoxide (PEO).

F-Polymers - Polytetrafluorethylene (PTFE)-Polytrifluorchloroethylene (PCTFE)-Copolymers-Copolymers with Hexafluoropropylene-Polytetrafluorethylene-co-perfluormethylvinylether--Polyperfluoralkylvinylether (Teflon PFA)-Polyvinylfluoride (PVF)-Polyvinylidenefluoride (PVDF).

Silicones - Methylpolysiloxanes-Phenylpolysiloxanes (PSI).

Polyamides (PA) - Polyamide 6 and 6,6-Polyamide 4 and other aliphatic Polyamides-Aromatic Polyamides.

Polycarbonate (PC)

Polyterephthalates (PET, PBT)

Polyphenyleneoxide (PPO)

Polysulfone (PSU)

Polyphenylenesulfide (PPS)

Polyethersulfones (PES)

Phenol/Formaldehyde Resins (PF)

Urea/Formaldehyde Resins (UF)

Melamine/Formaldehyde Resins (MF)

Unsaturated Polyesters (UP) - UP-Resins-Crosslinking of UP--Chemistry of Peroxides-Alkyd Resins.

High Temperature Resistant Polymers - Polyimides (PI)-Polybenzimidazole-Polyimidazopyrolone (Pyron)-Polycyclobutadiene.

Polyepoxides (EP)

Polyurethanes (PUR) - Diisocyanates-PU Elastomers-Relation Between Structure and Properties of PUR-Manufacture and Properties of PUR-Foams.

Flame Retardancy of Polymeric Materials

Auxiliary Chemicals

Health Hazards and Toxicity

Degradation and Stabilization

Environmental Behaviour of Plastics Materials

Plastics Waste Management

Reclamation, Recycling and Reuse of Plastics Waste.

PLASTICS PHYSICAL TECHNOLOGY (PPT)

H.Hubeny

Plastics Technology
Introduction
Cycle Process
Model Matrix
Quality and Polymer Processing: Materials - Processes - characteristic functions

Technological States: Basic Material - Intermediate Material - Resin - Additives - Moulding Material - Moulded Material - Semi-finished Product - Finished Product - Waste.
Concersion Processes: Refining - Syntheses - Compounding - Fabrication - Machining and Forming - Finishing - Application - Recycling

Molecular Structure
Linear Macromolecules: Molecular Models - Molecular weight - Helical Conformation - Polarity
Crosslinked Macromolecules
Thermodynamics of Molecules: Potentials - Molecular Motion

Morphological Structure: Amorphous - Mesomorphous - Crystalline Structure

Additives: Stabilizers - Fillers and Reinforcement Materials - Plasticizers - Colorants - Flame Retardants - Antistatic Agents - Blowing Agents - Antimyotika (Biozides) - Lubricants - Activators - Nucleating Agents

Rheology
Elasticity: Crystalline Elasticity - Rubber Elasticity
Viscosity: Newtonian Fluids - Non - Newtonian Fluids - Flow Theory - Morphological Interpretation

Properties of Plastics
Classification: Oscillation Twisting Test - Definitions (Thermoplastics, Thermosets, Elastomers, Thermoelastics)
Abbreviations
Price

Statistical Data
Thermoplastics Moulding Materials
Bulk Polymers: Polyolefines (PE, PP, PB, PMP Ionomers) - Styrene Polymers (PS, BS, ABS, SAN) - Vinylchloride Polymers (PVC + Cop).
Engineering Thermoplastics: PA - PUR - PETP - PBTB - PC - Phenoxy - POM - PPO - PPS - Polysulfones - Polyarylsulfones.
General Thermoplastics: CA, CAB - Chlorinated Polyethers - Fusible Polyfluoro-carbons (PCTFE, PFEP, PVDF)

Thermosetting Moulding Materials:
PF - UF - MF - UP - EP - PUR

Thermoelastic Moulding Materials (PMMA)

High Temperature Resistant Moulding Materials:
PTFE - PI - PBI - PBT - Developing Products.

Compounding

Terms

Particle size reduction: Crushing - Grinding

Mixing: Operations - Dry solid mixers - Static and screw (auger) mixer - Mullers - Tumble mixers - Ribbon blenders - Orbiting screw mixers - Cylindrical mixers - Fluid mixer - Melt mixers - Internal kneader - Extruders - Motionless mixers - Liquid mixers.

Pelletizing

Compounding parameters: Homogeneity - Gross uniformity - Texture and local structure - Melt behaviour - Colour matching.

Continuous Processing

Classification

Continuous casting and laminating: Operations - Solvent film casting - Multicomponent liquid resin processes - Laminating - Slab stock foaming - Pultrusion - Continuous coating - Operation - Spread coating - Cast coating - Roll coating - Transfer coating.

Calendering: Operation - Calender types - Rheological calculations - Calender coating and laminating .

Extrusion: Operation - Classification of extruders - Single-screw extruder design - Function - Extruder size and L/D-ratio - Feed screws - Theory of plasticating single screw extruders - Feed section - Transition section - Metering section - Screw and die characteristics - Multiple screw design - Twin screw extruder design - Function - Calculations - Screw and die characteristics - Extrusion processes - Internal flow design - Basic rheological relations - Rheology applied to die design - Tubular extrusion - Sheet and film extrusion - Profile extrusion - Extrusion coating and laminating - Foam extrusion - Extrusion controls and instrumentation - Process parameter control - Thickness control - Supervisory control loops - Cooling stresses.

Discontinuous Processing (Moulding)

Classification

Liquid phase moulding: Operations - Casting processes - Rotational moulding - Monomer casting - Reacting injection moulding - Reinforced composites moulding - Hand lay-up moulding - Spray-up moulding - Bag moulding - Filament winding - Coating.

Compression moulding: Operations - Moulds - Flow and curing behaviour - Shrinkage behaviour - Preheating - Wet moulding - Controls.

Transfer moulding: Operations - Moulds.

Injection moulding: Operations - Plasticating unit - Moulds - Processing variables - Requirements - Pressure - Flow rate - Temperature - Cooling rate - Shrinkage - Frozen strains - Entropy-elastic strains (orientation) - Energy-elastic strains (cooling stresses) - Injection moulding processes - Injection moulding thermosets - Coinjection moulding - Structural foam moulding - Multistation rotary injection moulding - Injection moulding controls - Process control - Process monitoring - Microprocessors - Injection work.

Blow moulding: Extrusion blow moulding - Operations - Continuous extrusion - Intermittent extrusion - Coextrusion - Moulds - Programming - Injection blow moulding - Operations - Two-position system - Three-position system - Four-position system - Developing systems - Stretch-blow moulding - Blow moulding controls - Wall thickness - Finished weight - Microprocessors.

Fabricating of Semi-Finished Goods

Technical terms

Machining: Operations - Physical conditions.

Forming: Operations - Vacuum forming - Blow forming - Mechanical forming - Operations - Folding - Bending - Beading - Pressure forming - Stamping.

Assembly: Welding - Operations - Friction welding - Hot-Gas welding - Hot-Plate welding - Heated wedge welding - Hot-Bar welding - Impulse welding - High-Frequency welding - Magnetic heat welding - Ultrasonic welding - Bonding - Adhesive bonding - Electromagnetic bonding - Mechanical fastening.

Separating

Finishing

Painting

Printing: Operations - Flexography - Gravure - Lithography - Silk screens - Jet printing.

Metallising: Operations - Electroplating - Vacuum metallising - Sputtering.

Hot stamping

Embossing

Irradiation

Application

Systematic development of application

Standards

Waste

Recycling

Cutting mills

Reprocessing lines

Extruder screen changers

Incineration

Outlook

MECHANICAL ENGINEERING AND MOULD DESIGN (MEM)

R.Hillisch, H.Revesz

Extrusion
Extruder Plants and -Dies: Pipe Manufacturing - Blown Film - Flat Film - Sheet Extrusion - Lamination - Wire - Covering - Pelletizing Plants - Monofilaments - Profile Extrusion Plants.

Pre-Set Elements: Silos - Transporting Systems - Compounding and Reworking Machines - Mixers - Kneaders - Mills - Preheating- and Drying Equipments - Vent Systems.

Elements of the Extruder: Classification - Function of Screws - Feeding - Designs of Barels and Screws - Drives - Bearings - Heating and Cooling - Temperature Control - Melt Pressure Gauges - Die Adapters.

Annexed Equipment: Sizing Dies - Cooling - Take off - Control Devices - Signators - Preliminary Treatment - Separating Equipment - Post Forming Equipment.

Principles of Extruder Die Design

Plants and Molds for Blow Molding
Accumulators - Tubing Dies - Orifices - Closing Units - Blowing Equipment - Severing Equipment - Ejection Equipment - Transporting - Blow Molds.

Molding of Thermosets.
Processing Techniques: Compression Molding - Transfer Molding - Injection Molding

Machines: Semi-automatic Presses - Automatic Presses - Mechanical - Hydraulic Presses - Compression- and Transfer Molding Machines - Plungers - Screw Plungers

Additional Equipment: Dosing - Preforming - Preheating - Finishing

Molds: Open Flash Mold - Positive Molds - Split Molds - Transfer Molds - Runners and Gates - Transfer Pot and Plunger Leaders - Ejector Pins - Mold Heating - Types of Steel - Special Machining Molds.

Design of Compression Molded Parts
Requirements - Draft of Surface - Wall-Thickness - Roundings and Ribs - Undercuts - Holes - Slots - Design of Threads - Metal Inserts.

Injection Molding
Techniques: Injection Molding - Injection Stamping - Flow Molding - Molding of Expanded Materials - Injection Blow Molding - Two Color Molding.

Machines: Classification - Technical Data - Injection Units - Screw Plunger - Nozzles - Closing Units - Safety Devices.

Additional Equipment: Material Storage - Transport - Preheating - Drying - Mixing - Dyeing - Cooling Equipments - Cutting Equipments.

Molds: Elements - Design of Sprue, Runner and Gate - Types of Molds: Single Cavity, Multiple Cavity, Three Plate, Four Plate, Split, Side Pull, Hot Runner, Calculation - Design of Molds.

PLASTICS APPLICATION ENGINEERING (PEN)

W.R.Jessenig

Plastics Survey

Shearmodulus temperature function

Plastics, materials for constructions
Thermoplastics
Thermosets
Composits
Hybridsystems

Long-time behaviour (static)

Stress-strain behaviour depending on temperature test speed and moisture

Economic aspects

Plastic points, tolerances

Construction of models and prototypes

Basic principles for mechanical calculation

Temporary variable deformations

Caracteristic dimensional functions

Reactive resin systems - Design of constructional parts - Friction and Wear - Snap-fit joints - Press-fit joints Ultrasonic Plastic assembly - Outsert technic - Screw-fit joints - Plastic screws - Adhesive joints - Literature

POLYMER PHYSICS (PPH)

H.Dragaun, H.Muschik, M.Nadax, H.Braunsteiner

Density Measurement

Measurement of Melt Viscosity

Measurement of K-Value

Measurement of Viscosity, Number and Determination of Intrinsic Viscosity

Optical Microscopy and Preparation

Electron Microscopy and Preparation

Thermal Analysis
DSC - Differential Scanning Calorimeter
TMS - 2 Thermomechanical Analyzer
TGS - 2 Thermogravimetric Analyzer

CONTROL ENGINEERING (CEN)

F.Gregori

Control Loop

Controlled System: Time-Behaviour - Heating-zone as Controlled System

Temperature Measurement
Resistance Thermometer: Cross-Coil Instrument - Moving Coil Instrument in Bridge Circuit (Deflection Method).

Thermocouples

Controllers
Continuous Controllers
Two-Position Controllers: Galvanometric Controller - Chopper bar Controller - Controller with inductive Pick-Up - Controller with Photoelectric Scanning - Electronic Controllers - Thermocouple as Detecting Element - Resistance Thermometer as Detecting Element.

Temperature Control
Hunting
Two Position Control with Feedback: PD-Control Behaviour - Thermal Feedback - Electronic Feedback - PID-Control Behaviour - Thermal Feedback - Electronic Feedback.

6.3. GENERAL LECTURE NOTES (PRACTICE)

COMPOUNDING AND CALANDRING (CC)

H.Wolanek

The Production of PVC-Compounds by Heater-Mixing

Testing Methods for PVC-Compounds

COMPUTATION ENGINEERING (CE)

F.Mayer

General Facts

Structure of an Computer

Programming Operations

Connection with an EDV-Plant

Computation of a problem in Connecting with Testing of Plastics Materials

Practical execution of a Programme at the Computer

Other Possibilities of Application in Plastics Engineering.

CONTROL TECHNIQUES (CT)

G.Minarovich

Open-Loop-Control

Voltage supply

Standardized connection diagrams and symbols

The Use of Instruments for measuring the Current, Voltage and Resistance

Functional Description of a Reversing Contactor Combination Automatic-Control

Definitions

Automatic Control System and Block Diagram

Transient Response of a Controlled Member

Temperature Behaviour of a Barrel Zone Controlled by Two-Step Action Controller without Feedback

Temperature Behaviour of a Controlling Member with Two-Step Action Controller and Feedback

Electrical Methods for Measuring the Temperature

Practical execution of a Programme at the Computer

Other Possibilities of Application in Plastics Engineering.

EXTRUSION (EX)

H.Revesz

Production of Tubular (Blown) Films

Extrusion of Blown Double - Layer Films

Production of Sheets

Production of Rigid PVC-Pipes

Blow Moulding

Production of Polyethylene Pipes

FINISHING (FI)

W. Mahr

Electroplating

Materials

Part Design

Moulding Factors

Chemical Pretreatment

FOAMING (FO)

H.Hubeny

Classification of Plastic Foams: Material - Stiffness - Cell Morphology - Density - Density Distribution - Fabrication Process

Properties

Processing: Expandable Bead Methods - Reactive Foam Moulding (Low Pressure - High Pressure - Mould Carrier - Foaming Plant - Slab Stock Foaming) - Thermoplastic Foam Moulding - Foam Extrusion

Polyurethane Technology:

Polyurethanes (Isocyanates - Polyethers - Polyesters) - Mould Materials - Practical Exercises.

INJECTION AND COMPRESSION MOULDING (IC)

H.Graf, R.Hillisch

Introduction

Adjustment of Processing Parameters.

Influence of the Mass Temperature and Injection Pressure on Shrinkage and Machanical Strength of Polystyrene Test Bars.
Testing of Performance Properties of Standardized Panels made of Expanded Thermoplastics with a varied injections Speed.

The Principles of Process Control in Injection Moulding

Compression Moulding of Testing-Cups
Determination of Curing time (Stiffness)

MACHINING AND FORMING (MF)

E.Strohmayer

Machining: Cutting - Guillotine shears - Drilling - Screwing - Turning - Planing - Milling - Filing - Grinding - Polishing.

Welding: Press-Welding - Hear-Impulsive Welding - High Frequency Welding - Hot-Gas Welding.

Forming: Bending - Whirl-Sintering - Vacuum Forming.

Workshop - Drawings - Work Instructions.

TESTING (PC, PP, QC)

W.R.Jessenig, H.J.Fischer, H.Hubeny

Part I

Molecular Investigations
Viscometry - Viscosity number - Intrinsic viscosity - k-value - Distribution of Molecular Weight - Density and specific Volume.

Structural Investigations
Oscillating twisting test - Thermoplastics - Elastomers - Thermosetting Materials - Glass Temperature - Dynamic Glass Transistion Temperature (according to DIN standards) - Melting Temperature - Decomposition Temperature - Melt Viscosity and Flow - Flow - Rheology - Therminology - Definitional Equations - Viscoelastic Behaviour - Measuring of viscosity in the capillary-tube rheometer.

Stability Behaviour
Permeation of Gases and Vapours - Mechanism of a Solution Diffusion - Gas Permeability.

Mechanical Behaviour
Short-Time Behaviour - Tensile Test - Measuring of Force with the Pendulum Force System - Electronic System for Measuring the Force - Electronic Force Measuring Head (Inductive) - Electric Force Measuring Sockets - Measuring of Elongation with the Mechanical Elongation Measuring - Electronic Elongation Measuring - Evaluation of the Tensile Test - Temperature Dependence - Dependence of characteristic values on strain rate in the Tensile Test - Compression Test - Bending Test - Impact Strength Test - Impact Tensile Test - Hardness Testing - Dropping Test - Friction and Wear, Burst Test - Internal Pressure Pipe Testing - Fundamental Principles - Wall Thickness Measuring - Conventional System - System DURAPIPE (ANGER) - Specimen End Fittings - Long-Time Behaviour - Creeping Test.

Optical Behaviour

Photoelasticity

Thermal Behaviour
Determination of characteristic physical values - Dimensional stability under heat - Dimensional stability under heat according to Martens - Vicat Softening Point VSP - Dimensional Stability under Heat according to ISO - Brittleness Temperature Tests according to DIN and according to ASTM - Shrinkage behaviour - Proof of Orientation in Moulded Parts - Classification of High Building Materials according to their Combustion Behaviour - General Facts - Executing of Test I - Evaluation - General Facts Test II - Execution of Test II - Evaluation.

Heat - and Sound Technology

Thermal Conductivity - Steam Permeability - Thermal Insulation - Step Sound Insulation - Air Sound Insulation - Degree of Accoustic Absorption - Dynamic Elasticity Modulus and Loss Factor.

Electrical Properties

Volume- and Surface Resistance - Tracking Resistance - Polarization and Dielectric Constant - The polarization of an insulating material - The dielectric constant is a criterion for the amount of polarization of an insulating material - Dielectric Loss Factor.

Part II

Hardness Testing by the Indentation Test

Dimensional Stability after Heat Storage (Shrinkage Test)

Testing of Homogeneity

Testing of Flammability

Compression Test

Tensile Test

Part III

Ultrasonics in Processing and Testing Materials

Ultrasonics in the Processing of Semi-Finished Goods
General Facts - Method - Sound Sources - Ultrasonic Rivetting - Ultrasonic Embedding.

REINFORCED PLASTICS (RF)

H.Hubacek, W.R.Jessenig

Technology

Reinforcing Materials

Types of Plastics

Practical Hints of Processing

QUALITY CONTROL

L.Radax

Statistical Evaluation - Preparation of Specimen - Tensile Test - Determination of the E-Modulus - Flexural Test - Modulus of Elasticity (flexural test) - Tensile Impact Test - Impact Flexural Test - Hardness - Shore Hardness - Vicat Softening Temperature - ISO / R 75 - Martens Temperature - Oszilating Twisting Test - Environmental Stress Cracking - Pipe Testing

6.4. SPECIAL LECTURE NOTES

The objective of the special lecture notes is to inform on new developments in processing, application, recycling and quality control of plastics technology at a higher comprehensive level.

DATA CONVERSION IN INJECTION MOULDING

H.Graf, F.Mayer

General Remarks
Measuring Pressure: Piezoelectric Transducer - Charge Amplifier.

Measuring Temperature: Fluctuation Compensation - Temperature Sensors - Preheatable Thermocouples - Plotter System

Measuring Front Flow

Measuring Distance: Inductive Measuring Sensors - Carrier Frequency Amplifier

Computerised Measuring: Digital Voltmeter - Interface - RS 232 Interface - System Computer

QUALITY CONTROL OF GRP PIPES

W.R.Jesrenig

Designation
Company Control: Resin Control (Purity - Viscosity - Solid Body Content - Gel-Time - Reactivity - Thermal Stability)
Textile-Glass Test (Fineness of Strand - Humidity - Rod Bending Test)
Filler Control (Resin Absorption - Sieve Analysis)
Reactant Control

Production Control: Regular Production Control - Choice of Specimens and Test Frequency - Requirements - Test Procedure - Gel-time - Wall thickness

Random Production Control

Acceptence Control

External Control: Test Volume - Recording - Designation - Condition at Delivery - Measurements - Pipe Stiffness - Longitudinal Tensile Force - Circular Tensile Force - Choice of Specimens - Expertise and Test Report.

NEW RURAL APPLICATIONS OF PLASTICS

H.Muschik

Introduction.
Protection of Plants by Nets.

Foils in Agriculture: Introduction - Flat Foils - "Mulch-Foils" - Plastic-Covered Tunnels - Foils for Sealing - Recycling of Foils - Greenhouses.

Containers for Plants.
Non Wovens for Mulch-Technique.

Irrigation: Introduction - Spray Tube - Sprinkler Irrigation Plants.

Waste Water and Drainage: Waste Water - Drainage.

Heating of Greenhauses.

Storage of Agricultural Products: Storage of Wood - Storage of Fruit and Vegetables in Foils - Storage of Fruits and Vegetables in Sacks - Storage of Liquids and Food.

Coating.
Technological Transfer.

QUALITY CONTROL AND DAMAGE ANALYSIS BY MORPHOLOGICAL METHODS

H.Dragaun

Introduction: Definition of Quality - Increase in Quality - Technological Problem - Continuous melt viscosimetry - Polypropylene Pressure Pipes - Morphology

Morphological Methods: Optical Microscopy - Electron Microscopy - X-ray Diffraction - Wide-Angle X-ray Scattering (WAXS) - Small-Angle X-ray Scattering (SAXS) - Thermoanalytical Methods - Calorimetric Methods - Dilatometric Methods - Spectroscopy - Infrared Absorption (IR) - Electron Spin Resonance (ESR) - Nuclear Magnetic Resonance (NMR)

Practical Application in Damage Analysis:
Crack Formation in Polyethylene (PE)-Pipe - Irregular characteristics of Polyethylene (PE) sheets during finishing - Different Abrasion Characteristics of a Polypropylene (PP) Drive-Component - Differentation of Polyblends in various Polyethylene (PE) types - Different Fracture Behaviour of Polypropylen/Polyethylen Copolymer - Fracture in a Moulded Part (fitting) of Rigid Polyvinylchlorid (PVC).

ENVIRONMENTAL ASPECTS OF PLASTICS TECHNOLOGY

E.Wogrolly

Introduction.
UN-Activities in the Field of Environmental Protection.

The Environmental Impact of Plastics:
Air Pollution: The Properties and Effect of Pollutants - Ozone, its possible biological Effects and Reduction in the Atmosphere - MAK-Values

Formaldehyde Odor and Health Problems within Residences:
Toxicity of Formaldehyde.
The Vinyl Chloride Problem.
Waste Water Treatment.

Some Aspects of Waste Disposal: Plastics Wastes in the Solid Wastes Steam - Reclaim, Recycling and Reuse of Plastics - Recycling Mixtures of Plastics - Separation of Plastics from mixed Refuse - Biodegradation - The Technology of Biodegradable Fillers - The Competiveness of Plastics with traditional Materials after the 1973 Oil Crisis.

6.5. RESEARCH PAPERS

The objective of research papers is to offer information in the field of polymer science and technology of LET-TGM at applied research level.

DATA CONVERSION IN TECHNOLOGY AND MORPHOLOGY

Extrusion:

New Possibilities of a Cascade Control of Extruders by Means of a Torsion-Sensitive Screw Tip - Continuous Measurement and Control of Viscosity throughout the Extrusion Process - Novel Systems for Viscosimetry of Polymer Melts and Solutions.

Injection Moulding:

The Principles of Process Control in Injection Moulding - Degassing of Plastics Materials on Injection Moulding Machines.

Morphology:

A Comparison of Critical Elongation as Determined by the Ball Indentation Method and by Creep Test on Injection Moulded Rigid PVC Test Specimens - The Technology and Morphology of Polypropyle Pressure Pipes - Microfibrils in Brittle-Fracture-Surfaces on Isotactic Polypropylene at 4.2 K - Shear-Induced β-form Crystallization in Isotactic Polypropylene.

POLYURETHAN STRUCTURAL FOAMS

Non-Destructive Determination of the Density Profile in Polyurethane Structural Foams - Measuring and Influencing of the Density Distribution in Polyurethane Structural Foams - Statistic Examination of Cell Size Distribution in Polyurethane Structural Doams.

RECYCLING

The Behaviour of Household Refuse containing PVC in Incinerators.

7. COLLOQUIUM

On the occasion of the 15th anniversary of the UNIDO In-Plant Group Training Programme in the Field of Plastics Technology and the Austrian National Day the Board of the Association for the Promotion of Plastics Technology (GFKT) and the Principal of the Technologisches Gewerbemuseum (TGM) have the honour of inviting to a Colloquium on

International Development in Plastics Technology

on Thursday 25 October 1984 at 2 p.m. in the Exnersaal of TGM, Wien-Brigittenau, Wexstraße 19-23 (drive in Jägerstraße 71).

Speeches:

Mr. F. Plöckinger, Principal, TGM
Ms. A. Tchetchaverian-Assenbauer, Officer-in-Charge, UNIDO
Ms. B. Dekrout, Counsellor, Austrian Federal Chancellery

The participants of the 15th Training Programme:

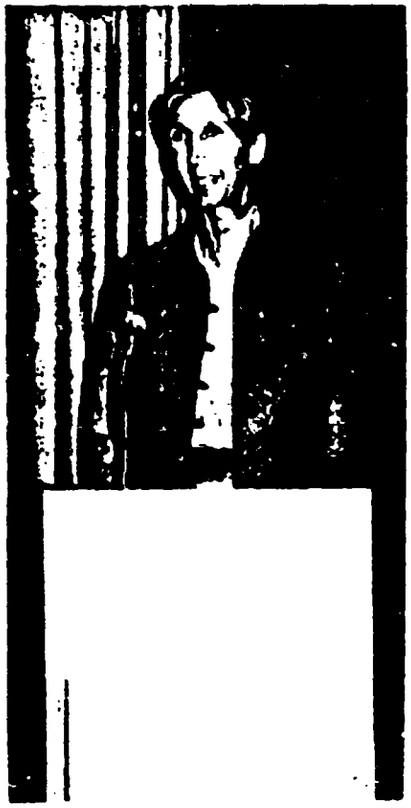
Argentinia: Mr. C. A. Plasse, Bangladesh: Mr. S. Sikder,
Bhutan: Mr. P. Juney, Mr. G. Derji,
Brazil: Mr. R. Melendez, Mr. R. Rivadulla,
Burma: Mr. U. T. Kyaw, Costa Rica: Mr. E. Onate,
Ecuador: Mr. S. E. Ramon, Ethiopia: Mr. S. Hagos,
Guatemala: Mr. H. N. Porras Calderon, Indonesia: Mr. Suhardjo,
Jamaica: Mr. J. A. McCarthy, Korea DPR: Mr. H. Sin U,
Malaysia: Mr. J. B. Yahya, Mauritius: Mr. V. K. Beedassy,
Morocco: Mr. Y. M. Zniber, Saudi Arabia: Mr. S. A. Al-Dakheel,
Singapore: Mr. Z. Seet, Sudan: Mr. B. E. Siddig Mohamad Ali,
Thailand: Mr. S. Pinye, Vietnam SR: Mr. T. Tu Trung,
Yemen PDR: Mr. A. A. Bin Shabedh, Zambia: Mr. S. W. Kaponda,
Zimbabwe: Mr. A. Hewa

Mr. A. Herrman, Chairman, GFKT
Mr. H. Hubeny, Programme Director, LKT-TGM

The Colloquium will be held in English.

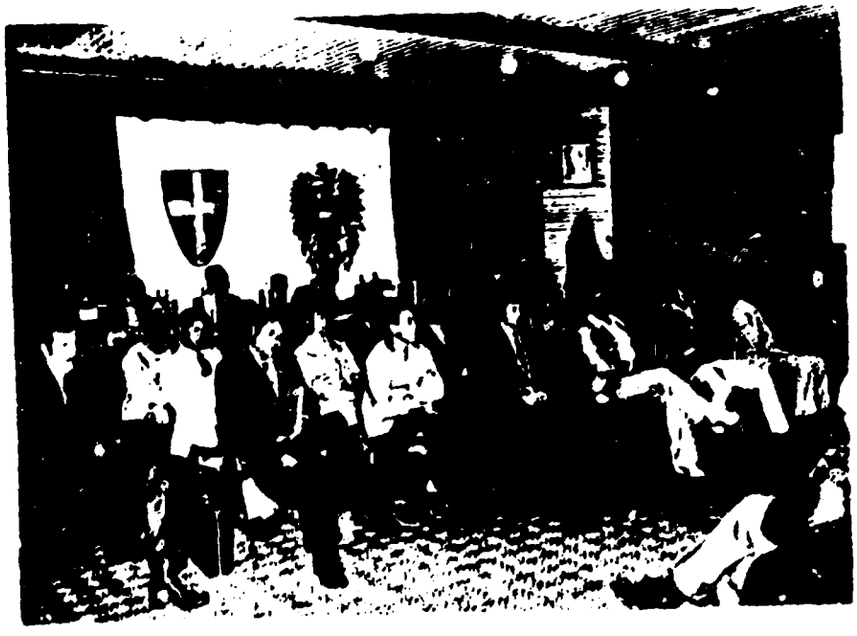
A. Herrman F. Plöckinger H. Hubeny

Some special lectures have been given by Mr.MUSCHIK on plastics in agriculture, Mr.BAUER, Austrian Industrial Investment Fund and Mr.SCHÄTZSCHOCK, Elwas Company, on plastics manufacturing.



Ms.B.Dekrout

Ms.A.Tcheknavorian-Asenbauer



8. PLANT VISITS

To the special interest of the participants 15 plant visits during the six-week course in Austria has been organized by LKT-TGM. The selection of the plants according to the interest of the participants gives a regional and technical survey on the Austrian plastic industry:

CHEMIE LINZ AG

St.Peter-Strasse 25
4021 Linz
Tel. 997/591-0
Telex: 21324

PE, PP-Compounds, stretched fibres, films, plastics application

CINCINNATI MILACRON AUSTRIA

Laxenburger Strasse 276
1232 Wien
Tel. 222/67 76 11-0
Telex: 131518

Twin screw extruders, single screw extruders, dies, down-stream-equipment, injection moulding machines

LUDWIG ENGEL KG

4311 Schwertberg
Tel. 07262/62 17 10
Telex: 2174521

Fully automatic in-line, injection moulding machines, two-colour systems, mould making, roboter systems

FEPLA-HIRSCH

Wiener Strasse 113
2700 Wr.Neustadt
Tel. 02622/45 41, 57 76
Telex: 16629

PE, PP film blowing, finishing, welding

GABRIEL CHEMIE

Stipcakgasse 6
1234 Wien
Tel. 222/67 46 23-0
Telex: 131376

Thermoplastic masterbatches, coloration, formulations

GREINER KG
Schaumstoffwerk

Greiner Strasse 70
4550 Kremsmünster
Tel. 07583/7251
Telex: 233711

PUR-foaming, slabstock foaming, cutting, milling injection moulding, printing, finishing, vacuum forming

HALVIC

Solvay-Halvic-Strasse 6
5400 Hallein
Tel. 06245/4551
Telex: 631050

PVC raw material production, quality control

KDAG-Kabel- u.Drahtwerke AG

Oswaldgasse 33
1120 Wien
Tel. 222/83 55 11
Telex: 131112

Cable and wire coating

KOLOSEUS

Haiding 24
4631 Krenglbach
Tel. 07249/6051
Telex: 25354

GRP processing, mould making

LUTZKYPLAST

Kremseggerstrasse 15
4550 Kremsmünster
Tel. 07583/7371
Telex: 2337113

Blow moulding, printing

MÜLLHYGIENISIERUNGSANLAGE
Oberes Ennstal
Aich-Assach

8966 Aich-Assach
Tel. 03686/41 19

Composting and recycling plant

SALEN

Symalenstrasse 2-6
3500 Krems
Tel. 901/5501
Telex: 71111

Pipe extrusion, injection moulding, pipe and fitting systems, drip irrigation systems, containers

POLOPLAST

Poloplaststrasse 1
4060 Leonding
Tel. 0732/80621
Telex: 21131

Pipe extrusion, injection moulding, pipe and fitting systems

THERMOPLAST

Traunauweg 22
4020 Linz-Kleinmünchen
Tel. 997/41331
Telex: 21090

Injection moulding, mould making

KARL WESS OHG

Wiener Strasse 54-56
2640 Gloggnitz
Tel. 02662/22 91

Mould- and die-making

Individual plant visits have been arranged to the following companies:

AUSTROPLAN Linke Wienzeile 234 1150 Wien Tel. 222 - 85 76 01/0	Planning and consulting
EREMA Engineering-Recycling Maschinen-Anlagen GmbH Ferd.Merkl-Strasse 39 4040 Linz Tel. 0732 - 52 175, 66 12 06	Plastic recycling machines
ISOVOLTA Österreichische Isolierstoffwerke AG 2351 Wiener Neudorf Tel. 02236 - 86 500/0	Laminated sheets
MAPLAN GmbH Schellinggasse 1 1010 Wien	Plastic processing equipment
PARA-CHEMIE Hauptstrasse 53 2440 Gramatneusiedl Tel. 02234 - 2241	PMMA casted sheets
PERSTORP Austria GmbH Sebastian Kohlgasse 3-9 1210 Wien Tel. 222 - 38 36 36	Aminoplastics, phenoplastics
WITTMANN Kunststoffgeräge GmbH Hosnedlgasse 15 1220 Wien Tel. 222 - 23 75 28	Plastic processing equipment

9. SPECIAL EQUIPMENT FOR THE TRAINING PROGRAMME

ALPINE, BRD; Extruders
AVL, Graz; Electronic Control Systems
BATTENFELD, BRD; Injection Moulding and Blow Moulding Machines
BATTENFELD-FISCHER, BRD; Blow Moulding
BATTENFELD Kunststoffmaschinen GmbH.,Kottingbrunn:
Injection Moulding Machines
BAUER, Schweiz; Measuring Instruments
BECKMANN, USA; IR-Equipment
BIZERBA, Vienna; Silo-Installation
BRANSON, USA; Ultrasonic Welding
BROSA, BRD; Control Instruments
BUCHER-GUYER, Schweiz; Presses
CHURCHILL, England; Water and Oil Circulating Controllers
CINCINNATI MILACRON, Vienna; Extruders,Injection Moulding Machine
COUDENHOVE Poly-Spray, Vienna; Spray-Up Machines
DEMES, BRD; Pre-Treatment Instruments
ENGEL, Schwertberg; Injection Moulding Machines
ERBA, Italy; Gaschromatography
FRANK, BRD; Testing Equipment
FUCHS, Vienna; Mills
GOERZ Electro, Vienna; Instruments
GÖTTFERT, BRD; Rheological Equipment
HAACK, Vienna; Laboratory Equipment
HAGEDORN & BAILLY, BRD; Water and Oil Circulating Controllers
HARTMANN & BRAUN, BRD; Control Systems
HASCO, Vienna; Moulds
HENSCHEL, BRD; Mixers
HONEYWELL Bull, Vienna; Time Sharing
HOTTINGER, Vienna; Torque Measurement Equipment
JOEL, Japan; Electron Microscopic Equipment
JOENS, BRD; Control Systems and Recorders
JUMO, M.K.Juchheim, BRD; Control Instruments
ILLIG, BRD; Vacuum Forming Machines
KIEFEL, BRD; Film-Extruder
KRAUSS-MAFFEI, BRD; Foaming, Extrusion, Recycling
K-TRON SODER, Schweiz; Metering-Computer
LÖDIGE, BRD; Mixer
MEDEK & SCHÖRNER, Vienna; Signator (Marker)
METRAWATT, BRD; Control Systems
METTLER, Schweiz; Analytical Instruments
MIKETRONIX, Pulkau; Electronic Equipment and Computer
NETSTAL, Schweiz; Injection Moulding Machines
PERKIN-ELMER, USA; Analytical Instruments
PHILIPS, Vienna; Control Systems and Recorders
PVL, Waldbreitbach (Austria); Electronic Equipment
REICHERT-JONG, Vienna; Microscopic Equipment
SARTORIUS, BRD; Analytical Instruments
SCHLUMBERGER, Vienna; Electronic Equipments
SINGLE, BRD; Water and Oil Cirulating Controllers
STAIGER & MOHILO, BRD; Instruments
STOUGAARD, Dänemark; Instruments
TIEDEMANN, BRD; Optical Instruments
TROESTER, BRD; Calanders, Roll Mills
UNILABOR, Vienna; Electronic Equipment
VIKING, UK; PUR-Foaming Machines
WITHOF, BRD; Control Systems
ZWICK, BRD; Testing Equipment

10. SPECIAL INDUSTRIAL DEVELOPMENT (SID) PROGRAMMES IN POLYMER ENGINEERING AND PLASTICS TECHNOLOGY

10.1. Top Level A:

Description: The SID-programme A is an individually arranged top-level programme for experienced canditates to help them solve their specific problems in plastics technology. It is designed as an individual tuition course through project work in a specific field of polymer processing, engineering, application and recycling including theoretical introduction, practical work, plant visits, individual contact with national and international organizations, companies and other institutions, educational training methods, computer-aided skills, publications, and membership to the Austrian Society for Polymer Engineering (GFKT).

Content: The project work is selected from the following fields of study:
Plastics processing and control engineering: injection moulding, extrusion, blow moulding, foaming, compounding, machining, forming, welding, bonding, finishing, mould design - application engineering: mechanical engineering, electrical engineering, electronics, agriculture and fishery, ecotechnology, bio-medical application, energy conversion, pipe- and fitting systems, transport and packaging - quality control: polymer physics (X-ray diffraction, electronmicroscopy, thermal analysis), polymer chemistry (analysis, IR-spectroscopy, chromatography), testing (mechanical, thermal, optical, electrical behaviour, ageing, stability and flammability) - environmental technology: industrial air contaminants control, toxicology, waste management (collection, transportation, disposal, composting, combustion, refuse derived fuel), reclamation (secondary usage and recycling of polymeric materials), hazardous waste - automation and computation: programming, microprocessors, roboters.

Services: Permanant individual tuition by senior lecturers - individual lectures - daily planning, review and evaluation of project work - permanant assistance - operators services - seminars with senior lecturers and guest lecturers - preparation and use of equipment and materials - computer aided literature and patent services - documentation - individual administrative facilities - - individual contacts with industry including transport in Austria.

Qualifications: Graduation and research experience.

Language: English, German, French, Spanish (interpreters for other languages can be arranged by request).

Institution Fees: US $ 5400,-- per man-month.

10.2. High Level B:

Description: The SID-programme B is an individually arranged high-level programme for candidates to help them solve their problems in polymer engineering and plastics technology. It is designed as an individual training course through project work in the field of plastics technology including theoretical introduction, practical work and plant visits.

Content: The project work is selected from the following fields of study:
Mould design - compounding and recycling - plastics processing (injection moulding, extrusion, blow moulding, foaming, machining, forming, finishing) - application engineering - testing methods - statistical evaluation - - automation and computation - trouble shooting - planning of maintenance.

Services: Introduction and evaluation by senior lecturers - instruction - weekly planning, review and evaluation of project work - limited operators services on request - preparation and use of equipment and materials - documentation - administrative facilities - contacts with industry.

Qualifications: Graduation and experience in industry.

Language: English, German (interpreters for other languages can be arranged by request).

Institution Fees: US $ 2200,-- per man-month.

10.3. Basic Level C

Description: The SID-programme C is an individually arranged basic-level programme for candidates to be trained in plastics technology. It is designed as an individual training course through project work in the field of plastics technology including introduction, practical work and plant visits.

Content: The project work is selected from the following fields of study:
Mould making - compounding - plastics processing - testing methods and sample preparation - trouble shooting - maintenance.

Services: Introduction, review and evaluation of project wor by senior lecturers - instruction - preparation and use of equipment and materials - administrative facilities - contacts with industry.

Qualifications: Experience in industry after completion of a technical school of equivalent.

Language: English, German (interpreters for other languages can be arranged by request).

Institution Fees: US $ 1500,-- per man-month.

10.4. Organization:

Austrian Laboratory for Plastics Technology LKT-TGM, (Laboratorium für Kunststofftechnik), Wexstrasse 19-23, A-1200 Vienna, Austria, Tel.: (0)-222-35 21 06 - 0 and (0)-222-35 35 11 - 478, Telex: 13 18 24 in co-operation with UNIDO-Headquarters, Chemical Industries Branch, Division of Industrial Operations, Vienna International Centre, P.O.Box 300, A-1400 Vienna, Telefon (0)-222-26 31 - 0, Telex 13 56 12.


Pruggerer-Dorfmusikanten


d' Freistoana z' Gröbming

Training

Technologisches Gewerbemuseum TGM, Top-Level Secondary Industrial School

Division of Plastics Technology

Five-year course in German after completion of school grade 8 or equivalent
Three-year course in German after completion of a technical school or equivalent

College of Plastics Technology

Post-secondary four-semester course in German after immatrikulation examination or equivalent
Foreign applicants must have an adequate command of German.
Certificates in foreign languages must provide certified translations into German and have to be recognized by the Federal Ministry of Education and Arts.
The courses lead to a qualification for university studies and for civil service and after three years in profession to the right to use the professional title »Ingenieur«.

Vocational Training Courses

Training courses for foremen and technicians in German in co-operation with the Industrial Promotion Institute (WIFI)

International Programmes

UNIDO training programmes and Special Industrial Development (SID) programmes in English.
Interpreters for other languages can be arranged by request.

Testing

Staatliche autorisierte Versuchsanstalt für Kunststofftechnik am TGM

Federal Material Testing Centre for Plastics Technology

Certification and licenses according to UN, IMCO, ADR, ISO, DIN, ASTM, ÖNORM, AUSTRIA Quality Regulation, GRIS and other national and international standards in physical and chemical plastics technology.
Certificates of the Federal Material Testing Centre are official Austrian documents.

Fields of Authorization:

Examination of polymer materials (thermoplastic, thermosetting and elastomeric materials) including processing and application engineering, analysis, structure; mechanical, thermal, optical and chemical behaviour; compounding, stability, ageing, flammability, general properties and recycling. Examination of plastics in engineering, agriculture, medical application, packaging, household and factory.
Examination of raw materials for plastics processing and application including compounds, additives and auxiliaries
Corrosion and protection including galvanizing, varnishes and coatings. Examination of environmental problems related to polymers, environment protection and recycling.

Research

Forschungsinstitut der Gesellschaft zur Förderung der Kunststofftechnik GFKT

Research Institute of the Austrian Society for Polymer Engineering

200 nationanal and international projects of applied research and development exist in the following fields:
Plastics processing — compounding — control engineering — mould design — application engineering — quality control: polymer physics, polymer chemistry, testing — environmental technology — automation and computation.

Major equipment for training, testing and research includes 5 injection moulding machines, 6 extruders with down stream equipment, 2 blow moulding machines, 1 foaming machine, 2 rolling mills, 3 presses, 4 mixers, various machine tools, 1 spray-up machine, 6 microprocessors, 3 electronic universal testing machines up to 200 kN, walk-in climatic chamber (— 25 / + 80°C), 3 weatherometers cold check tester, endurance testing beds, optical tension tester, scanning electron microscope, gas chromatograph, 2 spectrometers, differential scanning thermoanalysis systems, 5 torque and capillary viscosimeters. Testing equipment for gas and water pipes, fittings, containers, roofing materials, thermal isolation elements, windows, doors, low temperature heating systems.